

The Information Content of Stress Test Announcements

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Abstract

We exploit institutional features of the U.S. bank stress tests to disentangle different types of information garnered by market participants when the stress test results are released. By examining the reaction of different asset prices, we find evidence that market participants value the stress test announcements not only for the information on possible future capital distributions but also for the signals about bank resilience. These results back the use of stress tests by central banks to inform the broader public about the soundness of the banking system.

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1 Introduction

During the Global Financial Crisis, as some banks posted losses reaching into the hundreds of billion dollars, investors panicked and moved away from bank stocks, leading to double-digit declines across the sector. For example, on September 17, 2008, two days after Lehman Brothers collapsed, and one day after the U.S. government announced the 85-billion-dollar bailout for American International Group, in one of the more panicked reactions, the price of Morgan Stanley's shares dropped 24 percent on the news that the bank had begun merger talks with Wachovia. The opacity of the U.S. financial institutions and their assets were making it impossible for investors to distinguish between viable banks that were temporarily illiquid and weak banks that were insolvent. Although the Troubled Asset Relief Program (TARP) was ready to be deployed to absorb toxic assets, the Department of the Treasury decided to pair TARP with a stress test, a tool that would enhance transparency for the financial system and reduce the uncertainty that was driving the panic. Nowadays, stress tests have become the tool deployed around the world to ensure that banks have sufficient capital to withstand harsh economic conditions.

We seek to understand whether the U.S. stress tests achieved the objective of conveying which institutions had adequate capital positions, an antidote to a financial panic. With this goal, we analyze the reaction of market participants to stress test announcements. We first consider the reaction of bank stock prices. In this case, a rise in prices can be driven by two different, non-mutually exclusive factors: the influence on how banks dole out dividends and repurchase shares, whose approval by the Federal Reserve is linked to the stress test results, and news about the ability of the largest banks to withstand harsh economic conditions.¹ In order to distinguish between these two factors, we also look at the reaction of the spreads between credit default swaps (CDS) for banks and government bonds.

We find evidence that market participants react systematically to the stress test results and value them not only for the information on possible future capital distributions of the stress tested banks but also for the signals about bank resilience. A focus on the U.S. stress tests allows us to gauge the reaction to different types of information as, until 2019, the annual results used to be announced in two phases. For the first phase, which carried no supervisory consequences, we find that when results pointed to a more sizable capital cushion, credit default swap (CDS) spreads declined and stock prices rose systematically.² This configuration of reactions of stock returns and

¹In the United States, until 2019, the stress tests could trigger an objection to a bank's capital plan, which could curb share buybacks or dividends — more recently, the stress test results have been linked to the size of a capital buffer.

²We focus on the reaction of CDS spreads because they have several advantages over bond prices. CDS spreads primarily reflect credit risk, while bond prices may be affected by other factors, such as liquidity and funding costs. CDS markets are more liquid than bond markets, therefore CDS spreads reflect changes in risk in a timelier manner. Indeed, Blanco, Brennan and Marsh (2005) and Lee, Naranjo and Velioglu (2018), among others, find that CDS markets lead bond markets in the discovery of credit risk. Lastly, unlike bond contracts, CDS contracts are standardized

CDS spreads point to financial market participants acting on information about the underlying probability of default of each firm, as opposed to only reacting to changes in expected payouts. In connection with a second phase of the stress tests that had supervisory consequences, we also find evidence that when regulators prevented dividends or share buybacks from expanding, stock prices declined, but we do not detect a systematic response of CDS spreads. For this second phase, the consequences for payouts dominate, most likely because the information about the riskiness of the firms has been already extracted from the results of the first phase. Nonetheless, taken together, the results for the two phases point to stress tests being informative about the resilience of each firm even abstracting from supervisory consequences.

Previous attempts to size the market reaction to stress test announcements relied on case studies focused on the size of the market reaction surrounding the announcements without relating it to the size of the market surprise.³ These studies did not focus on specific metrics from the stress test results and did not control for market expectations to isolate the news component, even when they sized the market reaction over a window of many days surrounding the announcements. Accordingly, the previous results are clouded by the problem that the market reaction considered is not solely driven by the stress test announcements but also by a plethora of contemporaneous events—this commingling of the effects of different events is even more acute in studies that discard the direction of the market reactions.⁴ By contrast, our analysis exploits the structure of the U.S. stress tests to control for expectations. Furthermore, by tightening the event window and by looking for a systematic response to the news across the banks participating in the stress tests, our panel regression model can drown the background noise of other events.

As part of our analysis we revisit the stress test results from 2013 through 2019. We highlight that all previous event studies failed to control for other important contemporaneous events. Other case studies have focused on the market reaction in a three- to seven-day window centered on the stress-test announcements.⁵ As an example, in 2015, the results of the Comprehensive Capital Analysis and Review conducted by the Federal Reserve were released at 4:30 on March 11. Focusing on macroeconomic announcements, events for which there is an easily accessible record, the day before the release, March 10, macroeconomic news included wholesale inventories; the day following the release, March 12, macroeconomic news included initial jobless claims, advance retail sales, retail sales less autos, the import price index, business inventories and the monthly budget statement of

and homogeneous.

³For example, see Flannery, Hirtle and Kovner (2017); Fernandes, Igan and Pinheiro (2020); or Sahin, de Haan and Neretina (2020).

⁴As shown in Tables A.1 to A.4 in the online appendix there are numerous macro releases that occur in a 3-day window surrounding stress test announcements. For example, around the 2013 and 2015 DFAST announcement there were 27 and 29 macro releases, respectively. See also the related discussion in Section 3.1.

⁵Flannery, Hirtle and Kovner (2017) use a three-day window whereas Fernandes, Igan and Pinheiro (2020) use a seven-day window.

the U.S. Treasury.⁶ We ameliorate the problem of background noise by narrowing the analysis window—we focus on the overnight change in stock prices or on the daily change in CDS spreads. Moreover, our analysis relies on a panel regression model that links the market reaction to a specific measure of surprise across firms and stress-test cycles and reduces other events to background noise with the help of year fixed effects.

