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# Bank bailout under TARP in the US

BSG-WP-2016/010

January 2016

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## **Bank Bailout under TARP in the US<sup>+</sup>**

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### **Abstract**

In response to the recent global financial crisis, the US government launched the Troubled Assets Relief Program (TARP), the largest government bailout in US history. This paper examines the market responses to the TARP-related events as reflected in stock returns and tail risk. Our empirical strategy permits a counterfactual interpretation of the data and provides credible empirical evidence to answer the question “what would have happened to those banks that did in fact receive bailout funds if they had not received the bailout”. It is found that the market responded favorably to the announcement of TARP, which suggests that the launch of the bailout program indeed helped restore investors’ confidence in the financial system. However, the market tended to react negatively to the receipt of TARP bailout funds. Banks that received larger bailouts experienced greater stock price declines. This indicates that, instead of creating a certification effect, the receipt of bailout funds conveyed an adverse signal to the market. Besides, our empirical evidence suggests that TARP failed to reduce tail risk.

**JEL Classification Codes:** G18, G21, G28

**Keywords:** TARP bailout; abnormal returns; tail risk; counterfactual.

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+The author thanks the African Development Bank who supported the work financially, and Meng Qing and Patrick Asea for their input into the broader project. Comments from an anonymous referee and Peter Tufano are acknowledged. All errors are mine.







## 1. Introduction

“It’s very hard to know the counterfactual.”

Mervyn King, the Governor of the Bank of England, before the Treasury Select Committee on the Financial Crisis, March 2009.

Banks play a vital role in an economy; they finance the assets that lead to economic expansion and job creation. Yet almost everyone loves to hate the Troubled Asset Relief Program (TARP) which authorized the US Department of the Treasury to inject capital into banks in the midst of the worst global financial shock since the Great Depression. TARP, the largest government bailout in US history, flooded banks (in some cases whether they needed the funds or not) with money to prevent bank runs, prop up lending, and convince consumers and investors that the entire banking sector was safe.

Yet, whether TARP restored investor confidence by stabilizing financial markets and helped banks survive the global financial meltdown remains an open question. Whether TARP hindered or even worsened the financial crisis is the object of serious contention among policymakers, academics and the general public.<sup>1</sup> The heated debate over TARP has underscored the fact that economic theories can rarely explain with certainty whether one set of policies are superior to another or are certain to succeed in a given circumstance. Indeed, for every example of success with TARP, opponents are quick to show failures with them. Critics argue that conditions would have been better off without TARP implying that financial markets would have recovered faster and stronger if there were no bailouts. They also point to apparent successes with an alternative set of policies. Taylor (2009) concludes that “government actions and interventions caused, prolonged and worsened the financial crisis”. While, Blinder and Zandi (2010) argue,

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<sup>1</sup> An impressive list of academic economists wrote to the US Congress protesting TARP. It rapidly became a favorite punching bag of liberals, conservatives, Republicans, Democrats and the public. A Bloomberg poll in October 2009 asked how TARP had affected the economy. Forty-three percent of respondents said it weakened the economy; 21 percent said it made difference; only 24 percent said it helped, with 12 percent unsure one way or another. Commentators in newspapers from the Wall Street Journal to the New York Times disparaged TARP. On October 3, 2008, when TARP became law, one member of Congress even went so far as to say, “I don’t think it is too much of a stretch to say this may be the day America died”.

<sup>2</sup> This problem is referred to as the fundamental problem of causal inference (Holland, 1986).

<sup>3</sup> Recognizing the difficulty of pinpointing causal effects in empirical social science research, a large and influential body of work has developed methods for credible causal inference of the effects of a policy, program or treatment, including Abadie et al. (2002); Angrist et al. (1996); Angrist (2004); Heckman (1990); and Heckman (1979).

<sup>4</sup> See Bloomberg, October 3, 2008, quoting Representative John Yarmuth in his decision to reverse his vote in favor of the bill “the stock market drop on Monday served as a wake-up call to a lot of people”.

<sup>5</sup> In addition to the nine institutions identified by the US Treasury list, Wachovia, that had signed a definitive merger agreement with Wells Fargo, also received a capital injection. Of the ten institutions that received TARP capital on October 14, 2008 three were investment banks at the time and were not required to report as bank holding companies. Hence, comparable financial statement data and capital ratios for these three institutions are unavailable and we exclude them in our analyses requiring financial characteristics. In all tests, we also exclude Wachovia due to its merger agreement with Wells Fargo.

“If policymakers had not reacted as aggressively or as quickly as they did, the financial system might still be unsettled, the economy might still be shrinking, and the costs to U.S. taxpayers would have been vastly greater.”

Evaluation of public policies is a central task of economics yet as one observer noted wryly

“Judging the merits of economic policies is a taxing task. It remains impossible to assess the consequences of a path not taken. TARP passed; we know what occurred. We cannot say with certainty what would have occurred if TARP had not passed or if the government had pursued another option.”

This is precisely the objective of this paper. We ask the counterfactual question: what would have happened to those banks that did in fact receive bailout funds if they had not received the bailout? Clearly, this exact counterfactual is not observable; a single bank cannot simultaneously receive and not receive a bailout.<sup>2</sup> To resolve this problem we use propensity score stratification matching to select a control group of non-bailout banks that is closely matched to the group of bailed-out banks to artificially create such twins. We then use the matched groups to estimate the markets response to banks’ bailout decision in terms of stock market returns and systemic tail risk.

A causal effect is defined as the difference in outcome between a world in which the bank receives the treatment and a counterfactual world in which the same bank does not.<sup>3</sup> The treatment is acceptance of TARP bailouts. Estimates of effects in this framework are the effect of treatment on the treated (ETT) rather than the effect of treatment for the entire population. In other words, in estimating the effect of TARP bailouts, we are estimating the effect on those banks in the data who actually accepted bailout funds, not the hypothetical effect of bailouts on any bank which could conceivably have received bailout funds. In addition, the estimates from the model are estimates of the average treatment effect, rather than the effect on each individual bank.

To the best of our knowledge this is the first paper to examine the markets response to TARP-related events as reflected in stock returns and tail risk. Most prominently, we allow for non-random selection into the TARP bailout program by using propensity score matching methods. This strategy permits a counterfactual interpretation of the data and provides the first credible and robust empirical evidence that in the absence of bailouts there would have been greater tail risk and more negative abnormal returns than was the case with bailouts.

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Admittedly, ours is a very narrow question. We do not attempt to evaluate the costs and benefits of TARP, neither do we evaluate the impact of TARP on the real economy or the impact of another set of bailout policies. Other papers have attempted to address these questions. For instance, Veronesi and Zingales (2010) estimate the costs and benefits of TARP (which they refer to as Paulson's gift) and show that this government intervention increased the value of banks' financial claims by \$130 billion at a taxpayers' cost of \$21–44 billion with a net benefit between \$86–109 billion. Taliaferro (2009) studies the way banks used new capital under TARP. He finds that participating banks used roughly thirteen cents of every program dollar, to support new lending, while they retained a considerable portion, about sixty cents of every dollar, to shore up their capital ratios. Bayazitova and Shivdasani (2012) study selection into TARP and subsequent stock price reactions. Ivashina and Scharfstein (2010) demonstrate a relationship between credit line commitments and loan growth during the 2008 crisis. Ait-Sahalia et al. (2009) do not find strong evidence that either macroeconomic or financial policies had an advantage in calming interbank markets during the global financial crisis. Duchin and Sosyura (2009, 2014) study the political influences on TARP fund distributions. Harvey (2008), Bebchuk (2009), and Coates and Scharfstein (2009) critique the design of TARP and discuss various inefficiencies that could be created by the program. Berger and Roman(2014) and Li(2013) analyze the differences between TARP and non-TARP banks in terms of markups and loan supply. Kotter and Noth(2015) investigate the TARP distorted price competition among US banks.

The empirical methods used in previous studies do provide credible empirical evidence of causality between TARP bailouts and outcomes of policy interest. In other words, the methods cannot estimate the average treatment effect on the treated. Neither do any of the previous methods account for unobservable heterogeneity. The decision to receive bailouts is not exogenous to banks. Each bank self-selects into either the bailout or no-bailout regime, therefore estimates that do not account for self-selection may be biased. In order to correct for such bias, Heckman selection or instrumental variable approaches could be used. Yet, these approaches still assume that the outcome equations would differ only by a constant term between bailout and non-bailout banks. In reality, differences between the two groups may be more systematic, that is, there may be interactions between bailout choice and the other determinants of bank outcomes.

With the exception of Duchin and Sosyura (2010, 2014), Berger and Roman(2014), and Li(2013), previous studies do not construct an appropriate counterfactual group of banks that do not accept bailout funds. Constructing an appropriate counterfactual group of banks is essential for studying the impact of TARP. For example, suppose firm value is seen to decline after TARP, without a counterfactual you would not be able to determine whether it would have declined even more if firms that actually did accept bailout funds had not accepted bailout funds. Even though this cannot be observed, their hypothetical behavior can be proxied by the behavior of a sample of other banks that did not accept bailout funds.



Attempts to use propensity score matching alone-without some form of structural models futile because it cannot capture the policy impact of most interest – the average effect of the treatment on the treated (ATT). Propensity score matching can deal with structural differences between bailout and non-bailout banks, but only to the extent that these differences are based on observables. When there are unobserved factors that simultaneously influence banks bailout decision and say the financial health of the banks, such as managerial skills, ability, or motivation, then propensity score matching may still result in biased estimates.

In this paper we make use of various methodologies depending on the question. We use a simple event-study methodology based on a three-factor Fama-French model, to analyse the impact of TARP on stock returns, and construct a counterfactual of untreated banks which are then compared with treated banks. The untreated banks that constitute the counterfactual, are constructed using a propensity score matching method. We also make use of the buy-and-hold investment approach to analyzing returns and how they are impacted by TARP for both treated and untreated banks. The impact of TARP on tail risk is analysed using value at risk(VAR) and changes in VAR for treated and untreated banks.

The rest of the paper proceeds as follows. In Section 2, we discuss the background and events leading up to TARP. Section 3 describes the dataset and the characteristics of banks in our sample. Section 4 presents empirical evidence on the impact of TARP bailout events on stock returns. Section 5 investigates the valuation effect of bailout size using the event-study methodology. In Section 6, we look at the buy-and-hold returns of bailout and non-bailout banks over the TARP capital injection period. Section 7 examines the impact of TARP bailout on systemic tail risk as measured by value-at-risk. Section 8 concludes.

## 2. Background to TARP

As part of the government's measures in response to the global financial crisis, the Troubled Assets Relief Program (TARP) was the largest government bailout in US history (a brief history of US government bailouts is summarized in Appendix 1). The genesis of TARP lies in the days following the collapse of Lehman Brothers and the rescue of AIG in mid-September 2008. In the aftermath of these events, funding costs for financial institutions escalated sharply due to widespread fear of a domino effect of collapse among financial institutions that were unable to fund obligations and concerns about counterparty risk.

On September 20, 2008, Treasury Secretary Henry Paulson and Federal Reserve Chairman Ben Bernanke sent a financial rescue plan to Congress requesting approval to stabilize the financial system by purchasing troubled assets, primarily those related to mortgage-backed securities (MBS), from banks and other financial institutions. Though this initial plan was rejected by Congress, a modified version was approved on October 3, 2008. President George W. Bush signed into law the Emergency Economic Stabilization Act of 2008 (EESA) which authorized spending of up to \$700 billion to purchase or insure troubled assets, in an attempt to unlock credit markets and restore confidence in the banking system.<sup>4</sup> According to EESA, the term "troubled assets" was defined as:

- (i) Residential or commercial mortgages and any securities, obligations, or other instruments that are based on or related to such mortgages, that in each case was originated or issued on or before March 14, 2008, the purchase of which the Secretary determines promotes financial market stability; and
- (ii) Any other financial instrument that the Secretary, after consultation with the Chairman of the Board of Governors of the Federal Reserve System, determines the purchase of which is necessary to promote financial market stability, but only upon transmittal of such determination, in writing, to the appropriate committees of Congress.

On October 13, 2008 the Treasury announced that it would invest directly in the equity of a broad range of financial institutions and that these equity injections would be targeted at "healthy" firms.

