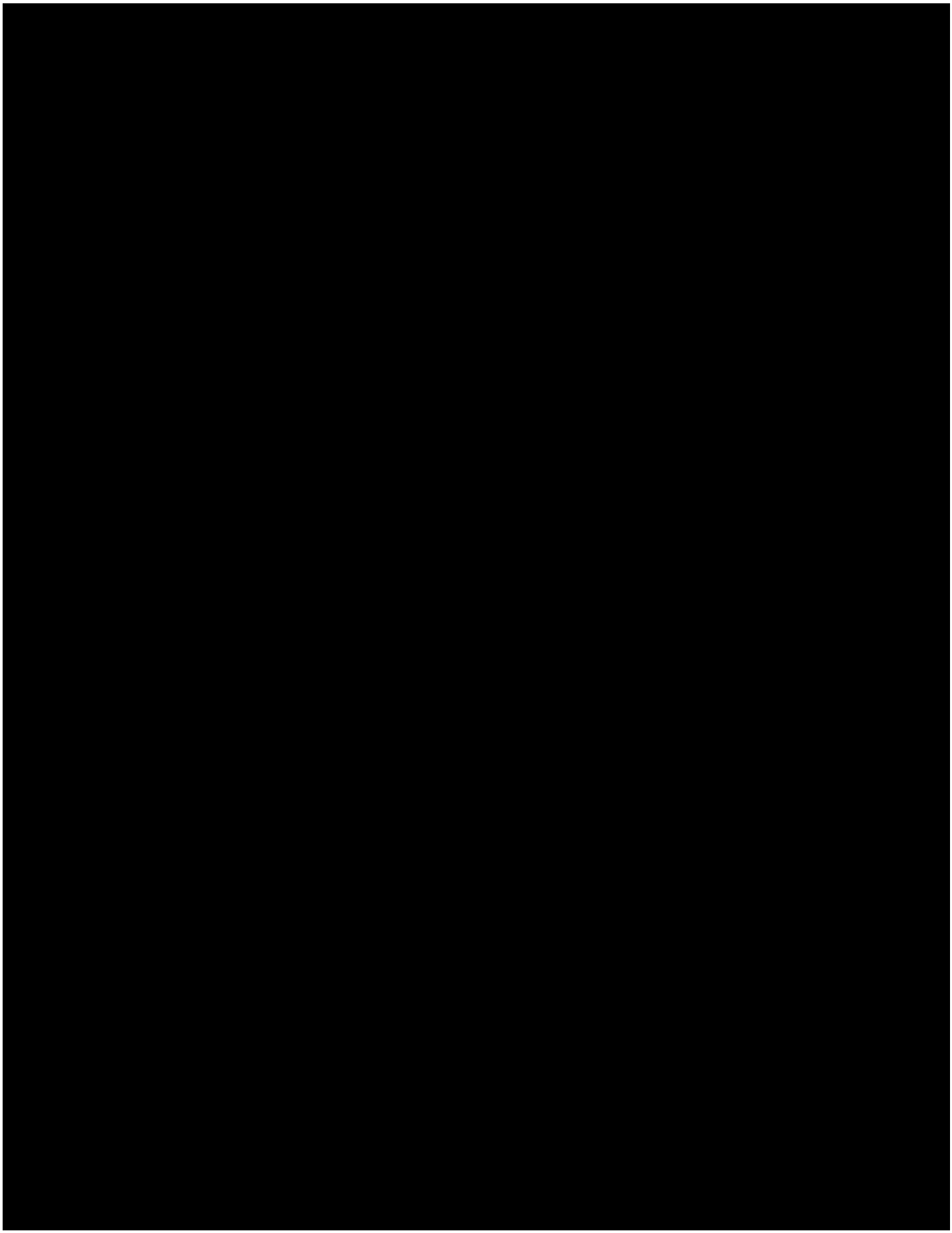

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March Madness in Wall Street: (What) Does the Market Learn from Stress Tests?

Prepared by Marcelo Fernandes, Deniz Igan, and Marcelo Pinheiro

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Abstract

Annual stress tests have become a regular part of the supervisors' toolkit following the global financial crisis. We investigate their capital market implications in the United States by looking at price and trade reactions, information asymmetry and uncertainty indicators, and bank activities. The evidence we present supports the notion that there is important new information in stress tests, especially at times of financial distress. Moreover, public disclosure seems to help reduce informational asymmetries. Importantly, public disclosure of stress test results (and methodology) does not seem to have reduced private incentives to generate information or to have led to distorted incentives.

JEL Classification Numbers: G14, G28, G32

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Authors' E-Mail Addresses: m.fernandes@qmul.ac.uk; digan@imf.org; marcelo@alumni.princeton.edu[†]

[†] Fernandes is at the Queen Mary University of London and São Paulo School of Economics, FGV. Pinheiro is at the Public Company Accounting Oversight Board (PCAOB). We are thankful to Jose Berrospide, Nigel Chalk, Jorge Chan-Lau, Stijn Claessens, Stephan Danninger, Phil de Imus, Morris Goldstein, Minsuk Kim, Emanuel Kopp, Alexander Michaelides, and participants at the conferences and seminars at the IMF, Federal Reserve of Boston, and the Systemic Risk Center at the London School of Economics for their comments. Nicola Babarcich, Ronan Cunha, and Huy Nguyen provided excellent research assistance. The views expressed in this paper are those of the author(s) and do not necessarily reflect the views or opinions of the Public Company Accounting Oversight Board, Board members, or members of the staff.

Contents

"In retrospect, the [Supervisory Capital Assessment Program] stands out for me as one of the critical turning points in the financial crisis. It provided anxious investors with something they craved: credible information about prospective losses at banks. Supervisors' public disclosure of the stress test results helped restore confidence in the banking system and enabled its successful recapitalization."

Ben Bernanke, speech on April 8, 2013 at the "Maintaining Financial Stability: Holding a Tiger by the Tail" conference sponsored by the Federal Reserve Bank of Atlanta

I. INTRODUCTION

Ever since the financial crisis of 2008–09 threatened to bring down the entire U.S. economy with repercussions for the global economy, policymakers and regulators have been looking for ways to enhance the supervisory frameworks to prevent a repeat. In the United States, these efforts mostly culminated in passing of the Dodd-Frank Wall Street Reform and Consumer Protection Act. But even before the passage of the Act regulators have separately been focused on honing the tools they have to ensure that banks can survive adverse, even disastrous, economic and financial conditions in what have now become known as "stress tests."

The jury is, however, still out when it comes to whether the stress tests have made the financial system safer. Opponents have argued that there was no useful information in the stress tests and the tests could actually be harmful as they create a false sense of security (see, for instance, Dowd, 2015). Of particular concern has been the possible effect of stress tests on capital markets and various agents' incentives. On the one hand, public disclosure of the supervisors' information subset may improve price efficiency and enhance market and supervisory discipline. On the other hand, private incentives to generate information may be diluted and risk-sharing opportunities may decrease. Moreover, banks may resort to accounting gimmicks and model convergence to anticipate and deliver on the supervisors' expectations. At the end, price informativeness may worsen and uncertainty may increase, leading to excessive volatility and a more vulnerable system.

In this paper, we examine the capital market implications of stress tests in the United States since the onset of the global financial crisis. A general objective of financial regulation is to reduce information asymmetry by mandating periodic disclosures to investors. In the midst of the global financial crisis, the demand for accurate information on the financial condition of the banks surged. The answer to this demand during the crisis came through the stress tests, which evaluated the impact of adverse scenarios on bank soundness and have become a mainstay of supervision. We ask whether and how capital markets react to the information revealed by the stress tests as well as if and how disclosure of these tests affects information

generation and processing in capital markets. In particular, we analyze equity and bond price changes and jumps, equity and credit bid-ask spreads, implied volatilities, and CDS spreads in a difference-in-difference event-study setup to tease out the effects of stress test announcement and results disclosure.

