Do stress tests affect bank liquidity creation?

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Abstract

We examine the impact of Federal Reserve stress tests from 2009 to 2016 on U.S. bank liquidity creation. Empirical results show that regulatory stress tests have a negative effect on both on- and off-balance sheet bank liquidity creation and asset-side liquidity creation. As banks enter the stress tests, they reduce their liquidity creation to avoid failing the stress tests. These results are consistent with the hypothesis that banks manage their risk exposures to meet higher capital requirements. The negative effect of stress testing on liquidity creation continues to persist in the quarters after the stress tests. Finally, stress test banks appear to increase liability-side liquidity creation. These findings highlight that the enhanced financial stability from greater regulatory scrutiny may be achieved at the expense of financial intermediation.

JEL Classification: G21; G28.

Keywords: Stress testing; Bank liquidity creation; SCAP; CCAR.

1 Introduction

Bank capital acts as a buffer to absorb losses and is particularly important for financial stability in periods of adverse economic conditions. Insufficient bank capital levels in the banking system hinder its ability to create liquidity and support economic growth. For this reason, stress tests aiming at evaluating the resilience of the banking system under adverse economic shocks are a very important component of the regulatory framework in the banking systems worldwide. The objective of stress tests is therefore to ensure that banks hold – at all times – an adequate amount of capital to withstand such shocks and sustain their credit supply. This is important because recent contributions have shown that the costs of bank bailouts are very large.[1]

In late February 2009, the Supervisory Capital Assessment Program (SCAP) was launched to measure the ability of the 19 largest U.S. financial institutions to withstand future economic crises. These were domestic bank holding companies (BHCs) with year-end 2008 assets exceeding $100 billion. Since 2011, the Federal Reserve has conducted the Comprehensive Capital Analysis and Review (CCAR). From 2014, the stress testing exercise has been expanded to include all BHCs with total assets exceeding $50 billion.

Annual stress tests have been shown to lead to changes in the risk management practices of BHCs (Acharya et al. 2018, Cornett et al. 2018). Participating banks tend to avoid investments that require high capital buffer according to the stress tests. To maximize the probability of passing the tests, these banks have the incentive to align their internal risk evaluation processes with the stress tests' criteria. Since stress tests take a more forward-looking perspective when evaluating bank risk, the annual implementation of stress tests should improve the supervision of bank capital. Nevertheless, there are concerns that stress tests might lead to constraints on the ability of banks to create liquidity – an essential function of banks (Diamond & Dybvig 1983).

In this paper, we are the first to provide empirical evidence on the impact of stress tests (SCAP and CCAR) on the liquidity creation of U.S. banks. We focus on liquidity creation because, alongside risk transformation (Bhattacharya & Thakor 1993, Diamond & Rajan 2001), it is one of the key functions of banks, which supports the economy (Berger et al. 2016, Huang et al. 2018). Liquidity is created when banks transform relatively liquid liabilities (e.g., demand deposits) into relatively illiquid assets (e.g., corporate loans). Liquidity can also be created off the balance sheet, as is the

[1] For example, Veronesi & Zingales (2010) estimate that the cost for taxpayers of the Treasury-Federal Deposit Insurance Corporation joint plan in 2008 was between $21 billion and $44 billion, and Cardillo et al. (2020) report that from 2008 to 2017 the governments of EU-15 countries spent 793 billion euros for recapitalizations of distressed banks.

case when banks extend loan commitments or lines of credits to businesses. Liquidity creation is a better measure of bank output than bank loans because it considers not only bank assets (in particular, loans), but also off-balance sheet activities, demand deposits, equity, and other bank liabilities (Berger & Sedunov 2017). By creating liquidity, banks promote economic growth and improve capital allocation in the financial system.

Existing literature suggests that capital support and government interventions affect bank liquidity creation (Berger et al. 2016), while stress tests lead to a reduction in credit supply of U.S. banks (Acharya et al. 2018). These studies suggest that government intervention and stress tests may reduce liquidity creation by banks. However, at present, there is no empirical work on the effect of stress tests on bank liquidity creation. This is the question that this paper aims to answer empirically. We employ a regression discontinuity approach that relies on the Federal Reserve's selection criterion to include banks in the stress tests as an exogenous source of variation and provide evidence that regulatory stress tests reduce banks' liquidity creation both on- and off-balance sheets. A test for the continuity of the density of the distance between the bank size and the threshold, which is the running variable in our regression discontinuity method, suggests that banks do not manipulate their balance sheets to avoid being included in the stress tests. We acknowledge that it is difficult to precisely gauge the impact of Federal Reserve stress tests on U.S. bank liquidity creation because so many government intervention programs, regulatory/policy actions, and financial market events occurred around the same time. Even so, we argue that our empirical design and additional robustness tests help mitigate some of the concerns.

Our main findings are as follows. First, consistent with the risk-management hypothesis discussed in Acharya et al. (2018), our results show that banks manage their risk exposures by cutting down the asset-side component of liquidity creation, particularly to risky borrowers, in order to meet the higher capital standards of the stress tests. Second, we document an increase in the liability-side liquidity creation. However, the result does not suggest that banks become riskier following the stress tests as customer savings deposits make up around 70–80% of the total liquid liabilities of stress test banks. Therefore, this result indicates that stress tests encourage banks to adopt a more stable funding structure. This happens plausibly because banks have an incentive to rely on more liquid and relatively cheaper funding sources to increase their profits as a consequence of the decrease in asset-side liquidity creation. Third, stress test banks are found to reduce liquidity creation as they enter the stress tests for the first time, and in the quarters when the stress tests start, to avoid failing the tests. For some components of liquidity creation, such behavior becomes even more pronounced in subsequent quarters.

We perform a number of robustness checks. First, we conduct the parallel trends test for the differences in the liquidity creation growth rate of stress test banks vis-à-vis non-stress test banks in the quarters prior to the stress tests. Second, we present the estimates of regression discontinuity under the local randomization inference, which is based on a 'stronger' alternative identification assumption. Third, we perform placebo tests by employing alternative cutoff values of $40, $60, $70, $80, $90, and $110 billion in total assets as the criterion for BHCs to be included in the stress tests. Fourth, we include in our sample BHCs with foreign parents and those with total assets exceeding $10 billion. Our empirical results remain robust to these additional checks.

Our paper contributes to two strands of literature: the literature on bank liquidity creation and the literature on the impact of stress tests on bank conduct. Motivated by the work of Berger & Bouwman (2009), recent studies have investigated the relationship between liquidity creation and the following variables: regulatory capital (e.g., Casu et al. 2019, Fu et al. 2016, Fungáčová et al. 2017, Horvath et al. 2014, Tran et al. 2016), competition (e.g., Horvath et al. 2016, Jiang et al. 2019), corporate governance (e.g., Andreou et al. 2016, Diaz & Huang 2017, Huang et al. 2018), monetary policy (e.g., Berger & Bouwman 2017), enforcement actions (e.g., Danisewicz et al. 2018), and real economic output (e.g., Berger & Sedunov 2017). Moreover, Bowe et al. (2019) investigate the impact of capital requirement reforms (incorporated in the Third Basel Capital Accord), the Troubled Asset Relief Program, and unconventional monetary policy on bank liquidity creation. The strand of literature on regulatory stress tests has investigated the impact of stress tests on banks' lending and risk exposure (Acharya et al. 2018), and banks' capital and dividend payouts (Cornett et al. 2018). However, despite the important implications of regulatory stress tests on banks' business practices, to the best of our knowledge, there is no empirical study documenting the impact of stress tests on U.S. bank liquidity creation.

Our empirical findings indicate that there might be a trade-off between the positive effects of stress tests, in terms of enhanced long-term financial stability, and the temporary negative effects on liquidity creation. This finding is important because Berger & Sedunov (2017) find that there is a positive relation between bank liquidity creation and real economic output. Thus, our findings have important implications for policy makers and bank regulators, given that stress tests might temporarily have an unintended adverse impact on the real economy. In this respect, our study is similar to the recent paper by Danisewicz et al. (2018), which reports a reduction in bank liquidity creation in response to regulatory enforcement actions, which ultimately leads to temporary adverse effects on local economic growth.[2] In addition to stress tests and enforcement actions, changes in regulatory requirements can influence the real economy via the lending channel. For example, Bindal et al. (2019) suggest that the size-based regulatory thresholds introduced by the Dodd-Frank Act of 2010 have had an impact on small-business lending and, ultimately, the real economy. Importantly, our empirical findings do not imply that stress tests should be avoided. In the long-term, the improved stability in the financial system arising from stress test exercises might offset the temporary economic costs resulting from a reduction in liquidity creation by banks.

An additional contribution of this paper to the literature on the impact of stress tests on bank conduct is the extended sample period. While previous empirical studies focus solely on the first stress test (e.g., Connolly 2018) or extend the analysis to include the 2014 stress test (e.g., Acharya et al. 2018, Shahhosseini 2015), our paper covers more recent stress tests in 2015 and 2016. Moreover, Acharya et al. (2018) and Connolly (2018) examine the lending implications *after* the implementation of the stress tests, whereas our paper explores the response of banks as they enter the stress tests. Finally, our research goes beyond the empirical analyses conducted by Acharya et al. (2018) and Connolly (2018), because not only do we consider bank lending, we also investigate the impact of stress tests on bank liquidity creation on both sides of the balance sheet (assets and liabilities) as well as liquidity creation originated by off-the-balance sheet items.

From a policy viewpoint, this paper suggests that, in the short-term, stress tests may be detrimental to financial intermediation. Our findings, however, also show that banks tend to increase liquidity creation on the liability-side in response to the stress tests. Since liquid liabilities consist mainly of customer deposits, our results indicate that banks may shift to a more stable funding structure as a result of stress tests. This finding is very important because literature on the impact of stress tests has so far neglected the liability-side of banks' balance sheets.

The remainder of this paper is organized as follows. Section 2 provides background on regulatory stress testing. Section 3 offers a literature review on regulatory stress testing. Section 4 introduces the data and the variables of interest. Section 5 discusses the methodology, the empirical results, and the findings. Section 6 presents the study summary and provides policy implications.

[2] Recent contributions also investigate the potential impact of enforcement actions on the syndicated loans' market and mergers and acquisitions in the banking industry. See, for example, Delis et al. (2020), Papadimitri et al. (2019).

2 Institutional background

Stress testing of large and systemically important financial institutions is one of the main prudential tools for enhanced supervision in the post-crisis regulatory reforms, many of which came from the passage of the well-known Dodd-Frank Act (DFA). After the financial crisis of 2007–2009, the U.S. banking system suffered from low capital positions and substantial risk exposures due to deteriorating macroeconomic conditions. In 2010, the DFA required that all BHCs with total consolidated assets exceeding $50 billion and non-bank financial institutions that are deemed systemically important by the Financial Stability Oversight Council be subject to the annual stress tests conducted by the Federal Reserve. Supervisory stress tests involve estimation of banks' expected capital levels according to their fundamentals under the baseline and various adverse economic scenarios (Hirtle & Lehnert 2015), while allowing for simultaneous assessment and comparison of exposures across banks (Hirtle et al. 2009). The results are then disclosed to the public and banks that fail the stress tests are subject to corrective actions.

The first stress test under the SCAP was launched by the Federal Reserve System in 2009 in response to the 2007–2009 financial crisis. The SCAP is a forward-looking exercise, which departs from traditional supervisory exercises based on backward-looking information. The purpose of the SCAP is to assess additional capital buffer that is deemed necessary to maintain credit supply under deteriorating economic conditions. All BHCs with assets exceeding $100 billion were subject to the stress test. Their revenues, expenses, losses, and capital ratios were projected under several economic scenarios. The outcomes of the stress test were disclosed to the public in May 2009. These include BHCs' Tier 1 capital, Tier 1 common capital and risk-weighted assets as of year-end 2008. Then, the capital levels for year-end 2010 were estimated on the basis of projections of banks' fundamentals under adverse scenarios.[3] The BHCs involved in the stress test were expected to have the Tier 1 risk-based capital and the Tier 1 common capital ratios at the end of 2010 above the supervisory benchmarks of 6% and 4%, respectively. The required SCAP additional capital buffer, which is the difference between the supervisory capital benchmark and the capital level estimated under the adverse scenario, was also included in the public release.

The results of the SCAP suggested that the aggregate capital needed for the 19 BHCs to meet the SCAP requirements was $185 billion, the majority of which was in the form of Tier 1 common capital. The aggregate supplemental capital needs were $75 billion after adjusting for the

[3] Such banks' fundamentals comprise the following variables: pre-provision net revenues, losses on different loan categories, securities and trading positions, and allowance for loan and lease losses for 2009 and 2010.

operating performance of the first quarter of 2009 for ten BHCs that were deemed insufficiently capitalized. Banks with an insufficient capital buffer were required to submit plans, which include details regarding how the capital buffer gap problem would be addressed. Nine out of ten BHCs that failed the stress test subsequently managed to raise sufficient capital privately. The substantial recapitalization of BHCs following the SCAP was widely regarded as a success of post-crisis regulatory actions in improving financial health of the U.S. banking system.

From 2011, the Federal Reserve started conducting the annual CCAR for the same BHCs that participated in the SCAP with an aim to determine if large U.S. banks had sufficient capital to withstand negative economic shocks and maintained credit lending under adverse conditions. From 2014, the stress test expanded to all BHCs with total consolidated assets of $50 billion or more. The CCAR requires participating BHCs to submit their internal stress test results and capital plans. The BHCs also go through a qualitative review of their risk management and internal capital planning processes. The quantitative assessment of CCAR requires that BHCs' capital ratios must be maintained at or above the regulatory levels. The capital plans of BHCs submitted to the authority describe details of their capital adequacy assessing processes, intended capital actions and distributions (e.g., dividend payments, capital issuances, and repurchases) for the next nine quarters. With BHCs' planned capital actions, the Federal Reserve System carries out the stress tests to project revenues, expenses, losses, and post-stress capital ratios for each bank under the three defined scenarios (i.e., 'baseline', 'adverse', and 'severely adverse'). The scenarios place more emphasis on the system-wide rather than the idiosyncratic risks of banks with an aim to reduce the likelihood of banks collectively facing constraints on capital under severe economic conditions. The ability of banks to maintain the post-stress capital ratios above the regulatory requirements is assessed by the Federal Reserve. The outcome of the CCAR is determined by the Federal Reserve System, taking into consideration the stress test results and the qualitative assessments of the banks' capital plans. In the CCAR, the Federal Reserve can object to a bank's capital plan and distributions on either quantitative or qualitative grounds or both. The objection of the plan may lead to restrictions in the distributions of bank capital, such as share repurchases or dividend payments.

Overall, the purpose of stress testing exercises is to provide a comprehensive assessment of capital adequacy and incentives for banks to undertake better risk management practices. Stress tests also take into account macroprudential risks in the assessment of bank capital positions, which depart from traditional supervision and regulation practices that involve setting capital rules that place more emphasis on bank idiosyncratic risks. By requiring banks to operate with sufficient capital buffers so that their financial intermediation function in stressed economic scenarios is maintained, it is argued that stress testing promotes the resilience of BHCs and reduces the systemic risk of the entire financial system in U.S.

3 Literature review and hypothesis development

3.1 Literature on stress testing models

The literature on stress tests is relatively new and still growing. Several recent papers highlight the importance of stress tests as a supervisory tool and evaluate the costs and benefits of different design choices (see, for example, Hirtle & Lehnert 2015, Schuermann 2014, and references therein). Other studies attempt to develop alternative models and approaches to carry out stress tests (see, among others, Acharya, Engle & Pierret 2014, Covas, Rump & Zakrajsek 2014, Kapinos & Mitnik 2016, Kupiec 2018). Recent theoretical contributions focus on how stress tests can affect bank lending (Shapiro & Zeng 2018) and how to develop an optimal disclosure policy for the stress test results (Leitner & Williams 2018). The latter topic is very important because of a debate on whether disclosing the results of stress tests enhances financial stability. For example, while Goldstein & Sapra (2014) argue that disclosure of the stress test results promotes financial stability but may worsen inefficiencies of individual banks. In this regard, Corona et al. (2017) suggest that it may lead to excessive bank risk-taking and an increase in bank failures.

