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Stavros Peristiani, Donald P. Morgan, and Vanessa Savino
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Abstract

We investigate whether the "stress test," the extraordinary examination of the nineteen largest U.S. bank holding companies conducted by federal bank supervisors in 2009, produced information demanded by the market. Using standard event study techniques, we find that the market had largely deciphered on its own which banks would have capital gaps before the stress test results were revealed, but that the market was informed by the size of the gap; given our proxy for the expected gap, banks with larger capital gaps experienced more negative abnormal returns. Our findings suggest that the stress test helped quell the financial panic by producing vital information about banks. Our findings also contribute to the academic literature on bank opacity and the value of government monitoring of banks.

Key words: supervisory capital assessment program, capital gap, event study

Introduction

Many observers have linked the financial panic of 2008 to bank opacity.[1] According to

this narrative, bank investors and counterparties could not judge bank solvency as well as bank

insiders. Fearing information asymmetries, investors panicked; if they were willing to quote a

price at all for bank securities, they did so only at steeply discounted rates. The result was a *new-*

fashioned, wholesale bank run characterized by unprecedented interbank lending rates,

precipitous haircuts in repo markets, and closed capital markets for banks.

The government responded to the panic with unprecedented measures, including liquidity

provision, debt and deposit guarantees, large scale asset purchases, direct assistance, and lastly

the Supervisory Capital Assessment Program (SCAP, or stress test). Introduced in February

2009, the "stress test" required the largest U.S. bank holding companies to undergo

simultaneous, forward-looking exams designed to determine if they would have adequate capital

to sustain lending to the economy in the event of an unexpectedly severe recession. If banks

deemed inadequately capitalized could not fill their gap privately, they would qualify for public

funds through the Capital Assistance Plan (CAP) announced the same day as the stress test.

The introduction of the stress test was greeted with a mixture of trepidation and

skepticism by financial analysts, with some worrying that undercapitalized banks would be

closed or nationalized based on the test results, and others expecting a "white-wash," in which

even undercapitalized banks would be given a pass. Determining when such fears were allayed

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[1] Gorton (2008, p.1): "The ongoing Panic is due to a loss of information." Dudley (2009, p. 6): "The difficulty in valuing opaque and heterogeneous securities has led to greater illiquidity, price volatility and market risk, bigger haircuts, and more forced deleveraging. Opacity has also led to an undue reliance on credit ratings." Lewis (2008, p. 344):"Their (Wall Street firms) complexity renders them in inherently opaque. Investors . . . will demand to be paid for opacity . . ."

and whether such skepticism was justified is the main reason for our study. The issue is timely because of the stress test underway in Europe.

The main question in our study is whether the stress test produced new information about banks. Using standard event study methods, we investigate how stock prices of stress-tested banks reacted to four key SCAP events: (1) the announcement of the stress test and CAP; (2) the clarification of the program, when Federal Reserve Chairman Bernanke indicated to Congress that the stress test results would not be used as a basis for nationalizing banks and the U.S. Treasury supplied details about CAP; (3) the release of a white paper detailing the stress test methodology; and (4) the release of the results. Hereafter, we call these events the "announcement," the "clarification," the "methodology," and the "results." Figure (1) provides more detail on these events.

We start with an aggregate level analysis in which we compare abnormal stock returns for the portfolio of nine banks that were ultimately deemed have capital gaps—the GAP banks— to abnormal returns for the nine banks that were ultimately deemed to be adequately capitalized—the NO GAP banks.[2] We distinguish between these sets across all four events, even though the gaps were not actually revealed until the results were made public. Thus, when looking at *ex ante* events, we would expect differences between the GAP and NO GAP banks only to the extent the market had deciphered beforehand which banks would have a gap.

The aggregate analysis reveals that the announcement and methodology events were essentially nonevents in terms of abnormal returns in stock prices for the stress-tested banks. By contrast, the clarification event was highly informative; abnormal stock returns around that clarification were positive and significant for the GAP banks, but insignificant for the NO GAP banks. That differential response makes sense as the stress test and CAP only bind for banks

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[2] All findings exclude GMAC because it is not a publicly traded company.

expected to have a capital gap. The differential response also indicates the market was largely able to distinguish between the GAP and NO GAP banks before the results were released.

The results were also informative; when the results were publicized, the abnormal returns were significant for GAP banks, but insignificant for NO GAP banks. Somewhat surprisingly, the aggregate abnormal return for the GAP banks was positive. Of course, the market response to the results depends on the size of the actual gap relative to the *expected* gap; perhaps aggregate response for the GAP banks was positive because capital gaps were smaller than expected.

To investigate that expectations hypothesis, we move from aggregate analysis to cross-sectional analysis, where we regress abnormal returns for each stress-tested bank on its revealed capital gap (per assets) and a proxy for the expected gap. Our proxy for the expected gap is the abnormal returns for each bank around the clarification. We reason (and provide evidence) that the abnormal return around the clarification is a good proxy for the expected gap because the stress test and CAP only bind for banks that are expected to have a gap. Given the proxy for the expected gap, we find a sensible and significant negative relationship between abnormal returns around the results and the capital gap. That final result indicates the stress test produced information about the banks that private sector analysts did not already know. By reducing bank opacity, the stress test may have helped quell the panic.

In the final section of the paper, we resolve the impact of the clarification by studying credit default swap (CDS) spreads. Recall the clarification was actually two events: indication from Chairman Bernanke that stress test would not be used as a basis for nationalizing weak banks sandwiched between details about the terms of the capital assistance plan. Which event actually mattered—the reassurance on no-nationalization or the CAP details? We reason that former event mattered to stock *and* bond holders, while the latter, by determining the dilutive

effects of the CAP, mattered only to shareholders.[3] Thus, if the CDS spreads also reacted to the

clarification, at least part of the impact reflected information that the stress tested banks would

not be nationalized. We find that CDS spreads fell sharply for the GAP banks, suggesting that

part of the reaction to the clarification was due to bond holders' relief that SCAP results would

not be used as a basis for nationalizing undercapitalized banks.

As the first to investigate the information value of the stress test, our paper extends the

growing literature on the rationale and efficacy of various government efforts to contain the

financial panic (Fleming, Hrung, and Keane 2009; Adrian, Burke, and McAndrews 2009;

Goldberg, Kennedy, and Miu 2010). We also add new evidence to the debate over bank opacity

(Morgan 2002, Flannery et al. 2004) and the related literature on the information value of

government bank examinations (Berger, Davies, and Flannery 2000; Flannery and Houston

1999; Berger and Davies 1998; Gunther and Moore 2003).

We proceed as follows. The background on SCAP and a timeline of events we study is

presented in Section 2. Section 3 presents the portfolio level analysis, and Section 4 reports

cross-sectional regressions. Section 5 studies CDS spreads. We conclude in Section 6.

2. SCAP Mechanics, Potential Information Value, and Timeline

This section provides background on the workings of the stress test, its potential for

information production, and a timeline of key events.

2.1. Mechanics

The nineteen largest U.S. bank holding companies as of year-end 2008, representing

approximately $10 trillion of bank assets (roughly two-thirds of total U.S. bank assets), were

subject to the stress test. In the first stage of the test, included banks were instructed to estimate

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[3] If bond holders expected to suffer losses on their claims if a bank was nationalized, they would be relieved to learn the stress test results would not be used as a basis for nationalization.

losses, profits, and loan loss reserves two years ahead under a baseline economic scenario and a more adverse (stress) scenario subject to guidance "indicative loss rate ranges" provided by supervisors (Hirtle, Schuermann, and Stiroh 2009).[4] Those initial estimates were then scrutinized and adjusted by supervisors, who then sought additional confidential information before formulating independent, final projections of losses and revenues. Those final projections determined each banks *pro forma* capital under the adverse scenario. That projected *pro forma* capital position, less the capital standard set by the supervisors for each bank, determined each banks' capital gap.[5] Banks with gaps were required to file capital plans describing how they intended to fill the gap (whether privately, via conversions, or via CAP) by November 2009.