A typical requirement of event studies is to isolate the surprise component for the event by controlling for market participants' expectations. We exploit the peculiar structure of the U.S. stress tests that used to differentiate them from the stress tests conducted in other countries. Through 2019, results for two distinct phases of the stress tests were announced one week apart, with the results of the Dodd Frank Act Stress Tests (DFAST) coming before the results for the Comprehensive Capital Analysis and Review (CCAR). The results were based on the same supervisory scenarios but differed by their assumption regarding capital plans for dividends and share buy-backs and by the supervisory consequences. The DFAST results used a dummy capital plan based on the distributions for the previous stress test cycle, while the CCAR results incorporated the new capital plans. Importantly, capital plans were made public only after the announcement of the CCAR results. Furthermore, the DFAST results bore no direct supervisory consequences for the firms, while the Federal Reserve could curb capital distributions based on the subsequent CCAR results.⁷

As a summary measure of the stress test announcements, we focus on the minimum values of tier 1 capital over the nine-quarter planning horizon for the stress tests, bank by bank. We size the surprises from the CCAR announcements as the minimum tier one capital under DFAST minus the minimum under CCAR over the same stress testing cycle. Given that the results for DFAST and CCAR only differed because of the approved capital plans under CCAR, a positive difference (a lower minimum tier 1 capital under CCAR) would have been indicative of larger approved distributions and greater resilience. Furthermore, we size the surprises from DFAST announcements as the difference between the minimum tier 1 capital under DFAST results for that cycle minus the minimum under the previous cycle's CCAR. Given that DFAST and CCAR results across consecutive cycles were derived under the same capital plan, a positive difference in minimum values of tier 1 capital would have pointed to stronger resilience to a severe recession and anticipated the possibility of increased capital distributions.⁸

We first show that, following the release of the DFAST results, increases in loss absorption capacity, as implied by a higher minimum value of tier 1 capital relative to the minimum in the previous stress test cycle lead to declines in CDS spreads and increases in stock prices. Although a higher tier 1 capital minimum under DFAST does not guarantee that a bank will be able to

⁶See Table A.4

⁷See Lehnert and Hirtle (2015) for a detailed description of the institutional details for the stress tests.

⁸Our regression strategy also accounts for differences in scenarios across cycles.

expand its payouts, we cannot exclude that market participants took such a signal from the results. However, the associated tightening of CDS spreads clearly points to market participants interpreting the DFAST results as indicative of greater resilience and may explain part of the stock price reaction through a risk-premium channel. Turning to the CCAR results, the reaction of stock prices was systematically related to actions undertaken by the Federal Reserve that curbed capital distributions. We show that when capital plans were objected to or not approved, stock prices declined. This result seems exclusively driven by the consequent restrictions on capital distributions, as we do not find evidence of a significant response of CDS spreads.

In sum, we find clear evidence that financial markets scrutinize the stress test results to understand whether participating firms can withstand harsh economic conditions. If we had found that only stock prices reacted systematically, it would have pointed to a perception of stress tests as obstacles to dividend distributions and share buybacks and, therefore, that only a restricted set of financial actors benefits from the stress tests. By contrast, our finding that CDS spreads respond with an opposite sign relative to the response of stock returns highlights the importance of information from the stress tests about the resilience of the banking system under adverse conditions. A corollary of this finding is that the stress test scenarios are severe but plausible, and that the stress test results are credible.

2 Literature Review

The academic literature on macroeconomic stress testing is expanding rapidly, building on early contributions to research on stress tests that drew heavily on the experience of practitioners. Henry et al. (2018) provide a comprehensive review. Blaschke et al. (2001), Kohn and Liang (2019), García and Steele (2022), and Calem, Correa and Lee (2020) provide overviews of the implementation, benefits, and consequences of stress testing banks, including lower frequency changes in business models and credit provision. Acharya, Berger and Roman (2018) find that stress-tested banks reduce credit supply relatively risky to decrease their credit risk. Using bank-firm matched data, Berrospide and Edge (2019) find that the higher capital requirements implied by the stress tests reduce bank commercial and industrial lending but leave no imprint on overall firm debt, investment, or employment, suggesting that firms find other credit sources to compensate for the reduction in loans from banks that participate in the stress tests. Cortés et al. (2020) find that banks most affected by stress tests reallocate credit away from riskier markets and raise interest rates on small loans but also find that stress tests do not reduce aggregate credit. In line with this evidence on aggregate credit, Bassett and Berrospide (2018) construct a capital gap measure as the difference between the capital estimates from the supervisory stress test models relative to the estimates from the banks' own models and find little connection between this gap and loan growth. We instead

focus on the high-frequency responses of financial market participants to the stress test results.

The theoretical contributions of Goldstein and Sapra (2014), Alvarez and Barlevy (2014), and Goldstein and Leitner (2018) show that disclosing supervisory information may be welfare improving and may promote financial stability. Relatedly, Heitz and Wheeler (2022) show empirically that public information production from the stress tests crowds out private information. Our empirical results contribute to this literature showing that stress test announcement can inform market participants about the riskiness of banks.

Sun, Wang and Zhang (2021) look at CDS spread reactions following dividends announcement in order to discriminate between the wealth transfer hypothesis and the information content (or signaling) hypothesis as articulated by Bhattacharya (1979), Bhattacharya (1980), John and Williams (1985), and Miller and Rock (1985). Sun, Wang and Zhang (2021) find that the information content hypothesis dominates especially for financial institutions. Also looking at CDS spread reactions, we show that a lower minimum value of the tier 1 capital ratio after the DFAST results, which may imply a dividend (or share buybacks) reduction, is informing market participants about the riskiness of the firms.

For the United States Flannery, Hirtle and Kovner (2017) emphasize that markets do react to stress test announcements. However, their analysis focuses on the absolute value of the asset price reactions in a three-day window around the date of the announcement, a window in which plenty of other events take place. As a result, they cannot disentangle whether the reaction they are capturing are linked to stress test announcements or to other contemporaneous news. For instance, they notice that even banks outside the stress tests show some reaction in their three-day window, which leads them to conclude that stress tests news have fundamental value for the entire banking sector. However, that reaction is also consistent with asset prices for all banks responding to the release of macroeconomic news.⁹ These problems are exacerbated by a focus on the absolute value of measures of market reaction. With a long event window, discarding the information on the direction of the market response makes it even easier to conflate the response to disparate events. We overcome these problems by linking measures of surprise to market reactions in a panel regression.