3.2 Stress tests and market implications

Recent empirical research on the impact of stress tests mostly relies on event studies to investigate the information content of stress tests and their financial market implications. Studying the events related to the SCAP, Morgan et al. (2014) show that stress test banks with larger capital deficiencies experience more negative abnormal returns. Fernandes et al. (2017) examine the price and trade reactions around the stress tests and document positive market reactions to the test announcements. Similarly, Flannery et al. (2017) find that stress tests provide information not only about the participating BHCs but also the fundamentals of the banking industry. Studies using data on European banks also confirm that stress tests offer valuable information to market participants (Petrella & Resti 2013) and may help the market detect fragile banks (Carboni et al. 2017).[4] Finally,

[4] However, these findings are at odds with the results provided by Lazzari et al. (2017).

several recent studies focus on the potential spillover effects of the release of the stress test results – either to other banks or to sovereigns (Breckenfelder & Schwaab 2018, Goncharenko et al. 2018).

3.3 Stress tests, bank capital and lending

As the consequence of failing stress tests can be severe, stress tests are likely to influence the behavior of participating banks. An emerging strand of literature attempts to quantify the effects of stress tests on bank credit provision and loan pricing (Acharya et al. 2018, Berrospide & Edge 2019, Calem et al. 2019, Connolly 2018, Cortés et al. 2019, Lambertini & Mukherjee 2016), capital ratios (Cornett et al. 2018), loan loss provisions and non-performing loans (Shahhosseini 2015), risk taking (Pierret & Steri 2018), and entrepreneurship and innovation (Doerr 2019). Other studies (see Bindal, Bouwman, Hu & Johnson 2019, Bordo & Duca 2018, Bouwman, Hu & Johnson 2018, Kovner & Van Tassel 2018) focus on the impact of the DFA on banks conduct, merger and acquisition behavior, and lending and the cost of capital. Studies focusing on European banks find that anticipation of stress tests can lead banks to reduce their risk-weighted assets instead of raising their levels of equity to increase capital ratios (Eber & Minoiu 2017, Gropp et al. 2018). A summary of the literature documenting the effects of stress tests on banks' behavior is given in Table A1 of the Appendix.

3.4 Hypotheses development: Impact of stress tests on bank liquidity creation

Banks that participate in the stress tests are required to have more capital relative to their credit risk exposure. Higher capital ratios can be achieved by reducing credit supply and substituting loans with relatively safer assets such as Treasury securities, especially when raising capital is costly (Acharya et al. 2018, Berger & Udell 1994, Brinkmann & Horvitz 1995, Thakor 1996). Higher capital ratios induced by the stress tests can also affect bank lending through other channels. Thakor (1996), among others, maintains that tighter capital requirement leads to increased banks' funding costs. Higher capital reduces creditors' risk which could result in weakened market discipline, reduced monitoring incentive, and increased costs of funding (Calomiris & Kahn 1991). With limited ability to pass these costs to borrowers due to competition, lending becomes less attractive to banks. For this reason, tighter capital requirements result in credit contractions. Supporting this view, De Jonghe et al. (2020) find evidence that higher capital requirements correspond to lower credit supply to firms and this credit contraction largely affects risky borrowers. Furthermore, as stress test banks are required to hold more capital against their risky lending, they may reduce moral hazard, induced by limited liability or government protection/guarantee, by restricting credit supply to risky borrowers (Acharya et al. 2016, Berger & Bouwman 2013). In other words, the risk-management hypothesis predicts that the higher capital requirement of the stress tests may lead to the adjustment of banks' portfolios that involves reductions in lending activities – particularly to risky borrowers (Acharya et al. 2018). Since credit lending is a key component of liquidity creation, bank liquidity creation declines as a result.

On the other hand, the moral hazard hypothesis suggests that requiring certain BHCs to participate in the stress tests may increase the moral hazard incentives of banks to take on more credit risk as these BHCs may be deemed systemically important to maintain a healthy banking industry (Acharya et al. 2018). Also, stress test banks may have lower returns as a result of increased capital and may engage in reaching-for-yield behavior by expanding credit lending to riskier borrowers (Acharya et al. 2018). Furthermore, it is argued that as capital enhances banks' safety and resilience, higher capital buffers as a consequence of the new regulatory framework are likely to improve their ability to expand credit provision (Berger & Udell 1994, Berger & Bouwman 2009, Bhattacharya & Thakor 1993, Coval & Thakor 2005). In a recent paper, Bahaj & Malherbe (2018) predict that the positive relationship between capital requirements and provision of credit is more likely at high levels of capital where banks have a low probability of failure. Although higher capital requirement reduces the value of implicit subsidy from a government guarantee, the extent to which the marginal loan is subsidized can increase, which leads to a lower marginal funding cost and increased bank credit lending. Similarly, higher capital can reduce banks' costs of funding, especially wholesale funding which is more sensitive to banks' risk (Berger & Bouwman 2013), improve banks' access to the risky debt markets (Carlson et al. 2013), thereby increasing the provision of credit (Chu et al. 2019). Higher capital can also strengthen market discipline, providing stronger incentives for banks to monitor borrowers (Mehran & Thakor 2011). These lead to improved credit access for borrowers. As a consequence of increased credit provision, bank liquidity creation may increase in response to regulatory stress tests.

Theories on the role of regulatory capital on bank liquidity creation yield conflicting predictions. Liquidity creation can be related to regulatory capital in two opposing ways. First, according to the 'financial fragility – crowding out' hypothesis, the relationship between liquidity creation and capital is negative. As banks gather funds from depositors to issue loans, they are inherently fragile, because they are exposed to the risk of bank runs in the absence of complete deposit insurance (Diamond & Rajan 2000, 2001). With the informational advantage obtained from monitoring borrowers, the bank may extract rents from depositors, withhold monitoring or repayment collection efforts.

Given the agency problem between the bank and depositors, depositors may be reluctant to provide funds. Therefore, such fragility is necessary because threats of premature withdrawal of demand deposits act as a disciplinary device (Calomiris & Kahn 1991). This fragility commits the banks to monitor borrowers and collect repayments, allowing them to create liquidity by granting more loans with more deposits. Because a higher capital ratio reduces the probability of financial distress, regulators can impose capital requirements to reduce fragility in the banking system. However, capital requirements, if binding, force banks to shift from deposit holdings to equity (Gorton & Winton 2000). Since deposits are liquid liabilities, liquidity creation decreases eventually.

On the contrary, the 'risk absorption' hypothesis points to a positive relationship between bank capital and liquidity creation. Bank risk increases with liquidity creation because it increases the expected loss resulting from sales of illiquid assets for liquidity reasons (see, among others, Allen & Gale 2004, Allen & Santomero 1997). In other words, given the mismatch between liquid liabilities and illiquid assets, the more liquidity banks create, the higher default risk they may face. Therefore, banks' liquidity creation increases their exposure to the risk of being unable to satisfy unexpected liquidity demands from customers and the associated losses of liquidating illiquid assets to meet such demands. For this reason, banks need to hold more capital to improve their solvency, which may allow them to obtain external funding on short notice or at lower costs. In addition, since well-capitalized banks tend to have higher risk absorption capacity, they are in a stronger position to create liquidity (Bhattacharya & Thakor 1993, Coval & Thakor 2005, Repullo 2004, von Thadden 2004). A recent study by Donaldson et al. (2018), which does not provide support for either hypothesis, shows that higher capital ratios enhance bank liquidity creation.

Following these two competing theories, regulatory stress tests may either increase or reduce bank liquidity creation. This leads to two alternative hypotheses to be tested in this paper:

Hypothesis 1: Risk-management/crowding out hypothesis – Regulatory stress tests have a negative impact on bank liquidity creation.

Hypothesis 2: Moral hazard/risk absorption hypothesis – Regulatory stress tests have a positive impact on bank liquidity creation.

4 Data and variables

4.1 Data

We collect data from a number of sources. Financial data is obtained from the Consolidated Financial Statements for BHCs (FR-Y9C). Bank liquidity creation measures are obtained from Christa Bouwman's website.[5] All variables are aggregated to the highest holder level. Our sample period starts in 2007Q1 and ends in 2016Q4. The 19 BHCs considered for the SCAP are: Ally Financial Inc, American Express Company, Bank of America Corporation, Bank of New York Mellon Corporation, BB&T Corporation, Capital One Financial Corporation, Citigroup Inc., Fifth Third Bancorp, Goldman Sachs Group, Inc., JPMorgan Chase & Co., KeyCorp, Metlife Inc., Morgan Stanley, PNC Financial Services Group Inc., Regions Financial Corporation, State Street Corporation, Suntrust Banks Inc., U.S. Bancorp, and Wells Fargo & Company.

Metlife Inc. did not participate in the 2013 CCAR as its commercial banking division was sold out and was not deemed a BHC in 2012. The 2014 CCAR was expanded to all BHCs with total assets exceeding $50 billion, increasing the total number of eligible BHCs, which were subject to the stress tests to 30. The new 12 BHCs include: BBVA Compass Bancshares Inc., BMO Financial Corp., Comerica Incorporated, Discover Financial Services, HSBC North America Holdings Inc., Huntington Bancshares Incorporated, M&T Bank Corporation, Northern Trust Corporation, RBS Citizens Financial Group Inc., Santander Holdings USA Inc., UnionBanCal Corporation, and Zions Bancorporation. The 2015 CCAR added Deutsche Bank Trust Corporation to the list of stress test banks. BancWest and TD Group were included in the 2016 CCAR. Metlife Inc. is removed from the sample as it is an insurance company and not comparable to other BHCs. This study relies on the website of the Federal Reserve's National Information Center to identify BHCs with assets greater than $20 billion as non-stress test banks.[6] The complete list of stress test banks over the sample period is provided in Table A2 of the Appendix.

4.2 Liquidity creation measures

Our liquidity creation measures are based on the methodology proposed by Berger & Bouwman (2009). Specifically, liquidity creation (LC) is defined as the 'cat fat' liquidity creation measure and accounts for both on-balance sheet and off-balance sheet items, which are classified by category.

[5] We would like to thank Christa Bouwman for making these data available in the public domain. For details, see `https://sites.google.com/a/tamu.edu/bouwman/data`.

[6] See, `www.ffiec.gov/nicpubweb/nicweb/nichome.aspx`.

Loan items are classified by category rather than by maturity because for the construction of liquidity creation measures, loan maturity is less important than the ability of banks to securitize and sell loans. *LC* measure is further broken down into on- and off-balance sheet liquidity creation measures as Berger & Bouwman (2009) find that, for large banks, half of the liquidity is created off the balance sheet. We utilize *LCON*, which is the liquidity creation measure that only includes on-balance sheet items and *LCOFF*, which is the off-balance sheet component of *LC*. Furthermore, we employ *LCA* and *LCL*, which are the asset and the liability components of liquidity creation, respectively. All the measures of liquidity creation are normalized by gross total assets, denoted by *GTA*. Table A3 in the Appendix provides details of the construction of liquidity creation measures.

4.3 Control variables

To control for bank-specific characteristics, a number of bank control variables are included in the liquidity creation regressions. One of them is the bank size (*SIZE*), which is the natural logarithm of gross total assets. It is important to account for credit risk as it helps to isolate the effect of capital on liquidity creation from the role of capital in supporting the risk transformation function of banks (Berger & Bouwman 2009). We proxy for credit risk using the ratio of non-performing loans to total loans (*NPL*) as in Du & Palia (2018). We also control for bank capitalization, denoted by *CAP*, which is measured by the ratio of equity to total assets (Berger & Bouwman 2009). To account for bank profitability, we use return on equity (*ROE*), which is the ratio of net income to equity (Casu et al. 2019). In robustness checks, we further include banks with foreign parents. The information about foreign banks can be found on the website of the Federal Reserve's National Information Center. The definitions of the variables used in our empirical analyses are given in Table 1.

4.4 Data description

Table 2 reports the descriptive statistics for the liquidity creation measures as well as the control variables of interest. The average liquidity creation, *LC*, appears to be 54.44%, while the averages of *LCON* and *LCOFF* are 26.34% and 28.10%, respectively. Consistent with Berger & Bouwman (2009), who find that for large banks half of the liquidity is created off the balance sheet, the mean value of *LCOFF* in our sample is greater than that of *LCON*. It can be seen from Table 2 that the average of *LCL* is 20.33%, which is much higher than the average of *LCA* (6.01%), suggesting that the banks in our sample appear to create more liquidity on the liability side than on the asset side of the balance sheet. As for the control variables, the average of return on equity, *ROE*, is

4.39%. Table 2 also shows that the average capital ratio, *CAP*, of the banks over the sample period is 10.95%, while the mean of non-performing loans to total loans ratio, *NPL*, is 2.36%.

Figure 1 plots the evolution of *LC*, over time, for the stress test banks and the non-stress test banks. The graph shows a marked reduction in *LC* from around $4,300 billion in 2008:Q4 to $3,500 billion in 2009:Q4 for the stress test banks, but not for the non-stress test banks. Such a pattern, however, is not clear in the following periods. For this reason, in the subsequent econometric analysis we present tests that exclude the first stress testing exercise to ensure the robustness of our results.

5 Empirical results

5.1 Univariate analysis

The results of the univariate analysis for the differences in the means and the medians of the main variables of the banks in the sample are reported in Table 3. The empirical examination includes all stress test and non-stress test banks in sample. Following Cornett et al. (2018), we divide our sample into three subperiods: year 2007, which is the year before the financial crisis and before the stress testing exercises; year 2009, which is the first year of the stress testing program; and the 2009–2016 period, which includes data for the full-sample. Once a BHC is classified as a stress test bank in a particular year, its quarterly observations in that year are included in the stress test category.

Table 3 shows that in 2007, which is the year before the stress tests, the BHCs that go into the stress test in 2009 have higher liquidity creation ratios than non-stress test banks. For example, the *LC* ratios are 92.19% for stress test banks versus 47.78% for non-stress test banks. Similarly, *LCOFF* ratios are 71.07% and 17.78% for stress test banks and non-stress test banks, respectively. This is consistent with the finding of Berger & Bouwman (2009) that large banks create more than half of their liquidity off the balance sheet. Nevertheless, non-stress test banks as a group appear to have a higher average *LCON* ratio than stress test banks (29.99% versus 22.12%). Stress test banks also have a lower average *LCA* ratio (7.73%) in comparison with non-stress test banks (14.7%).

In 2009, which is the first year of stress testing, non-stress test banks see no significant changes in the liquidity creation ratios when comparing column (5) to column (1). As for stress test banks, by comparing column (7) to column (3), it can be seen that their liquidity creation ratios have been significantly reduced during 2007 and 2009. Notably, the mean of *LC* in 2007 for stress test banks is 92.19%, which decreases to 59.61% in 2009. Similarly, both *LCON* and *LCOFF* ratios also decrease from 21.12% to 14.49% and from 71.07% to 45.12%, respectively, and both are statistically significant at the 10% and the 5% levels, respectively. Stress test banks appear to cut down their asset-side liquidity creation, *LCA*, from 7.73% in 2007 to 1.14% in 2009. The difference between the two estimates is statistically significant at the 5% level.

Comparing the results for 2007 (column (1)) and the period between 2009 and 2016 (column (9)), there are no significant changes in the total liquidity creation ratio, *LC*, for non-stress test banks, while there is a marginal increase in the liquidity creation on the balance sheet, *LCON* (34.69% versus 29.99%). In contrast, when comparing column (11) to column (3), stress test banks appear to have a lower liquidity creation, *LC*, on average during 2009–2016, decreasing from 92.19% in 2007 to 51.81%. The *LCOFF* ratio also falls from 71.07% in 2007 to 33.14% (also statistically different at the 1% significance level). Similarly, there is a decrease in the asset-side liquidity creation, *LCA*, to 0.1% in 2009–2016 (also statistically different at the 1% significance level). However, the liability-side liquidity creation, *LCL*, appears to increase during 2009–2016 to 18.57% in comparison with 13.38% in 2007 (again, statistically different at the 1% significance level). Overall, it appears that stress test banks reduce their liquidity creation as they enter the stress test, while no significant changes are observed for non-stress test banks.