The SCAP differed from ordinary bank examinations in three important ways (Bernanke 2009; Hirtle, Schuermann, and Stiroh 2009). First and perhaps most importantly was horizontalism; the SCAP banks were subject to simultaneous examinations with the same underlying assumptions about economic conditions and loan losses and the same quantitative techniques. By contrast, ordinary examinations are bank-by-bank over time, with little simultaneous comparison across banks.[6] Simultaneous information from other banks may have given supervisors the grounds to challenge incredible first-round projections by individual banks. Horizontalism also made the stress test especially suited to determining banks' *relative* value.

Second, the SCAP was forward looking; to assess banks' future capital needs, examiners forecasted loan losses two-to-three years into the future. By contrast, ordinary examinations

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[4] In the SCAP, the more severe economic scenario assumed GDP would shrink by 3.3 percent in 2009 and would remain flat in 2010, house prices would fall another 22 percent in 2009, and unemployment would rise to 8.9 percent.
[5] Banks with pro forma Tier 1 capital below 6 percent of common assets or tier 1 capital less than 4 percent of risk-weight assets had gaps (Hirtle, Schuermann, and Stiroh 2009 p. 5). Elliot (2009, p. 13) suggests (based on his interpretation of the white paper) that capital standards varied per bank according to supervisors' assessment of their risk profiles.
[6] Ordinary bank inspections are conducted according to a fixed (usually annual) schedule and the assumptions and techniques may vary by agency and over time (Hirtle and Lopez 1999).

focus on banks' current conditions. While researchers have found that the results of ordinary examinations have little or no predictive power for bank performance after accounting for market indicators (Berger, Davies, and Flannery 2000), the forward-looking aspect of the SCAP held the promise that the results might inform the market.

Lastly, the SCAP was unusually transparent. Not only were the outputs—projected losses and necessary capital buffers—publicized, so too were the inputs, the modeling assumptions, and the processes involved in producing the outputs. Ordinary inspections are opaque by comparison, with both the inputs and outputs kept confidential.[7]

2.2. *Potential Information Value and Bank Opacity*

At the most fundamental level, panic—whether personal or financial—is about the loss of information, or what psychologists call "perceptual narrowing."[8] The SCAP had the potential to reduce panic by improving the flow of information to outsiders—investors and analysts—trying to decipher the relative prospects of banks. U.S. Treasury Secretary Timothy Geithner indicated as much in his statement accompanying the release of the SCAP results:

> "The stress test will help replace the cloud of uncertainty hanging over our banking system with an unprecedented level of transparency and clarity."[9]

Investors' uncertainty about the banks' prospects had several sources. First, investors questioned the fundamental uncertainty about the banks' true capital adequacy going forward.

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[7] The interagency aspect made the SCAP different from ordinary examinations. The SCAP involved over 150 supervisors, examiners, economists, and experts in law and accounting from all three federal bank regulatory agencies: the Federal Reserve, the Federal Deposit Insurance Corporation, and the Office of the Comptroller of the Currency (Hirtle, Schuermann, and Stiroh 2009). Ordinary bank examinations are conducted separately by whichever agency has regulatory authority over the bank or bank holding company in question. By combining forces and sharing information, the SCAP was able to harness the expertise and knowledge at each agency. The presence of "irregular" regulators from other agencies may have reduced the risk of capture.

[8] For example, experimental psychologists have found that the peripheral vision of subjects under perceived pressure was diminished compared to a control group. See discussion in Lehrer (2009).

[9] Statement by U.S. Treasury Secretary Timothy Geithner, on May 7, 2009.

Second, they did not know how conservatively each bank was accounting for losses.[10] Third, they were uncertain how the government would handle insolvent banks—whether the government would nationalize the banks, thereby wiping out a large part of the value to private investors, or whether it would inject capital at terms that spared investors from a total loss. Lastly, there was uncertainty about how strict a capital standard would regulators apply to a given bank (Elliot 2009).

While the SCAP complemented other government programs created to contain the financial panic, it differed in its emphasis on information production. The Term Auction Facility (TAF) and other Federal Reserve liquidity programs did not disclose its advances to banks and other financial firms to spare users the "stigma" of borrowing from the Federal Reserve. The anonymity of the TAF, which may have been essential for the Federal Reserve to fulfill its role as lender of last resort, did not provide information to the market about which banks were solvent and which were not. The Federal Deposit Insurance Corporation (FDIC) guaranteed short-term debt and transaction deposits of all insured banks, without much discrimination among banks. Through the Capital Purchase Program (CPP), the government initially injected capital into banks, without the information-intensive review characteristic of SCAP. The provision of liquidity, guarantees, and capital were all important fronts in the "war" on panic, but they were not accompanied by information provision. The SCAP, by contrast, was clearly designed to produce information.

The potential information value of the stress test is even more important given that banks are presumed to be relatively opaque even in ordinary times. Actually, economists disagree about whether banks are more opaque than other types of firms. Morgan (2002) finds that bond raters

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[10] Gunther and Moore (2003) provide evidence on banks underreporting of losses. They find that the extent of underreporting increases in economic downturns and conclude that timely bank examinations are useful in uncovering underreporting.

disagree more over banks, and that the disagreement stems from the loans and other types of assets that define banks—trading assets in particular. He concludes that banks are inherently more opaque than other types of firms. By contrast, after finding that bank earnings are smoother and more predictable than for comparable nonbank firms, Flannery, Nimalendran, and Kwan (2004) conclude that banks are not particularly opaque; they are "boring." Given these conflicting findings, bank opacity should be viewed more as a hypothesis than a fact.[11]

Although the main question in our paper is whether the stress test produced information, we can use our investigation to test limiting cases of the bank opacity hypotheses. At one extreme is the hypothesis that banks are completely opaque to the market—they are black boxes. Under this hypothesis, we would expect the market to be surprised to learn which banks had capital gaps and by the size of the gaps. At the other extreme is the hypothesis that banks are completely transparent to the market—they are open books. Under that hypothesis we would expect the market to be unsurprised to learn which banks had gaps and the size of the gaps; given the transparency of banks, markets could decipher that information without government assistance. In the intermediate case where banks are neither black boxes nor open books, the market would be unsurprised to learn which banks had gaps, but they would be surprised by the size of the gaps.

2.3 Timeline

Figure 1 shows the timeline of the four events we study. On February 10, federal bank regulatory agencies released a seven-page fact sheet announcing a Financial Stability Plan, two

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[11] Ianotta (2006) confirms Morgan's (2002) findings using European banks. Hirtle's (2006) event study finds that the abnormal returns associated with mandatory certification of financial statements were larger for banks' split bond ratings. For evidence linking bank opacity to the panic, see Jones, Lee, and Yeager (2010). For more evidence on bank opacity, see Bannier, Behr, and Güttler (2009). Hyytinen and Pajarinen (2008) investigate the opacity of young firms using split ratings.

elements of which were the stress test and the CAP.[12] The single page of the fact sheet

pertaining to the stress test and the CAP indicated that all banking institutions with assets over

$100 billion would be required to participate in a "forward looking comprehensive stress test"

and that these institutions would have access to investments from the Treasury in the form of

preferred shares convertible to common equity, if necessary. The paucity of details on the stress

test confused even some astute observers.[13]

The government clarified details on the SCAP and CAP each day between February 23

and 25. On February 23, the government reiterated that it would supply capital under the CAP

via mandatorily convertible preferred shares, and that banks would be able to exchange Troubled

Asset Relief Program injections into mandatorily convertible preferred shares. The government

clarified that this was not a new capital standard for banks and revealed that the presumption of

CAP was for banks to "remain in private hands." On February 24, Chairman Bernanke delivered

the semiannual Monetary Policy Report to Congress. During the ensuing questions and answers

he elaborated on the government intended to use the stress test:

> "…the outcome of the stress test is not going to be fail or pass… I don't see any reason to destroy the franchise value or create the huge legal uncertainties of trying to formally nationalize a bank when it just isn't necessary."

