

The Information Value of the Stress Test and Bank Opacity

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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 useful information for 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 are consistent with the view that the stress tests produced valuable information about banks.

Many observers have blamed the financial panic of 2008 on 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 announcement of the stress test was greeted with a considerable 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. Nouriel Roubini was among the harshest

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 inherently opaque. Investors . . . will demand to be paid for opacity . . .”

critics: "...regulators have decided to add liberally to the fog of opacity. Why call them 'stress tests'? 'Fudge tests' would be a truer description."²

The main question in our study is whether the stress tests muddied the water or whether it produced new information about banks. The question is important because, if indeed the panic was partly about inadequate information, a necessary condition for the stress test to have reduced the panic is that it produced new information. 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 Federal Reserve document detailing the underlying 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. 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.

² Nouriel Roubini, "The 'Stress Tests' are Really Fudge Tests," Forbes.com, April 16, 2009. <http://www.forbes.com/2009/04/15/gdp-stress-tests-unemployment-banks-home-prices-opinions-columnists-nouriel-roubini.html>.

The aggregate analysis reveals that the announcement event was essentially a nonevent 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 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 estimate an abnormal returns model 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 cumulative return for each bank around the clarification. We reason (and provide evidence) that the abnormal cumulative 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 result is consistent with the view that the stress test produced information about the banks that private sector analysts did not already know.

As the first to investigate the information value of the stress test, our paper extends the large literature on the rationale and efficacy of various government efforts to contain the financial panic.³ We also add to the 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 1. Section 2 presents the portfolio level analysis, and Section 3 reports cross-sectional regressions. Section 4 studies CDS spreads. We conclude in Section 5.

1. 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.

1.1. 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 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). In particular, the SCAP more severe economic scenario assumed GDP would shrink by 3.3% in 2009 and would remain flat in 2010, house prices would fall another 22% in 2009, and unemployment would rise to 8.9%.

³ For example, see Fleming, Hrungr, and Keane (2009) and Adrian, Burke, and McAndrews (2009). Brave and Genay (2011) provide an extensive overview of all these Federal Reserve policies.

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 bank's *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 bank's capital gap.⁴ 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 several important ways (Bernanke 2009, Hirtle, Schuermann, and Stiroh 2009). First and perhaps most importantly was the horizontal nature of the process as all SCAP banks were subject to simultaneous examinations with the same underlying assumptions about economic conditions and loan losses and the same quantitative techniques.⁵ By contrast, ordinary examinations occur over time, with little simultaneous comparison across banks. Simultaneous information from other banks may have given supervisors the grounds to challenge incredible first-round projections by individual banks. The simultaneity of the stress test also made this approach 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 focus on banks' current conditions. Researchers have found that the results of ordinary examinations have little predictive power for bank performance after accounting for market

⁴ Banks with *pro forma* Tier 1 capital below 6% of common assets or Tier 1 capital less than 4% of risk-weighted assets had gaps (Hirtle, Schuermann, and Stiroh 2009, p. 5).

⁵ Ordinary bank examinations are conducted on a fixed (usually annual) schedule and the assumptions and techniques vary by agency and over time (Hirtle and Lopez 1999).

indicators (Berger, Davies, and Flannery 2000). The forward-looking aspect of the SCAP held the promise that the results might inform the market.

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.

Lastly, 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. 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.

Despite these apparent advantages of stress tests over ordinary bank examinations, there was also considerable skepticism about the effectiveness of these methods in accurately measuring the capital adequacy of banks. Haldane (2009) argues that risk management methodologies implemented over the last two decades, such as value-at-risk models and stress tests, had several shortcomings. These risk management tools underestimate the likelihood of extreme events, fail to fully consider contagion and spillover effects, and do not effectively measure principal-agent problems. In an editorial column for *Forbes*, Nouriel Roubini noted that the assumptions for the severe economic scenario for 2009 and 2010 described above were

already violated by the time the process was completed.⁶ That criticism was echoed by Simon Johnson who argued that the stress test economic scenarios were too benign and failed to capture the banks' vulnerability to a severe economic downturn.⁷ Taleb et al. (2012) argue that stress tests are only a first order approximation of the banks' exposure to adverse economic outcomes that can be misleading in the presence of model error. Overall, critics of stress tests considered these methods as temporary stop gap measures that do not accurately assess bank insolvency.

In addition to our paper, two recent other studies investigate the efficacy of stress tests. Bischof and Daske (2012) focus on the EU-wide stress tests and sovereign credit risk exposures disclosures, conducted by the European Central Bank and European Banking Authority, respectively. The study shows a significant rise in voluntary disclosure of sovereign credit risk exposures by banks participating in these stress tests. Goldstein and Sapra (2012) analyze in a theoretical context the potential costs and benefits of stress tests resulting from greater disclosure. While the common belief is that more information is always better because it enhances price discovery, the authors argue that this premise does not always hold in second-best environments dominated by informational frictions.