Table A4 of the Appendix further presents the univariate analysis for the differences in the means of bank balance sheet items. When comparing columns (4) and (6) to column (2), the results suggest that stress test banks reduce illiquid assets following the stress tests. For example, in 2009 and during the 2009–2016 period, the ratios of commercial real estate loans, loans to finance agricultural production, commercial and industrial loans, and intangible assets and premises are smaller than those in 2007. The table also shows an increase in saving deposits ratio of stress test banks after the stress tests. As saving deposits are more liquid and tend to account for a large proportion of banks' total liquid liabilities, the finding is consistent with the reported increase in stress test banks' *LCL*. Finally, by comparing column (6) to column (2), there is evidence that stress test banks reduce illiquid off-balance sheet items (e.g., unused commitments, net standby letters of credit, and commercial and similar letters of credit), while increase more liquid components (e.g., interest rate derivatives and foreign exchange derivatives) following the stress tests.

5.2 Regression discontinuity design

We exploit the Federal Reserve System's selection criterion for the stress tests as an exogenous source of variation to estimate the causal impact of stress tests on bank liquidity creation. Banks are selected on the basis of their size, and therefore stress test banks do not have counterparts that are not part of the stress test (Acharya et al. 2018, Cornett et al. 2018). In other words, the treatment status, which is conditional on bank size, is not driven by the outcome variables. This set-up allows us to employ a regression discontinuity (RD) approach to investigate the effect of regulatory stress tests on bank liquidity creation. The RD setting requires a known cutoff of a running variable in order to determine the treatment. The regulatory rule that obligates certain banks to participate in the stress tests provides a natural threshold and allows us to exploit the cross-sectional variation in the liquidity creation of stress test banks and non-stress test banks. The BHCs with total assets below the threshold fall naturally into the control group, while the treatment group consists of BHCs with total assets exceeding the threshold and therefore are subject to regulator stress tests.

The RD method focuses on the treatment effect induced by the variation in the treatment assignment around the cutoff and overcomes the effects of other potential confounders. The average effect of the treatment on banks that are close to the cutoff can be obtained by comparing the average outcomes of observations just below and above the threshold.[7] That is, the liquidity creation of banks just above the size cutoff subsequent to entering the stress tests is compared to the liquidity creation of banks that are exempt from the tests. In the absence of treatment, banks belonging to the treatment and the control groups are assumed to behave in a similar way. The identification strategy assumes that the assignment/running variable cannot be manipulated around the known threshold (see Lee & Lemieux 2010). In other words, the validity of our RD estimation method rests on the assumption that banks do not have control over whether they are over the size limits or not, which in turn, determines whether or not they are subject to the stress tests.[8]

In this paper, the local linear regression discontinuity is estimated non-parametrically, following Hahn et al. (2001), using the data closer to the cutoffs of $100 billion and $50 billion. The use of non-parametric approach is to mitigate the risk of misspecification, which is common in parametric analysis. The empirical approach is appealing as it reduces the bias arising from using the data farther away from the cutoff to estimate the discontinuity at the cutoff and the variation in the liquidity creation of banks near the size limits is attributable to the effect of the stress tests. The

[7] Cornett et al. (2018) also use a RD approach to examine bank behavior around Federal Reserve stress tests.

[8] The first round of the stress tests was announced and conducted in 2009. Participated banks were those whose total assets exceed $100 billion in 2008. The $100 billion and the $50 billion size requirements in 2009 and in 2014, respectively, were determined by the Federal Reserve System rather than BHCs. Therefore, it can be argued that banks had no control over whether it is in or out of the stress test group.

regression takes the following specification (see Lee & Lemieux 2010, Roberts & Whited 2013):

$$Y_{it} = \alpha + \beta_1 Stress_{it} + \beta_2 Assignment_{it} + \beta_3 (Stress_{it} \times Assignment_{it}) + \delta X_{it} + \upsilon_i + \gamma_t + \epsilon_{it}, \quad (1)$$

where Y_{it} is a proxy for bank liquidity creation for bank i at time t. The dummy variable, $Stress_{it}$, defines the treatment status and equals 1 if a bank is in the stress test group and 0 otherwise. As there was no stress test in 2010, $Stress_{it}$ takes the value of 0 for all banks in that year. The variable, $Assignment_{it}$, represents the distance between bank i's size (natural logarithm of gross total assets) and the cutoffs (normalized by natural logarithm). The interaction term, $Stress_{it} \times Assignment_{it}$, is included to capture the possible differences in the slope of the regression on both sides of the cutoff as explained in Bonner & Eijffinger (2016). X_{it} is a vector of control variables, and υ_i and γ_t represent bank fixed effects and time fixed effects, respectively.[9] In our regression discontinuity estimations, robust standard errors are clustered at the bank level. We exclude bank size, *SIZE*, from the RD regressions because of its high correlation with the *Assignment* variable.

Choosing a bandwidth in the local linear non-parametric RD model involves a bias-variance trade-off. On the one hand, a smaller bandwidth uses a fewer number of observations around the cutoff, thereby reducing the potential estimator's bias that arises from specifying an incorrect functional form. But this comes at the expense of reduced statistical precision due to a smaller sample size. On the other hand, a wider bandwidth employs more observations, thus improving estimation precision at the expense of increased risk of bias. While there are a variety of approaches for choosing the optimal bandwidth for the RD model in the literature, the selection of bandwidth remains a subjective decision. It is, therefore, suggested that the best practice is to experiment with different bandwidths to demonstrate the robustness of the findings (Roberts & Whited 2013). In this paper, the RD estimation is implemented using the optimal mean squared error (MSE-optimal) bandwidth that minimizes the mean square error following Imbens & Kalyanaraman (2012). As the choice of weighting kernel has been shown to have negligible impact on estimation in practice, we use the rectangular kernel as the weighting kernel.

[9] Bank fixed effects are included to take into account unobserved heterogeneity across banks in our sample. In particular, bank fixed effects wipe out unobserved time-invariant bank characteristics affecting bank liquidity creation. The main variation across banks comes from two sources: the bank fixed effects and the effects of participating in the stress tests. However, this is not a cause for concern as these two effects are not perfectly linearly correlated. For example, in 2009, 2011, and 2012, the same 15 out of 34 banks did not participate in the stress tests – representing around 44% of the sample of the stress test banks. In 2013, Metlife Inc., dropped out of the sample for the stress test banks and was the only BHC not participating in the stress test in 2016.

5.2.1 Graphical analysis

Figure 2 plots the discontinuity estimates at the threshold for bank liquidity creation measures. The x-axis measures the distance between banks' size at the cutoff. Banks with size above the cutoff are to the right of the threshold, while those below the cutoff are to the left. The lines represent the fitted regression lines for models, which include up to the fourth-order polynomial term. Figure 2 shows a clear discontinuity in bank liquidity creation measures at the cutoff. Specifically, within the proximity of the cutoff, stress test banks have lower total liquidity creation ratio, *LC*, than non-stress test banks. Similarly, other liquidity creation ratios (*LCON*, *LCOFF*, and *LCA*) of stress test banks are also lower than those of non-stress test banks, pointing to the negative impact of stress testing on bank liquidity creation. In contrast, the figure illustrates that the liability-side liquidity creation ratio, *LCL*, of stress test banks is higher than that of non-stress test counterparts.

5.2.2 Regression discontinuity estimation

We use a RD approach that exploits the bank size cutoff and separates stress test banks from non-stress test banks. By comparing banks around this cutoff, we can identify the effect of regulatory stress tests on U.S. bank liquidity creation. As mentioned earlier, the RD method assumes that banks in the vicinity of the threshold cannot manipulate the treatment status. This requires that the density of the running variable be continuous around the threshold. We follow the methodology proposed by McCrary (2008) to test for the discontinuity of the density of the running variable. Figure 3 plots the density of the running variable (in our case, *Assignment*). The x-axis represents the distance of banks' size from the stress test threshold and the y-axis represents the density of the running variable. The dots depict the density and the solid line represents the fitted density function of the running variable with a 95% confidence interval around the fitted line. A jump in the density at the threshold, if observed, is indicative of discontinuity and manipulations. The figure gives little indication of a strong discontinuity at the threshold. The discontinuity estimate of the density of the running variable is -0.1317 and is statistically insignificant at conventional levels. Therefore, the null hypothesis that the density of *Assignment* at the cutoff threshold is continuous cannot be rejected. Overall, it appears that banks do not manipulate their size with an aim to avoid being subject to the regulator stress tests.

We resort to a non-parametric local linear estimation with a rectangular kernel and the MSE-optimal bandwidth following Imbens & Kalyanaraman (2012). Table 4 reports the estimation results for the liquidity creation measures. The variable of interest is *Stress*, which captures the difference between stress test and non-stress test banks. For each of the measures of bank liquidity creation, we show the estimation results with and without control variables. We find that there is a negative and statistically significant discontinuity at the cutoff across all the measures of liquidity creation with the exception of the liability-side liquidity creation, *LCL*. For example, the estimated coefficients of *Stress* for the total liquidity creation, *LC*, (columns (1) and (2)) are -0.1161 and -0.1279, respectively, suggesting that banks reduce their liquidity creation when they are subject to the regulatory stress tests. The estimated effects are significant at the 1% significance level. Economically, the estimated coefficient of *Stress* in column (1) indicates that stress test banks reduce *LC* on average by around 11 percentage points relative to non-stress test banks. Since the sample mean for *LC* is around 54 percentage points, this reduction is around 21.4% of the sample mean. In column (2) the estimated reduction is around 23.5% of the sample mean. Considering the coefficient estimate of -0.6225 on *Assignment* and the coefficient estimate of 0.7019 on the interaction term, *Stress* × *Assignment*, in column (1), our result suggests that the reduction in *LC* actually becomes smaller as the bank becomes bigger, provided that the bank is included in the stress tests. In particular, an increase of $(-0.6225 + 0.7019) \times 1.4175 = 0.1125 \approx 11\%$ in the value of *LC*, evaluated at the sample mean, is associated with an increase of one-standard deviation in *Assignment* for stress test banks. The coefficient on the interaction term is interesting because it indicates that the impact of stress tests on *LC* is more pronounced for smaller banks closer to the cutoff than bigger banks, located farther away from the size cutoff. Similarly, the coefficient estimates of *Stress* for liquidity creation on the balance sheet, *LCON*, (columns (3) and (4)) are -0.0853 and -0.0914 and are statistically significant at the 5% and 1% levels, respectively.

Stress also reduces bank off-balance sheet liquidity creation. Specifically, the coefficient estimates of *Stress* for the liquidity creation off the balance sheet, *LCOFF*, (columns (5) and (6)) are -0.0362 and -0.0307, respectively (both are statistically significant at the 1% level). These results suggest that stress test banks reduce their off-balance sheet liquidity creation in response to regulatory stress tests, which may be due to the fact that off-balance sheet risk can materialize and contribute to the on-balance sheet risk. This may, in turn, affect the capital ratios of those banks that participate in the stress tests. As can be seen from Table 4, the coefficient estimates of *Stress* for the asset-side liquidity creation, *LCA*, (columns (7) and (8)) are -0.0849 and -0.0764, respectively, both of which are significant at the 1% significance level. These empirical findings are generally in line with Acharya et al. (2018), who document a reduction of credit supply of banks, especially to relatively risky borrowers. Stress test banks may attempt to cut down their risk exposure by shrinking their asset-side liquidity creation in an effort to increase their capital ratios. This is also consistent with Hyun & Rhee (2011) and Gropp et al. (2018), who provide evidence that banks shrink their risky assets instead of issuing new equity to meet higher capital requirements.

On the contrary, the coefficient estimates of *Stress* for the liability-side liquidity creation, *LCL*, (columns (9) and (10)) are both positive (0.1090 and 0.1140, respectively) and statistically significant at the 1% level. The results imply that banks increase their liability-side liquidity creation in response to stress tests. Table A4 in the Appendix shows the univariate analysis of liquid and illiquid components of both on- and off-balance sheet items of stress test and non-stress test banks. It appears that stress test banks increase their savings deposits following the stress tests. Table A5 in the Appendix shows that savings deposits account for a large proportion (around 70–80%) of stress test banks' total liquid liabilities. With a decline in liquidity mismatch as a result of the reduction in asset-side liquidity creation, banks may rely more on stable funding sources, which leads to an increase in liability-side liquidity creation. Furthermore, Cornett et al. (2018) report that stress test banks increase their capital ratios to avoid failing the stress tests. With the improved capital ratios and the reduced probability of default, banks may have incentives to increase liquidity creation on the liability side of the balance sheet. This can subsequently lead to enhanced bank profitability, which may compensate for the forgone profits from the reduced asset-side liquidity creation. Enhanced profitability may also result in increased retained earnings and capital. Consistent with our results, Berger et al. (2016) find that capital support, which improves banks' capital ratios increases bank liability-side liquidity creation. It should be noted that equity is also included in the calculation of liability-side liquidity creation and the increased equity should reduce *LCL*. Therefore, it is not clear whether or not banks issue more equity in response to regulatory stress tests.

Table 5 reports the RD estimation results for those banks that enter the stress tests for the first time. In all regressions, *Stress* is the dummy variable which is equal to 1 if the bank is required to participate in the stress test in a particular year but not the year before, and is equal to 0 otherwise. Similar empirical findings are reported indicating that stress tests lead to a reduction in bank total liquidity creation. Specifically, Table 5 presents evidence that for those banks that enter the stress tests for the first time, they tend to cut down on asset-side liquidity creation to reduce their risk exposure while adjusting funding activities to increase liability-side liquidity creation. Consistent with prior empirical findings, banks' off-balance sheet liquidity creation is also reduced in response to regulatory stress tests. When controlling for the covariates, the estimated coefficients of *Stress* remain consistent across the model specifications. Taken together, the empirical results suggest that regulatory stress tests have a positive or negative impact on different components of liquidity creation, but the total effect is negative.

5.3 Bank liquidity creation when they enter the stress test for the first time

In this subsection, we investigate the change in banks' liquidity creation as they enter the stress tests for the first time. The following regression is estimated using the ordinary least squares (OLS). To improve their chances of passing the stress tests, banks may manage their financial statements, thereby changing their liquidity creation. We follow Cornett et al. (2018) and estimate:

$$Y_{it} = \alpha + \beta_1 First\ Stress_{it} + \delta X_{it} + \gamma_t + \epsilon_{it}, \tag{2}$$

where Y_{it} is the measure of bank liquidity creation for bank i at time t. The dummy variable of interest is *First Stress*, which takes a value of 1 if the bank is subject to the stress test in a particular year, but not the year before. X_{it} is a vector of control variables. All the variables are measured as changes from the periods just before entering into the stress tests to the first year of stress testing. Because the starting point of each of the stress tests is in the third quarter, the focus of the analysis is the changes during the third quarter prior to each of the stress tests and the first year of the stress test. The analysis allows us to identify the difference-in-difference (DiD) between stress test banks and non-stress test banks as they enter the stress tests for the first time. In all of our regressions for this subsection, time fixed effects are included and standard errors are double clustered by both bank and time to control for unobserved heterogeneity within the variables.[10]

Table 6 presents the results from the OLS regressions of bank liquidity creation measures as they enter the stress tests for the first time. The variable of interest is *First Stress*, which is equal to 1 if the bank is subject to the stress test in a particular year but not the year before. This allows us to examine the differences in the liquidity creation of non-stress test banks and stress test banks as the latter enters the stress tests for the first time. All the variables are measured as changes from quarter 3 of the year $t-1$ to quarter 3 of year t as the starting point of the stress tests is quarter 3. Controlling for other bank-specific characteristics, the estimated coefficient of *First Stress* of -0.0843 is statistically significant at the 5% level in the regression (1) for total liquidity creation,

[10] Consistent with Cornett et al. (2018), we exclude bank fixed effects to avoid that the variation that we explore derive solely from the banks that enter the stress test for the first time. Moreover, clustering standard errors at the bank level only does not change qualitatively our empirical results.