According to a Bloomberg report, investors and analysts inferred from the Chairman's remark

that the SCAP will not be used as a "pretext for government takeovers of the largest banks."[14]

The following exchange about "too big to fail" may also have been informative:[15]

> Bernanke: I do believe that the failure of Lehman Brothers and its impact on the

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[12] The stress test was one element of the Financial Stability Plan. The Fact Sheet: Financial Stability Plan can be found at http://www.ustreas.gov/press/releases/tg18.htm. Publicly traded institutions not required to undergo the stress test would also be eligible to obtain capital after a supervisory review.

[13] Paul Krugman, for example: "It's really not clear what the plan means." *New York Times*, February 10, 2009. http://krugman.blogs.nytimes.com/2009/02/10/the-rorschach-plan-wonkish-or-at-least-hard-to-read

[14] http://www.bloomberg.com/apps/news?pid=newsarchive&sid=auD.fPbtkf5I&

[15] The following quotes are from transcript of the Semiannual Monetary Policy Report to the Congress (Senate Banking, Housing, and Urban Affairs Committee).

World financial market confirms that we made the right judgment with Bear Stearns; that the failure of a large international financial institution has enormously destructive effects on the financial system and the … (CROSSTALK)

Senator Bunning: In others words … There are some banks that are to big fail.

Bernanke: Absolutely.

Finally, in response to a question about "too big to fail," Chairman Bernanke replied:

…there is a 'too big to fail' problem, which is very severe. We need to think hard going forward how we're going to address that problem … But right now we're in the middle of the crises.

The market may have inferred from Chairman Bernanke's remarks that government did not intend to fail or nationalize any of the banks that were subject to the stress test. Finally, on February 25, the Treasury published an eight-page CAP term sheet, a four-page CAP white paper, and four pages of answers to frequently asked CAP questions.[16] The term sheet revealed that the mandatory convertible preferred (MCP) shares provided through the program would be converted into common equity only as needed to keep banks well capitalized and could be retired if financial conditions improved before the conversion became mandatory. The term sheet revealed the price at which MCP would convert to common equity, thus indicating the dilutive effect on existing common equity holders.[17] We call the February 23-25 event the clarification, but note that "the" clarification was actually multiple events, each with a potentially separate impact.

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[16] The CAP term sheet can be found at http://www.ustreas.gov/press/releases/reports/tg40_captermsheet.pdf; the CAP white paper at http://www.ustreas.gov/press/releases/reports/tg40_capwhitepaper.pdf; and the frequently asked questions at http://www.ustreas.gov/press/releases/reports/tg40_cap_faq.pdf.
[17] On February 25, the FDIC, Board of Governors of the Federal Reserve System, Office of the Comptroller of the Currency, and Office of Thrift Supervision announced that the SCAP examinations would begin and released answers to frequently asked questions (FAQ) about SCAP. The FAQ called the stress test SCAP for the first time.

The third event occurred on April 24 when the Federal Reserve Board released a twenty-page white paper describing the procedures employed in the stress test.[18] Although market analysts were not completely satisfied with the information and details provided through this release,[19] analysts could potentially use the white paper to predict the results of the stress test and to simulate the assessment for non-SCAP banks. We call this event the "methodology."

The fourth and final event is the release of the SCAP results on May 7 at 5:00 p.m. (after markets closed). The results revealed an aggregate gap of $75 billion, less than the consensus forecast of $100-200 billion (Elliot 2009). Treasury Secretary Geithner acknowledged the low-side outcome in his statement accompanying the results:

> The results are less acute than some had expected, in part because concern about the risk of a more severe recession have diminished, markets have improved, and banks, in anticipation of the release of the stress test, have acted in the last few months to increase capital.[20]

Table 1 reports the capital gap for each of the nineteen banks. Ten banks were estimated to have gaps and nine were deemed adequately capitalized. The estimated capital gap ranged from about $0.6 billion to $33.9 billion. Measured per bank assets, the estimated capital gap capital ranged from approximately 0.2 percent to 6.41 percent.

All four SCAP events were newsworthy. Figure 2 plots the number of times the *Wall Street Journal* mentioned the stress test each day between February 10, 2009, and June 23, 2009. Daily mentions were common from the date of announcement on February 10 and increased until the results were announced at the end of the day on May 7. Stress-test mentions increased noticeably around the clarification and the release of the white paper on the SCAP methodology.

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[18] http://www.federalreserve.gov/newsevents/press/bcreg/bcreg20090424a1.pdf

[19] A Keefe, Bruyette, and Woods report notes, for instance, that the Treasury did not fully clarify the basic assumptions on loan loss rates and capital levels that was planning to use for the stress tests("Treasury Stress Tests: Details Emerging, But Details Remain Murky," April 23, 2009).

[20] http://www.ustreas.gov/press/releases/tg123.htm

3. Portfolio Results

We begin simply by plotting relative stock prices for four "portfolios" of banks. Figure 3A plots the average relative stock price level (in January 1, 2009 terms) for SCAP banks and the next fifty largest publicly traded banks ("the next fifty"). Note the sharp divergence in their relative stock prices about a week after the clarification: share prices of the next fifty banks trended downward while share prices of the SCAP banks remained roughly constant. Several reasons may account for the divergence: it could reflect a belated reaction to the clarification, especially the realization that there was no explicit commitment on how these next fifty banks would manage through this financial crisis. The concerns about the next fifty banks were further magnified by the deteriorating credit quality of their commercial real estate assets.

Figure 3B plots relative stock prices for banks with capital gaps (GAP banks) and banks without (NO GAP). The capital gaps were not announced until May 7, so any *ex ante* differences between the curves reflects market *expectations* about which banks would have gaps and which would not; if the market were completely unaware about the identity of the two sets of banks, we would not expect any divergence in the lines around the SCAP events. On the contrary, stock prices for GAP banks dropped sharply in January relative to NO GAP banks, and prices for GAP banks became more volatile.[21] Share prices of the GAP banks appeared to rebound relative to NO GAP banks around the clarification and the results, although it is hard to be certain by just looking at the graph. The event study analysis below confirms those impressions and reveals other differences as well.

We formally investigate the impact of each event on stock returns using a standard, two-stage event study methodology that has been widely applied in the financial literature (see, for

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[21] It was roughly January 10, before the investors were able to spot differences between GAP and NO GAP banks.

example, Mikkelson and Partsch 1986; Campbell, Lo, and MacKinlay 1997).[22] In the first stage, we estimate a market model by regressing the daily stock return for each individual bank, R_{it}, on market return R_{mt}, proxied by the return on the S&P financial index:[23]

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{1}$$

The parameters α_i and β_i are estimated separately for each financial institution via ordinary least squares using daily data from July 1, 2006, to June 31, 2007. Note that the estimation period ends before the onset of the financial crisis, so the estimated parameters are not affected by events of 2008. The residuals or abnormal returns implied by the market model are given by

$$\hat{\varepsilon}_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \tag{2}$$

In the second stage, we sum the abnormal returns over the relevant "window" around the event date (T) to compute the cumulative abnormal return (CAR).