On October 14, 2008 the US Treasury unveiled the details of its Capital Purchase Program (CPP) which allocated \$250 billion towards purchases of preferred stock and equity warrant of US financial institutions. The nine largest financial institutions, including Bank of America, Bank of New York Mellon, Citigroup, Goldman Sachs, JP Morgan, Merrill Lynch, Morgan Stanley, State Street, and Wells Fargo, were identified as the initial recipients of an aggregate infusion of \$125 billion.<sup>5</sup> Other banks were also allowed to apply for the preferred stock investment by the Treasury until November 14, 2008. Capital injection through the purchase of preferred stock would qualify as Tier 1 capital but not dilute the voting power of the existing common shareholders, and thus was expected to be attractive to banks. On the same day, a program to offer government guarantees on new bank debt issues was unveiled, and the ceiling on the Federal

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<sup>4</sup> See Bloomberg, October 3, 2008, quoting Representative John Yarmuth in his decision to reverse his vote in favor of the bill "the stock market drop on Monday served as a wake-up call to a lot of people".

<sup>5</sup> In addition to the nine institutions identified by the US Treasury list, Wachovia, that had signed a definitive merger agreement with Wells Fargo, also received a capital injection. Of the ten institutions that received TARP capital on October 14, 2008 three were investment banks at the time and were not required to report as bank holding companies. Hence, comparable financial statement data and capital ratios for these three institutions are unavailable and we exclude them in our analyses requiring financial characteristics. In all tests, we also exclude Wachovia due to its merger agreement with Wells Fargo.

Deposit Insurance Corporation (FDIC) guarantee of non-interest bearing transaction accounts at banks was also increased at this time. The new bank debt guarantee initiative was finalized on November 21, 2008 as the Temporary Liquidity Guarantee Program (TLGP) which guaranteed senior unsecured bank debt, within prescribed limits, issued between October 14, 2008 and June 30, 2009.

Under CPP, the US Treasury would purchase non-voting senior preferred stock of qualifying financial institutions (QFIs), and banks could apply for this injection in amounts ranging from 1 percent to 3 percent of their risk weighted assets (RWA). In addition to senior preferred stock, the US Treasury would receive warrants with a ten year life to purchase common stock of qualifying banks for an amount equal to 15 percent of the preferred equity infusion. The dividend on the preferred stock was set at 5 percent, but would rise to 9 percent after three years. The financial terms of CPP capital were viewed to be very attractive for banks and substantially below the funding costs obtainable in public capital markets for most banks. However, CPP infusions forbade dividend increases on the common shares until the preferred shares were repaid fully and also set limits on executive compensation whereby senior executive benefit plans, severance, and golden parachute agreements had to be terminated or modified.

Following CPP and TLGP, TARP evolved to include several other components including the Public-Private Investment Program (PPIP) to acquire troubled loans and toxic assets from financial institutions and the Term Asset-Backed Securities Lending Facility (TALF) to support the issuance of asset-backed securities (ABS). Our analysis focuses on the CPP program because it remains the cornerstone of TARP and because it targets specific financial institutions, allowing us to study the characteristics of the banks supported by the capital injections. Henceforth, we refer to capital injections under the CPP program as TARP infusions. Since the initial preferred stock investment of \$125 billion into the nine financial institutions on October 14, 2008, TARP capital infusions have been made into a large number of other financial institutions.

To participate in the program, eligible financial institutions had to submit a short application to their primary federal banking regulator, namely the Federal Reserve, the Federal Deposit Insurance Corporation (FDIC), the Office of the Comptroller of the Currency (OCC), or the Office of Thrift Supervision (OTS). After receiving the application, the regulators assessed the financial condition of the applicant based on the CAMELS rating system. If the initial review by the banking regulator was successful, the application was forwarded to the Treasury's investment committee and then the assistant secretary for financial stability who made the final decision about the investment. As of July 30, 2009, over 2,700 applications had been submitted, of which 1,300 were sent to the Treasury, and 660 were approved for bailout funds. With the passage of the TARP legislation, banks across the country faced a difficult decision: should they accept government aid that could help keep them solvent but also open them to criticism of being bailed out? The banks' choice to apply for TARP funds thus was also a function of their own internal deliberations as to expected costs and benefits, managerial tastes, preferences and private information. Eventually, 758 banks took the deal and accepted funds through TARP. But others eager to protect their images or unwilling to accept the program's burdens opted against taking the assistance.

### 3. Sample and Data

#### 3.1 Sample Characteristics

To construct our main (universal) sample, we start with data available at bank holding company level from the Bank Holding Company Database provided by Federal Reserve Bank of Chicago. The dataset includes quarterly financial data on a consolidated basis for all domestic bank holding companies (BHCs) with total assets of \$500 million or more. The consolidated bank holding company financial data are desirable because the Troubled Assets Relief Program (TARP) is made at the level of holding companies.

From the universe we obtain two sub-samples. The first sub-sample is BHCs that accepted TARP bailout funds (bailout banks). The list of bailout banks is obtained via ProPublica's TARP database. The sub-sample of bailout banks is used to conduct our basic event study. The second sub-sample is "matched banks" that did not accept TARP bailout funds but are similar to the bailout recipients according to propensity score matching methods (counterfactuals).

More specifically, for the bailout sub-sample, we obtain data on TARP participant BHC from ProPublica's TARP database, which can be found at <http://bailout.propublica.org/main/list/index>. The database tracks where taxpayer money has gone in the ongoing bailout of the financial system. By December 30, 2011, 926 institutions had received bailout funds of \$700 billion (there is a separate bailout of Fannie Mae and Freddie Mac). We restrict our analysis to bank holding companies because TARP bailouts are made at the level of holding companies. Since we retrieve financial reporting data from Consolidated Financial Statements for Bank Holding Companies- FR Y-C (Call Report), we limit our sample to bank holding companies with total consolidated assets above \$500 million. In addition, we analyze publicly traded banks because our event study employs stock market data. We limit our bailout sub-sample for the event study to banks that participated in TARP and had ordinary shares listed on NYSE, AMEX, or NASDAQ.

Panel A of Table 1 shows that CPP capital of \$640 billion was provided to 926 firms, including 758 bank holding companies who received \$236 billion in bailout funds. Of the bank holding companies, 247 are publicly traded on the New York Stock Exchange (NYSE), American Stock Exchange (AMEX), or NASDAQ Stock Market (NASDAQ). For the non-bailout sub-sample, we start with 977 bank holding companies with consolidated assets of \$500 million or more as of September 30, 2008, and therefore have consolidated financial information available from Bank Holding Company Data before the announcement of TARP. After removing the bank holding companies that announced their participation in TARP, we end up with our non-bailout sub-sample. Table 1 presents the selection process for our bailout and non-bailout sub-samples.

**Table 1:** Sample Selection

| Selection Criteria                             | Bailout Amount | Number |
|--|----------------|--------|
| <b>Panel A: Bailout Banks</b>                  |                |        |
| • Firms that received bailout funds under TARP | \$640 billion  | 926    |
| • Retain bank holding companies only           | \$236 billion  | 758    |

|  |               |     |
|--|---------------|-----|
| • Retain bank holding companies that have ordinary shares listed on NYSE, AMEX, or NASDAQ                        | \$227 billion | 247 |
| • Retain bank holding companies with total consolidated assets of \$500 million or more as of September 30, 2008 | \$216 billion | 187 |

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**Panel B: Non-Bailout Banks**

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|   |      |     |
|---|------|-----|
| • Number of bank holding companies with total consolidated assets of \$500 million or more as of September 30, 2008 | N.A. | 976 |
| • Retain bank holding companies that have ordinary shares listed on NYSE, AMEX, or NASDAQ                           | N.A. | 318 |
| • Retain bank holding companies that did not receive TARP bailout funds by September 30, 2011                       | N.A. | 131 |

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*Notes:* Reported are the sample selection processes for the study. Panel A describes the construction of the sub-sample of bank holding companies that received TARP bailout funds by September 30, 2011 (i.e. bailout banks or treated group). Panel B describes the construction of the sub-sample of bank holding companies that did not receive TARP bailout funds by September 30, 2011 (i.e. non-bailout banks or control group).

### 3.2 Preliminary Analysis

We classify the banks following FDIC and Federal Reserve Guidelines into one of four size groups based on period-end book value of assets:

1. Greater than \$10 billion
2. Between \$3 billion and \$10 billion
3. Between \$1 billion and \$3 billion
4. Less than \$1 billion

Asset sizes of the BHCs as well as all accounting data are available from Bank Holding Company Data from Federal Reserve Bank of Chicago. All domestic bank holding companies with total assets of \$500 million or more are required to file FRY-9C on a consolidated basis. For the bank holding companies with data available we constructed a number of demographics, such as bank size and age, as well as financial variables, such as CAMELS. The main variables used in our analysis are listed in Table 2 along with their detailed definition and data sources.

**Table 2:** Definition of Main Variables and Source of Data

| Variable                        | Definition  | Source                                 |
|---------------------------------|---|--|
| Bailout amount<br>( <i>BA</i> ) | Amount of TARP funds received by a bailout bank (\$billions)                                  | Eye on the Bailout                     |
| Bailout ratio<br>( <i>BR</i> )  | Ratio of the amount of TARP funds received by a bailout bank to the bank's Tier 1 capital (%) | Eye on the Bailout;<br>BHC Data (BHCK) |

|                               |  |   |
|-------------------------------|--|---|
|                               |  | 8274)   |
| Capital adequacy<br>(CA)      | Ratio of Tier 1 capital to total risk-weighted assets (%)  | BHC Data (BHCK<br>8274 A223)  |
| Asset quality<br>(AQ)         | Ratio of noncurrent loans and leases (90 days or more past due or in nonaccrual status) to total loans and leases (%)  | BHC Data (BHCK<br>5525 5526 5369<br>B529)                             |
| Management<br>quality<br>(MQ) | Ratio of annualized total non-interest expense to annualized net operating income (%; net operating income is measured as the sum of net interest income and non-interest income)  | BHC Data (BHCK<br>4093 4074 4079)                                     |
| Earnings<br>(EAR)             | Ratio of annualized net income to average total assets (%)   | BHC Data (BHCK<br>4340 2170)  |
| Liquidity<br>(LIQ)            | Ratio of cash and balances due from depository institutions to deposits (%)  | BHC Data (BHCK<br>0081 0395 0397<br>BHDM 6631 6636<br>BHFN 6631 6636) |
| Sensitivity<br>(SEN)          | Ratio of the absolute difference between earning assets that are reparable within one year and interest-bearing deposit liabilities that are reparable within one year to total assets (% as a measure of sensitivity to interest rate risk) | BHC Data (BHCK<br>3197 3296 2170)                                     |
| Bank size<br>(SZ)             | Natural log of the book value of BHC's total assets (in thousands of US dollar) at quarter-end   | BHC Data (BHCK<br>2170)   |
| Bank age<br>(AGE)             | Number of years since the entity's general ledger was opened for the first time and/or the date on which the entity became active (years)  | BHC Data (RSSD<br>9950)   |
| Stock return<br>(R)           | Daily percentage change in stock price (%)   | CRSP US Stock   |
| Index return<br>(MKT)         | Daily return of the CRSP value-weighted index of all NYSE, AMEX, and NASDAQ firms (%)  | CRSP US Stock   |

*Notes:* Reported are the main variables used in the study along with their definitions and the sources of data. The bailout data is obtained from "Eye on the Bailout" database provided by ProPublica (<http://bailout.propublica.org/main/list/index>). Accounting information at bank holding company level is collected from Bank Holding Company Database provided by Federal Reserve Bank of Chicago ([http://www.chicagofed.org/webpages/banking/financial\\_institution\\_reports/bhc\\_data.cfm](http://www.chicagofed.org/webpages/banking/financial_institution_reports/bhc_data.cfm)). Income and expense attributed to each quarter is annualized and compared to average asset or liability balances for the corresponding quarter. Stock return data is retrieved from CRSP US Stock Database.

Table 3 below reports the summary statistics of the main variables used in the study. Reported are the mean, 25th percentile, median, 75th percentile, and standard deviation of each variable. The statistics for the financial variables reported in Table 3 are computed based on the Bank Holding Company Data

released at the end of September 2008, the latest financial information available before the announcement of TARP on October 14, 2008. The summary statistics for the four size groups are also reported in Appendix 3.