1.2. The Potential Information Value of the SCAP

Following the staggering collapse of several important financial firms in the fall 2008, the market was very uncertain about the solvency of many large banks. This was an unusually challenging and uncertain economic environment for investors, who typically rely on traditional sources of information, such as company reports and industry analysis, to evaluate the financial strength of large more complex financial institutions. The SCAP had the potential to increase the

⁶ Nouriel Roubini, "The 'Stress Tests' are Really Fudge Tests," *Forbes.com*, April 16, 2009.

⁷ Simon Johnson, "Federal Reserve Stress Tests Make Us All Muppets," *Bloomberg View*, May 18, 2012. <http://www.bloomberg.com/news/2012-03-18/federal-reserve-stress-tests-make-us-all-muppets.html>.

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.⁸

Investors' uncertainty about the banks' prospects had several sources. First, investors questioned the fundamental uncertainty about the banks' true capital adequacy going forward. Second, they did not know how conservatively each bank was accounting for losses.⁹ 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 government lending facilities, it differed in its emphasis on information production. The traditional discount window and the more recently created Term Auction Facility (TAF) do 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 discount window and TAF meant they, unlike the SCAP, could not provide information to the market about which banks were solvent and which were not.

1.3 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

⁸ Statement by U.S. Treasury Secretary Timothy Geithner, on May 7, 2009.

⁹ Gunther and Moore (2003) find that the extent of underreporting increases in economic downturns and conclude that timely bank examinations are useful in uncovering underreporting.

elements of which were the stress test and the CAP. 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.¹⁰

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 how the government intended to use the stress test:¹¹

...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.

¹⁰ For example, Paul Krugman notes: “It’s really not clear what the plan means,” (see “The Rorschach Plan (Wonkish, or at Least Hard to Read).” *New York Times*, February 10, 2009). <http://krugman.blogs.nytimes.com/2009/02/10/the-rorschach-plan-wonkish-or-at-least-hard-to-read>.

¹¹ The following quotes are from the transcript of the Federal Reserve’s First Monetary Policy Report 2009 (Senate Hearing 111-53, Committee on Banking, Housing and Urban Affairs, United States Senate, One Hundred Eleventh Congress). <http://www.gpo.gov/fdsys/pkg/CHRG-111shrg50814/html/CHRG-111shrg50814.htm>.

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."¹²

The following exchange about "too big to fail" (TBTF) may also have been informative:

Bernanke: I do believe that the failure of Lehman Brothers and its impact on the 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 ... (CROSSTALK)

Senator Bunning: In others words ... there are some banks that are too big to fail?

Bernanke: Absolutely.

Finally, in response to a question about TBTF, 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 are in the middle of the crisis.

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.¹³ 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

¹² Craig Torres, "U.S. to Get Bank Ownership Stakes Only as Losses Rise." *Bloomberg*, February 24, 2009.

<http://www.bloomberg.com/apps/news?pid=newsarchive&sid=auD.fPbtkf5I&>

¹³ The CAP term sheet can be found at: <http://www.treasury.gov/press-center/press-releases/Pages/tg40.aspx>.

The CAP white paper link is:

http://www.treasury.gov/press-center/press-releases/Documents/tg40_capwhitepaper.pdf.

effect on existing common equity holders.¹⁴ We call the February 23-25 event the clarification, but note that “the” clarification was actually multiple events, each with a potentially separate impact.

The third event occurred on April 24 when the Federal Reserve Board released a twenty-page methodology document describing the procedures employed in the stress test.¹⁵ Although market analysts were not completely satisfied with the information and details provided through this release,¹⁶ analysts could potentially use the document 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:¹⁷

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.

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

¹⁴ 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.

¹⁵ <http://www.federalreserve.gov/newsevents/press/bcreg/bcreg20090424a1.pdf>.

¹⁶ 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).

¹⁷ Statement from Treasury Secretary Tim Geithner Regarding the Treasury Capital Assistance Program and the Supervisory Assessment Program, tg-123, May 7, 2009.

<http://www.treasury.gov/press-center/press-releases/Pages/tg123.aspx>.

from about \$0.6 billion to \$33.9 billion. Measured per bank assets, the estimated capital gap capital ranged from approximately 0.21% to 6.41%.

2. PORTFOLIO RESULTS

We begin simply by plotting relative stock prices for four “portfolios” of banks. Panel A in Figure 2 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.

Panel B in Figure 2 plots relative stock prices for banks with capital gaps (GAP) 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. 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.