Our paper is also related to papers whose focus is on the stress tests conducted by the European Banking Authority. The event study surrounding the release of the 2011 European stress test results in Petrella and Resti (2013) show an abnormal reaction of stock prices for banks participating in the test. Philippon, Pessarossi and Camara (2017) use the scenarios for macroeconomic factors—GDP growth, inflation, and unemployment—to estimate the sensitivity of individual banks to

⁹Problems related to contemporaneous macroeconomic news are also pronounced for Fernandes, Igan and Pinheiro (2020) who consider a seven-day window in their event study. We focus on overnight stock returns and on one-day changes in CDS spreads.

macroeconomic shocks. They find these estimated sensitivities predict relatively well the realized losses of banks in subsequent years, backing the value of the stress test results. Georgescu et al. (2017) also focus on an event study for stock returns and CDS spreads but do not attempt to link these responses to measures of surprises as we do with our regressions. Borges, Mendes and Pereira (2019) found a significant stock market reaction to the European stress test results for participating banks. Kok et al. (2023) focus on the reaction of the business model of stress tested banks and find that banks that participated in the European stress tests subsequently reduced their credit risk relative to banks that were not part of the stress test.

Finally, our work is also related to the vast literature that explores the reaction of asset prices to macroeconomic announcements or to corporate announcements, such as dividends. On the macroeconomic side, early papers, such as Fama (1981), focused on the connection between stock returns and inflation measures or monetary aggregates. Boyd, Hu and Jagannathan (2005) investigate the information content of news about unemployment. On the corporate side, Brav and Heaton (2015) provide a helpful review of evidence from event studies.¹⁰ Unlike ours, most event studies are either focused on broad measures of stock returns or exclude financial firms. An exception is Kelly, Lustig and Nieuwerburgh (2016), which is squarely focused on banks.

3 Sizing Surprises and Market Reactions

For our analysis, we exploit the peculiar structure for the announcements of the U.S. stress tests. Through 2019, the U.S. stress tests consisted of two separate tests with results published about a week apart. The first results to be released were for DFAST, followed by those for CCAR. Both tests evaluated capital adequacy assuming exactly the same supervisory macroeconomic scenario. However, while the DFAST analysis was conducted assuming a dummy capital distribution plan, based on the previous year’s distributions, the capital calculations for the CCAR results were based on the proposed capital distributions for the current stress test cycle. We rely on the difference between the CCAR and the DFAST results to isolate the unexpected component of the stress test announcements. A further important difference between CCAR and DFAST is that they entailed different supervisory consequences: while the Federal Reserve did not take supervisory actions following the DFAST results, it could object to the capital distribution plans and put limits on payouts following the CCAR results.¹¹

Our analysis, based on an array of event studies, faces two challenges. First, we need to select a summary measure of the stress test results; and second, we need to control for market participants’

¹⁰See, in particular, Appendix 4 of Brav and Heaton (2015).

¹¹In some years the Federal Reserve issued objections to the capital plans, in others it issued “non-approvals.” Both carried the requirement to submit revised capital plans and curb payouts to shareholders prior to the approval of the new plans.

expectations of this summary measure in order to isolate the surprise component. Given that the principal aim of the stress tests is to assess the capital adequacy and capital planning practices of the participating firms, we focus on capital. In particular, our summary measure for each participating firm is the minimum value of the tier 1 capital ratio over the nine-quarter assessment period used by the U.S. stress tests.¹²

In order to identify the surprise component of these measures, we adapt our approach depending on whether we are analyzing the CCAR or the DFAST announcements. For the former, our surprise component is the difference between the minimum value for the tier 1 capital ratio attained under DFAST minus the one attained under CCAR over the same cycle. While the capital path under DFAST assumed a dummy plan based on the previous year's capital distributions, CCAR results were based on the latest approved capital plans. Accordingly, when this difference is positive, it points to an expansion in approved capital distributions relative to the previous year's. Given the relatively short time between the release of the DFAST and the CCAR results, this measure is a good proxy of the surprise component of the CCAR results. Moreover, capital plans were made available to the public only after CCAR results were released. This important feature guarantees that the implication of the capital distribution on the minimum value for the tier 1 capital ratio was a surprise for market participants.

To identify the surprise component of the DFAST results, we take the difference between the minimum value for the tier 1 capital ratio under DFAST and CCAR across adjacent cycles.¹³ Given that DFAST results were based on the assumption that the each participating firm would implement the same capital distributions approved by the Federal Reserve for the previous year's CCAR, a higher minimum capital requirement could have pointed to greater resilience and signal that the firm could proceed with a larger capital distribution compared to the previous year, if allowed by the following week's CCAR results. Needless to say, the difference between minimum value for the tier 1 capital ratio across two different stress test cycles may be also have been due to the differences in the stress scenarios. However, the stress scenarios were common to all the banks. We control for these scenario differences with time fixed effects.

¹²The Federal Reserve publishes stress test scenarios that cover 13 quarters. However, the last four quarters are used to compute provisions. Accordingly, the stress test results report the minimum tier 1 capital ratio over a nine-quarter assessment period.

¹³Among other factors, we also control for changes in starting capital. Recent papers have focused on the predictability of stress test results. Glasserman and Tangirala (2016), for example, make note of the high correlation across the scenario results across years and across banks.

3.1 Abnormal Overnight Trading Volumes and Returns

For the event studies, we focus on the banks headquartered in the United States.¹⁴ Figure 1 shows overnight returns around CCAR announcements. The data are from CRSP.¹⁵ The figure expresses these returns as percentiles of the distribution of overnight returns for each bank for the six months preceding each release. Overnight returns following CCAR announcement are mainly abnormal, coming from the tails of the distributions for the six months preceding the announcements.

Figure 1 also highlights important variation year by year. In 2013 and 2014, numerous objections to capital plans made for an overall muted response of equity prices. In later years, as the participating banks built larger capital buffers and improved their risk management practices, the number of objections progressively came down. Accordingly, equity prices reacted more buoyantly to generally improved capital and liquidity metrics. In that respect, the results for 2017 stand out even among the outliers, with the buoyancy attributed by contemporaneous commentary to improved capital metrics and the perception of a less stringent reactions by the Federal Reserve.¹⁶

As we only report the overnight returns for the banks included in our study, Figure 1 also gives a complete account of the firms in our dataset. Notice that Ally Financial and Citizens Financial Group became public companies after the release of the 2014 results, which explains missing values in the figure for those two banks for the 2013 and 2014 cycles. Missing values for other banks in certain cycles indicate that the Federal Reserve did not test those banks in those cycles.