While we experimented with windows of various sizes, we decided to focus on a three-day window to ensure that it precisely covers the duration of the event. The shorter window is particularly suitable for the clarification event and results. The window for the clarification, February 23-25, includes the days when CAP was clarified (February 23 and 25) and Chairman Bernanke's indication (on February 24) that SCAP banks would not be nationalized or let to fail. The window around the results, May 6-8, covers a joint statement on May 6 that the results were forthcoming the next day, the release on May 7 (after the market closed), and May 8, the first day traders could act on any new information revealed in the announcement. [24] Although the

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[22] All event study results exclude GMAC, as it is not a public company.

[23] To compensate for the fact that the S&P Financial Index is market weighted, we also re-estimated our analysis using an equally weighted analog of the S&P 500 Index. Overall, the findings were very similar.

[24] We also investigated a fourteen-day window,[-12, 1], to evaluate the stock market reaction to the SCAP results. Results for the longer window were similar to the results for the three-day window.

announcement and methodology events were arguably one-day events, we use the three-day window for uniformity. The longer windows allow for news leakages and delayed reactions.

We begin by comparing abnormal returns over the four events for various "portfolios" of banks. The first comparison is between the eighteen public banks included in the stress test (hereafter, "the SCAP banks") and the next fifty banks. The second comparison is between the NO GAP banks, which were ultimately deemed to have adequate capital, and the GAP banks, deemed to have capital deficiencies. For robustness, we calculate average and value-weighted (by market capitalization) portfolios. To be conservative, we only emphasize results that are significant under either calculation. Because the estimation window and event window are identical across all banks, we cannot assume an independent error covariance structure in abnormal returns when dealing with individual banks (Campbell, Lo, and MacKinlay, 1997, page 166). However, many of the problems stemming from the lack of cross-sectional independence are lessened when we compare abnormal returns at the aggregate (portfolio) level. We use the procedure in Brown and Warner (1985) and Mikkelson and Partsch (1986) to reduce the effect of dependence in the cross-sectional errors.

The estimated abnormal returns associated with each set of banks are reported in Table 2. The announcement generated no obvious, robust pattern of responses. While there were several significant responses using the equal-weighted index, those differences disappear or are only marginally significant with the value-weighted index. This non-reaction makes sense as the announcement did not supply much hard information about how the SCAP would be conducted, how the results would be used, or the terms and conditions of the CAP. As for stock market response, the announcement was a non-event.

The clarification, by contrast, was highly informative for SCAP banks. Abnormal returns for the SCAP banks were significant, positive, and large, while abnormal returns for the next fifty were insignificant and small. The difference between those abnormal returns was large and highly significant. Among SCAP banks, the abnormal returns for GAP banks were significant, positive, and large while the abnormal returns for NO GAP banks were insignificant and small. The difference between those abnormal was the largest in Table 2. The positive reaction of stock prices for the GAP banks to the clarification suggests something over that event was good news for the GAP banks.

We observe one robust response to the methodology event: abnormal returns for the next fifty were negative around that event. The details in the white paper may have revealed new information about how non-SCAP banks would be evaluated. Beyond that, the methodology was relatively uninformative.

Like the clarification, the release of results was highly informative for the GAP banks. Abnormal returns were significant and positive for SCAP banks, but insignificant for next fifty. The difference between their abnormal returns was also highly significant. Among the SCAP banks, abnormal returns for GAP banks were significant and positive. Abnormal returns for the NO GAP banks were significant, but not robust. The difference in abnormal returns between the GAP and NO GAP banks was significant and positive.

The non-response of NO GAP banks to the results indicates that the market had already predicted the identity of the GAP and NO GAP banks, so the zero gaps announced for the latter was not news. That finding goes against the complete opacity (black box) hypothesis.

The positive response to the results for GAP banks is puzzling at first; we expected that having a capital gap would be bad news for stockholders. Of course, the seemingly

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counterintuitive positive response could reflect that the aggregate gap was smaller than the market was expecting. The next section confirms that banks revealed to have larger gaps did indeed experience more negative abnormal returns once we account for the expected gap.

4. Cross-Sectional Regressions

This section reports cross-sectional regressions where we regress the cumulative abnormal returns around the results for bank (i) CAR_i^R on its unexpected gap:

$$CAR_i^R = \gamma_0 + \gamma_1[GAP_i - E(GAP_i)] + \upsilon_i. \tag{3}$$

We predict that an unexpectedly large GAP is associated with negative abnormal returns, that is, $\gamma_1 < 0$.

While we might proxy for $E(GAP_i)$ with an index of individual analysts' forecast of GAP_i, we use a more market-based measure, namely, the cumulative abnormal return for each bank around the clarification, or CAR_i^C. The intuition for that proxy is that the news surrounding the clarification only matters for the banks expected to have a capital gap. For example, the hint that none of the GAP banks would be nationalized or failed on the basis of the stress test results would be good news for banks expected to have a gap, but non-news for banks not expected to have a gap. Likewise, the terms of the CAP only matter to banks that would have to raise capital at those terms.

Before reformulating (3) in terms CAR_i^R, we provide some evidence that CAR_i^R can in fact proxy for $E(GAP_i)$. Our premise is that CAR_i^C and $E(GAP_i)$ are positively associated, that is

$$E(GAP_i) = \delta_0 + \delta_1 CAR_i^C + u_i, \tag{4}$$

where $\delta_1 > 0$. Since $E(GAP_i) = GAP_i + \varepsilon_i$, we can re-write equation (4)

$$GAP_i = \delta_0 + \delta_1 CAR_i^C + \omega_i, \tag{5}$$

such that $\omega_i = u_i - \varepsilon_i$. A Tobit estimate of (5) yields a positive coefficient on CAR_i^C that is

significant at the 5 percent level.[25] The pseudo R^2 for the Tobit regression is about 40 percent.

The strong positive relationship is also apparent in Figure 5. Having provided evidence in

support of (4), we can now use that equation to eliminate $E(GAP_i)$ from (3) to obtain

$$CAR_i^R = \mu_0 + \gamma_1 GAP_i - \gamma_1 \delta_1 CAR_i^C + \eta_i, \tag{6}$$

where $\eta_i = \gamma_1 u_i + \upsilon_i$ and $\mu_0 = \gamma_0 + \delta_0$. Restated in terms of (5), our prediction that $\gamma_1 < 0$

implies CAR_i^R will be negatively related to GAP_i and positively associated to CAR_i^C.

Furthermore, if we were to omit CAR_i^C from (5), the coefficient on GAP_i would be biased

upward.

Table 5 estimates versions of equation (5) controlling for the capital gap condition of the

bank. In particular, we include a dummy variable, NO GAP, equal to 1 if bank (i) did not have a

gap; and equal to 0, if otherwise. The regression also includes the gap-to-assets ratio

(GAP/ASSETS). Given the expected GAP, we expect a positive coefficient on NO GAP and

negative relationship with GAP/ASSETS. Regressions (1) – (3) show that when CAR_i^C is

omitted, the stress test results appear uninformative; the NO GAP dummy variable and

GAP/ASSETS are both insignificant and the adjusted R^2 is 0.01 or lower. Further, the

coefficients on NO GAP and GAP/ASSETS have the "wrong" sign. Note that models (1) – (3)

would not allow us to reject the complete transparency (open book) hypothesis about bank

opacity because the stress test results appear completely uninformative.