2.1 Event Study Analysis of Stock Returns

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 economics and financial literature (see, for example, Brown and Warner 1985, Mikkelsen and Partch 1986, Campbell, Lo, and MacKinlay 1997). 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} , measured by the return on the S&P financial index:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

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. Equation (1) assumes the standard capital asset pricing model (CAPM) specification. Ahern (2009) shows that the Brown and Warner (1985) event study methodology could be biased if the true market model includes additional determinants, such as the book-to-market factor, the earnings-to-price ratio, or a firm distress component. These misspecification biases are less likely in the more homogenous SCAP sample consisting of the top 19 largest U.S. banks. Moreover, the estimation period for the market model ends before the onset of the financial crisis, so the estimated parameters are not affected by the turmoil of 2008 and the distressed condition of some of the stress tested banks.

The residuals or abnormal returns implied by the market model are given by

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

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 four events. The shorter window is particularly suitable for the clarification event and results. The clarification event, which occurred during 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. Although the 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.¹⁸

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. To analyze the stock market reaction at these events, we calculate the average equally-weighted portfolios. For robustness, we also compared these different portfolios using value-weighted measures; the results were generally unchanged and thus are not reported in the table. 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, p. 166). Many of the problems stemming from the lack of cross-sectional independence are lessened when we compare abnormal returns at the aggregate (portfolio) level. The portfolio

¹⁸ In particular, we calculated the cumulative abnormal returns using a five-day window (-2,+2) and a seven-day window (-5,+1). Overall, the findings from these longer event windows were very similar.

approach proposed by Brown and Warner (1985) therefore helps 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 event generated no obvious, robust pattern of responses for the two different group comparisons. However, while excess returns for SCAP banks were insignificant around the announcement of the stress test, they were negative and statistically different for the next fifty banks. The non-reaction for SCAP banks makes sense as the announcement did not supply much hard information about how tests on these institutions would be conducted, how the results would be used, or the terms and conditions of the CAP. In contrast, the negative response for the next fifty banks may indicate that investors were disappointed that some of these large banks would not participate in SCAP and would not therefore release additional information when the stress test was completed.

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 returns 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.

The stock price response to the methodology event was smaller but significant. The abnormal returns for the next fifty were negative around that event. The reasons behind the observed negative stock price reaction for these non-SCAP banks after the methodology release

are less clear. Perhaps the negative response was part of the persistent fall experienced over the entire SCAP period. The methodology could have also revealed new information about how some of the larger and more vulnerable non-SCAP banks would be evaluated in future stress tests. The response for GAP banks was negative while NO GAP banks experienced positive abnormal returns. While the methodology document was generally technical, it also strongly reiterated in the introduction that, should any of the SCAP banks be deemed to need additional capital, they were expected to promptly ameliorate these deficiencies. To estimate potential losses, the stress test relied on the existing accounting framework under which the accrual loan book was not subject to market value fluctuations. Investors were concerned that this book-value approach would allow banks to mask significant balance sheet weaknesses. Moreover, it was becoming evident that some of the key economic assumptions of the adverse scenario detailed in the methodology document were too lenient. Given the worsening economic conditions, investors may have been concerned that the stress test might not fully value and conceal the extent of losses for weaker SCAP banks.

Like the clarification, the release of results was highly informative for the SCAP 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. 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 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.

3. CROSS-SECTIONAL REGRESSIONS

To better illustrate the relationship between abnormal returns around the time of the release of the results and expected gap, consider the simple model linking the cumulative abnormal returns around the results for bank (i) CAR_i^R on its unexpected gap:

$$CAR_i^R = \gamma_0 + \gamma_1[GAP_i - E(GAP_i)] + v_i. \quad (3)$$

We predict that an unexpectedly large difference between actual and expected GAP is associated with negative abnormal returns at the time of the release of the SCAP results, that is, $\gamma_1 < 0$.¹⁹

Note that $E(GAP_i)$ is a latent variable unobservable by market participants. One possibility is to proxy for $E(GAP_i)$ with an index of individual analysts' forecast of GAP_i . These publically available forecasts, however, were very sporadic, released by a handful of industry analyst firms, and generally not consistently available for all SCAP banks. Instead we use a more market-based measure, namely, the cumulative abnormal return for each bank around the clarification, or CAR_i^C .