**Table 3:** Summary Statistics of the Main Variables for Bailout Banks

| <b>Variable</b> | <b>Mean</b> | <b>25<sup>th</sup><br/>Percentile</b> | <b>Median</b> | <b>75<sup>th</sup><br/>Percentile</b> | <b>Standard<br/>Deviation</b> | <b>No. of<br/>Obs.</b> |
|-----------------|-------------|---------------------------------------|---------------|---------------------------------------|-------------------------------|------------------------|
| <i>BA</i>       | 0.97        | 0.02                                  | 0.04          | 0.13                                  | 3.7338                        | 247                    |
| <i>BR</i>       | 29.34%      | 24.54%                                | 28.71%        | 32.20%                                | 0.1641                        | 185                    |
| <i>CA</i>       | 10.01%      | 9.11%                                 | 9.80%         | 10.73%                                | 0.0160                        | 185                    |
| <i>AQ</i>       | 1.91%       | 1.07%                                 | 1.63%         | 2.29%                                 | 0.0141                        | 185                    |
| <i>MQ</i>       | 67.81%      | 58.85%                                | 65.45%        | 73.33%                                | 0.2967                        | 185                    |
| <i>EAR</i>      | -0.02%      | 0.06%                                 | 0.45%         | 0.76%                                 | 0.0186                        | 185                    |
| <i>LIQ</i>      | 4.20%       | 2.42%                                 | 3.01%         | 3.82%                                 | 0.0642                        | 185                    |
| <i>SEN</i>      | 15.42%      | 6.13%                                 | 13.56%        | 23.42%                                | 0.1088                        | 185                    |
| <i>BZ</i>       | 15.28       | 13.99                                 | 14.71         | 15.95                                 | 1.8899                        | 185                    |
| <i>AGE</i>      | 21.69       | 11.00                                 | 22.00         | 26.00                                 | 15.2418                       | 185                    |

*Notes:* The table reports the summary statistics of the main variables used in the study. Reported are the mean, 25th percentile, median, 75th percentile, and standard deviation of each variable listed in Table II. The statistics for the financial variables are computed based on the Bank Holding Company Data released at the end of September 2008, the latest financial information available before the announcement of TARP on October 14, 2008. *BA* represents bailout amount (in billions \$), *BR* bailout ratio, *CA* capital adequacy, *AQ* asset quality, *MQ* management quality, *EAR* earnings, *LIQ* liquidity, *SEN* sensitivity, *SZ* bank size (natural log of total assets in thousands \$), and *AGE* bank age (number of years). The detailed definition and data source are available in Table 2.

Table 4 presents the pair-wise correlation among the main variables. Again, the statistics for the financial variables are computed based on the latest financial information available before the announcement of TARP.

**Table 4:** Correlation Coefficient Matrix of Main Variables for Bailout Banks

| <b>Variable</b> | <b><i>BA</i></b> | <b><i>BR</i></b> | <b><i>CA</i></b> | <b><i>AQ</i></b> | <b><i>MQ</i></b> | <b><i>EAR</i></b> | <b><i>LIQ</i></b> | <b><i>SEN</i></b> | <b><i>BZ</i></b> |
|-----------------|------------------|------------------|------------------|------------------|------------------|-------------------|-------------------|-------------------|------------------|
| <i>BR</i>       | 0.01             | 1.00             |                  |                  |                  |                   |                   |                   |                  |
| <i>CA</i>       | -0.29***         | -0.25***         | 1.00             |                  |                  |                   |                   |                   |                  |
| <i>AQ</i>       | 0.13*            | -0.05            | -0.02            | 1.00             |                  |                   |                   |                   |                  |
| <i>MQ</i>       | -0.01            | 0.01             | -0.18**          | -0.23***         | 1.00             |                   |                   |                   |                  |

|            |         |       |          |          |          |       |         |         |         |
|------------|---------|-------|----------|----------|----------|-------|---------|---------|---------|
| <i>EAR</i> | 0.03    | 0.01  | 0.05     | -0.33*** | -0.48*** | 1.00  |         |         |         |
| <i>LIQ</i> | 0.21*** | -0.02 | 0.08     | -0.07    | 0.09     | -0.01 | 1.00    |         |         |
| <i>SEN</i> | 0.19**  | 0.07  | -0.30*** | 0.03     | 0.06     | -0.02 | 0.06    | 1.00    |         |
| <i>BZ</i>  | 0.74*** | 0.01  | -0.35*** | 0.13     | 0.01     | 0.01  | 0.37*** | 0.32*** | 1.00    |
| <i>AGE</i> | 0.57*** | 0.05  | -0.22*** | 0.08     | 0.00     | -0.01 | 0.21*** | 0.13*   | 0.58*** |

*Notes:* The matrix reports the correlation coefficients between each pair of the main variables used in the study. The financial variables used to estimate the pair-wise correlation coefficients are computed based on the Bank Holding Company Data released at the end of September 2008, the latest financial information available before the announcement of TARP on October 14, 2008. *BA* represents bailout amount (in billions \$), *BR* bailout ratio, *CA* capital adequacy, *AQ* asset quality, *MQ* management quality, *EAR* earnings, *LIQ* liquidity, *SEN* sensitivity, *SZ* bank size (natural log of total assets in thousands \$), and *AGE* bank age (number of years). The detailed definition and data source are available in Table 2. \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

Apart from the bank-level variables, we also collected time series of the TED spread, the LIBOR-OIS spread, the VIX index, and the “Noise” measure. The four time series are plotted in the four panels in Figure 1, with vertical reference lines indicating the date that Lehman filed for bankruptcy (15 September 2008) and the date that TARP was announced (14 October 2008), respectively. The time series data is obtained from Bloomberg.<sup>6</sup>

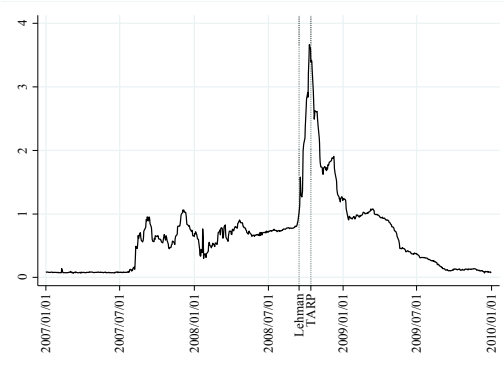
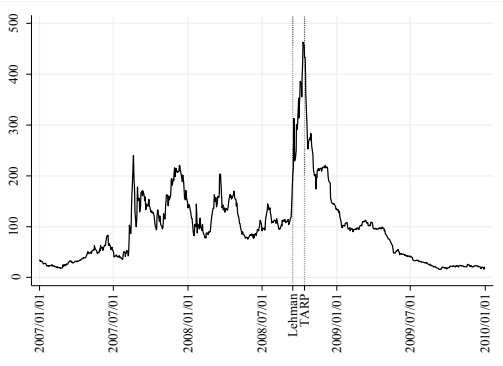
**Figure 1:** TED spread, LIBOR-OIS spread, VIX index and Noise Measure

**Panel A:** TED Spread

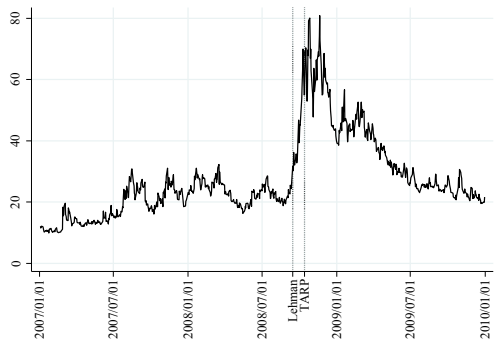
**Panel B:** LIBOR-OIS Spread

<sup>6</sup> The TED spread is the difference between the interest rates for the three-month Eurodollars contract, as represented by the London Interbank Offered Rate (LIBOR), and the three-month US government debt, as represented by the three-month Treasury bill interest rate. The size of the spread is denominated in basis points. The TED spread is an indicator of perceived credit risk in the general economy. This is because the Treasury bills are considered risk-free while LIBOR reflects the credit risk of lending to commercial banks. When the TED spread increases that is a sign that lenders believe the risk of default on interbank loans, i.e. counter-party risk, is increasing. LIBOR-OIS spread is the difference between LIBOR and the overnight indexed swap rate. The spread between the two rates is considered as a measure of health of the banking system. Three-month LIBOR is the generally floating rate of financing, which fluctuates depending on how risky a lending bank feels a borrowing bank is. The OIS is a swap derived from the overnight rate, which is generally fixed rate of interest over the same period. In the US, the spread is based on the LIBOR Eurodollar rate and the Federal Reserve’s Fed Funds rate. LIBOR is risky in the sense that the lending bank loans cash to the borrowing bank, and the OIS is considered stable as both counter-parties only swap the floating rate of interest for the fixed rate of interest. The spread between the two is therefore a measure of how likely it is that borrowing banks will default. This reflects risk premiums in contrast to liquidity premiums. The VIX is the ticker symbol for the Chicago Board Options Exchange Market Volatility Index, a popular measure of the implied volatility of S&P 500 index options. Often referred to as the fear index, it represents one measure of the market’s expectation of stock market volatility over the next 30 day period.

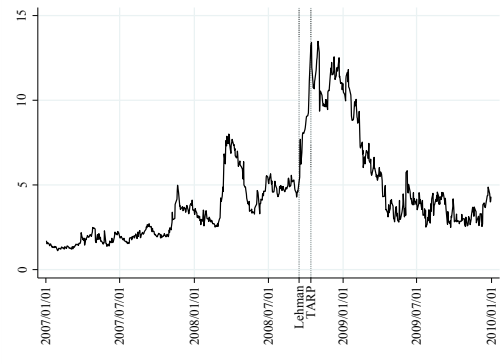




**Panel C: VIX Index**



**Panel D: Noise Measure**



*Notes:* The figure plots the time series of TED spread (difference between 3-month US LIBOR and US Treasury Bill), LIBOR-OIS spread (difference between the 3-month US LIBOR and the overnight SWAP rate), the VIX index from the Chicago Board of Option Exchange, and noise measure over the period of 2007 to 2009. The vertical reference lines indicate the events of Lehman's bankruptcy and the announcement of TARP respectively.

## 4. The Impact of TARP Bailouts on Stock Returns

### 4.1 Empirical Strategy

We conduct a standard event study to gauge the impact of TARP on stock returns. We are interested in two event dates. The first date is October 14, 2008 (the day of the announcement of TARP), and this date is the same for all banks in our sample. The second set of dates is the date that each bank in our sample actually received the TARP funds (the day of receipt), and each bank has a unique date.

We estimate bank returns using the following two models. The first model is Markowitz market model which is specified as follows

$$R_{it} = \alpha_i + \beta_{Mi} MKT_t + \varepsilon_{it}, \quad t \in [t_0, t_1] \quad (1)$$

where  $t_0$  and  $t_1$  denote the beginning and end of the time window where parameters are estimated (i.e. the estimation window),  $R_{it}$  is the daily stock market return of bank  $i$  between trading dates  $t - 1$  and  $t$  and  $MKT$  is defined as the daily return of the CRSP value-weighted index of all NYSE, AMEX and NASDAQ firms.

For the second model include the following Fama-French three factors model

$$R_{it} - RF_t = \alpha_i + \beta_{Mi} (MKT_t - RF_t) + \beta_{SMBi} SMB_t + \beta_{HMLi} HML_t + \varepsilon_{it} \quad (2)$$

where  $SMB$  is a size factor (small minus big) and  $HML$  is a value factor (high minus low).

We estimate the parameters of equation (1) and (2) with OLS using a window starting from September 17, 2007 to September 17, 2008 (i.e. the normal period), and use the estimated parameters to predict returns in windows of  $2T+1$  days around the event, i.e. 21 days, 11 days, 7 days, 3 days and 1 day before and after each event, or in other words  $[-10, +10]$ ,  $[-5, +5]$ ,  $[-3, +3]$ ,  $[-1, +1]$ , and  $[-1, 0]$ , where 0 is the day of the event.