We next explore whether abnormal returns could be connected with markets seizing up, but find little evidence of malfunctions. Figure 2 reports analogous statistics to those in Figure 1 but for stock trading volumes. The data source is again CRSP.¹⁷ The figure shows that the days immediately following CCAR releases are also characterized by abnormally elevated trading volumes, mainly in the upper tails of the distributions, which we interpret as indicating that markets were functioning smoothly. Furthermore, trading volumes for the day of the release of the CCAR results, shown in Figure 3, are generally much lower, closer to the median of the distribution,

¹⁴We exclude foreign intermediate holding companies that are also subject to the stress tests since the market reaction, only available for the parent company, would not be comparable to the market reaction for the domestic bank holding companies.

¹⁵Center for Research in Security Prices, CRSP 1925 US Stock Database, Wharton Research Data Services, <https://wrds-web.wharton.upenn.edu/wrds/>.

¹⁶A blog post by David Dowd published on the website of the Cato Institute shortly after the release of the CCAR 2017 results captured the mood this way: “This year, the news is particularly good. As usual, the key capital metrics across the system are better than ever. And whereas in previous years there were always [banks that] failed, the latest set of stress tests are the first in which all the banks passed and this year’s class laggard, Capital One, got only the mildest of slaps on the wrist.”

¹⁷Markit North America, Inc. Credit Default Swaps (CDS), Wharton Research Data Services, <https://wrds-web.wharton.upenn.edu/wrds/>.

underscoring a wait-and-see attitude for the results release after the close trading and highlighting the importance of the stress tests for market participants. In Figure 3 the trading volumes for 2016 stand out as elevated. The Brexit referendum on June 23, 2016, actually coincided with the release of the DFAST results. By June 24, it had become clear that the results of the referendum had gone against the predictions of financial market participants, leading to elevated trading volumes for about a week thereafter, particularly for banking-sector stocks, with volumes remaining elevated prior to the release of the CCAR results.¹⁸

Overnight returns following the release of DFAST results were also abnormal. The middle panel of Figure 4 shows data analogous to those in Figure 1 but the returns pertain to DFAST releases and are shown as a bar chart. The top and bottom panels of that figure allow a comparison with overnight returns for the day before the release of the stress test results and for the day after. This comparison highlights that overnight returns straddling the release of stress test results were indeed special: Abnormal returns, those in the upper percentiles of the distribution for the six months prior to each release, are much more prevalent.¹⁹ By contrast, on the day preceding and the day following the release of the results, the distribution of overnight returns is more uniform across the percentile bins shown.

We emphasize that this first look at the data cannot attribute the abnormal returns solely to the release of the stress test results. As an example of other events that can move financial markets, Table A.1 to Table A.4 in the appendix list releases of macroeconomic data in the three-day window surrounding the 2013 and 2015 results for DFAST and CCAR, respectively. We report news in this window since it was used by previous event studies. However, even just focusing on overnight returns (as we do), the table makes it clear that other macroeconomic news still confound the signal of the stress test results. Accordingly, our primary focus will be on isolating the systematic relationship between news from the stress test announcements and the market reaction through a panel regression model.

3.2 Other Data

For the event studies, apart from data on stock returns, we also use data on CDS spreads over Treasuries of comparable maturity. The data are from Markit. We select the most liquid contracts quoted in dollars with a maturity of 5 years. We focus on contracts for the senior debt tranche since these contracts are more widely traded than contracts on other tranches. CDS contracts are traded

¹⁸As noted in contemporaneous commentary in the financial press (see Campos, 2016), “the SP 500 turned negative for the year-to-date on Friday [the day after the Brexit referendum,] as Wall Street suffered its largest selloff in 10 months after Britain’s decision to leave the European Union caught traders wrong-footed. In the busiest trading volume for a single session in nearly five years, financial stocks led the decline on the SP 500 with a 5.4 percent drop—the largest for the sector since November 2011.”

¹⁹An online appendix shows an analogous pattern of overnight returns for CCAR result releases.

over the counter. The Markit data report quotes for 9:00 PM, the close of the trading day. While the CDS spread movements on the day surrounding stress test announcements do not tend to be as extreme (relative to their distribution) as the reaction of stock returns and traded volumes, they can still be sizable. Furthermore, there is significant heterogeneity in the results across banks.²⁰

Moving to additional controls, in some of our regressions we use: the starting level of the tier 1 capital ratio, as reported in the CCAR/DFAST results; the difference between the starting level of the tier 1 capital ratio across cycles, when we compare two different stress test cycles; the forced decrease in payouts — the difference between the tier 1 capital minimum in the final capital plan submission and the original submission; and an indicator for whether the capital plans were objected to or not approved.²¹ The consequences of an objection were the inability of making any capital distributions, unless expressly permitted by the Federal Reserve.²² Non-approvals generally carried less-dire consequences, with firms having to limit their capital distributions to the levels of prior years.

4 Event Study

The stress tests had a fixed format from 2013 through 2019, yielding seven events for our study. We exclude the 2016 results when analysing the reaction to the DFAST releases because confounding effects from the Brexit referendum, in line with our related discussion of trading volumes in Section 3.1. To compensate for the relatively short temporal dimension of the data, we exploit a larger cross-section. There are as many as 25 bank holding companies headquartered in the United States that have participated in the stress tests over the 2013-2019 period. Accordingly, we rely on panel regressions for our analysis.

We use the following panel regression model:

$$y_{i,t+v} = \alpha + \beta s_{i,t} + \Phi_t + \Omega_{i,t} + \Psi_i + u_{i,t+v} \quad (1)$$

where t is the day of the CCAR or DFAST announcement and where the left-hand-side term, $y_{i,t+v}$, is in turn:

- the overnight percentage change in the stock price of firm i through $t+1$ (which implies

²⁰The online appendix includes a figure for CDS spreads analogous to Figure 1 and another analogous to Figure 4.

²¹Before the public disclosure of the CCAR results, each participating firm was shown its own results and given an opportunity to reduce dividends and stock repurchases. In practice only those firms whose original capital distributions would have pushed them below statutory minima took advantage of this opportunity, which is why we are calling this revision a forced reduction in payouts.

²²A firm whose capital plan was objected to could resubmit a new capital plan ahead of the following year's stress tests, but was not required to do so.

$v = 1$). In other words, this is the opening price on the day $t+1$, following the announcement, minus the closing price on the day t of the announcement, divided by the closing price of day t , times 100.

- the daily change of the CDS spread for firm i for day t (which implies $v = 0$). In other words, this is the CDS spread surveyed at the end of day t minus the CDS spread surveyed at the end of day $t-1$.