The evidence we present indicates that there is important information in stress tests, especially at times of stress. Markets tend to react to stress test announcements, with the direction of the price reaction dependent on the nature of the news (e.g., whether the scenarios depict more or less stressful conditions than the markets foresee or whether a bank has failed or passed the quantitative thresholds). Higher moments of the distribution are also affected and trading activity picks up. Interestingly, the reaction is not limited to the tested banks only, affecting as well banks that are not subject to the tests. This suggests that stress tests reveal information about systemic risk (or the supervisor's perception thereof), which by definition is relevant for all banks. While the reaction seems to get weaker as stress tests become more established and the announcement dates more or less known, there appears to be still some information contained in the scenarios released from one year to the next and the supervisors' assessment of the banks' health. There is some indication that information asymmetry increases with announcements, though it then declines after the release of the results. Information uncertainty does not appear to be affected significantly, suggesting that markets may believe that the public disclosure contains useful information but continue to produce private information rather than simply rely on the information that supervisors make publicly available.

All in all, there is new information in stress tests and public disclosure helps reduce informational asymmetries and uncertainties, especially when markets are under distress. Moreover, public disclosure of stress test results (and methodology) does not seem to have reduced private incentives to generate information.

These findings have important policy implications. Borio et al. (2013) argue that macro stress tests are ill suited as early warning devices but they can be effective as crisis management and resolution tools. The finding that banks passing stress tests enjoy positive abnormal returns during times of heightened overall stress in the economy suggests that the market perceives stress tests in a similar way. Also supportive of this interpretation is the finding that the market learns new information about untested banks as well.

To the best of our knowledge, this is one of the first systematic, comprehensive studies of the capital market implications of bank stress tests in the United States. Several studies have looked at the market response to the release of stress testing results (see literature review in section II.B). The analysis of announcement dates in addition to results release dates is one feature that distinguishes ours from the existing studies. In addition, we examine not only

price reactions, but also the higher moments of the distribution as well as a range of market functioning indicators.

The rest of the paper is organized as follows. Section II provides a summary of the evolution of stress testing in the United States since the crisis and lays out the hypotheses of interest. Section III discusses the data and methodology. Section IV presents the results. Section V concludes.

II. BACKGROUND

This section first gives a description of supervisory stress tests in the United States, with particular attention on the public disclosure of their design and results.

A. A Brief History of Stress Testing in the United States

Supervisory Capital Assessment Program (SCAP)

Stress tests, in one form or another, have been present prior to the crisis, but the current framework has its beginnings in 2009.[1] This is when the Federal Reserve conducted simultaneous stress tests of the nation's largest banks under the 2009 Supervisory Capital Assessment Program (SCAP). This exercise aimed to address the uncertainty about the solvency of these institutions in the midst of the crisis by quantifying the impact on capital of further deterioration in financial markets and the economy (Bernanke, 2009). The 19 bank holding companies that were subject to the tests had assets of at least $100 billion as of end-2008 and constituted two-thirds of the system by assets and more than one-half by loans.

The SCAP was announced on February 10, 2009 and was part of the Treasury's Financial Stability Plan.[2] Additional clarification was provided on February 25, including the Treasury's commitment to make capital available to eligible banks through the Capital Assessment Program and to allow banks exchange their existing Capital Purchase Program preferred stock to help meet their buffer requirement. Detailed information on the design and methodology was made available on April 24. The exercise articulated two macroeconomic scenarios: (a) a baseline reflecting the consensus in February 2009; and (b) an adverse scenario designed to characterize a recession that is longer and more severe than the consensus expectation. The banks were then asked to project their credit losses and revenues for 2009 and 2010 under these scenarios. Supervisory teams evaluated the projections submitted by the banks in terms of substance and quality and against benchmarks that they

[1] See Bookstaber et al. (2013) and Hirtle and Lehnert (2014) for a more comprehensive overview.

[2] http://www.treasury.gov/press-center/press-releases/Pages/200921022303013043.aspx

independently developed. Senior supervisory officials made the final call on the necessary capital buffer for each bank, drawing on the results of the quantitative exercise and supervisory judgment. The results, on a bank-by-bank basis, were publicly released on May 7, 2009 (at 5 pm Eastern Standard Time).

Comprehensive Capital Assessment Review (CCAR)

SCAP has been followed by the Comprehensive Capital Assessment Review (CCAR), initiated in late 2010 with the first round of results in 2011. CCAR 2011 covered the same institutions that participated in the SCAP. The next year all bank holding companies with total consolidated assets of $50 billion or more were required to submit capital plans to be reviewed under the Capital Plan Review (CapPR). It was only in 2014 that all 30 bank holding companies with total consolidated assets of $50 billion or more became part of the CCAR.

The CCAR involves both a quantitative assessment of the capital positions and a qualitative assessment of the internal capital planning processes. Each bank holding company submits results of stress tests conducted under the scenarios specified by the Federal Reserve as well as under internal scenarios that are designed to capture the risks that are specific to its business focus and strategy. These accompany a capital plan that describes in detail the internal processes for assessing capital adequacy, the policies governing capital actions, and the intended capital distribution over a nine-quarter horizon. The Federal Reserve assesses the plans based on the submitted material and the supervisory stress test results.

Both quantitative and qualitative components are key inputs to the Federal Reserve's decision to object or not object to a bank holding company's capital plan. If the Federal Reserve does not object, the company can go on with the intended capital distributions. If the Federal Reserve objects, the company may only make the approved capital distributions.

Dodd-Frank Act Stress Tests (DFAST)

In parallel to the CCAR, the Dodd-Frank Act was passed in 2010 and required the Federal Reserve to conduct annual supervisory stress tests of all bank holding companies with assets greater than $50 billion (and certain large, complex financial institutions designated as systemically important) under three scenarios (baseline, adverse, and severely adverse) and to publicly disclose the results of these tests. The Dodd-Frank Act also requires all federally-regulated financial companies with $10 billion or more in total consolidated assets to annually conduct their own internal stress tests and to publicly disclose the results. This exercise is known as DFAST.

The supervisory portion of DFAST uses confidential regulatory report data as inputs into models developed or selected by Federal Reserve staff (and reviewed by an independent

group of Federal Reserve economists and analysts) to produce projections of pre-tax net income under the scenarios specified by the Federal Reserve. Equity capital and regulatory capital are then calculated using a standardized set of capital action assumptions that are specified in the Dodd-Frank Act.

Starting in 2013, DFAST and CCAR have been run in parallel, with projected losses under DFAST being used as inputs to the CCAR capital planning process. The two exercises are complementary but separate. In particular, the DFAST and CCAR stress tests are conducted using the same macroeconomic scenarios but differ in assumptions regarding the banks' capital distribution actions. In the former, generic assumptions specified in the regulation implementing the Dodd-Frank Act requirements are used. In the latter, the actions directly come from the capital plans individual banks submit to the Federal Reserve.

Table 1 provides a timeline and a summary of the SCAP, CCAR, and DFAST exercises, laying out the dates we would focus on in the empirical analysis. Table 2 gives a list of the bank holding companies that participated in each of the exercises.

Public Disclosure

Public disclosure is an important part of stress testing. Results were first published by the Federal Reserve following the SCAP, and since then, more details on results and views on capital plans have been released. The company-specific results for CCAR 2011 were not disclosed but some firms independently disclosed whether the Federal Reserve had objected to their capital plans. In later years, company-specific results have been made publicly available, with the release date falling in March.[3] Releases are often at or after market closing (with the exception of CCAR 2011, for which the test results were released at 11 am Eastern Standard Time). Typically, results of the DFAST are released about a week before the parallel CCAR results.

Information on design and scenarios are released in the fall of the year preceding the exercise. Information on models used by the supervisors has also been disclosed but the exact specification and parameter estimates are not revealed.