The rationale for using the CAR around the clarification as a proxy for the expected gap is straightforward in the case of a bank with an expected gap and a bank without an expected gap. For the bank with a gap, the news that banks would not be nationalized based on their gap would be good news while for the bank without a gap that news would be irrelevant. The

¹⁹ The variable GAP_i is a broad interpretation of a bank's capital deficiency that can either represent the nominal value of the gap or a relative measure such as the gap-to-assets ratio.

rationale is a little more nuanced in the case of two banks, both with gaps, but one with a bigger gap than the other. It is important to understand that investors were concerned about the solvency of some of the SCAP banks and had priced these concerns into share prices according to their own estimates of the probability of default. An important determinant of bank default is capital strength. For example, in the widely used Moody's KMV Merton's contingent-claims model, default is determined by the firm's market value and volatility of equity, and face value of liabilities divided by assets (that is, 1 minus the capital-to-assets ratio). According to this framework, a higher risk of default (i.e. a bigger expected capital deficiency) would manifest in a larger stock price discount. Accordingly, we would expect a larger share price discount (pre-clarification) for a bank with a bigger expected gap than for a bank with a smaller expected gap. It follows that the news that banks would not be nationalized (or failed) based on the size of their gap would have a larger impact on share prices, a larger abnormal return that is, for the bank with the larger expected capital gap. In other words, we are saying that the default discount to share prices pre-clarification was an increasing function of the expected gap, so the abnormal response to the clarification is also an increasing function of the expected gap.

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

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

where $\delta_1 > 0$ and u_i represents random noise. Since $E(GAP_i) = GAP_i + \varepsilon_i$, we can re-write equation (4) as

$$GAP_i = \delta_0 + \delta_1 CAR_i^C + \omega_i, \quad (5)$$

where $\omega_i = u_i - \varepsilon_i$. We use a Tobit regression model to estimate the relationship between GAP_i and CAR_i^C , where the capital gap is measured by the gap-to-assets ratio (GAP/ASSETS). Figure 3 shows a positive coefficient on CAR_i^C that is significant at the 5% level.²⁰ The pseudo R^2 for the Tobit regression is about 0.4. The strong statistical fit of the Tobit regression demonstrates that the clarification stock price responses are closely linked with capital gaps, which are in turn correlated with the expected gap.

Having provided evidence that the clarification CAR is a reasonable proxy for the expected GAP, we can now replace $E(GAP_i)$ with CAR_i^C in equation (3) to obtain:

$$CAR_i^R = \mu_0 + \gamma_1 GAP_i - \gamma_1 \delta_1 CAR_i^C + \eta_i, \quad (6)$$

where $\eta_i = v_i - \gamma_1 u_i$ and $\mu_0 = \gamma_0 - \gamma_1 \delta_0$. Restated in terms of the parameters of equation (6), 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 equation (6), the coefficient on GAP_i would be biased upward.

Table 3 presents several estimated (via OLS) versions of equation (6). We control for the capital gap of the bank using a normalized, continuous measure, GAP/ASSETS, and a dummy variable, NO GAP, equal to 1 if bank (i) did not have a gap; and equal to 0, if otherwise. Controlling for our proxy of the expected GAP, we expect a positive coefficient on NO GAP and negative coefficient on GAP/ASSETS. In both cases the logic is that a larger GAP indicates the bank was expected to have larger loan losses and there would be more dilution of existing shareholders to restore capital to the levels demanded by regulators. The alternative hypothesis

²⁰ The coefficient estimate for δ_1 is 0.04 with a t -statistic equal to 2.73. The estimate for the constant parameter δ_0 is insignificant.

is that the stress tests produced no new information about the value of banks' assets and their expected losses going forward. In that case, we would expect zero coefficients on GAP and GAP/ASSETS.

Models (1) – (3) show that when CAR_i^C is omitted, the stress test results appear uninformative; NO GAP 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.

Models (4) – (5), where we include CAR_i^C as a proxy for the expected GAP, tell an entirely different story. As predicted, this proxy for the expected gap enters positively and its coefficient is significant at the 1% level in both regressions. Including CAR_i^C boosts the regression adjusted R^2 to 0.62. Given CAR_i^C , GAP/ASSETS enters negatively, as predicted, and is significant at the 5% or 10% level, depending on the regression. Notice that in specification (4) that NO GAP has the predicted positive sign but is insignificant. Regression (5) reveals that when we exclude NO GAP, the coefficient on GAP/ASSETS is larger and becomes significant at the 5% level.

The insignificance of the NO GAP dummy in all the models suggests investors had already figured out which banks had gaps and which did not. Conditional on existing market expectations, however, investors responded negatively to a higher level of GAP/ASSETS because a higher gap signified greater-than-anticipated shareholder dilution. On the whole, the stress test determined that capital-deficient banks needed about \$75 billion of fresh capital. Some of the SCAP banks had already announced plans to tap the public markets and considered converting preferred shares into common equity, thus, diluting the claims of existing shareholders. Those unable to issue in the capital markets were faced with the tougher options of needing to rely on government funds or selling valuable assets.

Given the small sample of 18 SCAP banks, the regression results might be susceptible to outlier biases. To test for the presence of outliers, we calculated the DFBETA statistic that measures the influence of each bank observation on the regression parameter estimates. We find that DFBETA statistics for all eighteen banks are below the critical value threshold that indicates influential observations. The only plausible outlier candidate evident from our graphical analysis is Fifth Third Bancorp (FITB), which is one of the smallest banks in the SCAP sample. Consistent with the DFBETA evidence, however, the regression findings are unchanged when this bank is omitted from the estimation sample.