Given that the stress test results were released at 4:30 p.m., after the closing of the trading day on the New York Stock Exchange (at 4:00 p.m.), the overnight stock price changes identify the impact of the new information in the announcements. Unlike stock prices, CDS spreads are not available at a frequency higher than daily. However, given that CDS contracts are traded over the counter and that trading stops at 9:00 p.m., we can rely on market surveys for the end of the day when the stress test results were released. We difference the closing CDS spreads relative to the previous day's values to gauge the market reaction to the stress test results.

The terms on the right-hand side of Equation 1 differ depending on whether we are analyzing CCAR or DFAST results. Starting with the regression equation for CCAR, the term $s_{i,t}$ is the difference between the minimum value for the tier 1 capital ratio attained under the current year's DFAST minus the one attained under the current year's CCAR. The term $\Omega_{i,t}$ includes a dummy that captures supervisory actions of the Federal Reserve in the context of CCAR, non-approvals or objections; the starting capital; and forced decreases in payouts. The terms Φ_t and Ψ_i include time fixed effects and firm-specific fixed effects, respectively. Time fixed effects help us control for background macroeconomic conditions and events.

Turning to regression equation for DFAST, the term $s_{i,t}$ is defined as the difference between the minimum value for the tier 1 capital ratio in the current year's DFAST and the minimum value for the same ratio in the previous year's CCAR. The term $\Omega_{i,t}$ includes three types of firm-specific controls: 1) the difference in the starting tier 1 capital ratio between DFAST and the previous year's CCAR; 2) the starting capital; and 3) a dummy that captures decisions of the Federal Reserve for the previous CCAR cycle, non-approvals or objections. The terms Φ_t and Ψ_i include time fixed effects and firm-specific fixed effects, respectively. Time fixed effects are particularly important in our regression framework, especially when we compare current-year DFAST with previous year CCAR. Indeed, they allow us to control for differences in stress scenarios that may affect our surprise measure.

5 Capital Distributions vs. Resilience

The following two sections describe the regression results starting with DFAST and moving on to CCAR.

5.1 DFAST Results Offer Information on Resilience

Table 1 shows the results of panel regression models where the dependent variables are the percentage changes in stock prices and the changes in CDS spreads around DFAST announcements, expressed as basis points.

At a broad brush, when the DFAST minimum tier 1 capital ratio is higher than the previous year's CCAR minimum, stock prices systematically increase, as we can see from the estimated coefficients in columns (1) and (2). According to those coefficients, when a bank's minimum of the tier 1 capital ratio is one percentage point higher, the overnight stock return increases about 0.22 percentage point, all else equal.²³ This increase may happen for two non-mutually exclusive reasons: 1) market participants interpret increases in tier 1 capital ratio minima as a signal of greater resilience to adverse conditions, reducing the risk of holding the stocks of those banks; 2) market participants interpret the increase in tier 1 capital minima as a signal that banks may have more capital to distribute compared to the previous year, although there is no guarantee that the Federal Reserve will approve greater payouts until the following week's CCAR results are released. The reaction of CDS spreads can help corroborate or exclude the first reason. Columns (3) and (4), point to a systematic decrease of CDS spreads when the DFAST minimum tier 1 capital ratio is higher than the previous year's CCAR minimum. This decrease is even more significant, in statistical terms, than the increase in stock prices. This result points to financial market participants reading a higher stressed capital ratio as an indication of greater resilience of banks in the face of harsh economic conditions. A corollary of this finding is that financial market participants view the stress test scenario as relevant and the results as credible.

These results shed new light on the information content of DFAST announcements compared to previous studies. In particular, Flannery, Hirtle and Kovner (2017) find that while equity returns reacted to DFAST announcements, similar to our results, they also find that there were no significant changes in CDS spreads, the opposite of our findings. This difference may be due to the fact that they do not link changes in CDS spreads to a specific measure of market surprise, or that they look at changes over a very large window surrounding the announcements without isolating confounding factors like macro releases, as discussed above. To highlight the radical difference in

²³This increase is statistically significant at conventional levels based on standard errors that are robust to heteroscedasticity. This increase remains significant when considering standard errors that are clustered at the firm level, as documented in the online appendix.

our results, if we took the results of Flannery, Hirtle and Kovner (2017) at face value, we would reach the conclusion that the stress tests do not give any indication about the resilience of the banking sector—as CDS spreads do not react significantly according to their results—leaving the reaction of equities to be driven by expectations of changes in future income streams linked to the whims of the supervisor.

5.2 CCAR Results Point to Changes in Capital Distributions

Table 2 shows the results of panel regression models where the dependent variables are the overnight stock price returns and CDS spread changes around CCAR announcements.

In this case, and in contrast to the results for DFAST releases, the difference between the minimum value of the tier 1 capital ratio under DFAST and under CCAR has an insignificant coefficient for both stock returns and CDS spreads. However, from column (2) we can see that when the Federal Reserve issued a non-approval or an outright objection to the proposed capital plans, stock returns systematically decreased. This decrease is sizable for overnight returns. On average, it is sized at about 2.2 percentage points, all else equal. However, the insignificance of the coefficient on the same dummy in the regression of CDS spreads in column (4) indicates that the main concern of market participants at this phase of the stress tests is the impact of supervisory actions on capital distributions.²⁴ After all the previously released DFAST results already provided information on bank resilience in the face of adverse conditions that, as we showed, is systematically related to CDS spreads.

Our results shed new light also on the information content of CCAR announcements compared to previous studies, such as Flannery, Hirtle and Kovner (2017). Like us, they find that CDS spreads do not react to CCAR announcements, whereas they emphasize that stock prices do. However, their analysis cannot explain this general response of stock prices. By contrast, our results show a more circumscribed reaction of equities, one systematically connected to the issuance by the Federal Reserve of a non-approval or an outright objection to the proposed capital plans. Indeed, this is information in the CCAR announcements not conveyed by the preceding DFAST announcements.

6 Sensitivity Analysis

An online appendix documents robustness of our regression results to numerous specification changes. We refer the interested reader to that appendix and only sketch here the most salient changes we considered. We focus on two types of sensitivity analysis. The first type considers

²⁴The expectation that a firm could raise additional capital through equity issuance in connection with an objection would also be consistent with our regression results.

alternative specifications keeping the change in tier 1 minimum capital across stress test cycles as the surprise measure for the event studies. The second type of sensitivity analysis considers alternative surprise measures. In sum, the baseline results are strikingly robust.