The partial disclosure of information on the models underlying the exercise has been a point of criticism, but concerns about "model convergence" and risk shifting have prevented full

[3] The timing led Forbes to nickname the annual supervisory stress tests "March Madness." The company-run tests under the DFAST will have a different schedule, with the publication of the results between October 15 and 31 (for institutions with assets between $10 billion and $50 billion) and between June 15 and July 15 (for institutions with assets greater than $50 billion). The results of the company-run tests will be published beginning in 2016.

disclosure. The public disclosure of the "qualitative assessment" may shift the focus away from the quantitative models themselves over time, also given the degree of model uncertainty. Additionally, some have argued that bank-by-bank disclosure of results may reduce incentives to generate information on the status of the banks and, hence, the informativeness of market prices. Accounting gimmicks and distortion in bank activities due to the desire to avoid "failing" the stress tests have also been concerns.

B. Literature Review

A range of studies have focused on the price reactions to stress tests in the United States and the European Union. Findings are somewhat mixed.

Morgan, Peristiani, and Savino (2014) look at the bank holding companies included in the SCAP in 2009. They find that abnormal returns were lower for banks with a bigger surprise capital shortfall (i.e., there was a larger discrepancy between the capital gap calculated in the stress test and the ex ante expectation of the capital needed to meet minimum target levels under the stress scenario). Glasserman and Tangirala (2015) analyze the correlation patterns in loss projections between the 2013 and 2014 DFAST exercises and find that the current year's loss projections are highly correlated with the previous year's projections. Relatedly, projected loss rates have little relation to abnormal returns at the disclosure of the stress test results, suggesting that the market correctly "predicts" the results.

Other studies looked at the stress tests carried out by the European Banking Authority (EBA). Petrella and Resti (2013) examine the 2011 EBA stress tests and find that stress-tested banks that came out with less damage to their capital in the stress scenarios had cumulative abnormal returns higher than both untested banks and other tested banks. This is in line with the argument that stress tests reveal information about the strength of individual banks. Closer in spirit to our approach, Ellahie (2013) looks at a range of indicators including bond, equity, and CDS spreads to conclude that 2011 EBA stress testing exercise reduced information asymmetry in the market and revealed directional information on the capital strength of banks at the expense of increasing information uncertainty.

Candelon and Sy (2015) compare the U.S. stress test exercises to those conducted by the EBA, finding that cumulative abnormal returns vary through time and across jurisdictions. In particular, they show that the release of results have typically a positive effect on stress-tested banks' returns. This impact seems to have declined over time in the United States (that is, the 2009 SCAP exercise had a large and positive impact but the latter tests are associated with smaller and less significant impact), whereas the 2011 stress test in Europe had a *negative* significant impact on both tested and untested banks. They interpret these findings as indication that the design and governance of stress test exercise is a crucial component in if and what type of information is provided to the market. This is in line with Spargoli's

(2012) model in which a regulator will prefer to fully reveal banks' capital shortfall at times of crisis *if* she is able to recapitalize them, but will hold onto some information if she cannot recapitalize. Ong and Pazarbasioglu (2013) also emphasize the importance of credibility, as established through independent governance of tests, the requisite technical expertise, and clearly communicated plans for any backstop needs.

Flannery et al. (2015) take a step further and look at the information revealed by stress tests as well as their possible welfare implications. Looking at the absolute value of cumulative abnormal returns and trading volumes around CCAR and DFAST exercises, they report that stress-tested bank holding companies experience significant price and activity reaction and that the reaction is more prominent for more levered and riskier firms. Moreover, they find neither evidence of a reduction in information production (proxied by analyst coverage and forecast accuracy), nor of a decline in risk sharing (proxied by interbank borrowing), nor of a deterioration in vulnerability to runs (proxied by differential response for less liquid firms).

C. Empirical Predictions

Ultimately, previous studies summarized in the literature review aim to understand whether public disclosure of supervisory stress test scenarios and results provide new information to the market. With the exception of a few, however, they do not look at whether and how such disclosure affects production of private information and market functioning. This is somewhat in contrast to the theoretical models, which tend to focus on the optimality of disclosure and the effects of disclosure on incentives. Goldstein and Leitner (2013) point out to the trade-off a regulator faces between preventing a market breakdown by disclosing some information and destroying risk-sharing opportunities by disclosing too much information. In turn, they show that no disclosure is optimal during normal times but partial disclosure is optimal during bad times. Alvarez and Barlevy (2014) also show that, when the risk of contagion is high, mandatory disclosure can increase welfare. Goldstein and Sapra (2014) argue that stress tests uncover unique information to outsiders but disclosure may interfere with risk sharing, price efficiency, market discipline, and private information production—with implications for optimal bank behavior, market reaction to news, and vulnerability of the system as a whole.

In our empirical analysis, we focus on several indicators to provide an overview as comprehensive as possible of the market reaction to stress tests. Particularly, we seek to answer the following questions:

1. Is there new information in stress tests? What is the reaction in price, volatility, and trading when the market learns about the scenarios and results? Does this differ for "winners" and "losers"? Is this limited to stress-tested companies? How are information asymmetry and uncertainty in the market affected by public disclosure?

2. Are information gains greater for companies with certain characteristics (e.g., large, leveraged, opaque, complex, lower-quality disclosure)?
3. Is there a distortion of incentives? Do companies engage in more risk taking or more earnings management?

Is there new information in stress tests?

At first glance, stress test results should not affect prices much given that it is about a tail event that has a low probability of happening. However, in general, conditioning on the value of any quantile actually brings about information about the distribution and hence about the mean. In addition, if a bank fails a stress test, it may have to forgo capital redistribution in the form of stock buybacks and higher dividends. As equity buybacks and dividend increases are typically linked to positive returns, a negative price effect may ensue if the stress tests reveal a capital gap that leads the Federal Reserve to object a capital distribution plan.

Indeed, the possibility that the Federal Reserve may object to a capital plan has been a salient part of the news to which the tested institutions and the market has paid close attention. For instance, following CCAR 2012, JP Morgan Chase sent out a press release announcing that it had passed the test and that it planned to buy back as much as $15 billion of its stock and raise its quarterly dividend from 25 to 30 cents per share. Similar announcements by U.S. Bancorp, BB&T, Wells Fargo, and American Express followed. Indeed, bank holding companies publicly communicated their intended capital plans even when no company-specific results were released—in CCAR 2011: a New York Times story detailed the reactions by each bank on March 18, which varied from a 20-cent increase in dividend per share in the case of JP Morgan to an announcement that any dividend increase would wait until the next year in the case of Citigroup.

The possible impact on capital redistribution of stress tests, however, has not been limited to results release. Commentary has also applied to announcements of the scenarios to be used in the supervisory stress tests. For example, Bloomberg reported on October 23, 2014 that "Jaret Seiberg, an analyst at Guggenheim Securities LLC, wrote in a research note today about the scenarios that they will limit the ability of banks to get aggressive in returning capital to shareholders." Scenarios may reveal other information to the market, including on how supervisors see risks. Last but not least, information about a tested company may reveal relevant information for an untested company, perhaps through counterparty risk or the overall stress level in the system.

To systematically assess whether such a price reaction exists, we start by carrying out an event study analysis that distinguishes between the cumulative abnormal returns of the banks that failed with those that passed the CCAR. By this reasoning, pooling all banks and looking at their cumulative abnormal returns is likely to mask important differences and could generate insignificant results by averaging strongly positive and strongly negative reactions.

For this reason, we look at both the raw cumulative abnormal returns and their absolute values.[4] We look at both tested and untested banks. We also distinguish between banks that pass the stress test and those that fail at the time of the results release.

The outcome of a stress test is presumably much more informative for higher-order moments. The quantity and quality of information pertaining to a stock's expected future cash flows affect volatility and risk, which are crucial elements for risk measurement and management. We thus also look at the daily volatility and jump components of stock prices around the DFAST and CCAR announcements using 5-minute returns. It is then important to separate ex post the daily continuous part of the volatility process from the daily return variation induced by jumps. For this purpose, we compute the daily volatility by means of the bipower variation, whereas we estimate the jump component by means of the difference between the realized variance and the bipower variation.[5]

The arrival of new information, if any, would also be reflected in increased trading volumes, provided that such information affects prior beliefs. To rule out that volumes may increase on the dates we examine for reasons other than the stress-test related news, we use a measure of "abnormal" volume, computed as the difference between the actual trading volume and the predicted volume based on the relationship between the market volume and a particular bank stock's trading volume over the past three months.