Using the estimated parameters for the Markowitz market model (1), we define Market-adjusted return as follows

$$\hat{a}_{it} = \hat{\alpha}_i + \varepsilon_{it}, \quad t \in [t^* - T, t^* + T] \quad (3)$$

Similarly, using the estimated parameters for the Fama-French model (2), we define Fama-French adjusted return as follows

$$\hat{a}_{it} = RF_t + \hat{\alpha}_i + \varepsilon_{it} \quad (4)$$

We compute the abnormal returns of bank  $i$  as the deviation of the actual returns from those predicted by the Markowitz market model (1) and the Fama-French three factors model (2). The Fama-French benchmark factors are obtained from Kenneth R. French Data Library. Market capitalization and daily stock returns are retrieved from CRSP database. For the Markowitz market model, the abnormal returns are computed from the following equation

$$\hat{\varepsilon}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_{Mi} MKT_t, \quad t \in [t_0, t_1] \quad (5)$$

Similarly for the Fama-French model, we define the abnormal returns as follows

$$\hat{\varepsilon}_{it} = (R_{it} - RF_t) - \hat{\alpha}_i - \hat{\beta}_{Mkt}(MKT_t - RF_t) - \hat{\beta}_{SMB_i}SMB_t - \hat{\beta}_{HML_i}HML_t \quad (6)$$

The individual banks' abnormal returns are aggregated using  $\hat{\varepsilon}_{it}$  from either equation (5) or equation (6) for each trading day ( $t$ ) within estimation window  $[t^* - T, t^* + T]$ . The aggregated abnormal return for trading day  $t$  is

$$AR_t = \frac{1}{N} \sum_{i=1}^N \hat{\varepsilon}_{it} \quad (7)$$

Average cumulative abnormal returns ( $CAR_t$ ) are derived by summing the abnormal returns over various intervals

$$CAR_t = \sum_{i=t^*-T}^t AR_t \quad (8)$$

#### 4.2 The Announcement of TARP

Table 5 presents the mean, median and standard deviation of the following variables around the day of the announcement of TARP: (a) raw stock returns (b) market adjusted stock returns (c) Fama-French adjusted stock returns (d) market abnormal returns (e) Fama-French abnormal returns (f) cumulative abnormal returns for the market model (g) cumulative abnormal returns for the Fama-French model. The statistical significance of all the above variables are tested and indicated at the 1%, 5% and 10% significance levels, respectively. Standard errors are adjusted for heteroskedasticity and autocorrelation. As shown in the table, even though the average raw stock returns of bailout banks in the sample are negative over the event windows of  $[-10, +10]$  and  $[-5, +5]$  around the announcement of TARP, the adjusted returns, abnormal returns, cumulative abnormal returns are uniformly positive regardless of the model specification and the event window chosen. Bailout banks' stocks responded to the announcement of TARP favorably, implying that the launch of TARP indeed restored investors' confidence in the financial system.

**Table 5:** Returns around the Announcement of TARP

| Event Window | Variable             | Mean    | Median  | Standard Deviation |
|--------------|----------------------|---------|---------|--------------------|
| [-10, +10]   | Raw stock returns    | -0.2688 | -0.6452 | 8.3692             |
|              | Market-adjusted      | 0.5314  | 0.2064  | 8.0714             |
|              | Fama-French adjusted | 0.9728  | 0.7105  | 7.1287             |
|              | Market abnormal      | 0.5389  | 0.2593  | 8.0659             |
|              | Fama-French abnormal | 1.0452  | 0.7701  | 7.1252             |
|              | Market CARs          | 11.3174 | 10.3874 | 22.6704            |

|          |                      |         |         |         |
|----------|----------------------|---------|---------|---------|
|          | Fama-French CARs     | 21.9494 | 20.3621 | 28.9470 |
| [-5, +5] | Raw stock returns    | -0.3090 | -0.7092 | 9.3334  |
|          | Market-adjusted      | 0.4180  | -0.1989 | 8.9879  |
|          | Fama-French adjusted | 0.7862  | 0.3420  | 7.6155  |
|          | Market abnormal      | 0.4256  | -0.1708 | 8.9862  |
|          | Fama-French abnormal | 0.8587  | 0.3821  | 7.6162  |
|          | Market CARs          | 4.6818  | 4.0306  | 12.3306 |
|          | Fama-French CARs     | 9.4462  | 9.5255  | 14.2313 |
| [-3, +3] | Raw stock returns    | 0.7431  | 0.0000  | 10.5482 |
|          | Market-adjusted      | 1.1624  | 0.1088  | 10.2629 |
|          | Fama-French adjusted | 1.0865  | 0.5231  | 8.4742  |
|          | Market abnormal      | 1.1699  | 0.1840  | 10.2616 |
|          | Fama-French abnormal | 1.1590  | 0.5495  | 8.4770  |
|          | Market CARs          | 8.1896  | 7.3756  | 11.7458 |
|          | Fama-French CARs     | 8.1131  | 7.0935  | 11.7179 |
| [-1, +1] | Raw stock returns    | 1.6564  | 0.2207  | 10.3629 |
|          | Market-adjusted      | 1.1580  | 0.8671  | 11.3399 |
|          | Fama-French adjusted | 1.9108  | 1.3649  | 9.1580  |
|          | Market abnormal      | 1.1656  | 0.8097  | 11.3543 |
|          | Fama-French abnormal | 1.9834  | 1.4312  | 9.1702  |
|          | Market CARs          | 3.4967  | 1.5815  | 12.7179 |
|          | Fama-French CARs     | 5.9502  | 4.8520  | 11.9421 |
| [0]      | Raw stock returns    | 3.7565  | 2.0313  | 10.7747 |
|          | Market-adjusted      | 4.5966  | 2.4801  | 10.8843 |
|          | Fama-French adjusted | 2.9488  | 2.3082  | 9.8143  |
|          | Market abnormal      | 4.6041  | 2.4352  | 10.9128 |
|          | Fama-French abnormal | 3.0213  | 2.3408  | 9.8427  |
|          | Market CARs          | 4.6041  | 2.4352  | 10.9128 |
|          | Fama-French CARs     | 3.0213  | 2.3408  | 9.8427  |

*Notes:* Summary statistics are presented for the returns of the bailout banks around October 14, 2008 (the day of the announcement of TARP). The sample of banks that accepted TARP bailout funds during the October 2008 to December 2009 period is obtained from ProPublicas TARP database. Stock return data is retrieved from CRSP US Stock database. Reported are mean, median, and standard deviations of row

stock returns, market-adjusted stock returns, Fama-French adjusted returns, market abnormal returns, Fama-French abnormal returns, market CARs, and Fama-French CARs in event windows of  $2T + 1$  trading days around the announcement of TARP, i.e. 21 days, 11 days, 7 days, 3 days and 1 day around October 14, 2008. The return variables are defined in the text.

Table 6 shows the point and cumulative estimates of the average abnormal returns around the day of the announcement of TARP (i.e. October 14, 2008) estimated using one-factor market model. Figure 2 provides a graphical overview of the average CARs by plotting the average CARs against trading days relative to the day of the announcement of TARP along their 90 percent confidence bands. The point (daily average) and cumulative (relative to 10 days before the event) abnormal returns estimated using one-factor market model confirm the observation from Table 5. The average abnormal returns are significantly positive on the day of the announcement of TARP as well as the day after, both are greater than 4%, suggesting the event had an immediate effect on banks' stock performance. Even if we control for the pre-event trend (average daily abnormal return of 0.56% pre-event), the bailout banks' cumulative abnormal returns after the announcement of TARP are still significantly positive.

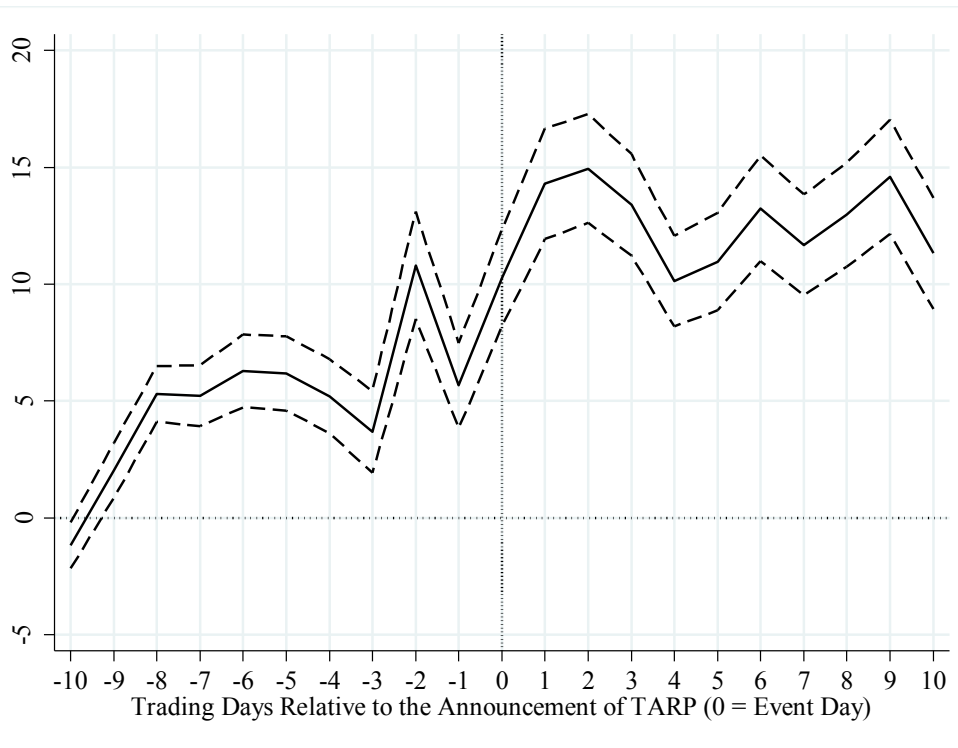
**Table 6:** Point and Cumulative Market Abnormal Returns around the Announcement of TARP

| Event Day | Point Estimation |           | CAR Estimation |           |
|-----------|------------------|-----------|----------------|-----------|
|           | Mean             | Std. Dev. | Mean           | Std. Dev. |
| -10       | -1.1797**        | 0.5995    | -1.1797**      | 0.5995    |
| -9        | 3.2076***        | 0.4783    | 2.0279***      | 0.7144    |
| -8        | 3.2726***        | 0.3762    | 5.3005***      | 0.7246    |
| -7        | -0.0726          | 0.3214    | 5.2278***      | 0.7879    |
| -6        | 1.0556**         | 0.4689    | 6.2834***      | 0.9428    |
| -5        | -0.1050          | 0.3486    | 6.1784***      | 0.9646    |
| -4        | -0.9712**        | 0.4053    | 5.2072***      | 0.9615    |
| -3        | -1.5332***       | 0.4652    | 3.6740***      | 1.0621    |
| -2        | 7.1279***        | 0.8051    | 10.8019***     | 1.3917    |
| -1        | -5.1411***       | 0.7728    | 5.6609***      | 1.1023    |
| 0         | 4.6041***        | 0.6944    | 10.2650***     | 1.2588    |
| 1         | 4.0336***        | 0.4975    | 14.2986***     | 1.4356    |
| 2         | 0.6496           | 0.4648    | 14.9482***     | 1.4079    |
| 3         | -1.5513***       | 0.3725    | 13.3969***     | 1.3123    |
| 4         | -3.2654***       | 0.3706    | 10.1315***     | 1.1757    |
| 5         | 0.8337**         | 0.3329    | 10.9652***     | 1.2634    |
| 6         | 2.2857***        | 0.3874    | 13.2509***     | 1.3685    |

|    |            |        |            |        |
|----|------------|--------|------------|--------|
| 7  | -1.5725*** | 0.3873 | 11.6785*** | 1.3074 |
| 8  | 1.2891***  | 0.3207 | 12.9676*** | 1.3491 |
| 9  | 1.6307***  | 0.3458 | 14.5982*** | 1.4816 |
| 10 | -3.2808*** | 0.4429 | 11.3175*** | 1.4425 |

*Notes:* The table shows the point and cumulative abnormal returns estimated using Markowitz market model in a window of ten days before and ten days after October 14, 2008 (the day of the announcement of TARP). The point and cumulative estimate of the average returns for the event are reported along their standard error. Standard errors are adjusted for heteroskedasticity and autocorrelation. The return variables are defined in the text. \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

**Figure 2:** The Evolvement of Market CARs around the Announcement of TARP.



*Notes:* The figure shows the average cumulative returns of the bailout banks in the sample in a window of ten days before and after October 14, 2008 (the day of the announcement of TARP), along their 90% confidence bands. CARs plotted in this figure are estimated using Markowitz market model.

Table 7 shows the point and cumulative estimates of the average abnormal returns around the day of the announcement of TARP estimated using Fama-French model. Figure 3 provides a graphical overview of the average CARs by plotting the average CARs against trading days relative to the day of the announcement of TARP (i.e. October 14, 2008) along their 90 percent confidence bands. The point and cumulative abnormal returns estimated using three-factor Fama-French model are more positive and more significant than their one-factor market model counterparts around the event window of 10 days

before and after the announcement of TARP, confirming that the TARP to a great extent restored investors' confidence in financial system.