6.1 Robustness to Specification Changes

Under CCAR, firms had a chance to reduce their proposed capital distributions to avoid a stressed capital minimum that fell short of the statutory ratios. The change in tier 1 capital minimum from DFAST to CCAR in our baseline specification is based on the CCAR minimum under the original plans. However, the regression includes a term for the (forced) decrease in payouts when firms resubmitted capital plans with lower distributions when the original plans put them below a statutory ratio.²⁵ This term is flagged in the results released by the Federal Reserve. As an alternative, we can compute the change in tier 1 capital minimum across DFAST and CCAR with the CCAR minimum based on the revised plans and exclude the term that captures the forced reduction in capital distributions. When we make these changes the regression results vary little quantitatively and are unchanged qualitatively.

The samples for the CCAR regressions and the DFAST regressions have different number of observations, complicating the comparison of results. The CCAR regressions have more observations because we do not need to compute the change in tier 1 minimum capital across stress test cycles. Moreover, we do not need to drop 2016 for the CCAR regressions—remember that the release of the DFAST results coincided with the announcement of the results for the Brexit referendum. When we drop the additional observations from the sample for the CCAR regressions, the coefficient on the objection dummy is even more statistically significant. There are no other changes of note in the regression results.

6.2 Robustness to Alternative Surprise Measures

The measure summarizing the information provided by the release of stress test results in our baseline regressions is based on tier 1 capital. However, the stress test results report the starting value and minimum conditional on the stress test scenarios for other statutory ratios: the tier 1 leverage ratio, the total risk-based capital ratio, and the common equity tier 1 ratio. We also consider surprise measures based on each of these alternative ratios and find that our results are extremely robust.

²⁵The banks participating in the U.S. stress tests were given a limited set of options for revising their capital plan submissions. See the section entitled “Limited Adjustments to Planned Capital Actions” in Board of Governors of the Federal Reserve System (2019).

7 Conclusion

We have found evidence that market participants reacted systematically to the stress test announcements and extracted different information from the two components of the U.S. stress test. From the DFAST results, released first, market participants took signal on the resilience of banks from changes in capital positions under stressed conditions. Banks with a higher stressed capital minimum relative to the previous stress test cycle systematically experienced an increase in their stock prices and a decrease in their CDS spreads. Our analysis of the market reaction to the release of the CCAR results points to a systematic response of stock returns to restrictions on payouts.

These results back the widespread use of stress tests to inform market participants on the soundness of banks. Our analysis shows that market participants valued the stress test announcements not only to gauge subsequent capital distributions, which would simply benefit a limited set of investors, but also as indicators of bank resilience, with importance for the broader public. In the United States, stress tests have supervisory consequences for bank capital, but our results point to the usefulness of the information provided by stress tests even when the results are not tied to capital actions by the regulator.

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Table 1: Market Reaction to DFAST Announcements

| | (1) | (2) | (3) | (4) |
|--------------------------------------|--------------------|--------------------|----------------------|----------------------|
| | Stock returns | Stock returns | Δ CDS spreads | Δ CDS spreads |
| DFAST-CCAR(-1) minimum | 0.216* (0.017) | 0.217* (0.017) | -0.383** (0.005) | -0.407** (0.004) |
| DFAST-CCAR(-1) start | 0.0710 (0.393) | 0.0776 (0.334) | -0.212 (0.174) | -0.162 (0.310) |
| Starting capital | -0.236* (0.015) | -0.236* (0.015) | 0.340+ (0.059) | 0.342+ (0.060) |
| Objection or non-approval, lagged | | -0.0660 (0.749) | | -0.446 (0.434) |
| r2 | 0.634 | 0.634 | 0.422 | 0.424 |
| N | 102 | 102 | 93 | 93 |

p-values in parentheses

+ $p < 0.1$, * $p < 0.05$, ** $p < 0.01$

Note: The dependent variables in the panel regressions in columns (1) and (2) are overnight returns surrounding DFAST announcements; columns (3) and (4) are for changes in CDS spreads at the end of the day of the DFAST announcements relative to the end of the day prior. *DFAST-CCAR min.* is the difference between the current year DFAST and the previous year CCAR minimum value of the tier 1 capital ratio over the nine-quarter assessment period used in the U.S. stress tests. *DFAST-CCAR(-1) start* is the difference between the starting level of the tier 1 capital ratio across cycles. *Starting capital* is the starting level of the tier 1 capital ratio. *Objections or non-approvals, lagged* is a dummy that assumes value one if the capital plans were objected to or not approved in the previous year CCAR. All the regressions include banks and year fixed effects. In parentheses we report the *p*-values where + $p < 0.1$, * $p < 0.05$, ** $p < 0.01$. These values are based on standard errors that are robust to heteroscedasticity.

Table 2: Market Reaction to CCAR Announcements

| | (1) | (2) | (3) | (4) |
|--------------------------------|-------------------|---------------------|----------------------|----------------------|
| | Stock returns | Stock returns | Δ CDS spreads | Δ CDS spreads |
| DFAST-CCAR minimum | 0.0629 (0.620) | 0.0401 (0.724) | -0.266 (0.463) | -0.269 (0.459) |
| Forced decrease in payouts | 0.311 (0.438) | 0.324 (0.347) | -0.301 (0.570) | -0.368 (0.486) |
| Starting capital | 0.305* (0.015) | 0.170+ (0.083) | 0.114 (0.718) | 0.144 (0.659) |
| Objections or non-approvals | | -2.145** (0.000) | | 0.532 (0.450) |
| r2 | 0.590 | 0.717 | 0.524 | 0.527 |
| N | 150 | 150 | 111 | 111 |

Note: The dependent variables in the panel regressions in columns (1) and (2) are overnight stock returns surrounding CCAR announcements; columns (3) and (4) are for changes in CDS spreads at the end of the day of the CCAR announcements relative to end of the day prior. *DFAST-CCAR min.* is the difference between the current year DFAST and CCAR minimum value of the tier 1 capital ratio over the nine-quarter assessment period used in the U.S. stress tests. *Forced decrease in payouts* is the difference between the tier 1 capital minimum in the final capital plan submission and the original submission. *Starting capital* is the starting level of the tier 1 capital ratio. *Objections or non-approvals* is a dummy that assumes value one if the capital plans were objected to or not approved. All the regressions include banks and year fixed effects. In parentheses, we report the p -values where $+p < 0.1$, $*p < 0.05$, $**p < 0.01$. These values are based on standard errors that are robust to heteroscedasticity.