Announcement of imminent public disclosure and the subsequent disclosure of results can also alter information asymmetry and uncertainty. The direction of such an effect may differ between announcement and results release.

The knowledge that there will be public release of information may incentivize investors to acquire and trade on private information. This increases information asymmetry between informed and uninformed traders, leading to a widening of the bid-ask spreads. When the information is publicly revealed, the bid-ask spreads may narrow if the information is

[4] Note that in the latter case (that is, when using absolute values) the standard parametric significance tests are no longer appropriate since they are based on the assumption that standardized returns follow a t-distribution. We cannot assume that for absolute returns and hence we employ Corrado's (1989) non-parametric test on mean ranked absolute returns.

[5] The realized variance gauges the quadratic variation of the process, which may be decomposed into the integrated variance of interest plus the contribution of the jump plus the variance of the microstructure noise, if any. The bipower variation is a consistent estimator of the integrated variance component in the absence of market microstructure noise. At the 5-minute frequency, we do not expect to find much microstructure noise. To be on the safe side, we also entertain a staggered version of the bipower variation that explicitly controls for any serial correlation induced by microstructure effects. See Barndorff-Nielsen and Shephard (2004) for more details on these measures.

deemed to be useful and a credible commitment device for disclosure of more information in the future.

As for information uncertainty, pending disclosure of information may increase uncertainty as investors reassess the distribution of a firm's future cash flows.[6] What happens in the aftermath of the information disclosure depends on how useful and precise the new information is to investors. If they view the new information as tainted, public disclosure may actually increase rather than decrease information uncertainty. We measure the degree of information uncertainty with equity option implied volatilities and the ratio of one-year to five-year CDS spreads.

Are information gains greater for companies with certain characteristics?

Interpretation of any impact of stress test disclosures on market indicators would be more complete with an examination of the impact in the cross section. Specifically, one would expect stress tests to reveal more information and price informativeness to improve more for banks that are more opaque and/or riskier (Quijano, 2014).

For this purpose, we look at how the market indicators around stress tests vary with risk characteristics of banks, using measures of leverage (Tier 1 capital divided by risk-weighted assets and market capitalization divided by total assets), riskiness (risk-weighted assets divided by total assets), asset opacity (the book value of bank premises and investments in unconsolidated subsidiaries, intangible assets, and "other assets" divided by total assets[7]), bank complexity (count of bank and nonbank subsidiaries), and earnings management (difference between discretionary realized security gains and losses and discretionary loan loss provisions as a percent of total assets).[8] We also use information on the identity of a company's auditor to see if there are differences in the market response, potentially indicating differences in the perceived quality of publicly disclosed financial information.

Is there a distortion of incentives?

Opponents of stress tests argue that, in addition to very little reliable information being produced through stress tests, the institutions subjected to these tests may be tempted to create complex business structures or to "cook the numbers" to ensure that they pass the test.

[6] We define information uncertainty as the ambiguity with respect to the implications of the new information for a firm's value. There are two sources for uncertainty: the volatility of a firm's underlying fundamentals and poor information.

[7] See Flannery et al. (2004) for more details.

[8] Discretionary components are obtained as error terms from fixed-effects OLS regressions of the reported values on the respective determinants. See Cornett et al. (2009) for more details.

Proponents may downplay these risks but they do worry that the banks may cut down lending to get their balance sheets in shape, with implications for economic growth. We examine the post-stress-test behavior of banks to see if they become more complex, engage in more earnings management, or reduce lending growth.

III. DATA AND METHODOLOGY

Data

The exercise involves gathering information from multiple data sources. We get the equity price information from CRSP and Datastream. Data on (publicly traded, nonconvertible, noncallable, on-the-run) bonds are from Bloomberg. Implied volatility and CDS series come from Datastream, whereas financial statement data is from Call Reports (via SNL). Finally, we thank Asger Lunde for sharing the realized measures we use to estimate the daily variance and jump contribution to the quadratic variation of the stock prices.

We focus on the largest 100 bank holding companies in the United States as of the last quarter of 2014, based on their assets. Summary statistics for key balance sheet and income statement indicators of tested and untested banks are in Table 3. Not surprisingly, the tested banks are much larger. They are not, however, necessarily riskier and more profitable than their untested counterparts.

Methodology

In addition to a usual event study set-up around the announcement of stress tests and the release of their results, we also employ a difference-in-difference event-study setup.[9] Specifically, we treat untested banks as the control group and estimate the following regression equation:

$$Y_{it} = \alpha + \beta_1 * Event_t + \beta_2 * Test_i + \beta_3 * Event_t * Test_i + \gamma X_{it} + \varepsilon_{it}$$

[9] Of course, the stress testing treatment is not random and, because of the covariates that predict which banks actually are tested, there is likely a bias in simply comparing outcomes for the tested and untested banks. To address this concern, we also identify a group of untested banks that can serve as a better control group for the tested banks using propensity matching techniques applied to total assets, market capitalization, Tier 1 ratio, risky assets, and return on assets. Results are similar and hence we do not report them for sake of brevity. A broader concern is that untested banks may be affected by the stress tests as well (as discussed further below). Given these caveats, we cautiously interpret the empirical findings as suggestive correlations rather than causal links.

where *Y* is the variable of interest (returns, trading, spreads, etc.), *Event* is a dummy variable capturing the window over which we measure the effect of the announcement and results releases, *Test* is a binary variable that takes the value of 1 for stress-tested banks, and *X* is a matrix of control variables specific to *Y* (log of the equity/bond price for spreads, stock return volatility for implied volatility, leverage for CDS, VIX for daily volatility and jump components).[10]

While our methodology primarily relies on detecting abnormal moves in the indicators for tested banks relative to untested banks, there may be additional information on what happens to untested banks. Particularly, in addition to serving as a control group, the untested bank subsample can be used to examine whether the stress tests reveal broader information (for instance, because of common exposures, business activities, supervisory viewpoints, etc.) for untested banks as well.

IV. RESULTS

We start with a traditional event study examining the indicators of interest around the stress testing announcements and results releases. We take a total event window of seven days, i.e., we examine the behavior of the indicator in the 3 days before and after the event date.[11] We report the results in Table 4 (announcements) and Table 5 (results releases).

In line with the previous studies on the market reaction to stress tests, the conventional event studies reveal evidence of small, often positive reactions in the cumulative abnormal return around announcement and results release dates. The coefficient estimate we obtain if we pool all events and directional results is not statistically significant, however; masking a great degree of variation across these dimensions. For instance, the cumulative abnormal return at announcement appears is in the 2009 exercise, but significantly negative in the exercises undertaken between 2011 and 2013. Looking at the results release, the returns for the banks that pass the stress test tend to be large and positive, while large and negative for those failing the test (see Figure 1).

This observation then suggests one should look at the absolute value of the returns because the direction of the price reaction depends on the discrepancy between the market's

[10] The results are robust to employing different control variables than listed here and to including more than one control variable at a time.

[11] The choice of the event window length aims to hit the right balance between capturing the market reaction in its entirety and tainting the measured response with reaction to news other than those related to the stress testing event in question. Results are robust to using a shorter window of three days (i.e., the day before the event, the event date, the day after the event).

expectation (based on their pre-disclosure information set and assessment) and the actual disclosure. Indeed, the results in this case indicate that there is valuable information in stress test announcements (Tables 4 and 5).[12]

The price reaction appears to be most striking for SCAP 2009. This is in line with the views expressed by policymakers on the objective of the first comprehensive stress testing exercise, i.e., to provide reliable information to markets at a time of heightened uncertainty. The reaction is much smaller in latter exercises but does not diminish in an obvious pattern as time goes by. This could be interpreted as a sign that, while the market has been learning and the exercise becoming more and more routine, there is still valuable information in public disclosures related to stress tests.