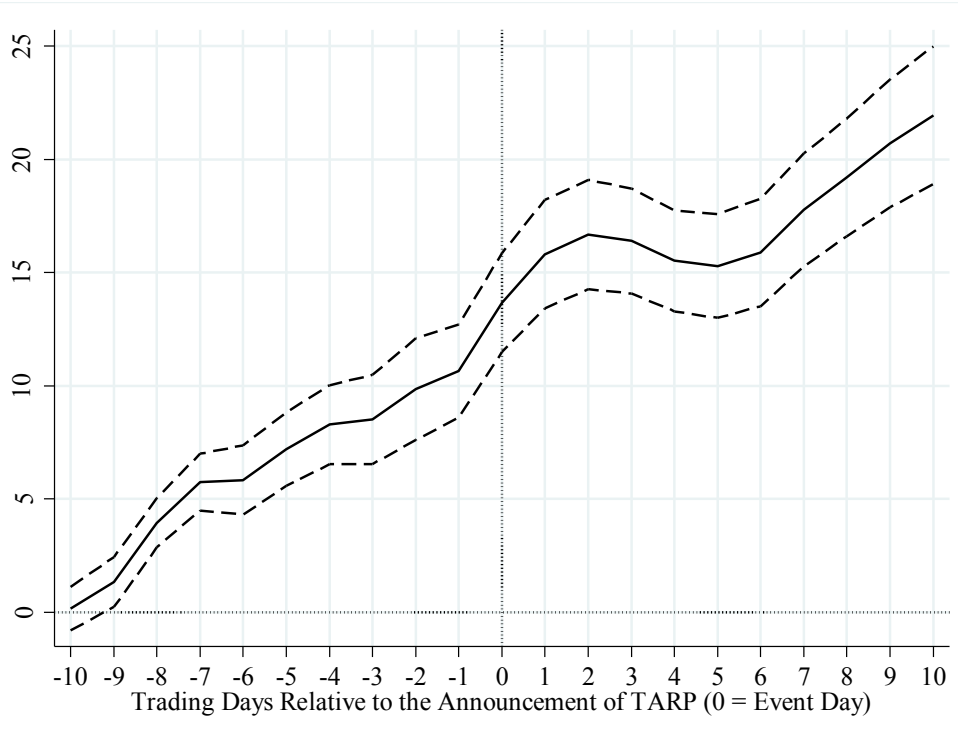
The cumulative Fama-French abnormal return over the entire event window is as high as 21.95%. The difference between Figure 2 and Figure 3 may be explained by the size effect that large bank responded to the announcement of TARP more positively than the small banks. To provide further insights, we split the bailout banks in our sample into 5 sub-samples based on their book value of assets as of the quarter-end of the announcement of TARP, i.e. 31 December, 2008. The cumulative abnormal return over the event window of 10 days before and after the event are reported for each of the 5 sub-samples, see Appendix 4. It clearly shows that the large banks were performing significantly better than the small banks when the TARP was announced. This difference may be because the large banks are more likely to be bailed out if it is needed in the future.

**Table 7: Point and Cumulative Fama-French Abnormal Returns around the Announcement of TARP**

| Event Day | Point Estimation |           | CAR Estimation |           |
|-----------|------------------|-----------|----------------|-----------|
|           | Mean             | Std. Dev. | Mean           | Std. Dev. |
| -10       | 0.1653           | 0.5822    | 0.1653         | 0.5822    |
| -9        | 1.1677***        | 0.4582    | 1.3330**       | 0.6633    |
| -8        | 2.6207***        | 0.3640    | 3.9537***      | 0.6573    |
| -7        | 1.7938***        | 0.3458    | 5.7475***      | 0.7581    |
| -6        | 0.0955           | 0.4566    | 5.8429***      | 0.9229    |
| -5        | 1.3640***        | 0.3818    | 7.2069***      | 0.9809    |
| -4        | 1.0793***        | 0.4109    | 8.2862***      | 1.0577    |
| -3        | 0.2222           | 0.4738    | 8.5085***      | 1.1922    |
| -2        | 1.3553**         | 0.6742    | 9.8637***      | 1.3584    |
| -1        | 0.7876           | 0.6538    | 10.6513***     | 1.2451    |
| 0         | 3.0213***        | 0.6263    | 13.6727***     | 1.3190    |
| 1         | 2.1412***        | 0.4406    | 15.8139***     | 1.4506    |
| 2         | 0.8704**         | 0.4359    | 16.6843***     | 1.4585    |
| 3         | -0.2849          | 0.3600    | 16.3994***     | 1.4062    |
| 4         | -0.8778***       | 0.3328    | 15.5216***     | 1.3467    |
| 5         | -0.2324          | 0.3210    | 15.2892***     | 1.3857    |
| 6         | 0.6062**         | 0.3574    | 15.8954***     | 1.4431    |
| 7         | 1.8690***        | 0.4024    | 17.7644***     | 1.5116    |
| 8         | 1.4465***        | 0.3216    | 19.2109***     | 1.5751    |
| 9         | 1.4977***        | 0.3391    | 20.7086***     | 1.7110    |

*Notes:* The table shows the point and cumulative abnormal returns estimated using Fama-French three-factor model in a window of ten days before and ten days after October 14, 2008 (the day of the announcement of TARP). The point and cumulative estimate of the average returns for the event are reported along their standard error. Standard errors are adjusted for heteroskedasticity and autocorrelation. The return variables are defined in the text. \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

**Figure 3:** The Evolvement of Fama-French CARs around the Announcement of TARP



*Notes:* The figure shows the average cumulative returns of the bailout banks in the sample in a window of ten days before and after October 14, 2008 (the day of the announcement of TARP), along their 90% confidence bands. CARs plotted in this figure are estimated using Fama-French three-factor model.

### 4.3 The Receipt of TARP Funds

Table 8 presents the mean, median and standard deviation of the same set of variables as defined in Table 5, but the event date is set to be the day that each bailout bank in our sample actually received the TARP funds, i.e. the day of receipt. In contrast to the results presented in Table 5, the bailout banks' stock returns around the day of the receipt of TARP funds are negative according to most of the measures, especially in the event window of 1 day before and after the event. However, the one-factor market model and three-factor Fama-French model give us conflicting results if alternative event windows are considered. Returns estimated using one-factor market model show a negative market reaction to the receipt of the bailout funds, while returns estimated using Fama-French three-factor model are all



positive even though their magnitudes are fairly small (close to zero). The medians of the returns are consistently negative regardless of the model specification and event window considered. Our empirical results are consistent with the findings of Bayazitova and Shivdasani (2012) that the receipt of TARP funds did not have meaningful certification effect.

**Table 8:** Returns around the Receipt of TARP Funds

| <b>Event Window</b> | <b>Variable</b>      | <b>Mean</b> | <b>Median</b> | <b>Standard Deviation</b> |
|---------------------|----------------------|-------------|---------------|---------------------------|
| [-10, +10]          | Raw stock returns    | -0.2144     | -0.1300       | 7.4602                    |
|                     | Market-adjusted      | -0.1937     | -0.2594       | 6.6341                    |
|                     | Fama-French adjusted | -0.0728     | -0.1534       | 6.5758                    |
|                     | Market abnormal      | -0.1862     | -0.2798       | 6.6376                    |
|                     | Fama-French abnormal | 0.0009      | -0.0917       | 6.5784                    |
|                     | Market CARs          | -3.9096     | -3.6984       | 20.6118                   |
|                     | Fama-French CARs     | 0.0184      | -1.2966       | 20.1531                   |
| [-5, +5]            | Raw stock returns    | -0.3758     | -0.3596       | 7.7510                    |
|                     | Market-adjusted      | -0.1881     | -0.2196       | 7.0529                    |
|                     | Fama-French adjusted | 0.0409      | -0.0512       | 7.0174                    |
|                     | Market abnormal      | -0.1805     | -0.2220       | 7.0558                    |
|                     | Fama-French abnormal | 0.1145      | -0.0091       | 7.0200                    |
|                     | Market CARs          | -1.9856     | -2.4537       | 14.1084                   |
|                     | Fama-French CARs     | 1.2593      | -0.9079       | 14.8878                   |
| [-3, +3]            | Raw stock returns    | -0.2312     | -0.3223       | 7.7341                    |
|                     | Market-adjusted      | -0.2338     | -0.2337       | 7.0137                    |
|                     | Fama-French adjusted | -0.0617     | -0.0964       | 7.0199                    |
|                     | Market abnormal      | -0.2263     | -0.2354       | 7.0153                    |
|                     | Fama-French abnormal | 0.0118      | -0.0525       | 7.0219                    |
|                     | Market CARs          | -1.5838     | -2.5484       | 14.4073                   |
|                     | Fama-French CARs     | 0.0826      | -0.9841       | 14.4458                   |
| [-1, +1]            | Raw stock returns    | -0.3670     | -0.5278       | 8.1077                    |
|                     | Market-adjusted      | -0.4157     | -0.2545       | 7.4903                    |
|                     | Fama-French adjusted | -0.1354     | -0.1101       | 7.3808                    |
|                     | Market abnormal      | -0.4082     | -0.2121       | 7.4915                    |
|                     | Fama-French abnormal | -0.0619     | -0.0382       | 7.3806                    |

|     |                      |         |         |         |
|-----|----------------------|---------|---------|---------|
|     | Market CARs          | -1.2245 | -1.3223 | 10.9505 |
|     | Fama-French CARs     | -0.1858 | -0.1244 | 10.6885 |
| [0] | Raw stock returns    | 0.9151  | 0.0000  | 8.5662  |
|     | Market-adjusted      | -0.2565 | -0.3593 | 8.1581  |
|     | Fama-French adjusted | 0.0776  | -0.2835 | 8.1485  |
|     | Market abnormal      | -0.2489 | -0.2121 | 8.1574  |
|     | Fama-French abnormal | 0.1511  | -0.2458 | 8.1434  |
|     | Market CARs          | -0.2489 | -0.2121 | 8.1574  |
|     | Fama-French CARs     | 0.1511  | -0.2458 | 8.1434  |

*Notes:* Summary statistics are presented for the returns of the bailout banks around the day that each bank in the sample actually received the TARP funds. This event date is specific to each bailout bank, ranging from October 2008 to December 2009. The sample of banks that accepted TARP bailout funds during this period is obtained from ProPublica's TARP database. Stock return data is retrieved from CRSP US Stock database. Reported are mean, median, and standard deviations of raw stock returns, market-adjusted stock returns, Fama-French adjusted returns, market abnormal returns, Fama-French abnormal returns, market CARs, and Fama-French CARs in event windows of  $2T + 1$  trading days around the date that each bank received the TARP funds, i.e. 21 days, 11 days, 7 days, 3 days and 1 day around the day of receipt. The return variables are defined in the text.

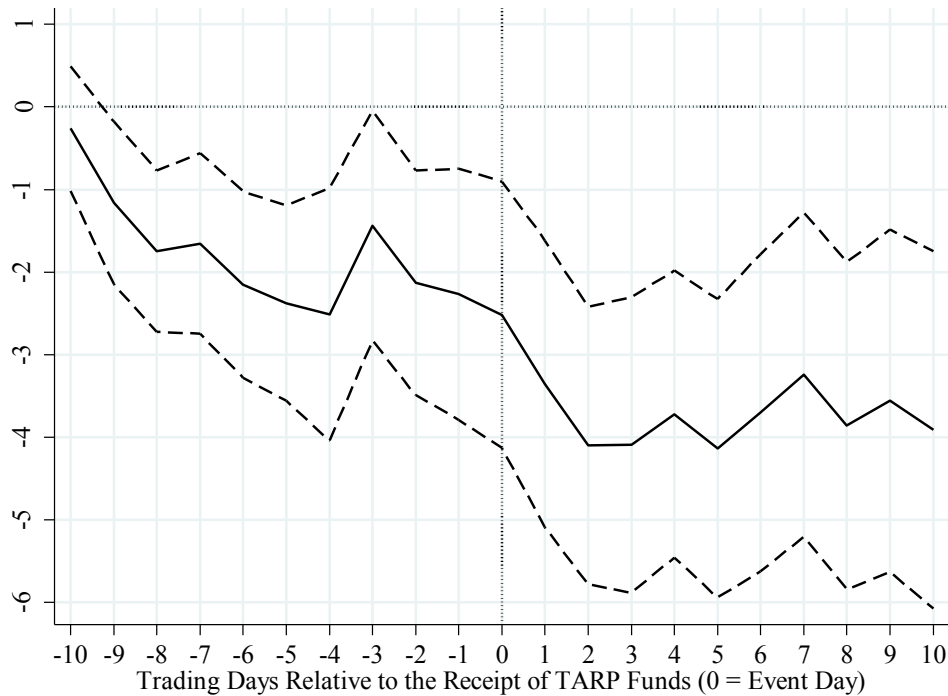
Table 9 reports the point and cumulative estimates of the average abnormal returns around the day of the receipt of TARP funds using market model. Figure 4 provides a graphical overview of the average CARs by plotting the dynamics of the average CARs against trading date relative to the day of the receipt of TARP funds along their 90 percent confidence bands. In line with the results reported in Table 8, the cumulative abnormal returns estimated using one-factor market model remain negative throughout the entire event window of 10 days before and after the banks actually received the bailout funds. The bailout bank experienced significantly negative abnormal returns immediately after the receipt of TARP funds. Although the bailout banks underperformed the market before they received the bailout funds, they performed even worse after the event. The negative cumulative abnormal returns are still significant even if we control for the pre-event downward trend. This may suggest that the receipt of TARP funds conveyed a signal that the bank is in trouble to the market, therefore the event was interpreted as a bad news by the outside investors.