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[25] The coefficient estimate is 0.04 with a *t*-statistic equal to 2.73. The estimated constant in the Tobit regression
model is insignificant.

Regressions (4) – (5), where we include CAR_i^C as a proxy for the expected GAP, tell an entirely different story. As predicted, CAR_i^C enters positively and its coefficient is positive at the one percent level in every regression. Including CAR_i^C boosts the regression R^2 to 0.62 or higher. Given CAR_i^C, the ratio of GAP/ASSETS enters negative, as predicted, and significant at the five or ten percent level, depending on the regression. Notice in specification (4) that NO GAP has the predicted sign but is insignificant. This result indicates investors had already figured out which banks had gaps and which did not. Regression (5) reveals that when we exclude NO GAP, the coefficient on GAP/ASSETS is larger and become significant at the 5 percent level.

Overall, the results in Table 3 strongly support our joint hypothesis that larger unexpected capital gaps were associated with more negative abnormal returns and that CAR_i^C is a good proxy for the expected gap. More broadly, they indicate that while the market was not surprised to learn which banks had capital gaps, it was surprised by the size of the gaps. This information led them to revalue banks accordingly.

In terms of the opacity hypothesis, Table 3 leads us to reject both the complete opacity (black box) hypothesis and the complete transparency (open book) hypothesis. Contrary to the former hypothesis, investors had already figured out which banks would have capital gaps. Contrary to the latter hypothesis, investors were surprised by the size of the GAP. Put another way, investors did not need the government to tell them which banks had capital shortages, but the government estimates of the size of the shortages did inform the market.

5. Resolving the Impact of the Clarification Using Bond Market Reactions

Recall that the clarification was multi-faceted; it included details about the terms of CAP and indication from Chairman Bernanke that the stress test would not be used as a basis for nationalizing banks with capital gaps. Which of those events mattered? This section tries to resolve the impact of the clarification by analyzing bond market reactions to the clarification and other SCAP events. We reason that the anti-dilutive benefits revealed in the clarification would matter primarily to shareholders, while the signal on nationalization would matter to bond holders *and* shareholders.[26] The results below suggest that at least part of the impact of the clarification was because investors were reassured that the stress tested banks would not be nationalized based on the results.[27]

Figure 4 traces the average CDS spread for the set of GAP banks and NO GAP banks relative to the average spread paid on CDS contracts of all U.S. financial firms. We constructed the index by taking a weighted average of all 124 financial firms with a five-year U.S. dollar North American CDS contract with an MR document clause.[28] The graph suggests CDS spreads reacted similarly (though with opposite sign) to each event as equity prices. In particular, swap spreads for the GAP banks fell over the clarification and results events.

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[26] Admittedly, a positive equity reaction might also influence CDS spreads. Norden and Weber (2004a) and Forte and Pena (2009) find that equity returns lead CDS and corporate bond spread changes. However, Norden and Weber (2004a) also point out that the CDS market is particularly sensitive to stock movements when credit quality deteriorates. We therefore expect that the positive announcement of the anti-dilutive benefits during this three-day clarification event would not greatly affect CDS market spreads. By contrast, the no-nationalization benefits would directly accrue to bond holders as well to the extent they doubted their claims would be paid at par in the event of nationalization and should elicit a greater market reaction.

[27] We study spreads on corporate CDS agreements instead of spreads in the secondary bond market based on the evidence in Blanco, Brennan, and Marsh (2005) that CDS prices lead in price discovery relative to secondary market corporate bond spreads and therefore are cleaner and more useful indicators of credit risk. The CDS data are from Markit CDS Pricing.

[28] We used market capitalization for the weighting. All subsidiaries and private firms were dropped from this index. The CDS data are for U.S. dollar senior unsecured debt. The CDS spreads are all categorized under the MR document clause, meaning that there is a restructuring agreements as a credit event, but the deliverable obligation against the contract has to be limited to those with a maturity of thirty months or less after the termination date of the CDS contract or the reference obligation that is restructured (regardless of maturity).

To calculate abnormal movements in CDS spreads we use a simplified version of the market return model proposed by Norden and Martin (2004) and Greatrex (2008).[29] First, we regress the change in the CDS spread for bank (i) at time (t), ΔCDS_{it}, on the change of the overall index, ΔI_{mt}:

$$\Delta CDS_{it} = \alpha_i \ + \ \beta_i \Delta I_{mt} + u_{it} \tag{7}$$

The model coefficients are estimated separately for each financial institution using ordinary least squares over the sample period July 6, 2006, to June 31, 2007. Then we sum the abnormal movements represented by the regression residuals, $\hat{u}_{it}$, over the event window.

Table 4 compares the cumulative abnormal change in the CDS spread for the GAP banks and NO GAP banks around the four key SCAP events.[30] The announcement of the SCAP had no effect on abnormal CDS movements, just as observed in the stock market. By contrast, the clarification was highly impactful for the GAP banks; their CDS spreads fell by 45 to 29 basis points relative to NO GAP banks. The positive reaction in the swap market suggests at least part of the impact of the clarification was owing to the hint from Chairman Bernanke that all the stress tested banks would not be nationalized. To reiterate, if all the impact of the clarification was due to the release of CAP terms, we would not have expected such a large abnormal movement in CDS spreads. The methodology was also informative to the bond market: CDS spreads for NO GAP banks fell in response to that event, consistent with the equity market results. Lastly, the results were also relatively informative and good news for the GAP banks; their CDS spreads fell by 59 basis points relative to spreads for NO GAP banks.

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[29] To be consistent, GMAC is also excluded from this part of our analysis.
[30] Very few of the next fifty banks had CDS information available so we could not include them as a comparison group.

6. Conclusion

The government countered the recent financial panic with liquidity, debt guarantees, capital, and in some cases, direct assistance. In only one case—the stress test—did the government directly attempt to produce information about the banks. Our results suggest the stress test was in fact informative. While investors did not need supervisors to tell them which banks had capital deficiencies, they were surprised by the size of the capital gaps and they used that information to revalue banks. The resulting information production may have helped quell the panic.

Pritsker (forthcoming) stresses the importance of information production by the central bank to opacity during financial panics. He contrasts information production, or what he calls "informational" easing with the liquidity provisions and debt and deposit guarantees the government supplied. He notes that the cost of the latter might be lower if uncertainty is lower. During a crisis, he notes, "steps to reduce uncertainty through information production should be taken as soon as possible (p. 1)".

On the academic front, our findings suggest that banks are neither black boxes nor open books. Rather, they are opaque to some intermediate degree. Horizontal examinations by the government, as in the stress test, can reduce the degree of opacity.

Of the four events we studied, the one with the biggest absolute impact on abnormal stock returns was the clarification around February 23-25, when details of the capital assistance plan were released and Federal Reserve Chairman Bernanke indicated that the stress-tested banks would not be nationalized. Precisely which of those sub-events was the driver of stock market returns is difficult to resolve, but the decline in credit default swap spreads around that event

suggest that part of the reaction was due to investors learning that the SCAP banks were not to be nationalized.

Our findings also bear on the stress test underway in the European Union. In particular, our findings that clarifying how the results will be used is important in reducing uncertainty, particularly for banks expected to have capital deficiencies. Publicizing the results is also informative, though supervisors must be prepared for the possibility of negative stock and bond prices reactions for banks revealed to have larger than expected capital gaps. Such revaluations are inevitable as the new information causes capital to flow from risky banks toward safer banks.