Another possible explanation for the difference in results for SCAP and the subsequent exercises may be the focus of market participants. To put it more precisely, in 2009, the main concern in the market was the credibility of official backstops. As turmoil continued, market participants needed assurances from the authorities that there were enough resources to bail out any institution that would be revealed to be weak by the tests. Such assurances came in two forms. First, the Federal Reserve specified an extreme but plausible scenario, credibly signaling that should the worst come, there were resources and willingness to put a backstop in place. Second, as mentioned in Section II.A, the Treasury reiterated its commitment to make capital available to banks. In subsequent exercises, market concern shifted to capital distribution plans and their approval by the Federal Reserve. Hence, market reaction in these cases tends to be *less* positive. This explanation is also consistent with CAR being smaller (or negative) at CCAR results release compared to the corresponding DFAST exercise (which does not have direct implications for capital distribution plans).

Interestingly, the findings show that there is significant price reaction for untested banks as well. This suggests that the information about stress-tested banks also reveal information on untested banks. The exact mechanism as to why is beyond the scope of this paper and is left for future research.[13]

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[12] An alternative approach is to examine the significance of the returns separately for failed and passed banks when the event is the results release. Again, the findings point to significant positive reaction when a bank passes the stress test and a significant negative reaction when a bank fails the stress test.

[13] A related question is whether the difference between tested and untested banks could be an indication that, in the presence of credible backstops, the market perceives tested banks to be too-big-to-fail. The results in Tables 4 and 5 for CAR are suggestive in that, compared to the untested banks, the tested banks actually experienced a larger boost when the test was announced and smaller decline when results were released in SCAP 2009—when the existence of a credible backstop mattered. The difference, however, is not statistically significant.

Looking at trading activity, we see some evidence that volumes increase around announcement and release dates, consistent with the interpretation that there is new information digested by the market.

Next, we look at the information indicators using the difference-in-difference approach (Tables 6 and 7). Realized volatility increases significantly for tested firms around announcements and results releases.[14] This is consistent with new information arrival. The jump component, which can be interpreted as a proxy for changes in risk, is not statistically significant in general but for the SCAP 2009 exercise. Not surprisingly, it seems to be the case that the tested companies were the ones perceived to be subject to greater risk and the announcement of the SCAP has reduced the perceived risk.[15] At the release of the results, the market appears to have digested new information for the market as a whole but more so for tested companies.

Albeit much weaker, there is also some evidence that equity bid-ask spreads and implied volatility tend to increase at the announcement (for all bank holding companies) and decrease with the results release (for tested companies). These findings are somewhat stronger in the earlier tests. This may indicate that public disclosure affects information asymmetry and uncertainty more when markets are under heightened levels of overall distress. Alternatively, it may indicate that markets learn what to expect from stress tests, becoming better at predicting the scenarios and how banks would perform under these scenarios as time passes. Yet another interpretation is that market participants learn how to anticipate supervisors' expectations (and assessments based on these expectations) rather than getting better at predicting the results.[16]

Bond bid-ask spreads and, especially, CDS spread ratios turn out to have coefficients different from what we would have expected, but limited data availability is an important caveat to keep in mind when interpreting these coefficients. In particular, the sign of the coefficient on the CDS ratio regressions switches from one stress testing exercise to next and these coefficients are often not statistically significant.

[14] The results shown are computed using realized kernel approach, which is heteroskedasticity and autocorrelation consistent. We use a 5-minute window to minimize market microstructure noise.

[15] The results obtained for all events do not change when regressions are run on all events ex-SCAP 2009.

[16] This interpretation may particularly apply to the qualitative portion of the tests. The very nature of the qualitative assessment and the elusiveness of the information released arguably leave little room for learning about the exercise itself but more about the supervisors' preferences.

All in all, the findings suggest that, relative to what happens to the untested banks, stress-tested banks experience stronger price reactions (with the direction depending on whether they pass or fail the test), increased trading volumes, a decline in information asymmetry, and some decline in information uncertainty when there is heightened distress. Table 8 further demonstrates the difference between passed and failed banks. There appears to be information in failure news as indicated by the asymmetric market reaction.

How does the market reaction vary by bank characteristics? Table 9 shows the results we obtain when we regress the absolute value of the cumulative abnormal return, abnormal volume, equity bid-ask spread, and implied volatility on the stress-test dummy, a measure of bank leverage, riskiness, opaqueness, complexity, earnings management, and their interaction. We also look at a specification that includes an indicator of and interaction with the auditing firm's identity. The findings somewhat provide support to the view that the disclosure of information is particularly important for riskier, more opaque, and more complex banks but there is little to pin down robust conclusions. The audit company seems to matter. The absolute value of cumulative abnormal return is *larger*, in general, for firms audited by three of the Big 4 companies (see Appendix Table for a list of these companies) and information asymmetry *increases* for tested firms audited by one of the Big 4 after the release of the stress-test results. Altogether, these results actually are in line with the notion that stress tests contain information for the system as whole and not only for the tested bank holding companies.

Do banks change their behavior in significant ways after the stress test results? Table 10 suggests that failed banks become less complex (i.e., number of subsidiaries decreases) and engage in more earnings management. The latter happens on a longer-term basis. Failed banks reduce earnings management in a cumulative sense in the two quarters following the stress test, even though the cumulative change for the full period in-between stress tests is positive and statistically significant. Lending growth in failed banks seems to slow down in the two quarters following the stress test but the results are not statistically significant in a longer horizon. The coefficient on the tested dummy is not significant, suggesting that any effect is the result of supervisory and other actions taken to help a failed bank get back in shape rather than the result of stress testing per se.

V. CONCLUSIONS

There is a particular concern that the public disclosure of stress test scenarios and results would affect information production in capital markets. Moreover, banks may strategically change their behavior to meet the hurdle set by the stress tests. This may manifest as suboptimal portfolio allocations, excessive reaction to news, and distortion of activities.

The evidence we present supports the notion that there is important information in stress tests, especially at times of turmoil. Markets tend to react positively to stress test announcements and, while the reaction gets weaker as stress tests become more established and the announcement dates known, there appears to be still some information contained in the scenarios released from one year to the next. There is some evidence that information asymmetry increases with announcements early on and declines when results are released. Information uncertainty seems to decrease somewhat following release of results, suggesting that markets believe that useful information is contained in the release.

All in all, there is new information in stress tests, especially when markets are under distress and public disclosure helps reduce informational asymmetries and uncertainties. Moreover, public disclosure of stress test results (and methodology) does not seem to have reduced private incentives to generate information.

An important caveat is that the sample period so far does not span a full cycle. The earlier tests were conducted immediately in the aftermath of major dislocation in the economy and the financial markets while the more recent tests have been conducted in a relatively "uneventful" economic and financial environment. Going forward, it will be important to analyze the disclosure of the tests during the upward phase of the credit cycle and see if they deliver the intended result when the peak is near.

References

Alvarez, F. and G. Barlevy, 2014, "Mandatory disclosure and financial contagion," Federal Reserve Bank of Chicago WP 2014–04.

Barndorff-Nielsen, O. and N. Shephard, 2004, "Power and bipower variation in stochastic volatility and jumps," *Journal of Financial Econometrics*, Volume 2 (1), pp. 1–37.

Bernanke, B. S., 2009, "Statement regarding the Supervisory Capital Assessment Program," May 7, accessible at http://www.federalreserve.gov/newsevents/press/bcreg/bernankescap20090507.htm

Bookstaber, R. J. Cetina, G. Feldberg, M. Flood, and P. Glaesserman, 2013, "Stress tests to promote financial stability: Assessing progress and looking to the future," Office of Financial Research Working Paper 0010.