Models (6) and (7) include the CAR around the methodology event. Our analysis of abnormal returns (Table 2) revealed a modest negative (positive) investor response for GAP (NO GAP) banks after the Federal Reserve released the methodology document. This differing response between GAP and NO GAP banks suggests that the release of the methodology details may have provided useful information by formally outlining the stress test approach and the underlying economic assumptions for its forecasting scenarios. Model (6) shows a positive but insignificant relationship between the methodology cumulative abnormal return CAR_i^M and CAR_i^R . The link between these two variables is more significant in regression (7) that also controls for CAR_i^C . This finding is consistent with our premise that some of the SCAP events were informative to the market. The positive, albeit weaker, effect of CAR_i^M indicates that investors may have updated their capital adequacy forecasts based on the methodology guidelines.

Overall, the results in Table 3 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.

4. CDS MARKET IMPACT

This section looks at the impact of the stress test on credit default swaps. 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.²¹ 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.

To calculate abnormal movements in CDS spreads we use a simplified version of the market return model proposed by Norden and Weber (2004a, 2004b) and Greatrex (2008). 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} :

$$\Delta CDS_{it} = \alpha_i + \beta_i \Delta I_{mt} + u_{it} \quad (7)$$

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.

²¹ 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 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).

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.²² The announcement of the SCAP had no effect on abnormal CDS movements, just as observed in the stock market. By contrast, the clarification had a big impact for the GAP banks; their CDS spreads fell by 21 basis points relative to NO GAP banks that experienced a 24 basis points increase. 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 bank bond holders; their CDS spreads fell by 59 basis points relative to spreads for NO GAP banks.

5. 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 findings are consistent with the hypothesis that 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 stock market reaction after the announcement of the SCAP was muted for participating banks because the release of the fact sheets did not offer much hard information on the CAP terms and stress test procedures. In contrast, the stock price index of the next fifty banks experienced a significant decline during the SCAP period as there was considerable uncertainty how these non-SCAP institutions would manage to navigate through this financial crisis. Of the four events we studied, the one with the biggest absolute impact on abnormal stock returns was

²² Very few of the next fifty banks had CDS information available so we could not include them as a comparison group.

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.

Our findings also bear on the Comprehensive Capital and Analysis Review (CCAR) stress test conducted annually by the Federal Reserve and similar ongoing initiatives in the European Union and other countries. 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)	Assets (\$ Trillions)	Capital Gap/Assets (%)
<u>Banks needing capital (GAP banks)</u>			
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	6.35
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
<u>Banks with adequate capital (NO GAP banks)</u>			
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. Information on bank assets was obtained from Capital IQ as of 2009:Q1. GMAC LLC does not have ticker symbol because it was not a public company.

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

	Announcement February 9-11	Clarification February 23 -25	Methodology April 23-27	Results May 6-8
SCAP banks	-1.24**	13.26***	-0.37	7.93***
Next Fifty banks	-4.32***	-0.21	-5.41***	2.48*
Difference	3.08**	13.47***	5.04***	5.45**
GAP banks	-1.24*	24.63***	-3.91***	12.77***
NO GAP banks	-1.25	1.88**	3.17***	3.10***
Difference	0.01	22.75***	-7.08***	9.67***

NOTES: This table reports the average CAR (in percent) 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 not subject to the 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 methodology 3-day window spans April 23-27 because the documentation was released on Friday, April 24, 2009. The average CAR for each set of banks is calculated on an equally weighted basis. GMAC is excluded from the SCAP sample because it was not a public company. The source for the stock return data is Capital IQ. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

TABLE 3
Are Big Capital Gaps Bad News?

	Dependent variable: Three-day CAR around SCAP results						
	<u>Model Specifications:</u>						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
NO GAP	-9.68 (1.08)	-8.64 (0.60)		10.07 (1.28)		-11.82 (0.96)	
GAP/ASSETS		0.103 (0.12)	0.61 (1.04)	-0.64* (2.08)	-1.09** (2.47)	0.17 (0.19)	-0.85* (1.98)
CAR _i ^C , Clarification CAR				1.15*** (5.70)	1.06*** (6.20)		1.08*** (6.01)
CAR _i ^M , Methodology						0.54 (1.17)	0.56* (1.99)
CONSTANT	12.77* (1.77)	11.73 (0.88)	4.86 (0.99)	-9.14* (1.84)	-0.67 (0.17)	13.17 (1.08)	-1.87 (0.52)
Adjusted R ²	0.01	-0.06	-0.01	0.62	0.62	-0.05	0.67