**Table 9: Point and Cumulative Market Abnormal Returns around the Receipt of TARP Funds**

| Event Day | Point Estimation |           | CAR Estimation |           |
|-----------|------------------|-----------|----------------|-----------|
|           | Mean             | Std. Dev. | Mean           | Std. Dev. |
| -10       | -0.2615          | 0.4571    | -0.2615        | 0.4571    |
| -9        | -0.9011**        | 0.4222    | -1.1627*       | 0.5972    |
| -8        | -0.5859          | 0.3877    | -1.7486***     | 0.5915    |
| -7        | 0.0942           | 0.4259    | -1.6544**      | 0.6610    |
| -6        | -0.4960          | 0.3999    | -2.1504***     | 0.6831    |
| -5        | -0.2266          | 0.4051    | -2.3771***     | 0.7165    |
| -4        | -0.1345          | 0.5779    | -2.5116***     | 0.9269    |
| -3        | 1.0749**         | 0.4933    | -1.4367*       | 0.8428    |
| -2        | -0.6945**        | 0.3428    | -2.1313**      | 0.8238    |
| -1        | -0.1377          | 0.4487    | -2.2690**      | 0.9216    |
| 0         | -0.2489          | 0.5190    | -2.5179**      | 0.9776    |
| 1         | -0.8379*         | 0.4600    | -3.3557***     | 1.0529    |
| 2         | -0.7471*         | 0.4066    | -4.1028***     | 1.0186    |
| 3         | 0.0075           | 0.4248    | -4.0954***     | 1.0850    |
| 4         | 0.3745           | 0.4150    | -3.7208***     | 1.0519    |
| 5         | -0.4153          | 0.3922    | -4.1361***     | 1.0947    |
| 6         | 0.4329           | 0.3655    | -3.7032***     | 1.1637    |
| 7         | 0.4601           | 0.3726    | -3.2431***     | 1.1885    |
| 8         | -0.6175*         | 0.3270    | -3.8606***     | 1.2005    |
| 9         | 0.3006           | 0.3526    | -3.5599***     | 1.2553    |
| 10        | -0.3497          | 0.3794    | -3.9096***     | 1.3115    |

*Notes:* The table shows the point and cumulative abnormal returns estimated using Markowitz market model in a window of ten days before and ten days after the day of the receipt of TARP funds (the event day is specific to each bailout bank). The point and cumulative estimate of the average returns for the event are reported along their standard error. Standard errors are adjusted for heteroskedasticity and autocorrelation. The return variables are defined in the text. \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

**Figure 4:** The Evolvement of Market CARs around the Receipt of TARP Funds



*Notes:* The figure shows the average cumulative returns of the bailout banks in the sample in a window of ten days before and after the bailout banks in the sample received the TARP funds (this event day is specific to each bank), along their 90% confidence bands. CARs plotted in this figure are estimated using Markowitz market model.

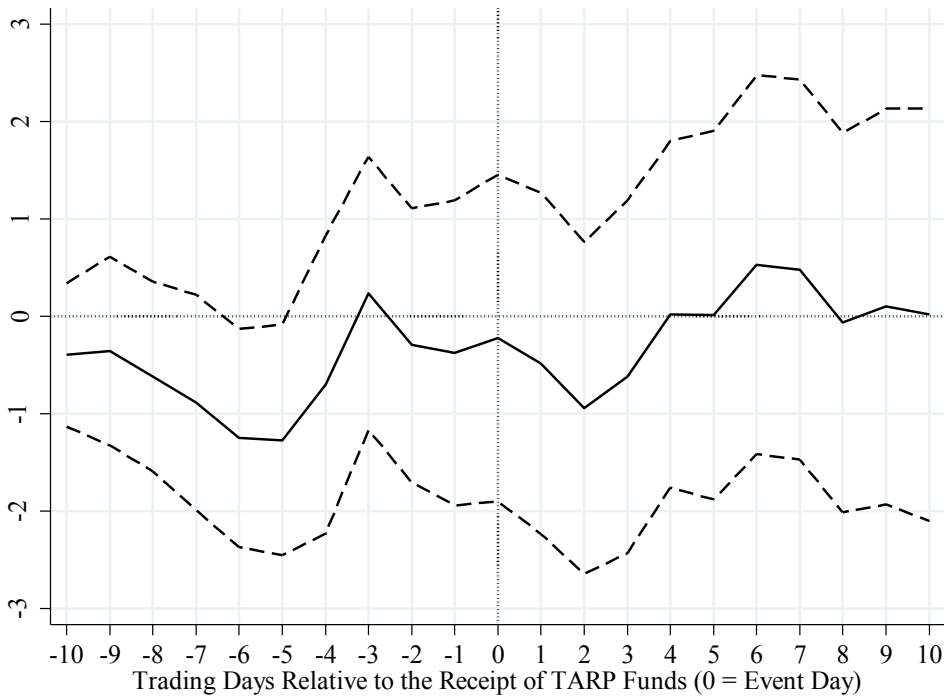
Table 10 shows the point and cumulative estimates of the average abnormal returns around the day of the receipt of TARP funds using Fama-French model. Figure 5 provides a graphical overview of the average CARs by plotting the average CARs against trading days relative to the day of the receipt of TARP funds along their 90 percent confidence bands. The point and cumulative abnormal returns estimated using Fama-French three-factor model show that the cumulative abnormal returns are not significantly different from zero during the period of 10 days before and after the banks received their bailout funds. Again, the difference between three-factor Fama-French model results and one-factor market model results may be caused by the size effect, which means the significantly negative abnormal return obtained using one-factor market model can largely be explained by the size factor included in the Fama-French three-factor model. To provide further evidence, we also report the sub-sample summary statistics for the cumulative abnormal returns for the 4 size groups as defined above, see Appendix 5. It seems that on average the big banks' cumulative abnormal returns over the period of 10 trading days before and after the receipt of the TARP funds are more negative than that of small banks. The smallest banks with book value of total assets less than \$1 billion experienced positive cumulative abnormal returns over the event window.

**Table 10:** Point and Cumulative Fama-French Abnormal Returns around the Receipt of TARP Funds

| Event Day | Point Estimation |           | CAR Estimation |           |
|-----------|------------------|-----------|----------------|-----------|
|           | Mean             | Std. Dev. | Mean           | Std. Dev. |
| -10       | -0.3969          | 0.4451    | -0.3969        | 0.4451    |
| -9        | 0.0411           | 0.4190    | -0.3557        | 0.5870    |
| -8        | -0.2615          | 0.3935    | -0.6172        | 0.5910    |
| -7        | -0.2675          | 0.4369    | -0.8847        | 0.6699    |
| -6        | -0.3636          | 0.3910    | -1.2482*       | 0.6799    |
| -5        | -0.0221          | 0.3972    | -1.2703*       | 0.7174    |
| -4        | 0.5682           | 0.5732    | -0.7021        | 0.9268    |
| -3        | 0.9399*          | 0.4942    | 0.2378         | 0.8496    |
| -2        | -0.5330          | 0.3580    | -0.2953        | 0.8514    |
| -1        | -0.0795          | 0.4355    | -0.3748        | 0.9487    |
| 0         | 0.1511           | 0.5182    | -0.2237        | 1.0167    |
| 1         | -0.2573          | 0.4526    | -0.4810        | 1.0611    |
| 2         | -0.4594          | 0.4127    | -0.9404        | 1.0329    |
| 3         | 0.3209           | 0.4359    | -0.6195        | 1.0976    |
| 4         | 0.6417           | 0.4183    | 0.0222         | 1.0777    |
| 5         | -0.0112          | 0.3700    | 0.0110         | 1.1462    |
| 6         | 0.5199           | 0.3563    | 0.5310         | 1.1789    |
| 7         | -0.0494          | 0.3671    | 0.4816         | 1.1827    |
| 8         | -0.5459*         | 0.3094    | -0.0643        | 1.1798    |
| 9         | 0.1660           | 0.3428    | 0.1016         | 1.2307    |
| 10        | -0.0833          | 0.3723    | 0.0184         | 1.2823    |

*Notes:* The table shows the point and cumulative abnormal returns estimated using Fama-French three-factor model in a window of ten days before and ten days after the day of the receipt of TARP funds (the event day is specific to each bailout bank). The point and cumulative estimate of the average returns for the event are reported along their standard error. Standard errors are adjusted for heteroskedasticity and autocorrelation. The return variables are defined in the text. \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

**Figure 5:** The Evolution of Fama-French CARs around the Receipt of TARP Funds



*Notes:* The figure shows the average cumulative returns of the bailout banks in the sample in a window ten days before and after the bailout banks in the sample received the TARP funds (this event day is specific to each bank), along their 90% confidence bands. CARs plotted in this figure are estimated using Fama-French three-factor model.

#### 4.4 Counterfactual Analysis

We also employ propensity score matching methods to check the robustness of our baseline results. We match bailout banks (treated) and non-bailout banks (untreated) on their financial variables (i.e. CAMELS variables) as well as demographic variables (i.e. bank size and age) as observed at the end of September 2008, the latest financial information available before the announcement of TARP. The matched bailout and their counterfactuals, i.e. non-bailout banks with similar background characteristics, are used to compare the performance in the event window of 3 days surrounding the receipt of TARP funds. The difference in performance between each bailout bank and its counterfactual is calculated. The average of the differences across all observations is the estimated average treatment effect on the treated (ATT).

We use the nearest neighbor method to match bailout bank to their counterfactuals. More specifically, we assign each matched counterfactual (non-bailout bank) a (fake) event day which is identical to the day of its bailout counterpart received the TARP funds. We then estimate and compute the cumulative abnormal return of the counterfactual 3 days before and after its fake event day. The difference from the observed outcome, which in this case is the accumulative abnormal return in the event window, for the bailout banks and their counterfactuals is the average causal effect. The estimated results for the causal model with outcome is reported in Table 11.