LC. This suggests that as banks participate in the stress test for the first time, they tend to alter their behaviors and reduce their total liquidity creation from quarter 3 prior to joining the stress test group to quarter 3 in the first year of stress testing. Similarly, in the regression for the liquidity creation on the balance sheet, *LCON*, as banks enter the stress tests, there is a significant (at the 1% level) reduction in the liquidity creation of banks on the balance sheet with an estimated coefficient of −0.0303. Similar findings are presented in columns (3) and (4) for liquidity creation off the balance sheet, *LCOFF*, and asset liquidity creation, *LCA*. The coefficient estimates of *First Stress* are −0.0540 and −0.0232, respectively. The reduction in the asset-side liquidity creation, *LCA*, that is found in the table is consistent with the risk-management hypothesis proposed by Acharya et al. (2018). The hypothesis suggests that stress test banks manage their risk exposure more prudently by reducing credit supply, particularly to risky borrowers to increase their capital ratios. Furthermore, Table 6 shows that the risk-management hypothesis also applies to liquidity creation off the balance sheet because banks adjust their off-balance sheet activities as they enter the stress tests. Nevertheless, as for the liability-side liquidity creation, *LCL*, the estimated coefficient on *First Stress* is statistically insignificant even though it remains negative in column (5).

Table 7 reports the results for the same regressions after excluding the first stress test. Consistent with the results in Table 6, the results in Table 7 confirm that (with the exception of *LCL*) all liquidity creation measures decrease as a result of banks entering the stress tests for the first time.

5.4 Bank liquidity creation around the stress test quarter

From 2009–2015, the starting point of the stress test is the third quarter, Q3, while the starting point of the stress test in 2016 is the first quarter, Q1. We examine the liquidity creation of stress test banks around the starting point of the stress tests by employing a DiD regression method following Cornett et al. (2018). At the starting point of the stress tests (i.e., $Q = t$), all the variables are measured as changes from quarter 2 to quarter 3 in 2009–2015 and from quarter 4 to quarter 1 in 2016. Similarly, we measure the changes in all the variables in the quarters before (i.e., $Q = t - 2$ and $Q = t - 1$) and after the starting point quarters (i.e., $Q = t + 1$). In all regressions, the variable *Stress*, which is equal to 1 if the bank participates in the stress test in a particular year and 0 otherwise, is the focus of our interest. The coefficient of the interaction between *Stress* and the quarters around the starting points of the stress tests captures the behavior of stress test banks around the stress tests. In all regressions conducted for this subsection, time fixed effects are included and standard errors are double clustered by bank and time to control for unobserved heterogeneity.

In this subsection, we empirically examine the liquidity creation of banks around the stress test starting points. Table 8 presents the regression results for changes in bank liquidity creation by quarters around the stress test starting points. The interaction variable, $\mathit{Stress} \times Q = t$, captures the effect of stress testing on the starting point quarters (between quarters 2 and 3 in 2009–2015, and between quarter 4 in 2015 and quarter 1 in 2016), $\mathit{Stress} \times Q = t + 1$ isolates the changes in liquidity creation in the quarter after the starting points (between quarters 3 and 4 in 2009-2015, and between quarter 1 and 2 in 2016). $\mathit{Stress} \times Q = t - 2$ and $\mathit{Stress} \times Q = t - 1$ isolate the changes in liquidity creation two quarters and one quarter before the stress tests, respectively.

Consistent with prior empirical findings, it can be seen that the coefficient estimates of $\mathit{Stress} \times Q = t$ are negative and statistically significant for all measures of liquidity creation, except for LCL, indicating that banks reduce their liquidity creation at the starting points of the stress tests to improve their chances of passing the tests. The findings point to differences between stress and non-stress test banks at the starting point of the stress tests as liquidity creation of stress test banks is reduced in comparison with that of non-stress test banks. Specifically, the coefficient estimate of $\mathit{Stress} \times Q = t$ for LC is -0.0125 and significant at the 1% significance level. The coefficient estimates of $\mathit{Stress} \times Q = t$ for $LCON$ and $LCOFF$ are -0.0034 and -0.0091, respectively (significant at the 1% and the 5% levels), indicating that stress testing appears to have a stronger effect on off-balance sheet liquidity creation of banks than on-balance sheet liquidity creation. The results are consistent with prior empirical analyses in which evidence in support of the risk-management hypothesis is reported. Stress test banks cut down their risk exposure, thereby reducing liquidity creation both on- and off-the-balance sheet. While the coefficient estimate for LCA is -0.0034 and significant at the 5% level, the coefficient estimate for LCL is statistically insignificant at conventional levels. For the quarters after the stress test starting points, Table 8 also shows that the coefficient estimates of $\mathit{Stress} \times Q = t + 1$ are negative and statistically significant at the 5% level for only $LCON$ and LCA (-0.0090 and -0.0064, respectively). Thes empirical results indicate that the impact of regulatory stress tests on bank liquidity creation appears to be strongest at the starting quarter of the stress tests as banks reduce their liquidity creation to improve the chances of passing the stress tests. The impact of stress tests on liquidity creation on the quarter after the stress tests is more pronounced but is only observed in some components of liquidity creation.

Table 9 presents the results after excluding the first stress test. The coefficient estimates on $\mathit{Stress} \times Q = t$ are slightly smaller than those reported in Table 8, but they are still negative and statistically significant at the 5% or 1% level for *LC*, *LCON*, and *LCA*.

5.5 Robustness checks

For robustness checks, we begin with testing the parallel trends assumption, which in our case implies that in the absence of the stress tests, the trend growth rates for the liquidity creation measures of stress test and non-stress test banks are not statistically different. Table 10 presents *t*-tests for differences in mean between treatment and control groups in eight quarters prior to the stress test following Roberts & Whited (2013). The test examines the differences in the growth rate in liquidity creation measures between the treatment and control groups during each pre-treatment quarter. We find that the null of equality of means cannot be rejected in 34 out of 40 cases at conventional levels, which largely confirms the validity of the parallel trends assumption.

Next, we present the estimates of RD under the local randomization inference, which is based on a 'stronger' alternative identification assumption. The local randomization assumption holds that, within a narrow bandwidth around the threshold, observations are as good as randomly assigned to treatment and control groups. That is, the treatment assignment could be regarded as a randomization mechanism near the cutoff (Lee 2008). Following the procedure in Cattaneo et al. (2015, 2016), a small neighborhood around the cutoffs where the local randomization assumption is deemed most plausible is selected. Table 11 presents the results of the difference-in-means tests for the measures of liquidity creation between the stress test banks and the non-stress test banks using the randomization inference. The estimates of the treatment effects are largely consistent with our main findings. For example, the difference in the means of *LC* between stress test and non-stress test banks is statistically significant at the 1% significance level.

To test whether the actual cutoff fits the data better than other nearby cutoffs, placebo tests are conducted to see if discontinuity in bank liquidity creation is still observed at artificially determined thresholds. The following alternative thresholds other than \$100 and \$50 billion are selected: \$40, \$60, \$70, \$80, \$90, and \$110 billion. Using the alternative thresholds as the artificial cutoffs, all banks in the sample are re-assigned into the treatment or the control groups, based on whether or not the banks' gross total assets exceed the artificial cutoffs, respectively. Table 12 presents the estimation results using the alternative cutoffs. Using the alternative cutoff of \$40 billion, the estimated coefficient of *Stress* is negative in column (3). Using the alternative cutoff of \$60 billion, even though the estimated coefficients of *Stress* are negative for *LCA* in both columns (7) and (8), we find that the estimated coefficient is positive for *LC* in column (2). Overall, the results suggest that the treatment effect is not observed at the artificially determined thresholds in most regressions.

We perform an additional robustness check by running the RD regressions that include banks with assets larger than $10 billion. Table 13 presents the results of RD when banks with assets larger than $10 billion are included. Overall, the results are consistent with our main empirical findings. Finally, we run the RD regressions and include banks with foreign parents. Table 14 presents the results of RD when banks with foreign parents are included. Collectively, we still find that stress tests have a significantly negative impact on bank liquidity creation. Banks appear to reduce all components of liquidity creation with the exception of liability-side liquidity creation.

6 Concluding remarks

In this paper, we investigate the impact of Federal Reserve stress tests from 2009 to 2016 on U.S. bank liquidity creation. To do so, we employ a regression discontinuity approach to provide evidence that regulatory stress tests may lead to a reduction in bank liquidity creation both on and off the balance sheet. In particular, we show that asset-side liquidity creation decreases in response to the stress tests, a finding that is in line with the risk-management hypothesis: stress test banks cut down credit lending, particularly to risky borrowers, to reduce their risk exposures (Acharya et al. 2018). However, on the liability-side there is an increase of liquidity creation, driven by more customer deposit funding. This finding suggests that banks seek to offset the increase in funding costs resulting from the stress tests by moving from non-deposit funding to cheaper funding sources.

From a policy perspective, to the extent that stress testing discourages bank liquidity creation, an important bank output which contributes to economic growth (Bhattacharya & Thakor 1993), stress tests might lead to a reduction in the amount available for financing, thereby slowing economic growth. Nevertheless, as excessive liquidity creation increases the probability of default (Imbierowicz & Rauch 2014), which can result in financial instability and may lead to financial crises (Acharya et al. 2011, Acharya & Naqvi 2012, Berger & Bouwman 2017), the reduction of excessive liquidity creation as a consequence of regulatory stress tests can be socially desirable in terms of enhancing the safety and soundness of the banking system. For these reasons, it is important for policymakers and bank regulators to consider the trade-off between the benefits of greater financial stability and the benefit of greater liquidity creation when designing a regulatory framework that promotes the soundness of the banking system but also minimizes the impact on economic activity.

References

Acharya, V., Engle, R. & Pierret, D. (2014), 'Testing macroprudential stress tests: The risk of regulatory risk weights', *Journal of Monetary Economics* **65**, 36–53.

Acharya, V. & Naqvi, H. (2012), 'The seeds of a crisis: A theory of bank liquidity and risk taking over the business cycle', *Journal of Financial Economics* **106**(2), 349–366.

Acharya, V. V., Berger, A. N. & Roman, R. A. (2018), 'Lending implications of U.S. bank stress tests: Costs or benefits?', *Journal of Financial Intermediation* **34**, 58–90.

Acharya, V. V., Mehran, H. & Thakor, A. V. (2016), 'Caught between Scylla and Charybdis? Regulating bank leverage when there is rent seeking and risk shifting', *Review of Corporate Finance Studies* **5**(1), 36–75.

Acharya, V. V., Shin, H. S. & Yorulmazer, T. (2011), 'Crisis resolution and bank liquidity', *Review of Financial Studies* **24**(6), 2166–2205.

Allen, F. & Gale, D. (2004), 'Financial intermediaries and markets', *Econometrica* **72**(4), 1023–1061.

Allen, F. & Santomero, A. M. (1997), 'The theory of financial intermediation', *Journal of Banking & Finance* **21**(11), 1461–1485.

Andreou, P. C., Philip, D. & Robejsek, P. (2016), 'Bank liquidity creation and risk-taking: Does managerial ability matter?', *Journal of Business Finance & Accounting* **43**(1-2), 226–259.

Bahaj, S. & Malherbe, F. (2018), The forced safety effect: How higher capital requirements can increase bank lending. Working paper.

Berger, A. N. & Bouwman, C. H. S. (2009), 'Bank liquidity creation', *Review of Financial Studies* **22**(9), 3779–3837.

Berger, A. N. & Bouwman, C. H. S. (2013), 'How does capital affect bank performance during financial crises?', *Journal of Financial Economics* **109**(1), 146–176.

Berger, A. N. & Bouwman, C. H. S. (2017), 'Bank liquidity creation, monetary policy, and financial crises', *Journal of Financial Stability* **30**, 139–155.

Berger, A. N., Bouwman, C. H. S., Kick, T. & Schaeck, K. (2016), 'Bank liquidity creation following regulatory interventions and capital support', *Journal of Financial Intermediation* **26**, 115–141.

Berger, A. N. & Sedunov, J. (2017), 'Bank liquidity creation and real economic output', *Journal of Banking & Finance* **81**, 1–19.

Berger, A. N. & Udell, G. F. (1994), 'Did risk-based capital allocate bank credit and cause a "credit crunch" in the United States?', *Journal of Money, Credit and Banking* **26**(3), 585–628.

Berrospide, J. M. & Edge, R. M. (2019), 'The effects of bank capital buffers on bank lending and firm activity: What can we learn from five years of stress-test results?'. Board of Governors of the Federal Reserve System, Finance and Economics Discussion Series 2019-050.

Bhattacharya, S. & Thakor, A. V. (1993), 'Contemporary banking theory', *Journal of Financial Intermediation* **3**(1), 2–50.

Bindal, S., Bouwman, C. H. S., Hu, S. & Johnson, S. A. (2019), 'Bank regulatory size thresholds, merger and acquisition behavior, and small business lending', *Journal of Corporate Finance* . Forthcoming.

Bonner, C. & Eijffinger, S. C. W. (2016), 'The impact of liquidity regulation on bank intermediation', *Review of Finance* **20**(5), 1945–1979.

Bordo, M. D. & Duca, J. V. (2018), 'The impact of the Dodd-Frank Act on small business'. National Bureau of Economic Research Working Paper No. 24501.

Bouwman, C. H. S., Hu, S. S. & Johnson, S. A. (2018), 'Differential bank behaviors around the Dodd-Frank Act size thresholds', *Journal of Financial Intermediation* **34**, 47–57.

Bowe, M., Kolokolova, O. & Michalski, M. (2019), 'Too big to care, too small to matter: Macrofinancial policy and bank liquidity creation'. Working paper.

Breckenfelder, J. & Schwaab, B. (2018), 'Bank to sovereign risk spillovers across borders: Evidence from the ECB's Comprehensive Assessment', *Journal of Empirical Finance* **49**, 247–262.

Brinkmann, E. J. & Horvitz, P. M. (1995), 'Risk-based capital standards and the credit crunch', *Journal of Money, Credit and Banking* **27**(3), 848–863.

Calem, P., Correa, R. & Lee, S. J. (2019), 'Prudential policies and their impact on credit in the United States', *Journal of Financial Intermediation* . Forthcoming.

Calomiris, C. W. & Kahn, C. M. (1991), ‘The role of demandable debt in structuring optimal banking arrangements’, *American Economic Review* **81**(3), 497–513.

Carboni, M., Fiordelisi, F., Ricci, O. & Lopes, F. S. S. (2017), ‘Surprised or not surprised? The investors’ reaction to the comprehensive assessment preceding the launch of the banking union’, *Journal of Banking & Finance* **74**, 122–132.

Cardillo, G., Onali, E. & Torluccio, G. (2020), ‘Does gender diversity on banks’ boards matter? evidence from public bailouts’, *Journal of Corporate Finance* . Forthcoming.

Carlson, M., Shan, H. & Warusawitharana, M. (2013), ‘Capital ratios and bank lending: A matched bank approach’, *Journal of Financial Intermediation* **22**(4), 663–687.

Casu, B., di Pietro, F. & Trujillo-Ponce, A. (2019), ‘Liquidity creation and bank capital’, *Journal of Financial Services Research* **56**(3), 307–340.

Cattaneo, M. D., Frandsen, B. R. & Titiunik, R. (2015), ‘Randomization inference in the regression discontinuity design: An application to party advantages in the US Senate’, *Journal of Causal Inference* **3**(1), 1–24.

Cattaneo, M. D., Titiunik, R. & Vazquez-Bare, G. (2016), ‘Inference in regression discontinuity designs under local randomization’, *Stata Journal* **16**(2), 331–367.

Chu, Y., Zhang, D. & Zhao, Y. E. (2019), ‘Bank capital and lending: Evidence from syndicated loans’, *Journal of Financial and Quantitative Analysis* **54**(2), 667–694.

Connolly, M. F. (2018), ‘The real effects of stress testing’. Working paper.