Borio, C., M. Drehmann, and K. Tsatsaronis, 2013, "Stress testing macro stress testing: Does it live up to expectations?" *Journal of Financial Stability*, Volume 12 (June), pp. 2–15.

Candelon, B. and A. N. R. Sy, 2015, "How did markets react to stress tests?" IMF Working Paper WP/15/75.

Cornett, M. M., J. J. McNutt, and H. Tehranian, 2009, "Corporate governance and earnings management at large U.S. bank holding companies," *Journal of Corporate Finance*, Volume 15, pp. 412–430.

Corrado, C., 1989, "A non parametric test for abnormal security-price performance in event studies," *Journal of Financial Economics*, Volume 23, pp. 385–395.

Dowd, K., 2015, "Central bank stress tests: Mad, bad, and dangerous," *Cato Journal*, Volume 35 (3), pp. 507–524.

Ellahie, A., 2012, "Capital market consequences of EU bank stress tests," manuscript, London School of Economics.

Flannery, M. J., S. H. Kwan, and M. Nimalendran, 2004, "Market evidence on the opaqueness of banking firms' assets," *Journal of Financial Economics*, Volume 71(3), pp. 419–460.

Flannery, M. J., B. Hirtle, and A. Kovner, 2015, "Evaluating the information in the Federal Reserve stress tests," Federal Reserve Bank of New York Staff Reports No. 744.

Glasserman, P. and G. Tangirala, 2015, "Are the Federal Reserve's stress test results predictable?" Office of Financial Research Working Paper 15–02.

Goldstein, I. and Y. Leitner, 2013, "Stress tests and information disclosure," Federal Reserve Bank of Philadelphia Working Paper 13–26.

Goldstein, I. and H. Sapra, 2014, "Should banks' stress test results be disclosed? An analysis of the costs and benefits," manuscript, The Wharton School.

Hirtle, B. and A. Lehnert, 2014, "Supervisory stress tests," Federal Reserve Bank of New York Staff Reports, no. 696.

Morgan, D. P., S. Peristiani, and V. Savino, 2014, "The information value of the stress test," *Journal of Money, Credit, and Banking*, Volume 46, pp. 1479–1500.

Ong, L. and C. Pazarbasioglu, 2013, "Credibility and crisis stress testing," IMF Working Paper WP/13/178.

Petrella, G. and A. Resti, 2013, "Supervisors as information producers: Do stress tests reduce bank opaqueness?" *Journal of Banking and Finance*, Volume 37, pp. 5406–5420.

Quijano, M., 2014, "Information asymmetry in U.S. banks and the 2009 bank stress test," *Economics Letters*, Volume 123 (2), pp. 203–205.

Spargoli, F., 2012, "Bank recapitalization and the information value of a stress test in a crisis," manuscript, Universitat Pompeu Fabra.

Table 1. Timeline of Stress Tests

	Announcement	Results release	Revision / Correction / Qualitative results	Summary
SCAP 2009	February 10, 2009	May 7, 2009		A total of 19 banks assessed, 10 of which had a capital gap: Bank of America, Citigroup, Wells Fargo, Morgan Stanley, PNC, GMAC, SunTrust, Regions Financial, Fifth Third Bank, and KeyCorp.
CCAR 2011	November 17, 2010	March 18, 2011		No bank-specific results released, some banks voluntarily disclosed that they had passed while Bank of America revealed on March 23 that the Fed had rejected its dividend distribution plan.
CCAR 2012	November 22, 2011	March 13, 2012	March 16, 2012	Four banks failed: Citigroup, Ally, SunTrust, and MetLife.
DFAST 2013	November 15, 2012	March 7, 2013		Only Ally failed.
CCAR 2013	November 9, 2012	March 14, 2013		Capital plans by Ally and BB&T are rejected while those by Goldman Sachs and JP Morgan conditionally approved.
DFAST 2014	November 1, 2013	March 20, 2014	March 24, 2014	Only Zions failed.
CCAR 2014	November 1, 2013	March 26, 2014		In addition to Zions, capital plans by Citigroup, RBS, HSBC, and Santander rejected.
DFAST 2015	October 23, 2014	March 5, 2015		All banks pass.
CCAR 2015	October 23, 2014	March 11, 2015		Plans of Deutsche Bank and Santander rejected, while that of Bank of America received a conditional non-objection.

Table 2. List of Stress Test Participants

	SCAP 2009	CCAR 2011	CCAR 2012	CCAR 2013	CCAR 2014	CCAR 2015	Country
ALLY FINANCIAL INC.	1	1	1	1	1	1	USA
AMERICAN EXPRESS COMPANY	1	1	1	1	1	1	USA
BANK OF AMERICA CORPORATION	1	1	1	1	1	1	USA
BANK OF NEW YORK MELLON CORPORATION, THE	1	1	1	1	1	1	USA
BB&T CORPORATION	1	1	1	1	1	1	USA
BBVA COMPASS BANCSHARES, INC.	0	0	0	0	1	1	ESP
BMO FINANCIAL CORP.	0	0	0	0	1	1	CAN
CAPITAL ONE FINANCIAL CORPORATION	1	1	1	1	1	1	USA
CITIGROUP INC.	1	1	1	1	1	1	USA
COMERICA INCORPORATED	0	0	0	0	1	1	USA
DEUTSCHE BANK TRUST CORPORATION	0	0	0	0	0	1	DEU
DISCOVER FINANCIAL SERVICES	0	0	0	0	1	1	USA
FIFTH THIRD BANCORP	1	1	1	1	1	1	USA
GOLDMAN SACHS GROUP, INC., THE	1	1	1	1	1	1	USA
HSBC NORTH AMERICA HOLDINGS INC.	0	0	0	0	1	1	GBR
HUNTINGTON BANCSHARES INCORPORATED	0	0	0	0	1	1	USA
JPMORGAN CHASE & CO.	1	1	1	1	1	1	USA
KEYCORP	1	1	1	1	1	1	USA
METLIFE, INC. 1/	1	1	1	0	0	0	USA
M&T BANK CORPORATION	0	0	0	0	1	1	USA
MORGAN STANLEY	1	1	1	1	1	1	USA
NORTHERN TRUST CORPORATION	0	0	0	0	1	1	USA
PNC FINANCIAL SERVICES GROUP, INC., THE	1	1	1	1	1	1	USA
RBS CITIZENS FINANCIAL GROUP, INC. 2/	0	0	0	0	1	1	GBR/USA
REGIONS FINANCIAL CORPORATION	1	1	1	1	1	1	USA
SANTANDER HOLDINGS USA, INC.	0	0	0	0	1	1	ESP
STATE STREET CORPORATION	1	1	1	1	1	1	USA
SUNTRUST BANKS, INC.	1	1	1	1	1	1	USA
U.S. BANCORP	1	1	1	1	1	1	USA
UNIONBANCAL CORPORATION 3/	0	0	0	0	1	1	JPN
WELLS FARGO & COMPANY	1	1	1	1	1	1	USA
ZIONS BANCORPORATION	0	0	0	0	1	1	USA

1/ Metlife, Inc. dropped out of the stress test exercise after it sold its commercial bank and de-registered as a bank holding company in 2012.
2/ The Royal Bank of Scotland (RBS) sold about 25 percent of its stake in Citizens Financial Group, Inc. in the fall of 2014, with plans to gradually shed the rest by the end of 2016.
3/ Effective July 1, 2014, UnionBanCal Corporation changed its name to MUFG Americas Holding Corporation.