**Table 11: Propensity Matching Estimate of Receiving TARP Funds on the Bailout Banks**

| <b>Panel A: Logistic regression of receiving TARP funds on bank characteristics</b>      |                    |                  |                    |                |                                |                    |
|--|--------------------|------------------|--------------------|----------------|--------------------------------|--------------------|
| <b>Variable</b>  | <b>Coefficient</b> | <b>Std. Dev.</b> | <b>z-statistic</b> | <b>p-value</b> | <b>95% confidence interval</b> |                    |
| <i>CA</i>  | -16.6126           | 6.3852           | -2.60              | 0.01           | -29.13                         | -4.10              |
| <i>AQ</i>  | 13.9568            | 6.2954           | 2.22               | 0.03           | 1.62                           | 26.30              |
| <i>MQ</i>  | 0.0193             | 0.1666           | 0.12               | 0.91           | -0.31                          | 0.35               |
| <i>EAR</i>   | 7.2442             | 4.9073           | 1.48               | 0.14           | -2.37                          | 16.86              |
| <i>LIQ</i>   | -3.3221            | 2.0722           | -1.60              | 0.11           | -7.38                          | 0.74               |
| <i>SEN</i>   | -0.4131            | 1.1382           | -0.36              | 0.72           | -2.64                          | 1.82               |
| <i>SZ</i>  | 0.2619             | 0.1056           | 2.48               | 0.01           | 0.05                           | 0.47               |
| <i>AGE</i>   | 0.0094             | 0.0122           | 0.77               | 0.44           | -0.01                          | 0.03               |
| <i>Constant</i>  | -1.8016            | 1.7748           | -1.02              | 0.31           | -5.28                          | 1.68               |
| <b>Panel B: Estimate difference in balance</b>   |                    |                  |                    |                |                                |                    |
| <b>Variable</b>  | <b>Sample</b>      | <b>Treated</b>   | <b>Control</b>     | <b>% bias</b>  | <b>% reduce</b>                | <b>t-statistic</b> |
| <i>CA</i>  | Unmatched          | 0.0990           | 0.1143             | -26.70         |                                | -2.38              |
|  | Matched            | 0.0990           | 0.0977             | 2.20           | 91.70                          | 0.60               |
| <i>AQ</i>  | Unmatched          | -0.0202          | -0.0274            | 28.40          |                                | 2.52               |
|  | Matched            | -0.0202          | -0.0175            | -10.50         | 63.00                          | -1.66              |
| <i>MQ</i>  | Unmatched          | -0.4277          | -0.4118            | -2.10          |                                | -0.18              |
|  | Matched            | -0.4277          | -0.3522            | -9.80          | -374.40                        | -0.97              |
| <i>EAR</i>   | Unmatched          | 0.0000           | -0.0076            | 22.00          |                                | 1.96               |
|  | Matched            | 0.0000           | -0.0007            | 2.20           | 90.10                          | 0.38               |
| <i>LIQ</i>   | Unmatched          | 0.0405           | 0.0718             | -14.60         |                                | -1.30              |
|  | Matched            | 0.0405           | 0.0362             | 2.00           | 86.20                          | 0.93               |
| <i>SEN</i>   | Unmatched          | 0.1530           | 0.1351             | 15.90          |                                | 1.40               |
|  | Matched            | 0.1530           | 0.1649             | -10.60         | 33.00                          | -0.84              |
| <i>SZ</i>  | Unmatched          | 15.4600          | 14.6300            | 49.90          |                                | 4.39               |
|  | Matched            | 15.4600          | 15.2390            | 13.30          | 73.40                          | 1.15               |
| <i>AGE</i>   | Unmatched          | 24.0380          | 19.9800            | 31.80          |                                | 2.80               |
|  | Matched            | 24.0380          | 22.3400            | 13.30          | 58.10                          | 1.16               |
| <b>Panel C: Estimate of average effect of the receipt of TARP funds on bailout banks</b> |                    |                  |                    |                |                                |                    |

| Variable        | Sample | Treated | Controls | Difference | S.E. | t-statistic |
|-----------------|--------|---------|----------|------------|------|-------------|
| $CAR_{-10, 10}$ | ATT    | -2.0761 | -0.0303  | -2.05      | 1.16 | -1.77       |

*Notes:* The table reports propensity score matching estimate of the average effect of the receipt of TARP funds on the stock performance of the bailout banks. Panel A reports the estimation results for the logistic regression of a binary bailout variable (bank actually received TARP funds=1, and bank did not actually receive TARP funds=0) on bank characteristics. The estimated logistic regression is then used to predict each bank's propensity score, i.e. the probability of receiving TARP funds. According to the predicted propensity score, each bailout bank is matched to its "nearest neighbor" who did not actually receive bailout funds. Panel B assesses balance between treated and control groups. Reported are the estimated difference in means between bailout banks and non-bailout banks for bank characteristics variables before and after matching. A decrease in difference implies an increase in balance with respect to that covariate. Panel C reports the propensity matching estimate of the average effect of the receipt of TARP funds on the banks who actually received TARP funds. The outcome variable is defined as the cumulative abnormal return over the event window of 3 days before and after the receipt of TARP funds.

Table 11 presents the propensity score matching estimate of the average effect of the receipt of TARP funds on bailout banks. Panel A reports the estimated results for the logistic regression of receiving TARP funds on bank-level characteristics. The probability of receiving TARP funds is highly significantly related to a bank's capital adequacy. Banks with lower tier 1 capital to total risk-weighted assets ratio are more likely to receive bailout funds, suggesting that TARP mainly targets at low capital banks. Besides, earnings is also an important determinant of the probability of receiving bailout funds which is significant at 5% level. The other variables are statistically insignificant. The estimated logistic regression is then used to predict the propensity score, i.e. the probability of the receiving TARP funds for all the sample banks. According to the predicted propensity score, each bailout bank is matched to its "nearest neighbor" who did not actually receive bailout funds.

Panel B of Table 11 reports the estimate difference in balance of the bank characteristics variables before and after propensity score matching. Substantial decreases in means between bailout banks and their counterfactuals are observed in all the characteristics variables except management quality variables (*MQ*). The percentage reductions in imbalance due to matching for capital adequacy (*CA*) and earnings (*EAR*) are 91.70% and 90.10% respectively.

Panel C of Table 11 reports the propensity matching estimate of ATT, which in this case is the average effect of the receipt of TARP funds on bailout banks. The average cumulative abnormal return for the matched bailout banks in the event window of 3 days before and after the receipt of their TARP fund is -2.08%, while that for non-bailout banks is -0.03%. Therefore, average treatment effect on the treated is -2.05%. Since the propensity score estimate effectively controls the observed confounding variables, i.e. CAMELS variables, bank size and age, the estimated difference of -2.05% in performance between bailout banks and their counterfactuals can be reasonably interpreted as the effect of the acceptance of TARP funds on the bailout banks.

#### 4.5 Robustness Checks

Our benchmark results (reported in Tables 6 and 9, parallel with Figures 2 and 4 respectively) show that abnormal returns were significantly positive around the announcement of TARP, while they were



significantly negative around the receipt of TARP funds. A concern in any event study is that the findings are simply price momentum around the event dates. The price momentum around the event dates may either react pre-existing information flows or trading activities unrelated to the events. To check the robustness of our benchmark results, we test whether the abnormal returns are greater in the 3 days right after the events (i.e. day 0, day 1, and day 2) than in the average of the 10 days surrounding the events. We regress a bank's abnormal stock return on a dummy (*Dummy3*) that is equal to 1 for the 3 days immediately after the event under consideration and 0 otherwise. The regression is specified as follows,

$$\hat{\varepsilon}_{it} = \gamma_i + \gamma_{Dummy} Dummy3_t + \sigma_{it}, \quad t \in [t^* - T, t^* + T] \quad (9)$$

where  $\hat{\varepsilon}_{it}$  is the abnormal return for bank  $i$  on day  $t$  estimated using Markowitz market model,  $\gamma_i$  is a bank-specific constant term, and *Dummy3* is a dummy variable which is equal to 1 for the 3 days right after the event, and 0 otherwise. If the abnormal returns are greater in the 3 days right after the event, the coefficient on the dummy variable ( $\gamma_{Dummy}$ ) is expected to be statistically significant.

Alternatively, we include a control that interacts the bailout size with a dummy that is equal to 1 for the 3 days right after the event and 0 otherwise. Thus, the interaction term is a variable that takes on the value of the amount of bailout received by a bank for the 3 days right after the event, and 0 otherwise. The alternative specification of the robustness test regression is specified as follows,

$$\hat{\varepsilon}_{it} = \gamma_i + \gamma_{Interaction} (B_i \times Dummy3_t) + \sigma_{it}, \quad t \in [t^* - T, t^* + T] \quad (10)$$

where  $B_i$  measures the amount of bailout funds that a bank accepted (\$ billions). Equations 9 and 10 are estimated for both the announcement of TARP and the receipt of funds to check the robustness of our baseline results. The estimated coefficients of interest, i.e.  $\gamma_{Dummy}$  and  $\gamma_{Interaction}$ , are reported in Table 12. We also estimate Equations 9 and 10 using Fama-French abnormal returns as dependent variable for comparison purpose, testing Fama-French abnormal returns in the 3 days right after the event are significantly higher than the average over the entire event window. The results of the robustness check reported in Panel A clearly show that the abnormal returns are indeed significantly higher in the 3 days immediately after the announcement of TARP than the average of 10 days before and after the event, regardless of the specification of the test. The interaction term that interacts the dummy variable with the bailout size is also significantly positive. It should be noted that the amount of bailout funds that received by the banks was not known at the time when the TARP was announced. The significantly positive coefficient on the interaction term may imply that the abnormal returns immediately after the announcement of TARP are higher for the banks that were expected to receive larger amount of bailout funds in the future. Hence, the results presented in Panel A confirm that the announcement of TARP indeed had a positive effect on the performance of banks who received TARP funds later on. The results based on the abnormal return estimated using market model in Panel B show that, even if we take the price momentum around the receipt date into account, the stock price decline of the banks are still significant for the 3 days immediately after they received TARP funds. The negative abnormal stock return are even more statistically significant for the banks that received larger amount of TARP funds. However, the abnormal returns estimated using Fama-French model are not significantly greater in the 3 days right after the banks received bailout funds, even though on average the Fama-French abnormal returns are lower in the 3-day window. Once we interact the dummy with the bailout size, the coefficient becomes

highly significant, confirming that market interprets the receipt of TARP funds as bad news, and thus penalizes the recipients of TARP funds, especially those who received large amounts.

**Table 12:** Abnormal Returns Immediate After TARP Events

| Dependent Variable                    | Coefficient            | Estimate   | Standard Deviation |
|---------------------------------------|------------------------|------------|--------------------|
| <b>Panel A: Announcement of TARP</b>  |                        |            |                    |
| Market abnormal return                | $\gamma_{Dummy}$       | 2.9830***  | 0.3209             |
|                                       | $\gamma_{Interaction}$ | 0.3445***  | 0.0895             |
| Fama-French abnormal return           | $\gamma_{Dummy}$       | 1.1267***  | 0.2828             |
|                                       | $\gamma_{Interaction}$ | 0.1577***  | 0.0538             |
| <b>Panel B: Receipt of TARP Funds</b> |                        |            |                    |
| Market abnormal return                | $\gamma_{Dummy}$       | -0.4960**  | 0.2408             |
|                                       | $\gamma_{Interaction}$ | -0.2230*** | 0.0616             |
| Fama-French abnormal return           | $\gamma_{Dummy}$       | -0.2210    | 0.2710             |
|                                       | $\gamma_{Interaction}$ | -0.1431*** | 0.0516             |

*Notes:* The robustness tests check whether the abnormal returns are greater in the 3 days right after the event than in the average over the entire event window under consideration. The robustness tests are specified as  $\hat{\epsilon}_{it} = \gamma_i + \gamma_{Dummy} Dummy3_i + \sigma_{it}$ , where  $Dummy3_i$  is a dummy variable which is equal to 1 for the 3 days right after the event, and 0 otherwise. Alternatively, we interact the dummy with the amount of bailout funds received by a bank (US dollar in billions), and estimate  $\hat{\epsilon}_{it} = \gamma_i + \gamma_{Interaction} (B_i \times Dummy3_i) + \sigma_{it}$ , where the interaction term takes on the value of the amount of bailout received by a bank for the 3 days right after the event, and 0 otherwise. If the abnormal returns are greater in the 3 days right after the event than the average over the entire window, the coefficients on the dummy variable ( $\gamma_{Dummy}$ ) and the interaction term ( $\gamma_{Interaction}$ ) are expected to be statistically significant. Reported are estimated coefficients of interest, i.e.  $\gamma_{Dummy}$  and  $\gamma_{Interaction}$ , along their standard error. Standard errors are adjusted for heteroskedasticity and autocorrelation. \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