NOTES: This table reports the cross-sectional regression coefficients (robust absolute t-statistics) for the sample of eighteen publicly traded financial institutions subject to the stress test. The independent variable NO GAP equals one (zero) if the bank had a positive (zero) gap. The variable GAP/ASSETS represents the gap announced with results divided by total assets summarized in Table 1. To get a better scale on the parameter estimate, the GAP/ASSETS values are multiplied by 10. The variable CAR_i^C represents the cumulative abnormal return for the three-day window around the clarification event. The variable CAR_i^M is the cumulative abnormal return for the three-day window around the methodology event. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively

TABLE 4
Average Cumulative Abnormal Change in CDS Spreads for SCAP Banks around SCAP Events

	Announcement February 9-11	Clarification February 23 -25	Methodology April 23-27	Results May 6-8
GAP banks	0.01	-0.17**	0.02	-0.50
NO GAP banks	0.02	0.24**	-0.18***	0.07
Difference	-0.01	-0.41***	0.20***	-0.57**
Observations	15	15	15	15

NOTES: This table reports the average cumulative abnormal CDS spread around each event for the two groups of banks. 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 bank observations is limited to fifteen because some institutions did not have comparable CDS contracts. 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 average cumulative abnormal change in CDS spread is calculated on an equally weighted basis. The CDS data are from Markit CDS Pricing. The symbols *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

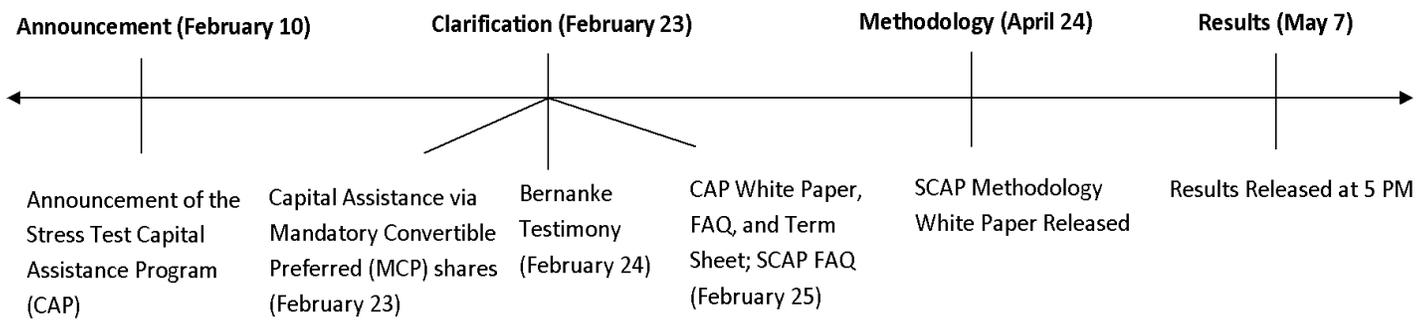
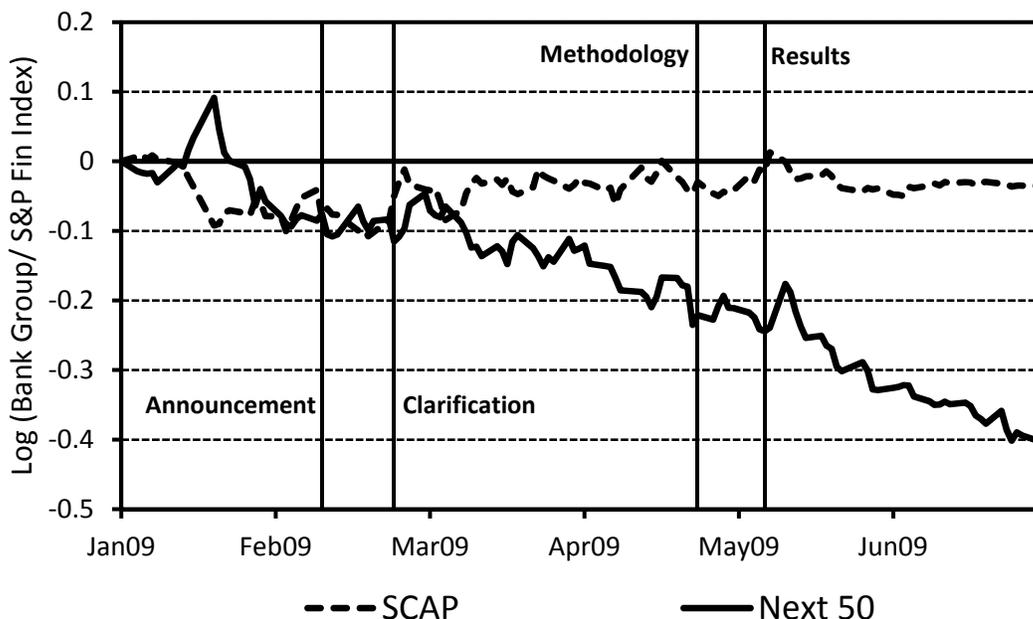