Table 3. Summary Statistics

	All		Tested		Untested	
	Mean	St. Dev.	Mean	St. Dev.	Mean	St. Dev.
Assets (billion dollars)	187.0	454.0	609.0	728.0	36.8	67.8
Market cap (billion dollars)	16.8	37.4	55.1	57.8	3.3	4.1
Tier 1 Capital / RWA (percent)	12.9	3.2	12.4	2.2	13.1	3.5
RWA / Total assets (percent)	72.4	15.0	71.1	17.4	73.0	13.9
ROAA (percent)	0.7	1.8	0.8	1.4	0.6	1.9
Opacity (percent)	7.1	4.3	8.6	3.1	6.6	4.5
Complexity (log number)	2.4	1.9	4.5	1.6	1.7	1.4
Earnings management (percent)	-0.01	0.50	-0.01	0.49	-0.01	0.50

RWA: Risk-weighted assets. ROAA: Return on average assets. Opacity: Book value of bank premises and investments in unconsolidated subsidiaries, intangible assets, and "other assets" divided by total assets. Complexity: Count of subsidiaries. Earnings management: Difference between discretionary realized security gains and losses and discretionary loan loss provisions as a percent of total assets.

Table 4. Reaction around Announcement

	Cumulative abnormal return (CAR)			Absolute value of CAR			Abnormal volume		
	Tested	Untested	Difference significant?	Tested	Untested	Difference significant?	Tested	Untested	Difference significant?
All events	-0.14	-0.08	No	3.30	2.54	Yes	0.89*	-0.07	Yes
SCAP 2009	3.95	0.53	No	9.47	3.66	Yes	3.80*	1.07*	Yes
CCAR 2011	-4.11*	-1.36*	Yes	4.50	2.08	Yes	0.13	-1.37*	Yes
CCAR 2012	-0.49	-0.15	No	1.93	2.30	No	-0.78*	-1.39*	Yes
DFAST 2013	-0.23	-0.98	No	1.50	2.68	Yes	0.11	0.66*	No
CCAR 2013	-1.32*	-1.11*	No	1.80	1.98	No	-0.26	-0.11	No
DFAST & CCAR 2014	-0.40	0.89*	No	2.40	2.15	No	-0.09	0.10	No
DFAST & CCAR 2015	1.34*	1.95*	No	2.53	2.97	No	3.05	1.74*	No

Traditional event study. The sample is composed of the largest 100 bank holding companies as of 2014Q4. Abnormal activities are computed by estimating the relationship between the variable and its market equivalent over the 30 trading days (approximately two months) prior to the event in question. * denotes statistical significance at conventional levels (10 percent or lower).

Table 5. Reaction around Results Release

	Cumulative abnormal return (CAR)			Absolute value of CAR			Abnormal volume		
	Tested	Untested	Difference significant?	Tested	Untested	Difference significant?	Tested	Untested	Difference significant?
All events	1.56	1.51	No	3.77	3.28	Yes	.34*	0.09	Yes
SCAP 2009	-1.53	-2.32	No	12.49	6.77	Yes	1.47*	0.54	Yes
CCAR 2011	-0.89	0.36	Yes	2.14	2.04	No	0.61	0.22	No
CCAR 2012	4.35*	4.92*	No	4.46	5.02	No	1.46*	0.65*	Yes
DFAST 2013	1.38	1.44*	No	2.49	2.28	No	-0.19	-0.16	No
CCAR 2013	-0.13	1.07*	Yes	1.91	2.14	No	-0.32	0.02	No
DFAST 2014	2.35*	1.48*	Yes	2.97	1.95	Yes	0.58	0.56	No
CCAR 2014	-0.46	0.50	Yes	1.56	2.16	Yes	0.02	-0.03	No
DFAST 2015	4.84*	4.23*	Yes	4.84	4.40	No	-0.25	-0.82*	No
CCAR 2015	2.72*	2.23*	Yes	2.72	2.48	No	0.14	-0.35	No

Traditional event study. The sample is composed of the largest 100 bank holding companies as of 2014Q4. Abnormal activities are computed by estimating the relationship between the variable and its market equivalent over the 30 trading days (approximately two months) prior to the event in question. * denotes statistical significance at conventional levels (10 percent or lower).

Table 6. Information Indicators around Announcement

	Realized volatility			Jump component		
	Event	Tested	Event & Tested	Event	Tested	Event & Tested
All events	-1.339	0.840	3.309***	0.0570	0.130	0.0792
SCAP 2009	2.217	42.69***	-0.863	1.094	6.933***	-4.363**
	Bid-ask spread, equity			**Bid-ask spread, bond**		
	Event	Tested	Event & Tested	Event	Tested	Event & Tested
All events	0.152**	-0.0617	0.307	0.0158	-0.0738	-0.0148
SCAP 2009	-0.0725	-0.0462	0.0114	n.a.	n.a.	n.a.
	Implied volatility			**CDS spread, 1-year / 5-year**		
	Event	Tested	Event & Tested	Event	Tested	Event & Tested
All events	0.00189	0.0341	-0.00203	0.142***	-0.325***	-0.154***
SCAP 2009	-0.0738**	0.223	-0.0932**	0.0351	n.a.	n.a.

Difference-in-difference estimates. The sample is composed of the largest 100 bank holding companies as of 2014Q4. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 7. Information Indicators around Results Release

	Realized volatility			Jump component		
	Event	Tested	Event & Tested	Event	Tested	Event & Tested
All events	1.770***	0.857	3.530***	-0.317	0.140	-0.423
SCAP 2009	7.683***	25.96***	6.767*	0.290	2.399	-6.543
	Bid-ask spread, equity			**Bid-ask spread, bond**		
	Event	Tested	Event & Tested	Event	Tested	Event & Tested
All events	0.545***	-0.285**	-0.372*	0.0383	-0.0807*	-0.0395
SCAP 2009	-0.0182	0.0506	0.0435	n.a.	n.a.	n.a.
	Implied volatility			**CDS spread, 1-year / 5-year**		
	Event	Tested	Event & Tested	Event	Tested	Event & Tested
All events	0.000863	-0.0270	-0.00683	-0.0266***	-0.276***	0.0423***
SCAP 2009	-0.0278	-0.0186	-0.0623*	0.0207	n.a.	n.a.

Difference-in-difference estimates. The sample is composed of the largest 100 bank holding companies as of 2014Q4. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 8. Passed versus Failed

	Absolute value of CAR			Abnormal volume		
	Passed	Failed	Difference significant?	Passed	Failed	Difference significant?
All events	3.26	7.42	Yes	0.19	1.47*	Yes
SCAP 2009	8.82	15.74	Yes	0.74	2.11*	No
	Realized volatility			**Jump component**		
	Event	Tested	Event & Tested	Event	Tested	Event & Tested
All events	1.852***	1.311	15.09***	-0.287	0.429	-3.594
SCAP 2009	6.862***	33.67***	10.15*	0.259	6.029***	-12.98

Traditional event study. The sample is composed of the largest 100 bank holding companies as of 2014Q4. Abnormal activities are computed by estimating the relationship between the variable and its market equivalent over the 30 trading days (approximately two months) prior to the event in question. * denotes statistical significance at conventional levels (10 percent or lower) in the upper panel. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively, in the lower panel.