Figure 1: Overnight Returns Following CCAR Announcements (percentiles of the distribution for the preceding six months).

| Bank | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|------|------|------|------|------|------|------|
| Ally Financial Inc. | | | 100 | 100 | 99 | 100 | |
| American Express Company | 74 | 53 | 87 | 74 | 92 | 93 | |
| BB&T Corporation | 1 | 23 | 93 | 91 | 98 | 92 | |
| Bank of America Corporation | 98 | 77 | 26 | 91 | 98 | 93 | 98 |
| Capital One Financial Corporation | 67 | 85 | 89 | 85 | 7 | 86 | 88 |
| Citigroup Inc. | 54 | 1 | 97 | 89 | 98 | 92 | 92 |
| Comerica Incorporated | | 31 | 93 | 90 | 99 | | |
| Discover Financial Services | | 28 | 97 | 80 | 96 | 92 | |
| Fifth Third Bancorp | 40 | 17 | 90 | 89 | 98 | 92 | |
| Huntington Bancshares Incorporated | | 68 | 89 | 81 | 98 | 84 | |
| JPMorgan Chase & Co. | 4 | 54 | 81 | 81 | 98 | 95 | 96 |
| KeyCorp | 40 | 78 | 94 | 96 | 97 | 95 | |
| M&T Bank Corporation | | 32 | 84 | 97 | 93 | 94 | |
| Morgan Stanley | 55 | 34 | 99 | 69 | 97 | 91 | 93 |
| Northern Trust Corporation | | 47 | 93 | 10 | 97 | 87 | 94 |
| RBS Citizens Financial Group, Inc. | | | 49 | 94 | 99 | 87 | |
| Regions Financial Corporation | 65 | 19 | 99 | 87 | 99 | 95 | |
| State Street Corporation | 44 | 38 | 92 | 86 | 97 | 22 | 89 |
| SunTrust Banks, Inc. | 11 | 63 | 91 | 89 | 99 | 98 | |
| The Bank of New York Mellon Corporation | 24 | 59 | 98 | 91 | 96 | 90 | 94 |
| The Goldman Sachs Group, Inc. | 4 | 54 | 89 | 86 | 98 | 74 | 97 |
| The PNC Financial Services Group, Inc. | 23 | 52 | 95 | 90 | 99 | 84 | 93 |
| U.S. Bancorp | 15 | 34 | 89 | 87 | 97 | 93 | 88 |
| Wells Fargo & Company | 91 | 98 | 95 | 81 | 98 | 99 | 92 |
| Zions Bancorporation | | 84 | 94 | 93 | 99 | | |

Note: Overnight returns following the release of the CCAR results expressed as percentile of the distribution of overnight stock returns for each bank for the six months preceding the release of the results. The percentiles reported are based on calculations by the authors on data from CRSP.

Figure 2: Stock Trading Volumes on the Day Following the Release of the CCAR Results (shown as percentiles of the distribution for the preceding six months)

| Bank | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|------|------|------|------|------|------|------|
| Ally Financial Inc. | | | 88 | 99 | 65 | 80 | |
| American Express Company | 88 | 34 | 86 | 83 | 58 | 53 | |
| BB&T Corporation | 97 | 91 | 77 | 86 | 82 | 74 | |
| Bank of America Corporation | 96 | 88 | 80 | 80 | 84 | 73 | 73 |
| Capital One Financial Corporation | 92 | 70 | 76 | 86 | 85 | 45 | 59 |
| Citigroup Inc. | 81 | 87 | 81 | 76 | 79 | 67 | 60 |
| Comerica Incorporated | | 79 | 72 | 87 | 73 | | |
| Discover Financial Services | | 28 | 73 | 54 | 73 | 36 | |
| Fifth Third Bancorp | 92 | 88 | 91 | 90 | 80 | 74 | |
| Huntington Bancshares Incorporated | | 75 | 63 | 96 | 87 | 91 | |
| JPMorgan Chase & Co. | 96 | 77 | 67 | 72 | 80 | 68 | 73 |
| KeyCorp | 94 | 81 | 89 | 96 | 80 | 81 | |
| M&T Bank Corporation | | 83 | 79 | 90 | 90 | 92 | |
| Morgan Stanley | 91 | 72 | 83 | 85 | 78 | 72 | 78 |
| Northern Trust Corporation | | 60 | 47 | 90 | 67 | 41 | 94 |
| RBS Citizens Financial Group, Inc. | | | 11 | 97 | 73 | 85 | |
| Regions Financial Corporation | 93 | 81 | 95 | 92 | 95 | 81 | |
| State Street Corporation | 94 | 85 | 79 | 94 | 46 | 57 | 97 |
| SunTrust Banks, Inc. | 91 | 64 | 64 | 74 | 80 | 79 | |
| The Bank of New York Mellon Corporation | 92 | 83 | 79 | 80 | 61 | 82 | 82 |
| The Goldman Sachs Group, Inc. | 82 | 54 | 39 | 64 | 69 | 45 | 67 |
| The PNC Financial Services Group, Inc. | 80 | 65 | 85 | 83 | 70 | 82 | 77 |
| U.S. Bancorp | 90 | 77 | 72 | 71 | 77 | 74 | 77 |
| Wells Fargo & Company | 94 | 80 | 77 | 72 | 84 | 91 | 82 |
| Zions Bancorporation | | 95 | 90 | 96 | 89 | | |