Figure 1. Timeline of SCAP Events

Panel A. SCAP Banks versus Next Fifty Public Banks



Panel B. GAP versus No GAP Banks

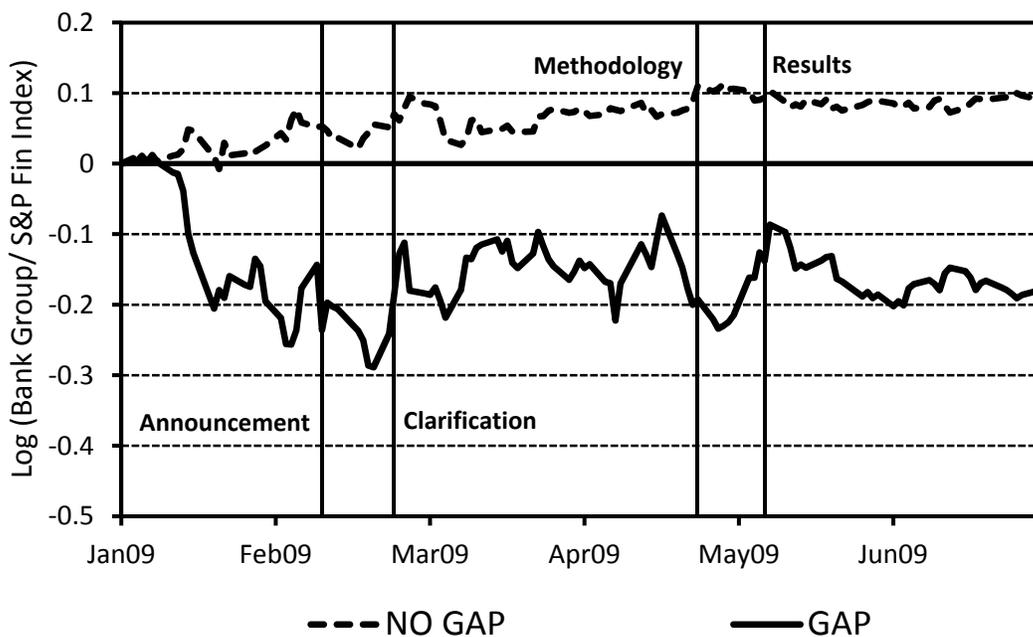


Figure 2. Relative Stock Prices Comparisons

NOTES: This figure plots the log of the normalized average of daily stock prices for each set of bank groups divided by the S&P Financial Index, normalized to 0 at January 1, 2009. GMAC is excluded because it was not a public company.