Cornett, M. M., Minnick, K., Schorno, P. J. & Tehranian, H. (2018), ‘An examination of bank behavior around Federal Reserve stress tests’, *Journal of Financial Intermediation* . Forthcoming.

Corona, C., Nan, L. & Zhang, G. (2017), ‘The coordination role of stress test disclosure in bank risk taking’. Working paper.

Cortés, K., Demyanyk, Y., Li, L., Loutskina, E. & Strahan, P. E. (2019), ‘Stress tests and small business lending’, *Journal of Financial Economics* . Forthcoming.

Coval, J. D. & Thakor, A. V. (2005), ‘Financial intermediation as a beliefs-bridge between optimists and pessimists’, *Journal of Financial Economics* **75**(3), 535–569.

Covas, F. B., Rump, B. & Zakrajsek, E. (2014), 'Stress-testing US bank holding companies: A dynamic panel quantile regression approach', *International Journal of Forecasting* **30**(3), 691–713.

Danisewicz, P., McGowan, D., Onali, E. & Schaeck, K. (2018), 'The real effects of banking supervision: Evidence from enforcement actions', *Journal of Financial Intermediation* **35**, 86–101.

De Jonghe, O., Dewachter, H. & Ongena, S. (2020), 'Bank capital (requirements) and credit supply: Evidence from pillar 2 decisions', *Journal of Corporate Finance* . Forthcoming.

Delis, M. D., Iosifidi, M., Kokas, S., Xefteris, D. & Ongena, S. (2020), 'Enforcement actions on banks and the structure of loan syndicates', *Journal of Corporate Finance* . Forthcoming.

Diamond, D. W. & Dybvig, P. H. (1983), 'Bank runs, deposit insurance, and liquidity', *Journal of Political Economy* **91**(3), 401–419.

Diamond, D. W. & Rajan, R. G. (2000), 'A theory of bank capital', *Journal of Finance* **55**(6), 2431–2465.

Diamond, D. W. & Rajan, R. G. (2001), 'Liquidity risk, liquidity creation, and financial fragility: A theory of banking', *Journal of Political Economy* **109**(2), 287–327.

Diaz, V. & Huang, Y. (2017), 'The role of governance on bank liquidity creation', *Journal of Banking & Finance* **77**, 137–156.

Doerr, S. (2019), 'Unintended side effects: Stress tests, entrepreneurship, and innovation'. Working paper.

Donaldson, J. R., Piacentino, G. & Thakor, A. (2018), 'Warehouse banking', *Journal of Financial Economics* **129**(2), 250–267.

Du, B. & Palia, D. (2018), 'Short-term debt and bank risk', *Journal of Financial and Quantitative Analysis* **53**(2), 815–835.

Eber, M. & Minoiu, C. (2017), 'How do banks adjust to stricter supervision?'. Working Paper.

Fernandes, M., Igan, D. & Pinheiro, M. (2017), 'March madness in Wall Street: (What) does the market learn from stress tests?', *Journal of Banking & Finance* . Forthcoming.

Flannery, M., Hirtle, B. & Kovner, A. (2017), 'Evaluating the information in the Federal Reserve stress tests', *Journal of Financial Intermediation* **29**, 1–18.

Fu, X. M., Lin, Y. R. & Molyneux, P. (2016), 'Bank capital and liquidity creation in Asia Pacific', *Economic Inquiry* **54**(2), 966–993.

Fungáčová, Z., Weill, L. & Zhou, M. (2017), 'Bank capital, liquidity creation and deposit insurance', *Journal of Financial Services Research* **51**(1), 97–123.

Goldstein, I. & Sapra, H. (2014), 'Should banks' stress test results be disclosed? An analysis of the costs and benefits', *Foundations and Trends in Finance* **8**(1), 1–54.

Goncharenko, R., Hledik, J. & Pinto, R. (2018), 'The dark side of stress tests: Negative effects of information disclosure', *Journal of Financial Stability* **37**, 49–59.

Gorton, G. & Winton, A. (2000), Liquidity provision, bank capital, and the macroeconomy. University of Minnesota Working paper.

Gropp, R., Mosk, T., Ongena, S. & Wix, C. (2018), 'Banks response to higher capital requirements: Evidence from a quasi-natural experiment', *Review of Financial Studies* **32**(1), 266–299.

Hahn, J., Todd, P. & Van der Klaauw, W. (2001), 'Identification and estimation of treatment effects with a regression-discontinuity design', *Econometrica* **69**(1), 201–209.

Hirtle, B. & Lehnert, A. (2015), 'Supervisory stress tests', *Annual Review of Financial Economics* **7**(1), 339–355.

Hirtle, B., Schuermann, T. & Stiroh, K. J. (2009), 'Macroprudential supervision of financial institutions: Lessons from the SCAP', *Federal Reserve Bank of New York Staff Reports* (409).

Horvath, R., Seidler, J. & Weill, L. (2014), 'Bank capital and liquidity creation: Granger-causality evidence', *Journal of Financial Services Research* **45**(3), 341–361.

Horvath, R., Seidler, J. & Weill, L. (2016), 'How bank competition influences liquidity creation', *Economic Modelling* **52**, 155–161.

Huang, S.-C., Chen, W.-D. & Chen, Y. (2018), 'Bank liquidity creation and CEO optimism', *Journal of Financial Intermediation* **36**, 101–117.

Hyun, J.-S. & Rhee, B.-K. (2011), 'Bank capital regulation and credit supply', *Journal of Banking & Finance* **35**(2), 323–330.

Imbens, G. & Kalyanaraman, K. (2012), 'Optimal bandwidth choice for the regression discontinuity estimator', *Review of Economic Studies* **79**(3), 933–959.

Imbierowicz, B. & Rauch, C. (2014), 'The relationship between liquidity risk and credit risk in banks', *Journal of Banking & Finance* **40**, 242–256.

Jiang, L., Levine, R. & Lin, C. (2019), 'Competition and bank liquidity creation', *Journal of Financial and Quantitative Analysis* **54**(2), 513–538.

Kapinos, P. & Mitnik, O. A. (2016), 'A top-down approach to stress-testing banks', *Journal of Financial Services Research* **49**(2), 229–264.

Kovner, A. & Van Tassel, P. (2018), 'Regulatory changes and the cost of capital for banks', *Federal Reserve Bank of New York Staff Reports* (854).

Kupiec, P. H. (2018), 'On the accuracy of alternative approaches for calibrating bank stress test models', *Journal of Financial Stability* **38**, 132–146.

Lambertini, L. & Mukherjee, A. (2016), 'Is bank capital regulation costly for firms? Evidence from syndicated loans'. Working paper.

Lazzari, V., Vena, L. & Venegoni, A. (2017), 'Stress tests and asset quality reviews of banks: A policy announcement tool', *Journal of Financial Stability* **32**, 86–98.

Lee, D. S. (2008), 'Randomized experiments from non-random selection in U.S. House elections', *Journal of Econometrics* **142**(2), 675–697.

Lee, D. S. & Lemieux, T. (2010), 'Regression discontinuity designs in economics', *Journal of Economic Literature* **48**(2), 281–355.

Leitner, Y. & Williams, B. (2018), 'Model secrecy and stress tests'. Working paper.

McCrary, J. (2008), 'Manipulation of the running variable in the regression discontinuity design: a density test', *Journal of Econometrics* **142**(2), 698–714.

Mehran, H. & Thakor, A. (2011), 'Bank capital and value in the cross-section', *Review of Financial Studies* **24**(4), 1019–1067.

Morgan, D. P., Peristiani, S. & Savino, V. (2014), 'The information value of the stress test', *Journal of Money, Credit and Banking* **46**(7), 1479–1500.

Papadimitri, P., Staikouras, P., Travlos, N. G. & Tsoumas, C. (2019), 'Punished banks' acquisitions: Evidence from the U.S. banking industry', *Journal of Corporate Finance* **58**, 744–764.

Petrella, G. & Resti, A. (2013), 'Supervisors as information producers: Do stress tests reduce bank opaqueness?', *Journal of Banking & Finance* **37**(12), 5406–5420.

Pierret, D. & Steri, R. (2018), 'Stressed banks', *Swiss Finance Institute Research Paper* (17-58).

Repullo, R. (2004), 'Capital requirements, market power, and risk-taking in banking', *Journal of Financial Intermediation* **13**(2), 156–182.

Roberts, M. R. & Whited, T. M. (2013), Endogeneity in empirical corporate finance, Vol. 2 of *Handbook of the Economics of Finance*, Elsevier, pp. 493–572.

Schuermann, T. (2014), 'Stress testing banks', *International Journal of Forecasting* **30**(3), 717–728.

Shahhosseini, M. (2015), 'The unintended consequences of bank stress tests'. Working paper.

Shapiro, J. & Zeng, J. (2018), 'Stress testing and bank lending'. Working paper.

Thakor, A. V. (1996), 'Capital requirements, monetary policy, and aggregate bank lending: Theory and empirical evidence', *Journal of Finance* **51**(1), 279–324.

Tran, V. T., Lin, C.-T. & Nguyen, H. (2016), 'Liquidity creation, regulatory capital, and bank profitability', *International Review of Financial Analysis* **48**, 98–109.

Veronesi, P. & Zingales, L. (2010), 'Paulson's gift', *Journal of Financial Economics* **97**(3), 339–368.

von Thadden, E.-L. (2004), 'Bank capital adequacy regulation under the new Basel Accord', *Journal of Financial Intermediation* **13**(2), 90–95.

Table 1: Variable definitions

Variable	*Notation*	*Measure*	*Data source*
Dependent variables			
Liquidity creation	*LC*	Total amount of 'cat fat' liquidity creation normalized by gross total assets. This liquidity creation measure classifies loans according to category and includes off-balance sheet items.	Bouwman's website
	LCON	Total amount of 'cat nonfat' liquidity creation normalized by gross total assets. This liquidity creation measure classifies loans according to category and excludes off-balance sheet items.	Bouwman's website
	LCOFF	Total amount of 'fat' liquidity creation normalized by gross total assets. This measures off-balance sheet liquidity creation.	Bouwman's website
	LCA	Asset-side liquidity creation	Bouwman's website
	LCL	Liability-side liquidity creation	Bouwman's website
Explanatory variables			
	Stress	Dummy taking value 1 if a bank is in the stress test group and 0 otherwise.	Federal Reserve's SCAP & CCAR reports
	Assignment	Distance between bank size (natural logarithm of gross total assets) and the normalized cutoffs.	FR-Y9C
Control variables			
Bank size	*SIZE*	Natural logarithm of gross total assets	FR-Y9C
Bank capitalization	*CAP*	Equity to total assets	FR-Y9C
Return on equity	*ROE*	Net income to equity	FR-Y9C
Non-performing loans	*NPL*	Total non-performing loans to total loans	FR-Y9C

Table 2: Summary statistics

Variable	Mean	S.D.	Min	Max	Obs.
Dependent variables					
LC	0.5444	0.3362	-0.2744	2.3620	1397
LCON	0.2634	0.1975	-0.4579	0.6433	1397
LCOFF	0.2810	0.3373	-0.0233	2.3704	1397
LCA	0.0601	0.1523	-0.3849	0.3851	1397
LCL	0.2033	0.1030	-0.2005	0.3945	1397
Explanatory variables					
Stress	0.5175	0.4999	0.0000	1.0000	1397
Assignment	0.3732	1.4175	-1.7158	3.9424	1397
CAP	0.1095	0.0240	0.0456	0.2134	1397
NPL	0.0236	0.0209	0.0000	0.1418	1397
ROE	0.0439	0.0605	-0.5396	0.2919	1397
SIZE	18.5234	1.4072	16.7049	21.6700	1397

The table reports summary statistics of all variables for the period 2007–2016. *LC* is the liquidity creation. *LCON* is the on-the balance sheet liquidity creation measure. *LCOFF* is the off-balance sheet liquidity creation. *LCA* and *LCL* denote asset and liability components of liquidity creation, respectively. *Stress* is the dummy equal to 1 if the bank is subject to the stress test and 0 otherwise. *Assignment* represents the distance between bank size (natural logarithm of gross total assets) and the normalized cutoffs. *ROE* is the return on equity, *SIZE* is the natural logarithm of gross total assets, *CAP* is the equity to total assets, and *NPL* is the total non-performing loans to total loans.

Table 3: Univariate analysis of stress test and non-stress test banks

	2007				2009				2009-2016			
	Non-stress test		Stress test		Non-stress test		Stress test		Non-stress test		Stress test	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Variable	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
LC	0.4778	0.4938	0.9219***	0.6995***	0.5819	0.4365*	0.5961***	0.5234**	0.5225	0.5147	0.5181***	0.5572**
LCON	0.2999	0.3276	0.2112**	0.2902	0.2767	0.2998	0.1449*	0.1965	0.3469*	0.3641	0.1867	0.2495
LCOFF	0.1778	0.1787	0.7107***	0.3615***	0.3052	0.1361***	0.4512**	0.2327**	0.1756	0.1342***	0.3314***	0.2185***
LCA	0.1470	0.1632	0.0773**	0.1235**	0.1312	0.1469	0.0114**	0.0439	0.1043*	0.1234*	0.0010***	0.0429
LCL	0.1529	0.1660	0.1338	0.1470*	0.1455	0.1595	0.1335	0.1420	0.2426***	0.2586***	0.1857***	0.1892***

The table reports the univariate analysis for stress test and non-stress test banks. Columns (3) and (4) test if the mean and median values of the variables are significantly different from those in columns (1) and (2), respectively. Columns (5) and (6) test if the mean and median values of the variables are significantly different from those in columns (1) and (2), respectively. Columns (7) and (8) test if the mean and median values of the variables are significantly different from those in columns (3) and (4), respectively. Columns (9) and (10) test if the mean and median values of the variables are significantly different from those in columns (1) and (2), respectively. Columns (11) and (12) test if the mean and median values of the variables are significantly different from those in columns (3) and (4), respectively. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, and *LCL* is the liability component of liquidity creation. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 4: Regression discontinuity estimation for bank liquidity creation

	(1) *LC*	(2) *LC*	(3) *LCON*	(4) *LCON*	(5) *LCOFF*	(6) *LCOFF*	(7) *LCA*	(8) *LCA*	(9) *LCL*	(10) *LCL*
Stress	-0.1161***	-0.1279***	-0.0853**	-0.0914***	-0.0362***	-0.0307***	-0.0849***	-0.0764***	0.1090***	0.1140***
	(0.0352)	(0.0346)	(0.0385)	(0.0306)	(0.0112)	(0.0115)	(0.0257)	(0.0281)	(0.0113)	(0.0120)
Assignment	-0.6225**	-0.5921**	-0.5353*	-0.4950*	-0.1220	-0.1231	-0.0787	-0.0874	0.0820	0.0677*
	(0.2706)	(0.2503)	(0.2971)	(0.2693)	(0.0847)	(0.0724)	(0.1339)	(0.1372)	(0.0535)	(0.0376)
Stress×*Assignment*	0.7019***	0.7021***	0.6358**	0.6181**	0.0688	0.0675	0.2344	0.2410	-0.0516	-0.0776
	(0.2604)	(0.2517)	(0.3069)	(0.2686)	(0.1141)	(0.1069)	(0.1752)	(0.1785)	(0.1248)	(0.0815)
CAP		0.0312		0.1177		-0.3906		-0.4554		-0.2359
		(0.7700)		(0.6863)		(0.6701)		(0.6691)		(0.2918)
ROE		0.1652**		0.1174*		0.0223		0.0059		0.0208
		(0.0747)		(0.0604)		(0.0381)		(0.0578)		(0.0643)
NPL		-0.9096		-1.9502***		0.6803		-0.1841		-2.1713***
		(1.1760)		(0.6244)		(0.6460)		(0.4161)		(0.6050)
Constant	0.4638***	0.4778***	0.2448***	0.2664***	0.2313***	0.2571***	0.0826***	0.1292**	0.1551***	0.2204***
	(0.0076)	(0.0830)	(0.0058)	(0.0698)	(0.0048)	(0.0633)	(0.0162)	(0.0597)	(0.0038)	(0.0296)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	151	151	156	156	173	173	223	223	211	211
Adjusted R^2	0.1683	0.1986	0.1298	0.2391	0.0441	0.0889	0.1959	0.1939	0.3149	0.5647