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Table 1: Stress Test Results

	Capital Gap (Billions of Dollars)	Assets (Trillions of U.S. Dollars)	Capital Gap/ Assets %
Banks Needing Capital (Gap Banks)			
Bank of America (BAC)	33.9	2.322	1.46
Wells Fargo (WFC)	13.7	1.286	1.07
GMAC LLC	11.5	0.181	6.41
Citigroup (C)	5.5	1.823	0.30
Regions Financial (RF)	2.5	0.142	1.76
Suntrust (STI)	2.2	0.179	1.23
KeyCorp (KEY)	1.8	0.098	1.84
Morgan Stanley (MS)	1.8	0.626	0.29
Fifth Third (FTIB)	1.1	0.119	0.92
PNC Financial (PNC)	0.6	0.286	0.21
Banks with Adequate Capital (No Gap Banks)			
American Express (AXP)	0	0.121	0
Bank of New York Mellon (BK)	0	0.203	0
BB&T (BBT)	0	0.143	0
Capital One (COF)	0	0.177	0
Goldman Sachs (GS)	0	0.925	0
JP Morgan Chase (JPM)	0	2.079	0
Metlife (MET)	0	0.491	0
State Street Corporation (STT)	0	0.142	0
US Bancorp (USB)	0	0.264	0

Notes: Capital gaps were officially announced on May 7, 2009. Bank assets are from Capital IQ as of 2009:Q1

Table 2. Average Cumulative Abnormal Returns (CAR) around the Four SCAP Events

Reported is the average CAR for the two sets of banks for each of the four events. The SCAP banks are the eighteen public stress-tested banks. The "next fifty" are the next fifty largest publicly traded banks (by assets) not subject to SCAP. GAP (NO GAP) banks are the SCAP banks revealed to (not) need capital. The four events are described in detail in Figure 1. For all events, CARs are calculated around a three-day window [-1, 0, 1], where 0 is the event day. The average CAR for each set of banks is calculated equally weighted and value-weighted by market capitalization.

	Announcement Feb 9-11		Clarification Feb 23 -25		Methodology Apr 23-27		Results May 6-8	
Weighting:	Equal	Value	Equal	Value	Equal	Value	Equal	Value
SCAP Banks	-1.24**	0.25	13.26***	6.64***	-0.37	1.36***	7.93***	3.37***
Next Fifty Banks	-4.32***	-1.14	-0.21	-0.98	-5.41***	-2.96***	2.48*	-0.34
Difference	3.08**	1.39*	13.46***	7.62***	5.04***	4.32***	5.46**	3.71***
GAP Banks	-1.24*	1.17	24.63***	16.79***	-3.91***	2.43***	12.77***	10.09***
NO GAP Banks	-1.25	-0.35	1.88**	-0.06	3.17***	0.47	3.10***	-2.20***
Difference	0.01	1.52*	22.75***	16.86***	-7.08***	1.97*	9.68***	12.28***

*Significant at 10 percent
**Significant at 5 percent
*** Significant at 1 percent

Table 3: Are Big Capital Gaps Bad News?

Reported are cross-sectional regression coefficients (robust t-statistics) for the eighteen publicly traded financial institutions subject to the stress test. NO GAP equals one (zero) if bank i had positive (zero) gap. GAP/ASSETS equal gap announced with results per assets. Clarification CAR or measures abnormal returns for three-day window around the clarification event; the Clarification CAR is included as a proxy for the expected gap. GMAC is excluded because it is not a public company.

	Dependent Variable: Three-Day CAR around SCAP Results				
	(1)	(2)	(3)	(4)	(5)
NO GAP	-9.68	-8.64		10.07	
	(1.08)	(0.60)		(1.28)	
GAP/ASSETS		0.103	0.61	-0.64*	-1.09**
		(0.12)	(1.04)	(2.08)	(2.47)
CAR_i^C, Clarification				1.15***	1.06***
				(5.70)	(6.20)
Constant	12.77*	11.73	4.86	-9.14*	-0.67
	(1.77)	(0.88)	(0.99)	(1.84)	(0.17)
Adjusted R²	0.01	-0.06	-0.01	0.62	0.62

*Significant at 10percent
**Significant at 5 percent
***Significant at 1 percent

Table 4. Average Cumulative Abnormal Change in CDS Spreads for SCAP Banks around Key SCAP Events

This table reports the average cumulative abnormal CDS spread around each event for the two groups of banks. CDS spreads are computed using an equal-weighted or value-weighted CDS market index. The abnormal CDS spreads are calculated over a three-day window [-1, 0,1] around each event, where 0 equals day of the event. The number of observations is limited to fifteen because some institutions did not have CDS contracts of the type we analyzed that were traded on event days. More specifically, Fifth Third Bank and PNC did not have traded contracts during any event. BB&T did not have a traded contract on the day of the announcement and clarification. Sun Trust did not have a traded contract on the day of the methodology and result events. GMAC is excluded from all events The CDS data are from Markit CDS Pricing.

	Announcement Feb 9-11		Clarification Feb 23 -25		Methodology Apr 23-27		Results May 6-8	
Weighting:	Equal	Value	Equal	Value	Equal	Value	Equal	Value
GAP Banks	0.00	-0.02	-0.21**	-0.24***	0.02	-0.01	-0.52	-0.51*
NO GAP Banks	0.02	0.05	0.24**	0.05	-0.18***	-0.11***	0.07	0.08
Difference	-0.02	-0.07	-0.45***	-0.29***	0.20***	0.10***	-0.59**	-0.59**
Observations	15	15	15	15	15	15	15	15

*Significant at 10percent
**Significant at 5percent
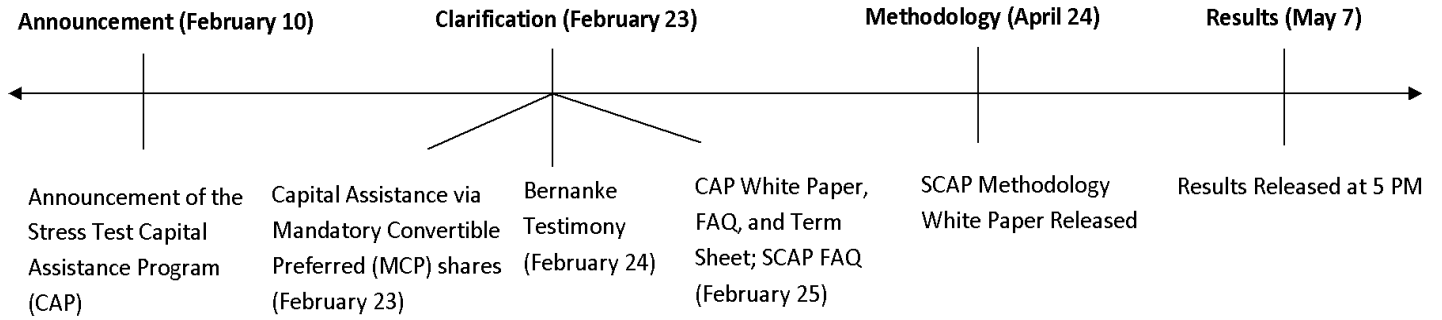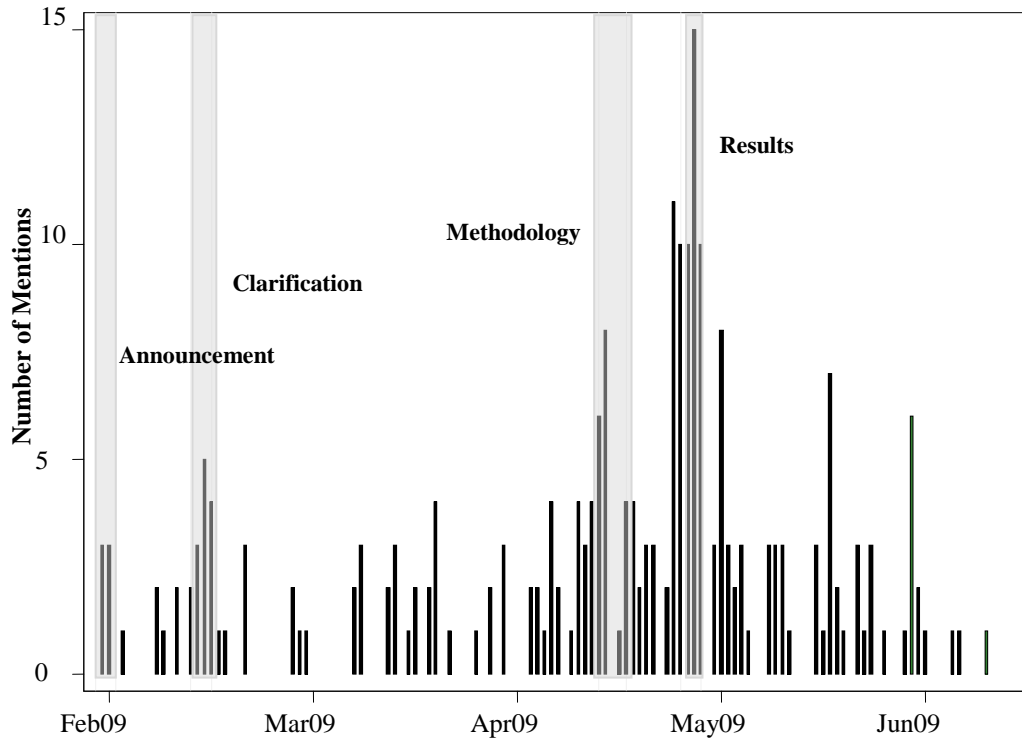*** Significant at 1 percent.