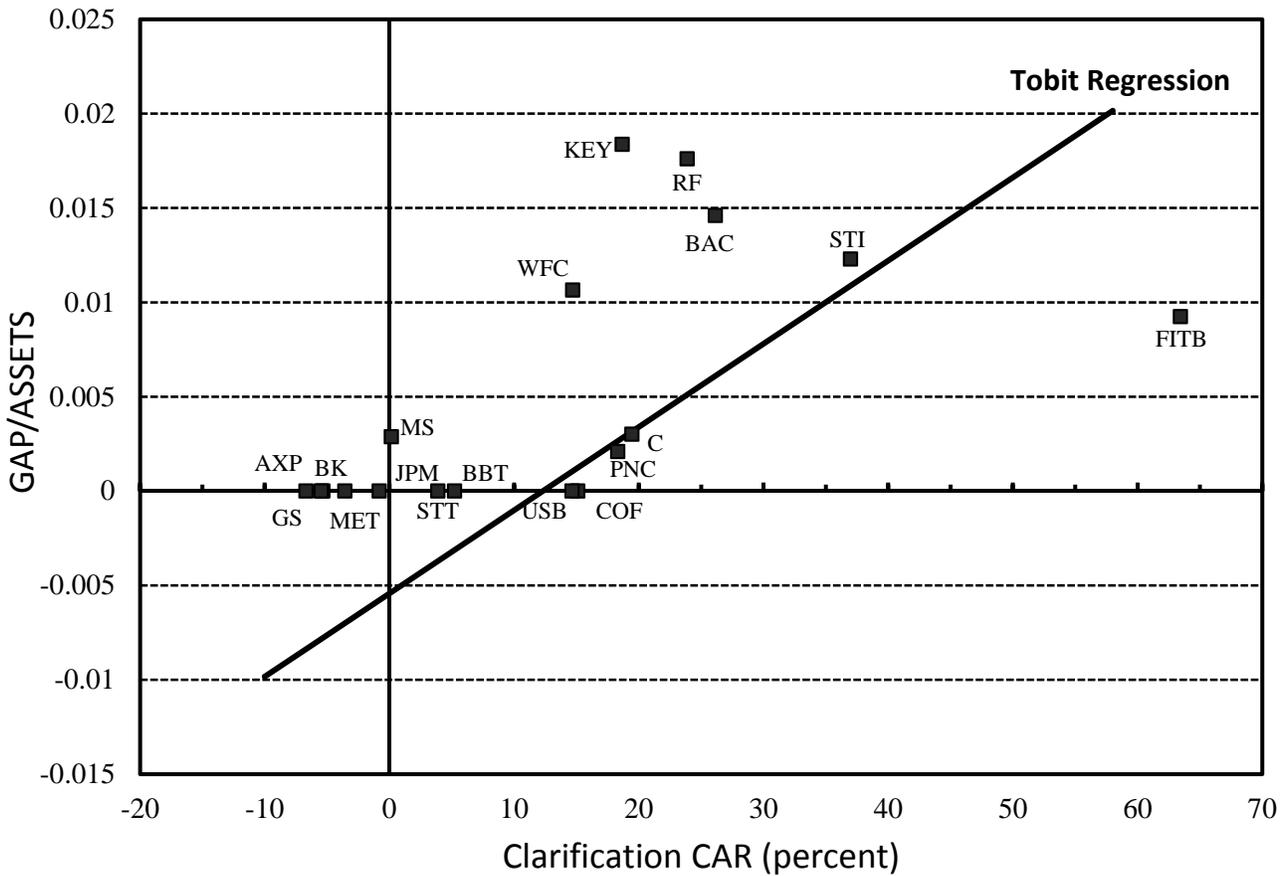


Figure 3. The Relationship between the Clarification CAR and the Capital GAP/ASSETS Ratio

NOTES: This figure 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. AXP= American Express Company. BAC= Bank of America Corporation. BK= Bank of New York Mellon Corporation. C= Citigroup Inc., COF=Capital One Financial Corp., FITB= Fifth Third Bancorp, GS= Goldman Sachs., JPM= JPMorgan Chase., KEY= KeyCorp, MET= MetLife Inc., MS= Morgan Stanley, PNC= PNC Financial Services Group, RF= Regions Financial Corp., STI= Sun Trust Bank, STT= State Street Corporation, USB= US Bancorp, and WFC= Wells Fargo Corporation.

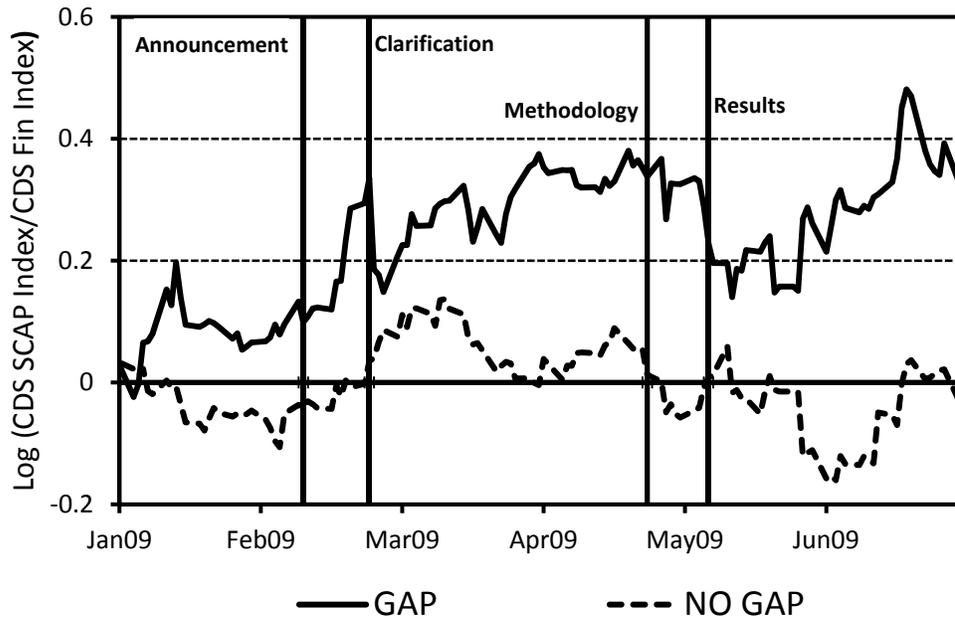


Figure 4. Relative Swap Spreads for GAP Banks and NO GAP Banks

NOTES: This figure plots the log of the average CDS spread for each set of banks divided by the CDS financial index (normalized to zero at January 1, 2009). The CDS financial index used in this chart was constructed using Markit CDS Pricing and represents the daily weighted average of all financial firms with a five-year dollar-denominated 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.