The table reports the regression discontinuity estimates of change in the measures of bank liquidity creation as a result of the treatment (being included in the stress test group). The results are obtained using a pooled non-parametric approach with the rectangular kernel. All estimations use the optimal bandwidth following Imbens & Kalyanaraman (2012). The variable of interest is *Stress*, which defines the treatment status and is a dummy variable equal to 1 if a bank is in the stress test group and 0 otherwise. *Assignment* represents the distance between bank size (natural logarithm of gross total assets) and the normalized cutoffs. Robust standard errors are clustered at the bank level and reported in parentheses. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, *LCL* is the liability component of liquidity creation, *CAP* is the equity to total assets, *ROE* is the return on equity, and *NPL* is the total non-performing loans to total loans. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 5: Regression discontinuity estimation for bank liquidity creation with banks entering the stress tests for the first time

	(1) *LC*	(2) *LC*	(3) *LCON*	(4) *LCON*	(5) *LCOFF*	(6) *LCOFF*	(7) *LCA*	(8) *LCA*	(9) *LCL*	(10) *LCL*
Stress	-0.0849***	-0.0594***	-0.0587***	-0.0559***	-0.0257***	-0.0043	-0.0536***	-0.0605***	0.0190***	0.0324***
	(0.0138)	(0.0183)	(0.0122)	(0.0174)	(0.0036)	(0.0129)	(0.0081)	(0.0170)	(0.0042)	(0.0109)
Assignment	-0.3952**	-0.4156**	-0.3443	-0.3436*	-0.0370	-0.0484*	-0.1423	-0.1472	0.1122*	0.1016
	(0.1891)	(0.1886)	(0.2036)	(0.1944)	(0.0265)	(0.0255)	(0.1132)	(0.1121)	(0.0599)	(0.0605)
Stress×*Assignment*	0.2410*	0.1074	0.1492*	0.1399	0.0730	-0.0822	0.1757*	0.1869**	0.0294	0.0056
	(0.1361)	(0.1686)	(0.0780)	(0.0931)	(0.0467)	(0.0842)	(0.1026)	(0.0839)	(0.0441)	(0.0432)
CAP		-0.5866		-0.5173		0.4460		0.3341		-0.2641
		(1.0386)		(0.8956)		(0.4824)		(0.5031)		(0.2950)
ROE		0.0422		0.1225		-0.1139		0.1030		-0.0306
		(0.1296)		(0.1097)		(0.0945)		(0.0622)		(0.0522)
NPL		-0.8643		0.4371		-1.9625*		-0.3212		-0.4765
		(1.4696)		(0.8854)		(1.0600)		(0.3706)		(0.4388)
Constant	0.5136***	0.5763***	0.2862***	0.3401***	0.2319***	0.1882***	0.0999***	0.0612	0.1939***	0.2227***
	(0.0287)	(0.0909)	(0.0146)	(0.0879)	(0.0208)	(0.0385)	(0.0117)	(0.0464)	(0.0059)	(0.0303)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	136	136	146	146	137	137	158	158	160	160
Adjusted R^2	0.1122	0.0982	0.2332	0.2363	-0.0019	-0.0111	0.1764	0.1991	0.2935	0.2967

The table reports the regression discontinuity estimates of change in the measures of bank liquidity creation as a result of the treatment (being included in the stress test group for the first time). The results are obtained using a pooled non-parametric approach with the rectangular kernel. All estimations use the optimal bandwidth following Imbens & Kalyanaraman (2012). The variable of interest is *Stress*, which defines the treatment status and is a dummy variable equal to 1 if a bank is in the stress test group for the first time and 0 otherwise. Banks that are subject to the stress tests in subsequent years are excluded from the sample. *Assignment* represents the distance between bank size (natural logarithm of gross total assets) and the normalized cutoffs. Robust standard errors are clustered at the bank level and reported in parentheses. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, *LCL* is the liability component of liquidity creation, *CAP* is the equity to total assets, *ROE* is the return on equity, and *NPL* is the total non-performing loans to total loans. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 6: Changes in bank liquidity creation measures as they enter the stress tests for the first time

	(1) *LC*	(2) *LCON*	(3) *LCOFF*	(4) *LCA*	(5) *LCL*
First Stress	-0.0843**	-0.0303***	-0.0540*	-0.0232***	-0.0071
	(0.0398)	(0.0082)	(0.0320)	(0.0043)	(0.0103)
SIZE	-0.1047	-0.1356***	0.0309	-0.0969***	-0.0386*
	(0.0673)	(0.0124)	(0.0634)	(0.0169)	(0.0198)
CAP	2.9729**	-0.8411***	3.8140***	-0.4013	-0.4398**
	(1.3129)	(0.3170)	(1.3229)	(0.2720)	(0.2145)
ROE	-0.0944	0.0803	-0.1747	0.0799*	0.0004
	(0.1458)	(0.0498)	(0.1676)	(0.0470)	(0.0119)
NPL	-1.7642	-1.2295	-0.5347	-1.1965	-0.0330
	(2.2298)	(1.5416)	(2.6521)	(1.1046)	(0.6662)
Constant	-0.0264	-0.0131	-0.0133	-0.0360*	0.0229**
	(0.0304)	(0.0289)	(0.0287)	(0.0197)	(0.0105)
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	142	142	142	142	142
Adjusted R^2	0.1988	0.0753	0.2448	0.1343	0.0889

The table reports results from the ordinary least squares regressions examining the changes of bank liquidity creation as they enter the stress test group with changes in other observable control variables included as independent variables. All variables are measured as changes from quarter 3 of year *t−1* to quarter 3 of year *t*. The variable of interest is *First Stress*, which is a dummy equal to 1 if a bank is subject to the stress test in a particular year but not the year before and 0 otherwise. Time fixed effects are included in all regressions and robust standard errors reported in parentheses are double clustered by bank and time. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, *LCL* is the liability component of liquidity creation, *SIZE* is the natural logarithm of gross total assets, *CAP* is the equity to total assets, *ROE* is the return on equity, and *NPL* is the total non-performing loans to total loans. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7: Changes in bank liquidity creation measures as they enter the stress tests for the first time excluding the first stress test

	(1) *LC*	(2) *LCON*	(3) *LCOFF*	(4) *LCA*	(5) *LCL*
First Stress	-0.0321***	-0.0206***	-0.0115***	-0.0290***	0.0084***
	(0.0035)	(0.0034)	(0.0022)	(0.0021)	(0.0009)
SIZE	-0.1610***	-0.0844**	-0.0766**	-0.1344***	0.0500**
	(0.0464)	(0.0408)	(0.0362)	(0.0329)	(0.0220)
CAP	-0.5232	-0.1795	-0.3437	0.2706	-0.4501**
	(0.4446)	(0.2590)	(0.3308)	(0.3836)	(0.1861)
ROE	0.1015	0.1130	-0.0115	0.1739	-0.0609
	(0.1662)	(0.1700)	(0.0448)	(0.1172)	(0.0641)
NPL	-0.3519	-2.0079*	1.6560**	-1.0517	-0.9562**
	(0.8044)	(1.1293)	(0.6568)	(1.0498)	(0.4139)
Constant	-0.0131	-0.0256	0.0125	-0.0348**	0.0092*
	(0.0134)	(0.0167)	(0.0080)	(0.0149)	(0.0053)
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	107	107	107	107	107
Adjusted R^2	0.0774	0.0326	0.2012	0.1792	0.1426

The table reports results from the ordinary least squares regressions examining the changes of bank liquidity creation as they enter the stress test group with changes in other observable control variables included as independent variables. In all regressions, the first stress test is excluded. All variables are measured as changes from quarter 3 of year $t-1$ to quarter 3 of year t. The variable of interest is *First Stress*, which is a dummy equal to 1 if a bank is subject to the stress test in a particular year but not the year before and 0 otherwise. Time fixed effects are included in all regressions and robust standard errors reported in parentheses are double clustered by bank and time. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, *LCL* is the liability component of liquidity creation, *SIZE* is the natural logarithm of gross total assets, *CAP* is the equity to total assets, *ROE* is the return on equity, and *NPL* is the total non-performing loans to total loans. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Regressions of changes in bank liquidity creation around the stress test quarter

	(1) *LC*	(2) *LCON*	(3) *LCOFF*	(4) *LCA*	(5) *LCL*
Stress $\times$ $Q = t-2$	-0.0019	-0.0002	0.0021	0.0021*	-0.0023
	(0.0044)	(0.0013)	(0.0046)	(0.0011)	(0.0016)
Stress $\times$ $Q = t-1$	-0.0074	-0.0015	-0.0060	0.0014	-0.0029
	(0.0060)	(0.0025)	(0.0051)	(0.0019)	(0.0018)
Stress $\times$ $Q = t$	-0.0125***	-0.0034***	-0.0091**	-0.0034**	-0.0000
	(0.0047)	(0.0013)	(0.0043)	(0.0014)	(0.0019)
Stress $\times$ $Q = t+1$	-0.0105	-0.0090**	-0.0015	-0.0064**	-0.0026
	(0.0068)	(0.0040)	(0.0075)	(0.0027)	(0.0027)
SIZE	-0.3025***	-0.1457***	-0.1568*	-0.1217***	-0.0240
	(0.0990)	(0.0285)	(0.0952)	(0.0310)	(0.0213)
CAP	1.5130*	-0.8317***	2.3447**	-0.3286	-0.5031***
	(0.8857)	(0.2114)	(1.0258)	(0.3073)	(0.1318)
ROE	-0.0035	0.0182	-0.0217	0.0127	0.0056
	(0.0475)	(0.0178)	(0.0440)	(0.0184)	(0.0108)
NPL	0.1354	-0.1053	0.2406	-0.0437	-0.0615
	(0.6869)	(0.1945)	(0.5775)	(0.2457)	(0.1771)
Constant	-0.0169***	0.0039	-0.0208***	-0.0027	0.0067***
	(0.0045)	(0.0029)	(0.0033)	(0.0024)	(0.0016)
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	1,156	1,156	1,156	1,156	1,156
Adjusted R^2	0.1095	0.0492	0.1035	0.0554	0.0336

The table reports results from the ordinary least squares regressions examining the changes in measures of bank liquidity creation around the stress tests (quarter 3 in 2009–2015 and quarter 1 in 2016) controlling for changes in bank-specific independent variables. *Stress* is the dummy variable, which is equal to 1 if the bank is subject to the stress test in a particular year and 0 if it is not. The interaction term, *Stress* $\times$ $Q = t$, isolates changes in the measures of liquidity creation in the stress test starting point quarter (changes between quarter 2 and quarter 3 in 2009–2015 and between quarter 4 and quarter 1 in 2016). *Stress* $\times$ $Q = t+1$ captures changes in quarter after the stress tests (between quarter 3 and quarter 4 in 2009–2015 and between quarter 1 and quarter 2 in 2016. *Stress* $\times$ $Q = t-1$ captures changes in quarter preceding the stress tests (between quarter 1 and quarter 2 in 2009–2015 and between quarter 3 and quarter 4 in 2015) and *Stress* $\times$ $Q = t-1$ isolates the changes in two quarters preceding the stress tests. All variables are measured as changes from $t-1$ to t. Time fixed effects are included in all regressions and robust standard errors reported in parentheses are double clustered by bank and time. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, *LCL* is the liability component of liquidity creation, *SIZE* is the natural logarithm of gross total assets, *CAP* is the equity to total assets, *ROE* is the return on equity, and *NPL* is the total non-performing loans to total loans. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9: Regressions of changes in bank liquidity creation around the stress test quarter excluding the first stress test

	(1) *LC*	(2) *LCON*	(3) *LCOFF*	(4) *LCA*	(5) *LCL*
$Stress \times Q = t-2$	0.0039	-0.0005	0.0044*	0.0015	-0.0020
	(0.0027)	(0.0016)	(0.0025)	(0.0014)	(0.0017)
$Stress \times Q = t-1$	-0.0040	-0.0023	-0.0018	0.0012	-0.0034**
	(0.0048)	(0.0021)	(0.0039)	(0.0017)	(0.0016)
$Stress \times Q = t$	-0.0080**	-0.0023***	-0.0057	-0.0031**	0.0008
	(0.0040)	(0.0003)	(0.0043)	(0.0014)	(0.0021)
$Stress \times Q = t+1$	-0.0176***	-0.0066*	-0.0110***	-0.0059**	-0.0007
	(0.0061)	(0.0039)	(0.0042)	(0.0029)	(0.0023)
SIZE	-0.1944***	-0.1380***	-0.0564***	-0.1202***	-0.0179
	(0.0341)	(0.0329)	(0.0155)	(0.0332)	(0.0233)
CAP	-0.4595*	-0.4621**	0.0026	0.1915	-0.6536***
	(0.2723)	(0.1898)	(0.2289)	(0.2549)	(0.1339)
ROE	-0.0043	0.0163	-0.0206	0.0113	0.0050
	(0.0121)	(0.0213)	(0.0191)	(0.0223)	(0.0174)
NPL	-0.0140	-0.2064	0.1924	-0.1085	-0.0979
	(0.4645)	(0.3342)	(0.1949)	(0.3180)	(0.1803)
Constant	0.0064***	0.0058***	0.0006	-0.0018**	0.0076***
	(0.0016)	(0.0011)	(0.0009)	(0.0007)	(0.0007)
Time FE	Yes	Yes	Yes	Yes	Yes
Observations	1,046	1,046	1,046	1,046	1,046
Adjusted R^2	0.0399	0.0469	0.0079	0.0761	0.0487

The table reports results from the ordinary least squares regressions examining the changes in measures of bank liquidity creation around the stress tests (quarter 3 in 2011–2015 and quarter 1 in 2016) controlling for changes in bank-specific independent variables. In all regressions, the first stress test is excluded. *Stress* is the dummy variable, which is equal to 1 if the bank is subject to the stress test in a particular year and 0 if it is not. The interaction term, *Stress* × *Q* = *t*, isolates changes in the measures of liquidity creation in the stress test starting point quarter (changes between quarter 2 and quarter 3 in 2011–2015 and between quarter 4 and quarter 1 in 2016). *Stress* × *Q* = *t+1* captures changes in quarter after the stress tests (between quarter 3 and quarter 4 in 2011–2015 and between quarter 1 and quarter 2 in 2016. *Stress* × *Q* = *t−1* captures changes in quarter preceding the stress tests (between quarter 1 and quarter 2 in 2011–2015 and between quarter 3 and quarter 4 in 2015) and *Stress* × *Q* = *t−1* isolates the changes in two quarters preceding the stress tests. All variables are measured as changes from *t−1* to *t*. Time fixed effects are included in all regressions and robust standard errors reported in parentheses are double clustered by bank and time. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, *LCL* is the liability component of liquidity creation, *SIZE* is the natural logarithm of gross total assets, *CAP* is the equity to total assets, *ROE* is the return on equity, and *NPL* is the total non-performing loans to total loans. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 10: Tests for parallel trends

Tests for parallel trends before SCAP 2009								
	t−1		*t−2*		*t−3*		*t−4*	
	Difference means	Wilcoxon *p*-value	Difference means	Wilcoxon *p*-value	Difference means	Wilcoxon *p*-value	Difference means	Wilcoxon *p*-value
LC	0.0382	0.2126	-0.0162	0.7252	0.0766	0.2673	0.0252	0.7697
LCON	0.0110	0.6893	-0.0132	0.4821	0.0552	0.0759*	-0.0218	0.1432
LCOFF	0.0271	0.3118	-0.0030	0.5468	0.0214	0.6978	0.0471	0.7697
LCA	0.0093	0.9812	-0.0152	0.1196	0.0410	0.0401**	0.0004	0.9533
LCL	0.0017	0.7242	0.0019	0.5468	0.0141	0.8244	-0.0223	0.1139
	t−5		*t−6*		*t−7*		*t−8*	
	Difference means	Wilcoxon *p*-value	Difference means	Wilcoxon *p*-value	Difference means	Wilcoxon *p*-value	Difference means	Wilcoxon *p*-value
LC	0.1209	0.0610*	-0.0639	0.0790*	0.0750	0.0890*	-0.0934	0.1710
LCON	-0.0055	0.3488	-0.0027	0.5982	0.0293	0.3135	0.0000	0.7638
LCOFF	0.1264	0.3798	-0.0611	0.2416	0.0457	0.2077	-0.0934	0.3006
LCA	-0.0236	0.4465	0.0046	0.3488	0.0122	0.5708	-0.0010	0.8152
LCL	0.0181	0.2659	-0.0073	0.1432	0.0170	0.0198**	0.0010	0.8674