Figure 1. Timeline of SCAP Events

Announcement (February 10)
Announcement of the Stress Test Capital Assistance Program (CAP)

Clarification (February 23)
Capital Assistance via Mandatory Convertible Preferred (MCP) shares (February 23)

Bernanke Testimony (February 24)

CAP White Paper, FAQ, and Term Sheet; SCAP FAQ (February 25)

Methodology (April 24)
SCAP Methodology White Paper Released

Results (May 7)
Results Released at 5 PM

32

Figure 2. Daily Mentions of "Stress Test" in *Wall Street Journal*

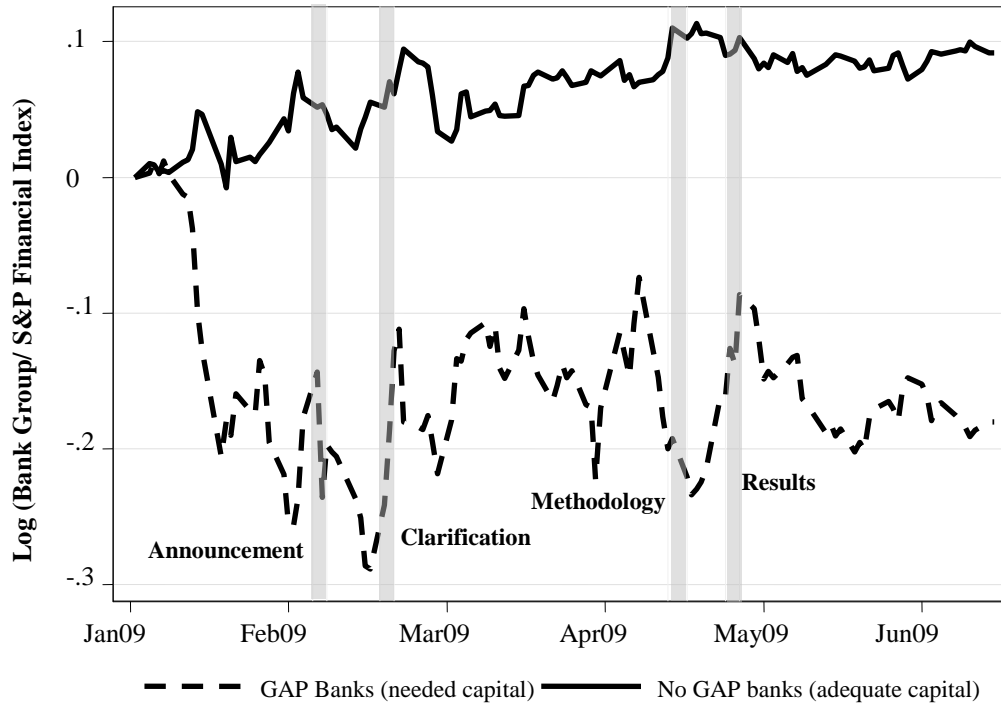

Source: Authors' tabulations.

Notes: Plotted are daily mentions of "stress test" in the *Wall Street Journal*. The methodology window is five days in this chart (only) because "stress test" was mentioned in the weekend *Wall Street Journal*. The event study window is three days for the methodology because the market is closed on weekends.

Figure 3A. Relative Stock Prices for SCAP Banks and the Next Fifty Public Banks
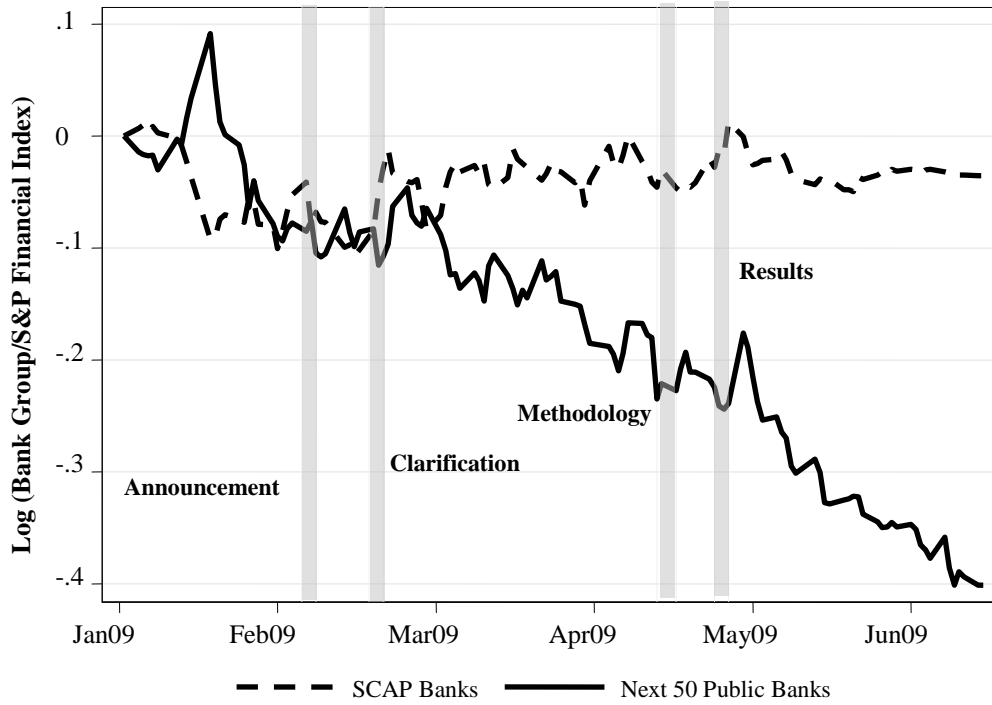
Notes: This chart plots the log of the normalized average of daily stock prices for each set of bank groups divided by the normalized S&P Financial Index, normalized to 0 on January 2, 2009. GMAC is excluded because it is not a public company.