Table 9a. Market Reaction to Stress Test Results and Bank Characteristics

	Cumulative abnormal return (absolute value)								Abnormal volume							
Stress tested (dummy = 1)	0.641*	1.992	-0.0560	-0.125	1.289**	0.923	1.242	-0.246	0.313	1.207	1.262**	-0.0692	1.828***	1.127**	0.331	-0.808
Tier 1 Capital / RWA		0.0405								0.0884						
* Stress tested		-0.113								-0.0564						
Market cap / Total assets			-7.503								5.345					
* Stress tested			1.441								-6.112*					
RWA / Total assets				0.00595								-0.00898				
* Stress tested				0.00894								0.00653				
Opacity					-0.0116								0.0170			
* Stress tested					-0.0983								-0.182**			
Complexity						-0.0977								0.157*		
* Stress tested						-0.0385								-0.262**		
Earnings management							-0.328								-0.152	
* Stress tested							-2.931								0.410	
Auditor 1								1.636								0.663
* Stress tested								0								0
Auditor 2								1.314*								0.0276
* Stress tested								1.182								1.659*
Auditor 3								1.345*								-0.017
* Stress tested								0.875								1.629*
Auditor 4								1.842*								0.0766
* Stress tested								-0.338								0.749

The sample is composed of the largest 100 bank holding companies as of 2014Q4. Abnormal activities are computed by estimating the relationship between the variable and its market equivalent over the 30 trading days (approximately two months) prior to the event in question. Regressions include year fixed effects. Robust standard errors are clustered at the bank holding company level. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 9b. Market Reaction to Stress Test Results and Bank Characteristics

	Spread, equity								Implied volatility							
Stress tested (dummy = 1)	-0.222	0.444	-0.284	-1.795**	-0.414	0.0337	-0.405**	-1.351	-0.007	0.00907	-0.0293*	-0.004	-0.00305	0.0171	-0.00454	-0.0181**
Tier 1 Capital / RWA		0.0152								-0.000214						
* Stress tested		-0.0428								-0.00123						
Market cap / Total assets			-0.0183								-0.133					
* Stress tested			0.420								0.159					
RWA / Total assets				-0.0172**								0.000242				
* Stress tested				0.0235**								-1.31e-05				
Opacity					-0.0380								0.000283			
* Stress tested					0.0301								-0.000421			
Complexity						0.0295								0.00260		
* Stress tested						-0.0830								-0.00620**		
Earnings management							-0.216								0.0107	
* Stress tested							0.382								0.00102	
Auditor 1								0.853								-0.006
* Stress tested								0								0
Auditor 2								-0.513								-0.016
* Stress tested								1.392								0.0295*
Auditor 3								-0.384								n.a.
* Stress tested								1.112								n.a.
Auditor 4								-0.681**								0.0108
* Stress tested								1.680*								0

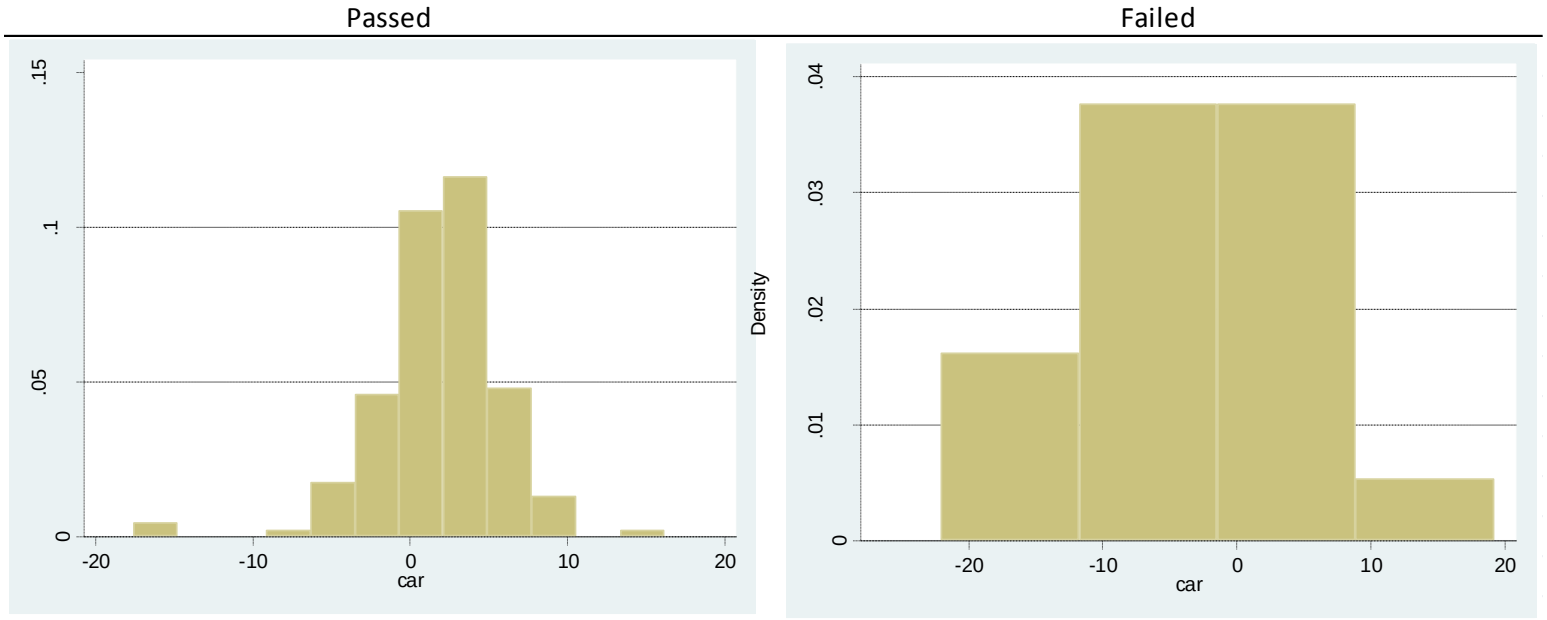
The sample is composed of the largest 100 bank holding companies as of 2014Q4. Abnormal activities are computed by estimating the relationship between the variable and its market equivalent over the 30 trading days (approximately two months) prior to the event in question. Regressions include year fixed effects. Robust standard errors are clustered at the bank holding company level. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 10. Post-Stress-Test Behavior

	Quarterly changes					
	Complexity		Earnings management		Lending growth	
Tested	-0.0139	-0.0103	-0.00824	-0.0173	-0.00431	-0.00280
Failed		-0.0201*		0.0444**		-0.00852
	Cumulative change two quarters following a stress test					
	Complexity		Earnings management		Lending growth	
Tested	-0.0446	-0.0450	-0.0329	0.0107	-0.00726	0.00162
Failed		0.00368		-0.368***		-0.0750***
	Cumulative change in-between stress test news					
	Complexity		Earnings management		Lending growth	
Tested	-0.0505*	-0.0397	-0.0386	-0.0724*	-0.0334	-0.0278
Failed		-0.0933*		0.294**		-0.0487

OLS regressions. The sample is composed of the largest 100 bank holding companies as of 2014Q4. Regressions include year fixed effects and size, as measured by log assets, as a control. Robust standard errors are clustered at the bank holding company level. ***, **, and * denote statistical significance at the 1, 5, and 10 percent levels, respectively.

Figure 1. Cumulative Abnormal Return around Results Release



Appendix Table. Description of Variables

	Summary
Assets	Total assets (BHCK2170 in Call Report)
Market cap	Market value of equity (price times shares outstanding)
Tier 1 Capital	Already expressed in percent of risk-weighted assets. Basel III definition if available, Basel I definition otherwise (BHCA8274 and BHCK8274 in Call Report, respectively)
RWA	Risk-weighted assets (as reported in SNL)
ROAA	Return on average assets (as reported in SNL)
Spread	Relative equity/bond spread calculated as the difference between ask and bid divided by half of the difference between ask and bid
Realized volatility	Daily volatility computed by means of the bipower variation at 5-minute frequency
Implied volatility	At-the-money equity call option implied volatility in standard deviations (as reported in Datastream)
CDS spread	Ratio of the one-year CDS spread to the five-year CDS spread
Opacity	Book value of bank premises (BHCK2145) and investments in unconsolidated subsidiaries (BHCK2130), intangible assets (BHCK5507), and "other assets" (BHCK2160) divided by total assets (BHCK2170)
Complexity	Count of subsidiaries including nonbank and thrift subsidiaries (RSSD9146, BHCP2794, BHCP2796)
Earnings management	Difference between discretionary realized security gains and losses and discretionary loan loss provisions as a percent of total assets. Discretionary components of realized security gains and losses (BHCK3196 plus BHCK3521 in Call Report) and loan loss provisions (BHCK4230) are obtained from fixed-effects OLS regressions of the reported values on the respective determinants following Cornett et al (2009).
Auditor	Indicator for each of the Big 4 auditing companies (Deloitte, Ernst & Young, KPMG, PWC)
Lending growth	Change in total loans net of earned income (BHCK2122 in Call Report)