The table reports tests for parallel trends for the eight quarters preceding the stress tests by showing differences in mean changes of bank liquidity creation variables. The difference in means at *t−1* is the difference in mean change for *t−2* to *t−1* between treatment and control groups. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, and *LCL* is the liability component of liquidity creation. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 11: Regression discontinuity estimation under local randomization

		Statistic	Control obs.	Treatment obs.
LC		-0.130***	107	82
	p-value	(0.000)		
	95% Confidence interval	[-0.211, -0.045]		
LCON		-0.018	107	82
	p-value	(0.576)		
	95% Confidence interval	[-0.080 , 0.048]		
LCOFF		-0.112***	107	82
	p-value	(0.000)		
	95% Confidence interval	[-0.182, -0.038]		
LCA		-0.029	107	82
	p-value	(0.299)		
	95% Confidence interval	[-0.084, 0.023]		
LCL		0.011	107	82
	p-value	(0.517)		
	95% Confidence interval	[-0.021, 0.042]		

The table reports the effect of stress testing on measures of bank liquidity creation the under local randomization inference following Cattaneo et al. (2015, 2016). *Statistic* is the difference-in-means estimate between the treatment group and control group within a narrow bandwidth near the cutoffs where the local randomization assumption is most plausible. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, and *LCL* is the liability component of liquidity creation. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 12: Falsification tests for estimated effect using different cutoff values

	(1) *LC*	(2) *LC*	(3) *LCON*	(4) *LCON*	(5) *LCOFF*	(6) *LCOFF*	(7) *LCA*	(8) *LCA*	(9) *LCL*	(10) *LCL*
Cutoff $40 billion	-0.0731	-0.0381	-0.0567**	-0.0234	0.0101	0.0076	-0.0148	-0.0133	-0.0212	0.0054
	(0.0591)	(0.0510)	(0.0242)	(0.0250)	(0.0297)	(0.0272)	(0.0278)	(0.0272)	(0.0144)	(0.0131)
Cutoff $60 billion	0.1576	0.1173*	-0.0087	-0.0031	0.1527	0.1580*	-0.0317**	-0.0212*	0.0118	0.0148
	(0.1162)	(0.0670)	(0.0228)	(0.0213)	(0.1071)	(0.0901)	(0.0140)	(0.0124)	(0.0128)	(0.0120)
Cutoff $70 billion	0.2234	0.2310	0.0101	0.0077	0.2123	0.2740	-0.0081	-0.0028	0.0154	0.0106
	(0.2324)	(0.2259)	(0.0283)	(0.0315)	(0.2553)	(0.2544)	(0.0171)	(0.0180)	(0.0150)	(0.0156)
Cutoff $80 billion	-0.2767	-0.3131	-0.0768	-0.0884	-0.1983	-0.2164	-0.0404	-0.0504	-0.0182	-0.0193
	(0.2051)	(0.2242)	(0.0786)	(0.0830)	(0.1614)	(0.1819)	(0.0461)	(0.0482)	(0.0256)	(0.0304)
Cutoff $90 billion	-0.0732	-0.0456	0.0257	0.0463	-0.0889	-0.1274	-0.0039	0.0001	0.0061	0.0257*
	(0.1174)	(0.0860)	(0.0420)	(0.0478)	(0.1034)	(0.1023)	(0.0182)	(0.0213)	(0.0127)	(0.0146)
Cutoff $110 billion	-0.0268	-0.0596	0.0125	-0.0338	-0.0168	-0.0168	-0.0016	-0.0235	-0.0314	0.0203
	(0.0338)	(0.0363)	(0.0204)	(0.0317)	(0.0142)	(0.0133)	(0.0164)	(0.0171)	(0.0286)	(0.0269)
Control variables	NO	YES	NO	YES	NO	YES	NO	YES	NO	YES

The table reports regression results for measures of bank liquidity creation using different cutoffs. Robust standard errors are reported in parentheses. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, and *LCL* is the liability component of liquidity creation. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 13: Regression discontinuity estimation for bank liquidity creation including banks with asset size greater than $10 billion

	(1) *LC*	(2) *LC*	(3) *LCON*	(4) *LCON*	(5) *LCOFF*	(6) *LCOFF*	(7) *LCA*	(8) *LCA*	(9) *LCL*	(10) *LCL*
Stress	-0.1105***	-0.0976***	-0.0827**	-0.0806**	-0.0362***	-0.0321***	-0.0836***	-0.0756***	0.1094***	0.1140***
	(0.0358)	(0.0366)	(0.0380)	(0.0314)	(0.0111)	(0.0109)	(0.0209)	(0.0205)	(0.0113)	(0.0119)
Assignment	-0.5803**	-0.5416**	-0.5155*	-0.4748*	-0.1214	-0.1199*	-0.0267	-0.0426	0.0830	0.0677*
	(0.2765)	(0.2615)	(0.2932)	(0.2673)	(0.0839)	(0.0697)	(0.0833)	(0.0913)	(0.0539)	(0.0375)
Stress×*Assignment*	0.6635**	0.6246**	0.6149*	0.5920**	0.0672	0.0696	0.1721	0.1839	-0.0559	-0.0776
	(0.2807)	(0.2679)	(0.2988)	(0.2655)	(0.1080)	(0.1022)	(0.1235)	(0.1304)	(0.1254)	(0.0799)
CAP		-0.6622		-0.1238		-0.3511		-0.5584		-0.2359
		(0.7963)		(0.5827)		(0.6337)		(0.6488)		(0.2908)
ROE		0.0936		0.0927*		0.0321		0.0110		0.0208
		(0.0627)		(0.0498)		(0.0348)		(0.0603)		(0.0644)
NPL		-1.5214		-2.0864***		0.6592		-0.2411		-2.1717***
		(1.1601)		(0.5994)		(0.6476)		(0.4009)		(0.5858)
Constant	0.4711***	0.5621***	0.2451***	0.2934***	0.2301***	0.2522***	0.0952***	0.1534**	0.1550***	0.2210***
	(0.0059)	(0.0870)	(0.0055)	(0.0593)	(0.0040)	(0.0600)	(0.0101)	(0.0612)	(0.0039)	(0.0296)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	177	177	170	170	177	177	241	241	213	213
Adjusted R^2	0.1499	0.2077	0.1235	0.2459	0.0479	0.0888	0.1895	0.1947	0.3131	0.5669

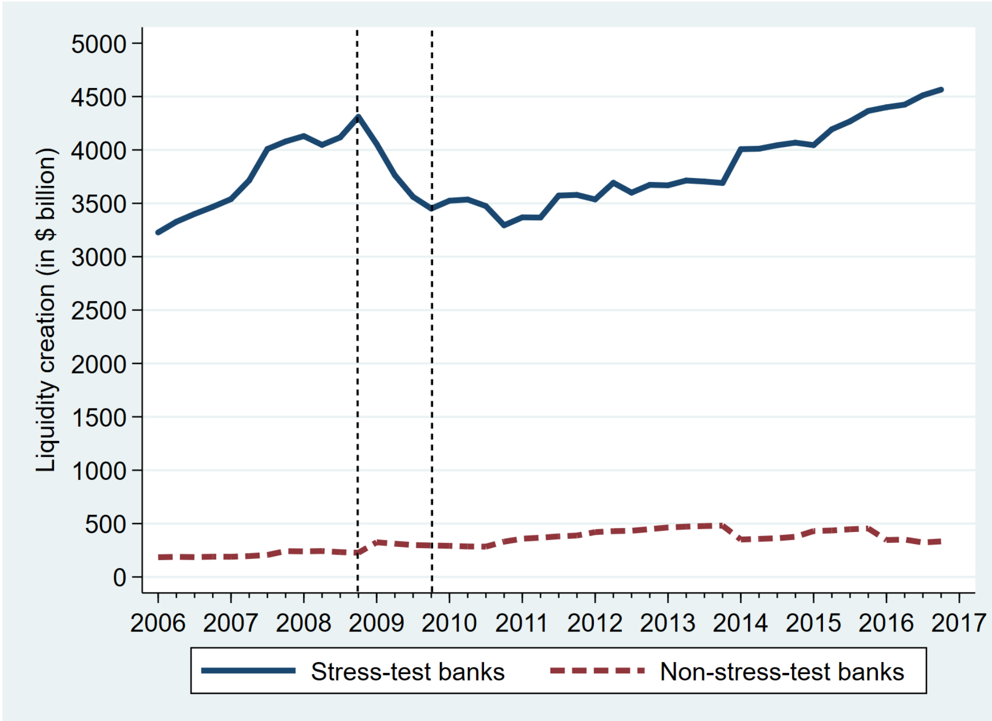
The table reports the regression discontinuity estimates of change in the measures of bank liquidity creation as a result of the treatment (being included in the stress test group) including banks with asset size greater than $10 billion. The results are obtained using a pooled non-parametric approach with the rectangular kernel. All estimations use the optimal bandwidth following Imbens & Kalyanaraman (2012). The variable of interest is *Stress*, which defines the treatment status and is a dummy variable equal to 1 if a bank is in the stress test group and 0 otherwise. *Assignment* represents the distance between bank size (natural logarithm of gross total assets) and the normalized cutoffs. Robust standard errors in parentheses are clustered at the bank level. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, *LCL* is the liability component of liquidity creation, *CAP* is the equity to total assets, *ROE* is the return on equity, and *NPL* is the total non-performing loans to total loans. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 14: Regression discontinuity estimation for bank liquidity creation including banks with foreign parents

	(1) *LC*	(2) *LC*	(3) *LCON*	(4) *LCON*	(5) *LCOFF*	(6) *LCOFF*	(7) *LCA*	(8) *LCA*	(9) *LCL*	(10) *LCL*
Stress	-0.1332**	-0.1564***	-0.1148**	-0.1339***	-0.0152	-0.0189*	-0.0598*	-0.0655**	0.0431	0.0122
	(0.0606)	(0.0526)	(0.0449)	(0.0458)	(0.0175)	(0.0099)	(0.0318)	(0.0322)	(0.1003)	(0.0741)
Assignment	0.1957	0.1173	0.2289	0.1695	0.0021	-0.0161	0.0636	0.0497	0.8837	0.7698
	(0.3211)	(0.2791)	(0.2981)	(0.2635)	(0.0369)	(0.0337)	(0.1814)	(0.1524)	(0.6099)	(0.5193)
Stress×*Assignment*	-0.2692	-0.0349	-0.2836	-0.0984	-0.0164	0.0246	0.0610	0.0894	-1.1891	-0.8852
	(0.4191)	(0.3635)	(0.3382)	(0.3244)	(0.1027)	(0.0632)	(0.2274)	(0.2151)	(0.7505)	(0.5978)
CAP		-1.0061		-0.5445		-0.2213		0.9638		-1.7989
		(2.1065)		(1.6509)		(0.4372)		(1.0943)		(1.6597)
ROE		-0.3624**		-0.2701**		-0.1075**		-0.2313**		0.0597
		(0.1551)		(0.1320)		(0.0417)		(0.1024)		(0.1861)
NPL		-6.3264***		-4.9556***		-1.2220***		-1.0326		-4.3616***
		(1.2605)		(1.1841)		(0.2197)		(0.8234)		(0.5595)
Constant	0.5292***	0.7863***	0.3488***	0.5189**	0.1849***	0.2373***	0.1151***	0.0242	0.2032***	0.5010**
	(0.0117)	(0.2866)	(0.0097)	(0.2288)	(0.0034)	(0.0526)	(0.0047)	(0.1410)	(0.0222)	(0.1970)
Time FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bank FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	208	208	217	217	197	197	226	226	134	134
Adjusted R^2	0.0323	0.1550	0.0511	0.1503	-0.0086	0.1126	0.0025	0.0550	0.2543	0.4322

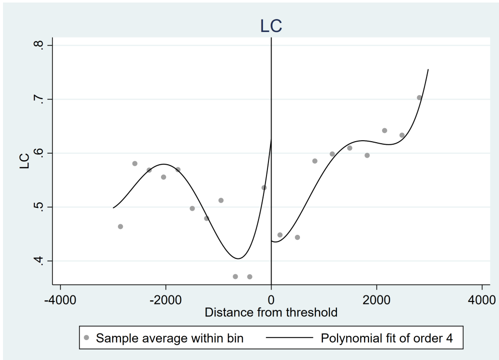
The table reports the regression discontinuity estimates of change in the measures of bank liquidity creation as a result of the treatment (being included in the stress test group) for domestic banks as well as banks with foreign parents. The results are obtained using a pooled non-parametric approach with the rectangular kernel. All estimations use the optimal bandwidth following Imbens & Kalyanaraman (2012). The variable of interest is *Stress*, which defines the treatment status and is a dummy variable equal to 1 if a bank is in the stress test group and 0 otherwise. *Assignment* represents the distance between bank size (natural logarithm of gross total assets) and the normalized cutoffs. Robust standard errors reported in parentheses are clustered at the bank level. *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, *LCL* is the liability component of liquidity creation, *CAP* is the equity to total assets, *ROE* is the return on equity, and *NPL* is the total non-performing loans to total loans. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Figure 1: Liquidity creation over time

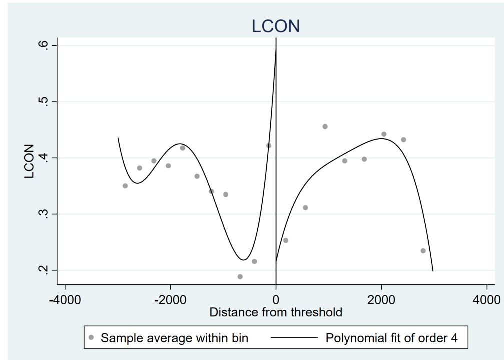


The figure shows the dollar amount of total liquidity creation of stress test banks and non-stress test banks from 2006:Q1–2016:Q4. All dollar values are expressed in 2016 dollars. The solid line refers to stress test banks and the dashed line represents non-stress test banks.