Figure 3B. Average Stock Price for GAP Banks and NO GAP Banks Relative to the S&P Financial Index


Notes: This chart plots the log of the normalized average of daily stock prices for each set of bank groups divded by the normalized S&P Financial Index, normalized to 0 on January 2, 2009. GMAC is excluded because it is not a public company.

Figure 4. Relative Swap Spreads for GAP Banks and NO GAP Banks
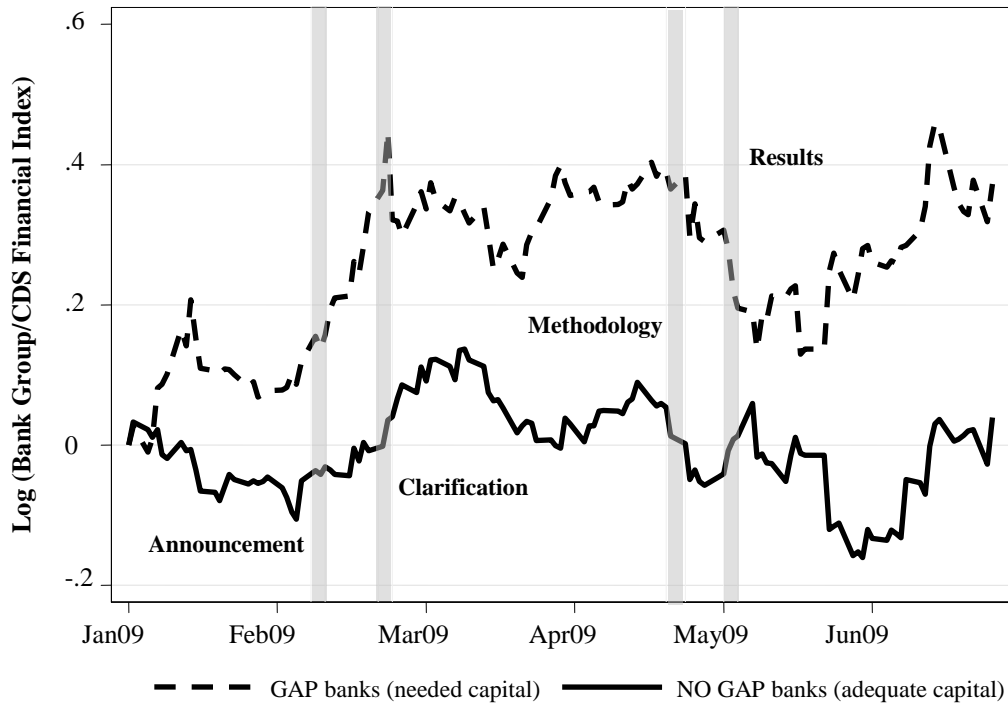
Notes: Plotted is the log of the average CDS spread for each set of banks divided by the CDS financial index, each normalized to zero at January 2, 2009. The CDS financial index used in this chart was constructed by the authors using Markit CDS Pricing. It represents the daily weighted average of all financial firms with a five-year USD North American CDS contract with an MR document clause. Spreads were weighted by market capitalization. All subsidiaries and private firms were dropped from this index, leaving 124 public firms.

Figure 5. The Relationship between the Clarification CAR and the Capital Gap/Assets Ratio
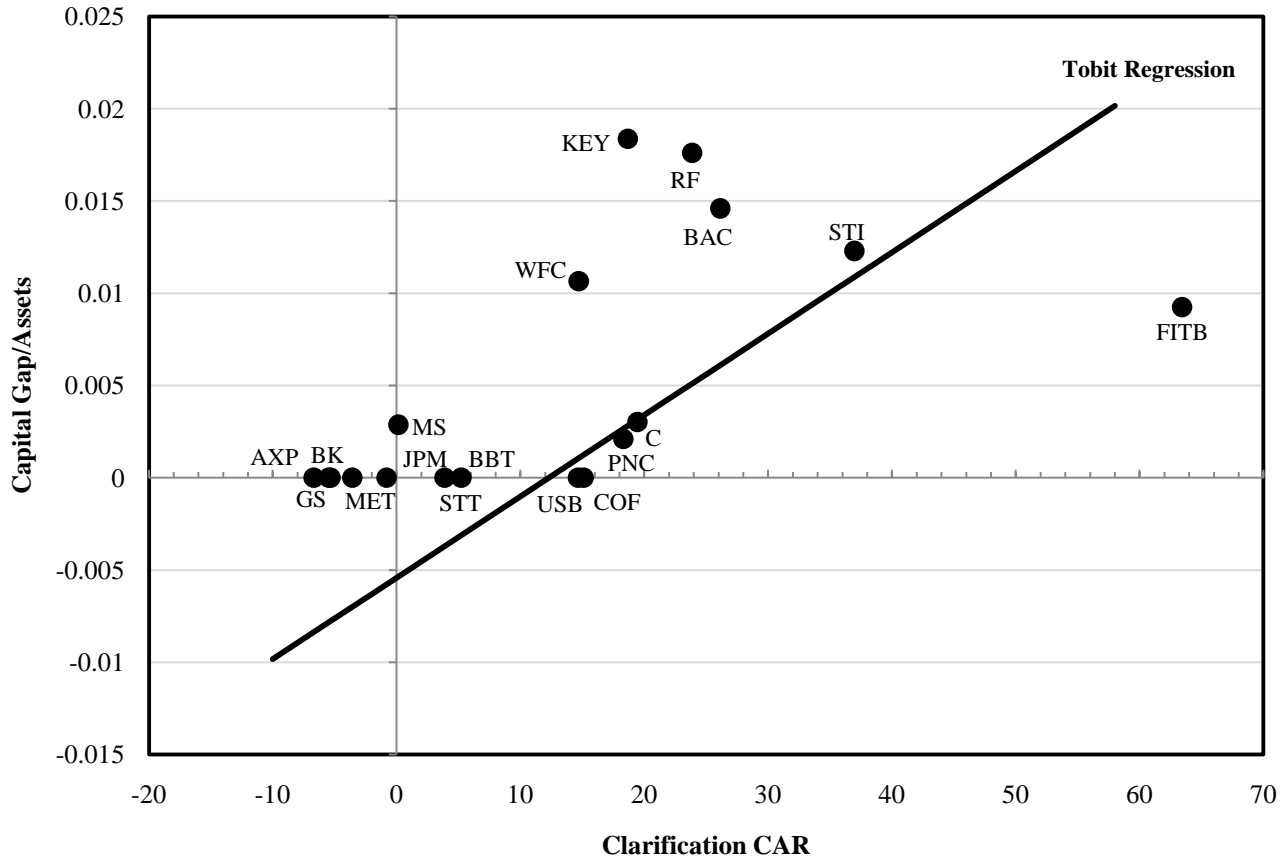
Notes: This chart plots the cumulative abnormal return (CAR) around the clarification on February 23-25 against the capital gap announced on May 7. The Tobit model regresses the GAP/assets on the clarification CAR and a constant. GS= Goldman Sachs, KEY= KeyCorp., WFC= Wells Fargo Corporation, PNC= PNC Financial Services Group, RF= Regions Financial Corp., BAC= Bank of America Corporation, C= Citigroup Inc., FITB= Fifth Third Bancorp, USB= US Bancorp, AXP= American Express Company, MS= Morgan Stanley, JPM= JP Morgan Chase, MET= Metlife Inc., BK= Bank of New York Mellon Corporation, STI= Sun Trust Bank, Inc., and STT= State Street Corporation.