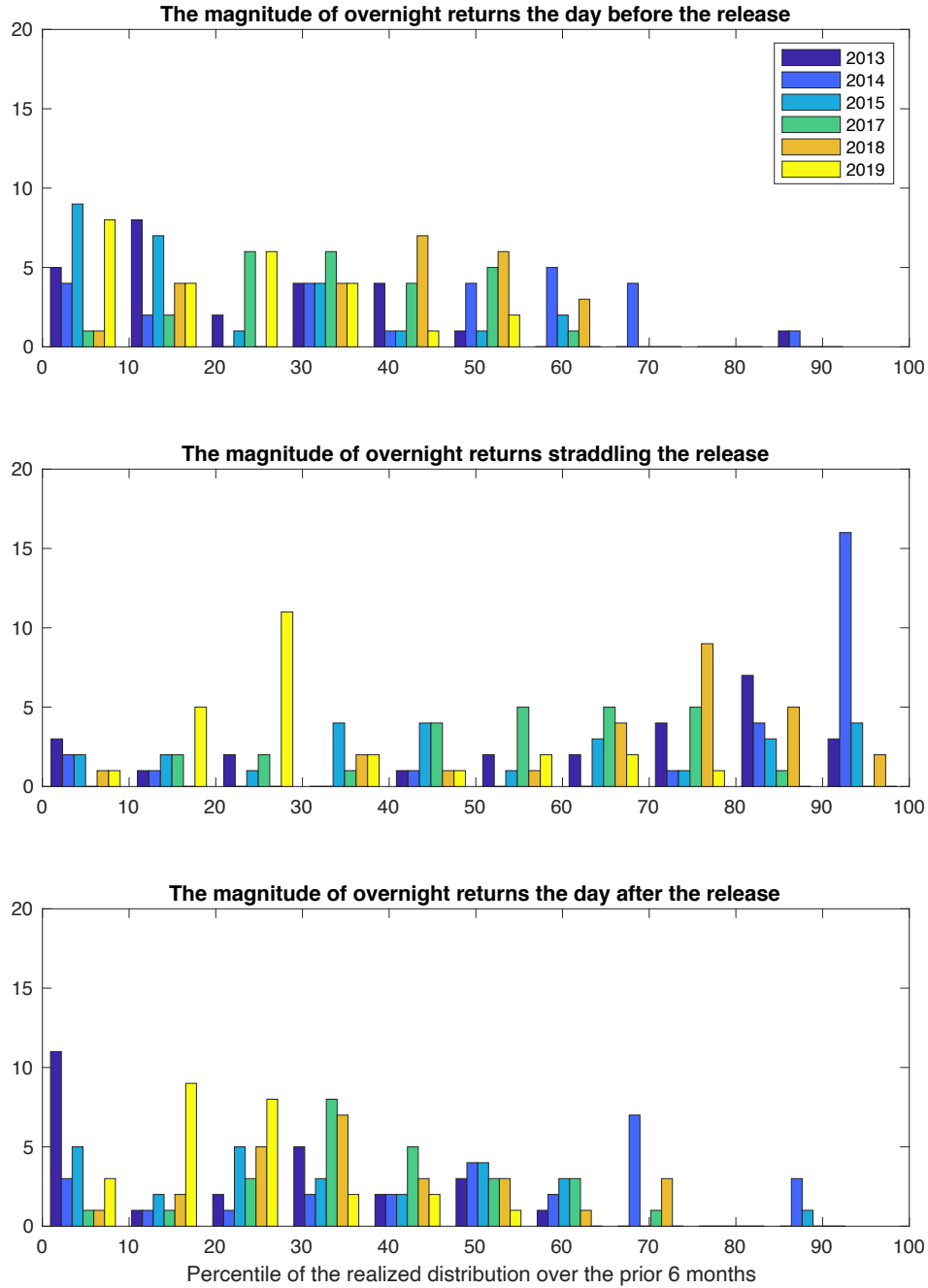
Note: Stock trading volumes for the day following the release of the CCAR results expressed as percentiles of the distribution of daily trading volumes for each bank for the six months preceding the release of the results. The percentiles reported are based on calculations by the authors on data from CRSP.

Figure 3: Stock Trading Volumes on the Day of the Release of the CCAR Results (shown as percentiles of the distribution for the preceding six months).

| Bank | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
|---|------|------|------|------|------|------|------|
| Ally Financial Inc. | | | 9 | 82 | 69 | 19 | |
| American Express Company | 37 | 23 | 51 | 71 | 35 | 25 | |
| BB&T Corporation | 61 | 89 | 57 | 85 | 70 | 55 | |
| Bank of America Corporation | 77 | 72 | 67 | 78 | 78 | 61 | 44 |
| Capital One Financial Corporation | 68 | 53 | 39 | 75 | 69 | 19 | 19 |
| Citigroup Inc. | 69 | 77 | 74 | 75 | 66 | 59 | 25 |
| Comerica Incorporated | | 58 | 29 | 90 | 83 | | |
| Discover Financial Services | | 35 | 52 | 29 | 43 | 23 | |
| Fifth Third Bancorp | 73 | 65 | 71 | 87 | 57 | 70 | |
| Huntington Bancshares Incorporated | | 81 | 51 | 88 | 65 | 65 | |
| JPMorgan Chase & Co. | 78 | 74 | 50 | 73 | 65 | 56 | 39 |
| KeyCorp | 73 | 92 | 74 | 96 | 69 | 72 | |
| M&T Bank Corporation | | 63 | 73 | 82 | 58 | 90 | |
| Morgan Stanley | 87 | 64 | 62 | 73 | 78 | 74 | 46 |
| Northern Trust Corporation | | 28 | 28 | 89 | 64 | 35 | 52 |
| RBS Citizens Financial Group, Inc. | | | 2 | 92 | 68 | 40 | |
| Regions Financial Corporation | 88 | 68 | 56 | 84 | 86 | 63 | |
| State Street Corporation | 62 | 72 | 80 | 87 | 57 | 40 | 71 |
| SunTrust Banks, Inc. | 79 | 56 | 46 | 68 | 58 | 54 | |
| The Bank of New York Mellon Corporation | 57 | 63 | 87 | 85 | 56 | 49 | 34 |
| The Goldman Sachs Group, Inc. | 54 | 27 | 16 | 53 | 46 | 38 | 18 |
| The PNC Financial Services Group, Inc. | 59 | 61 | 64 | 89 | 69 | 64 | 41 |
| U.S. Bancorp | 84 | 76 | 54 | 54 | 43 | 50 | 23 |
| Wells Fargo & Company | 71 | 61 | 58 | 69 | 69 | 51 | 49 |
| Zions Bancorporation | | 91 | 81 | 92 | 85 | | |

Note: Stock trading volumes for the day of the release of the CCAR results expressed as percentiles of the distribution of daily trading volumes for each bank for the six months preceding the release of the results. The volumes relate to stock trades preceding the release, which took place after the end of the trading day. The percentiles reported are based on calculations by the authors on data from CRSP.

Figure 4: Extreme values of Overnight Stock Returns for Stress-Tested Banks Are Prevalent When Results Are Announced: Reactions to DFAST Results Across Cycles



Note: The absolute value of the overnight returns shown are expressed as percentiles of their realized distribution for the six months prior to the release of the stress test results. The middle panel shows the absolute value of overnight returns based on stock prices at the market closing and opening straddling the announcement of DFAST results. For comparison, the top and bottom panel show analogous returns for the day before and for the day after the announcement of DFAST results, respectively. The percentiles shown are based on calculations by the authors on stock price data from CRSP.