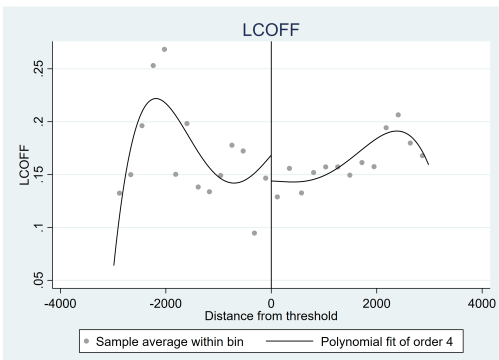
Figure 2: Regression discontinuity estimation using bank size to assign the treatment group



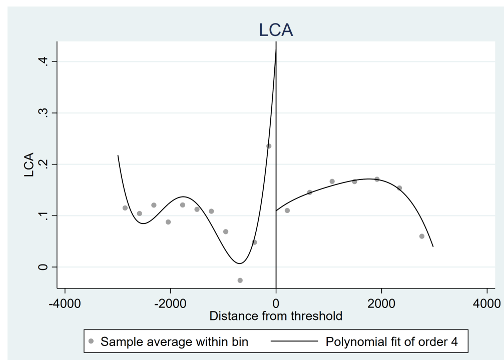
(a) RD Plot: LC



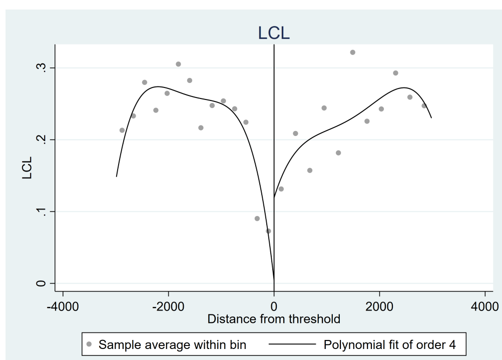
(b) RD Plot: LCON



(c) RD Plot: LCOFF



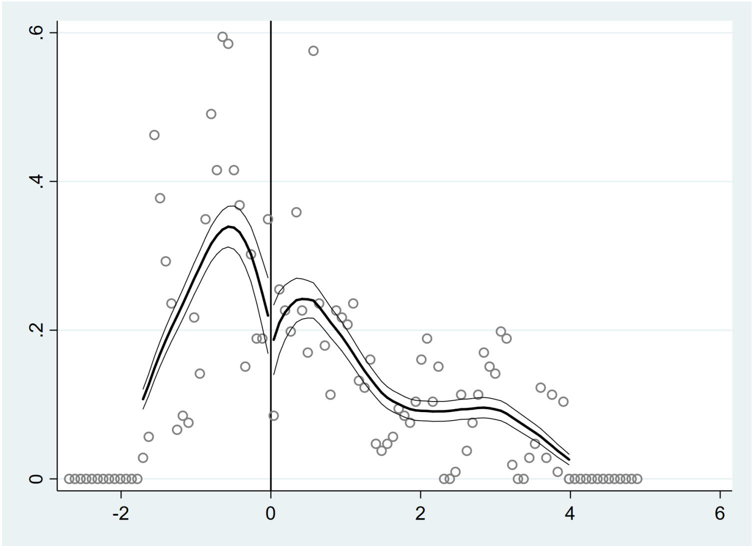
(d) RD Plot: LCA



(e) RD Plot: LCL

The figure shows the regression discontinuity (RD) results using a non-parametric approach that estimates the change in bank liquidity creation given that the bank is in the treatment group (stress test banks). The purpose is to show whether there is discontinuity in banks' measures of liquidity creation at the size cutoff ($100 billion or $50 million). *LC* is the liquidity creation, *LCON* is the on-the balance sheet liquidity creation measure, *LCOFF* is the off-balance sheet liquidity creation, *LCA* is the asset component of liquidity creation, and *LCL* is the liability component of liquidity creation. Observations to the left (right) of the threshold belong to control group (treatment group).

Figure 3: Density distribution of the bank size distance from the stress test threshold



The figure shows the density of the running variable to test for the discontinuity in the running variable following McCrary (2008). The x-axis represents the distance between the bank size and the threshold (*Assignment*) and the y-axis represents the density of the running variable. The dots represent the density and the solid line depicts the fitted density function of the running variable with a 95% confidence interval around the fitted line.

Appendices

Table A1: Summary of the literature on the effects of stress tests on banks' behaviors

Author(s)	Stress tests	Findings
Acharya et al. (2018)	SCAP & CCAR	Those banks that are subject to the stress tests cut down their credit supply, particularly to relatively risky borrowers, thereby bringing down credit risk. Banks became safer in terms of capital ratios as well as risk-weighted asset ratios.
Berrospide & Edge (2019)	CCAR	Stress tests reduce commercial and industrial and small business lending. However, firms' overall debt, investment spending, and employment are largely unaffected.
Bindal et al. (2019)	DFA	Banks that are right below the size threshold increase the likelihood of doing acquisitions and the number of acquisitions.
Bordo & Duca (2018)	DFA	The passage of the DFA has induced a reduction in banks' lending to small businesses.
Bouwman et al. (2018)	DFA	Those banks that are near below certain thresholds have incentives to alter their behaviors to avoid crossing the thresholds and incurring greater regulatory costs. These behaviors include growing assets and credits more slowly and charging higher interest rates on commercial loans.

Table A1 continued

Calem et al. (2019)	CCAR	The 2011 CCAR resulted in a decrease in the share of jumbo mortgage originations of stress-test banks and the effect was more pronounced for weakly capitalized banks.
Connolly (2018)	SCAP	Stress-test banks shift their lending toward relatively safer firms after the SCAP. Stress-test banks are found to be less likely to enter into new syndicated loans after the first stress test, which led to a change in the composition of syndicate members away from tested banks. However, the overall borrowing and firm outcomes were not dramatically affected.
Cornett et al. (2018)	SCAP & CCAR	A significant increase in capital ratios for stress-test banks at the starting point of the tests but not for non-stress test banks is reported. Banks that are subject to the stress tests also reduced their dividends considerably more than non-stress test banks as they entered the tests. Stress-test banks have incentives to spend on lobbying activities significantly more than non-stress test banks.
Cortés et al. (2019)	CCAR	An increase in interest rates and a reduction in credit supply to small businesses is documented. The loan portfolios of stress-test banks are also rebalanced away from riskier borrowers. Small non-stress test banks increased their market share, and the aggregate credit remained unchanged.

Table A1 continued

Doerr (2019)	SCAP & CCAR	Stress test banks reduce lending to small businesses, which negatively affects entrepreneurship and innovation by young firms.
Eber & Minoiu (2017)	ECB's Comprehensive Assessment	Eurozone banks shrank their assets, particularly securities in anticipation of stricter supervision and the CA program. A decline in loan supply is found for only banks with low levels of capital.
Gropp et al. (2018)	2011 EBA Capital Exercise	Stress-test banks reduce their risk-weighted assets including loans to both corporate and retail customers instead of raising their levels of equity to increase capital ratios.
Kovner & Van Tassel (2018)	DFA	Banks' cost of capital has fallen after the passage of the DFA, implying a decrease in banks' systematic risk.
Lambertini & Mukherjee (2016)	SCAP & CCAR	Stress test failure resulted in higher loan spreads, pointing to the cost associated with increased capital requirements.
Pierret & Steri (2018)	CCAR & DFA	The CCAR exercises reduce excessive risk-taking by enhancing banks' level of supervision and highlight the importance of bank supervision that cannot be substituted by stringent capital requirements in promoting prudent lending.

Table A1 continued

Shahhosseini (2015)	SCAP & CCAR	To meet the capital requirements of the stress tests, banks restructured by reducing their net loan charge-offs and increasing non-performing loans, leading to increases in loan loss provisions and loan loss reserves.

Table A2: List of stress test bank holding companies

	2009 SCAP	2011 CCAR	2012 CCAR	2013 CCAR	2014 CCAR	2015 CCAR	2016 CCAR
Ally Financial Inc.	1	1	1	1	1	1	1
American Express Company	1	1	1	1	1	1	1
Bancwest Corporation	0	0	0	0	0	0	1
Bank of America Corporation	1	1	1	1	1	1	1
Bank Of New York Mellon Corporation	1	1	1	1	1	1	1
BB&T Corporation	1	1	1	1	1	1	1
BBVA Compass Bancshares, Inc.	0	0	0	0	1	1	1
BMO Financial Corp.	0	0	0	0	1	1	1
Capital one Financial Corporation	1	1	1	1	1	1	1
Citigroup Inc.	1	1	1	1	1	1	1
Comerica Incorporated	0	0	0	0	1	1	1
Deutsche Bank Trust Corporation	0	0	0	0	0	1	1
Discover Financial Services	0	0	0	0	1	1	1
Fifth Third Bancorp	1	1	1	1	1	1	1
Goldman Sachs Group, Inc.	1	1	1	1	1	1	1
HSBC North America Holdings Inc.	0	0	0	0	1	1	1
Huntington Bancshares Incorporated	0	0	0	0	1	1	1
JPMorgan Chase & Co.	1	1	1	1	1	1	1
Keycorp	1	1	1	1	1	1	1
Metlife, Inc.	1	1	1	0	0	0	0
M&T Bank Corporation	0	0	0	0	1	1	1
Morgan Stanley	1	1	1	1	1	1	1
Northern Trust Corporation	0	0	0	0	1	1	1
PNC Financial Services Group, Inc.	1	1	1	1	1	1	1
RBS Citizens Financial Group, Inc.	0	0	0	0	1	1	1
Regions Financial Corporation	1	1	1	1	1	1	1
Santander Holdings USA	0	0	0	0	1	1	1
State Street Corporation	1	1	1	1	1	1	1
Suntrust Banks, Inc.	1	1	1	1	1	1	1
TD Group US Holdings	0	0	0	0	0	0	1
U.S. Bancorp	1	1	1	1	1	1	1
UnionBanCal Corporation	0	0	0	0	1	1	1
Wells Fargo & Company	1	1	1	1	1	1	1
Zions Bancorporation	0	0	0	0	1	1	1
Total	19	19	19	18	30	31	33

The table reports the name of stress test bank holding companies (BHCs) with value 1 indicating that the BHC participated in a particular stress test and 0 otherwise. UnionBanCal Corporation changed its name to MUFG Americas Holdings Corporation in 2014.

Table A3: Definitions of liquidity creation measures

Assets		
Illiquid assets (weight=1/2)	Semiliquid assets (weight=0)	Liquid assets (weight=-1/2)
Commercial real estate loans (CRE)	Residential real estate loans (RRE)	Cash and due from other institutions
Loans to finance agricultural production	Consumer loans	All securities (regardless of maturity)
Commercial and industrial institutions loans	Loans to depository institutions	Trading assets
Other loans and lease financing receivables	Loans to state and local governments	Fed funds sold
Other real estate owned (OREO)	Loans to foreign governments	
Customers' liability on bankers' acceptances		
Investment in unconsolidated subsidiaries		
Intangible assets		
Premises		
Other assets		
Liabilities plus equity		
Liquid liabilities (weight=1/2)	Semiliquid liabilities (weight=0)	Illiquid liabilities (weight=-1/2)
Transactions deposits	Time deposits	Bank's liability on bankers' acceptances
Savings deposits	Other borrowed money	Subordinated debt
Overnight federal funds purchased		Other liabilities
Trading liabilities		Equity
Off-balance sheet guarantees (notional values)		
Illiquid guarantees (weight=1/2)	Semiliquid guarantees (weight=0)	Liquid guarantees (weight=-1/2)
Unused commitments	Net credit derivatives	Net participations acquired
Net standby letters of credit	Net securities lent	
Commercial and similar letters of credit		
All other off-balance sheet liabilities		
Off-balance sheet derivatives (gross fair values)		
		Liquid derivatives (weight=-1/2)
		Interest rate derivatives
		Foreign exchange derivatives
		Equity and commodity derivatives

Source: Berger & Bouwman (2009). $LC = 1/2 \times$ illiquid assets $- 1/2 \times$ liquid assets $+ 1/2 \times$ liquid liabilities $- 1/2 \times$ illiquid liabilities $- 1/2 \times$ equity $+ 1/2 \times$ illiquid guarantees $- 1/2 \times$ liquid guarantees $- 1/2 \times$ liquid derivatives.

Table A4: Univariate analysis of liquidity creation components

Variable	2007 Non-stress test Mean (1)	Stress test Mean (2)	2009 Non-stress test Mean (3)	Stress test Mean (4)	2009-2016 Non-stress test Mean (5)	Stress test Mean (6)
Assets						
Commerical real estate loans/Total assets	0.4215	0.3019***	0.3881	0.2479*	0.2491***	0.1134***
Loans to finance agricultural production/Total assets	0.0024	0.0020***	0.0018	0.0013*	0.0011**	0.0006***
Commercial and industrial loans/Total assets	0.1609	0.1140**	0.1441	0.0961*	0.0962***	0.0478***
Other loans and lease financing receivables/Total assets	0.0020	0.0033	0.0019	0.0022	0.0065***	0.0044
Other real estate owned (OREO)	0.0008	0.0005*	0.0028***	0.0017***	0.0020***	0.0010***
Investment in unconsolidated subsidiaries/Total assets	0.0002	0.0019***	0.0001	0.0016	0.0001	0.0008***
Intangible assets/Total assets	0.0346	0.0484**	0.0209***	0.0319***	0.0143***	0.0159***
Premises/Total assets	0.0101	0.0098	0.0095	0.0076**	0.0086***	0.0054***
Other assets/Total assets	0.0449	0.0520**	0.0552***	0.0657***	0.0525	0.0752***
Cash and due from other institutions/Total assets	0.0578	0.0401	0.0733	0.0959***	0.0601	0.0553**
All securities/Total assets	0.1464	0.1598	0.1619	0.1688	0.1212**	0.0890***
Trading assets/Total assets	0.0142	0.0490***	0.0122	0.0805	0.0186	0.0582
Fed funds sold/Total assets	0.0294	0.0365	0.0169*	0.0338	0.0086***	0.0131***
Liabilities plus equity						
Transactions deposits/Total liabilities	0.0774	0.0528***	0.0774	0.0504	0.0234***	0.0210***
Savings deposits/Total liabilities	0.2947	0.2970	0.2595	0.3586**	0.3353*	0.4504***
Overnight federal funds purchased/Total liabilities	0.0332	0.0195***	0.0228*	0.0044***	0.0093***	0.0022***
Trading liabilities/Total liabilities	0.0056	0.0297***	0.0064	0.0395	0.0041	0.0335
Subordinated debt/Total liabilities	0.0212	0.0183	0.0199	0.0152	0.0045***	0.0046***
Other liabilities/Total liabilities	0.0027	0.0049***	0.0044*	0.0081**	0.0027	0.0057*
Equity/Total assets	0.0980	0.1124**	0.1026	0.1172	0.1167	0.2479***
Off-balance sheet						
Unused commitments/Total assets	0.3045	0.5833***	0.5928	0.5628	0.3040	0.2627***
Net standby letters of credit/Total assets	0.0443	0.0599	0.0355	0.0475**	0.0221**	0.0270***
Commercial and similar letters of credit/Total assets	0.0014	0.0019	0.0006***	0.0011**	0.0006***	0.0009***
All other off-balance sheet liabilities/Total assets	0.0068	0.0411**	0.0041	0.0313	0.0020**	0.0420
Interest rate derivatives/Total assets	0.0033	0.0889***	0.0091***	0.7740**	0.0052***	0.4370***
Foreign exchange derivatives/Total assets	0.0036	0.0269***	0.0066	0.0758*	0.0045	0.0480*
Equity and commodity derivatives/Total assets	0.0060	0.0121	0.0030	0.0101	0.0015*	0.0043**

The table reports the univariate analysis of liquidity creation components between stress test and non-stress test banks. Column (2) tests if the mean values of the variables are significantly different from those in column (1). Column (3) tests if the mean values of the variables are significantly different from those in column (1). Column (4) tests if the mean values of the variables are significantly different from those in column (2). Column (5) tests if the mean values of the variables are significantly different from those in column (1). Column (6) tests if the mean values of the variables are significantly different from those in column (2). Only liquid and illiquid balance sheet items are reported. Some items are not presented due to their small values. ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.

Table A5: Univariate analysis of liquid liabilities

Variable	2007 Non-stress test Mean (1)	 Stress test Mean (2)	2009 Non-stress test Mean (3)	 Stress test Mean (4)	2009-2016 Non-stress test Mean (5)	 Stress test Mean (6)
Transactions deposits/Total liquid liabilities	0.1822	0.1374**	0.1607	0.1556	0.0426***	0.0574***
Savings deposits/Total liquid liabilities	0.7288	0.6891	0.7692	0.6711	0.9291***	0.7832***
Overnight federal funds purchased/Total liquid liabilities	0.0727	0.0584	0.0551	0.0168***	0.0169***	0.0080***
Trading liabilities/Total liquid liabilities	0.0161	0.1150***	0.0148	0.1563	0.0112	0.1511

The table reports the univariate analysis of liquid liabilities between stress test and non-stress test banks. Column (2) tests if the mean values of the variables are significantly different from those in column (1). Column (3) tests if the mean values of the variables are significantly different from those in column (1). Column (4) tests if the mean values of the variables are significantly different from those in column (2). Column (5) tests if the mean values of the variables are significantly different from those in column (1). Column (6) tests if the mean values of the variables are significantly different from those in column (2). ***, **, and * denote statistical significance at the 1%, 5%, and 10% levels, respectively.