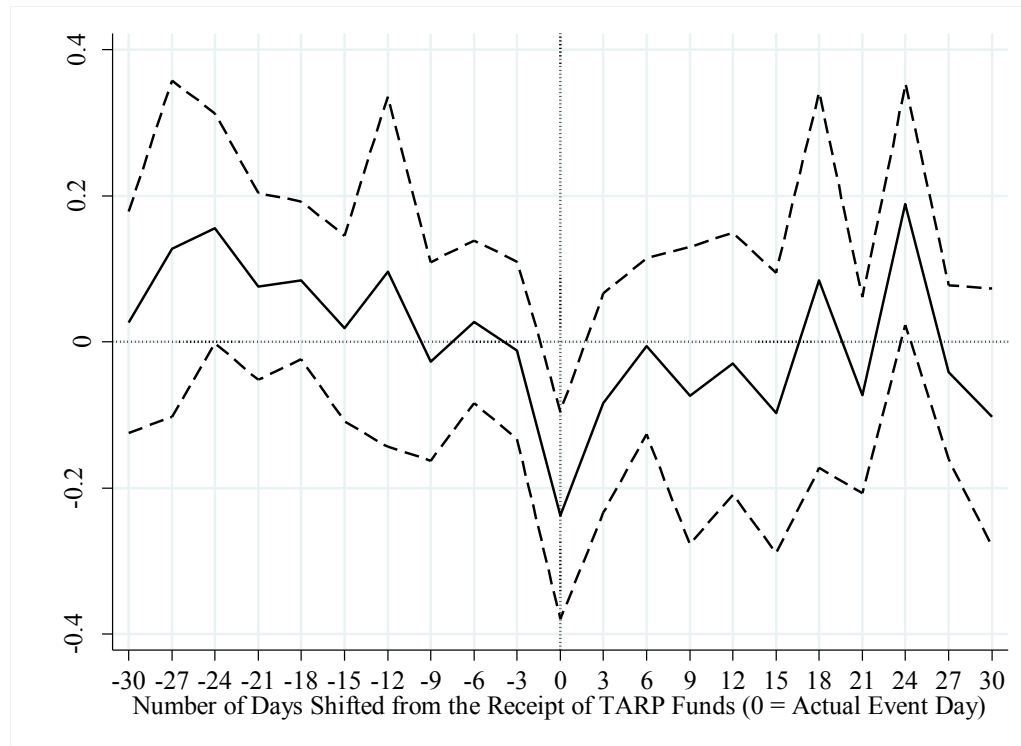
As additional evidence that our results are not an artifact of the data, we re-estimate Equation 10 on a set of placebo dates. We shift the 3-day window forwards as well as backward by 3S days, i.e. 3, 6, 9, 12, 15, 18, 21, 24, 27, and 30 days. For each 3S day shift, we estimate

$$\hat{\epsilon}_{it} = \gamma_i + \gamma_{Interaction3S} (B_i \times Dummy3_{t+3S}) + \sigma_{it}, \quad S = 0, 1, 2, 3, \dots, 10 \quad (11)$$

We graph our estimates of the coefficient on the interaction term against the number of days shifted from the actual receipt of TARP funds in Figure 6. The thick line plotted in Figure 6 indicates the estimated coefficients for a regression of daily abnormal returns estimated using Markowitz market model on an indicator for placebo receipt date interacted with the size of TARP funds received by the bailout banks. Out of the 21 time-shifted regressions,  $\gamma_{Interaction3S}$ , is only significantly negative at 1% significance level

for  $S = 0$ , which is identical to the actual receipt date. The estimated coefficients using the other 20 placebo dates are all smaller in absolute value and statistically less significant. The estimate is also significant at 1% significance level for  $S = 8$ , i.e. shift the event day forward by 24 days, but with positive sign. The placebo estimates reinforce that there were sizable negative abnormal returns just after the receipt of TARP funds, and the decline in bailout banks' stock prices was caused by the acceptance of TARP funds. Note that this robustness test is not applicable to the announcement of TARP, because in that case the event date is common to all the banks. Even if the time-shifted regression is estimated, the coefficient of interest ( $\gamma_{Interaction3S}$ ) is still highly likely to be statistically significant since the interaction term may capture either size effect (large amount of bailout funds are expected to committed to larger banks, and thus positively correlated) or other market factors that affect sample banks' abnormal returns systematically on the placebo dates.

**Figure 6: Time-Shifted Placebos**



*Notes:* The time-shifted placebos test whether the results are an artifact of the data, by re-estimating Equation 3 days right after event interacted on a set of placebo dates. We shift the 3-day window forwards as well as backward by 3S days, i.e. 3, 6, 9, 12, 15, 18, 21, 24, 27, and 30 days. For each 3S day shift, we estimate  $\hat{\epsilon}_{it} = \gamma_i + \gamma_{Interaction3S}(B_i \times Dummy3_{t+3S}) + \sigma_{it}$ , where  $S = 0, 1, 2, 3, \dots, 10$ . The solid line plots the estimated coefficients on the interaction term ( $\gamma_{Interaction3S}$ ). The horizontal axis labels denote the number of days by which we shift the receipt of TARP. The dashed lines represent the 99% confidence intervals using standard errors that are adjusted for heteroskedasticity and autocorrelation.

## 5. The Impact of Bailout Size on Stock Returns

### 5.1 Empirical Strategy

To answer the question of whether the size of the bailout had an effect on bank abnormal returns, we calculate the cumulative abnormal differential return (CADR) between banks that accepted a “large” amount of bailout funds relative to banks that accepted a “small” amount. The way in which we define the size of the bailout (large versus small) will be given a precise quantitative definition below. The abnormal returns of bank  $i$  at time  $t$ ,  $\hat{\varepsilon}_{it}$ , are computed as the deviation of the actual returns from those predicted by the Markowitz market model in a window of  $2T+1$  days around the bailout event (the event window is the day of the receipt of TARP funds). If the size of the bailout is not an important determinant, then the average abnormal returns of banks with large and small bailouts should not be sufficiently different following the bailout event. This hypothesis can be formally tested by estimating the parameters of the following regression,

$$\hat{\varepsilon}_{it} = \sum_{t=t^*-T}^{t^*+T} (\delta_{0t} + B_i \delta_{1t} + X_i' \delta_{2t}) \times D_{it} + \xi_{it} \quad (12)$$

where  $D_{it}$  is an event time-dummy that takes the value 1 when  $t = \tau$  and zero otherwise, and  $\delta_{0\tau}$  is the average abnormal return at event time  $\tau$  among all banks included in the regression. The variable  $B_i$  measures the amount of bailout funds that a bank accepted, which in the preferred specification is a continuous variable that is increasing in a bank’s acceptance of bailout funds. We use the amount of TARP funds (US dollar in billions) that actually received by the bailout banks in the sample as the measure of  $B_i$ . The parameters  $\delta_{1\tau}$  are the key coefficients, since they are estimates of the average increase (decrease) in abnormal returns at event time  $\tau$  resulting from a larger acceptance. The vector  $X_i$  includes several bank characteristics that may be related to the banks’ propensity to accept bailout funds such as size, age, leverage, ownership and type of bank. Equation 12 is essentially estimated by regressing the abnormal return of a bailout bank on the amount of TARP funds it received and other bank characteristics for each trading day in the event window of 10 days before and after the acceptance of bailout funds. In other words, the cross-sectional regression is repeatedly estimated 21 times for the 21 trading days in the event window. Under the hypothesis that the size of the bailout has no effect on firm value, the  $\delta_{1\tau}$  coefficients should not be significantly different from zero. In contrast, under the alternative hypothesis that the size of the of bailout is important for firm value, these coefficients should be significantly negative around or immediately after the event and the cumulative abnormal differential return (CADR) defined as

$$CADR_{\tau} = (B^{Large} - B^{Small}) \times \sum_{t=t^*-T}^{t^*+T} \hat{\delta}_{1t}, \quad t \in [t^* - T, t^* + T] \quad (13)$$

should also decrease significantly immediately after the bailout (or announcement) event. The variables  $B^{Large}$  and  $B^{Small}$  are the 75<sup>th</sup> and 25<sup>th</sup> percentile values of  $B_i$  in the sample, so the CADR is scaled by the interquartile range of bailout amount and captures the difference in cumulative abnormal returns between a bank with a large bailout (75<sup>th</sup> percentile) and a bank with a small bailout (25<sup>th</sup> percentile).

In addition to the CADR, we will also report and provide statistics for the relative cumulative abnormal differential returns (*R-CADR*), which are simply the CADR relative to the pre-bailout event average differential returns  $\bar{\delta}_{1PRE}$

$$R-CADR_t = (B^{Large} - B^{Small}) \times \sum_{\tau=t^*-T}^t (\hat{\delta}_{1\tau} - \bar{\delta}_{1PRE}), \quad t \in [t^* - T, t^* + T] \quad (14)$$

$$\bar{\delta}_{1PRE} = \frac{1}{T} \sum_{\tau=t^*-T}^{t^*-1} \bar{\delta}_{1\tau} \quad (15)$$

These relative CADRs clean for possible pre-event trends in the average abnormal returns of banks with different amounts of bailout funds and provide sharper evidence that the findings are driven by post bailout event differences.

The analysis estimates and characterizes the evolution of these coefficients during a 10 (trading) day window following either the bailout (or announcement) event. Since the identification of the  $\hat{\delta}_{1\tau}$  coefficients comes across exclusively from the across-banks differences in abnormal returns, testing whether they differ from zero provides a sharp test of the hypothesis that the size of the bailout.

## 5.2 Bailout Size and Abnormal Return

To formally test the hypothesis that the size of the bailout has an effect on firm abnormal return, we first estimate a simple version of Equation 12 that includes only the amount of bailout funds that a bank received (in \$ billion). The estimation results are reported in Table 13 and Figure 7.

According to the results presented in Table 13, we can firmly reject the null hypothesis that the size of the bailout size has no effect on firm value. The scaled abnormal differential returns of banks with large and small bailout (i.e.  $(B^{Large} - B^{Small}) \times \hat{\delta}_{1\tau}$ , where  $B^{Large}$  and  $B^{Small}$  are \$0.125 billion and \$0.02 billion respectively) are positive on average before the event day, suggesting that the banks with large bailout performed relatively better than those with small bailout before they actually received the funds. However, the scaled abnormal differential returns turned out to be negative immediately after the banks received their bailout funds (except for day 3 and day 7), which means that the banks with large bailouts experienced a significantly larger stock price decline than those with small bailouts after the event. It seems that market penalized banks with large bailouts. If we take into account their relatively good pre-event performance, the negative abnormal returns experienced by banks with large bailouts become even more significant as shown in Table 14 and Figure 8.

**Table 13:** Point and Cumulative Abnormal Differential Returns of Banks with Large and Small Bailouts (Simple Specification)

| Event Day | Point Estimation (scaled) |           | CAR Estimation |           |
|-----------|---------------------------|-----------|----------------|-----------|
|           | Mean                      | Std. Dev. | Mean           | Std. Dev. |
| -10       | 0.0541***                 | 0.0201    | 0.0541***      | 0.0201    |

|    |            |        |           |        |
|----|------------|--------|-----------|--------|
| -9 | 0.0402***  | 0.0145 | 0.0944*** | 0.0286 |
| -8 | -0.0235*** | 0.0077 | 0.0708*** | 0.0226 |
| -7 | -0.0170**  | 0.0065 | 0.0539**  | 0.0217 |
| -6 | -0.0202**  | 0.0083 | 0.0337**  | 0.0170 |
| -5 | 0.0130     | 0.0086 | 0.0467**  | 0.0227 |
| -4 | 0.0227**   | 0.0106 | 0.0694**  | 0.0304 |
| -3 | -0.0171**  | 0.0077 | 0.0523    | 0.0326 |
| -2 | 0.0156***  | 0.0055 | 0.0679**  | 0.0325 |
| -1 | -0.0071    | 0.0168 | 0.0608    | 0.0453 |
| 0  | -0.0430*** | 0.0106 | 0.0178    | 0.0484 |
| 1  | -0.0291*** | 0.0102 | -0.0113   | 0.0546 |
| 2  | -0.0036    | 0.0182 | -0.0149   | 0.0401 |
| 3  | 0.0093     | 0.0101 | -0.0056   | 0.0472 |
| 4  | -0.0057    | 0.0152 | -0.0112   | 0.0471 |
| 5  | -0.0370*** | 0.0098 | -0.0482   | 0.0522 |
| 6  | -0.0059    | 0.0132 | -0.0540   | 0.0582 |
| 7  | 0.0197     | 0.0170 | -0.0344   | 0.0496 |
| 8  | -0.0206**  | 0.0087 | -0.0550   | 0.0509 |
| 9  | -0.0145    | 0.0123 | -0.0695   | 0.0490 |
| 10 | -0.0098    | 0.0154 | -0.0793   | 0.0614 |

*Notes:* The table shows the point and cumulative abnormal returns estimated using Markowitz market model in a window of ten days before and ten days after the day of the receipt of TARP funds (the event day is specific to each bailout bank). The point and cumulative estimate of the average returns for the event are reported along their standard error. Standard errors are adjusted for heteroskedasticity. The return variables are defined in the text. The scaled point estimates are defined as  $(B^{Large} - B^{Small}) \times \hat{\delta}_{lr}$ . \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

**Figure 7:** Cumulative Abnormal Differential Returns (CADR) around the Receipt of TARP Funds



Notes: The figure shows the cumulative abnormal differential returns of the banks with large and small bailout (25th and 75th percentile of the amount of bailout funds that a bank accepted in the sample) in a window ten days before and after the bailout banks in the sample received the TARP funds (the event day is specific to each bank), along their 90% confidence bands. *CADRs* plotted in this figure are estimated using a simple version of equation (10) that include only a bank's bailout size  $B_i$ .

Table 14 and Figure 8 report the point and cumulative estimates of the differential abnormal return relative to the pre-event trends.

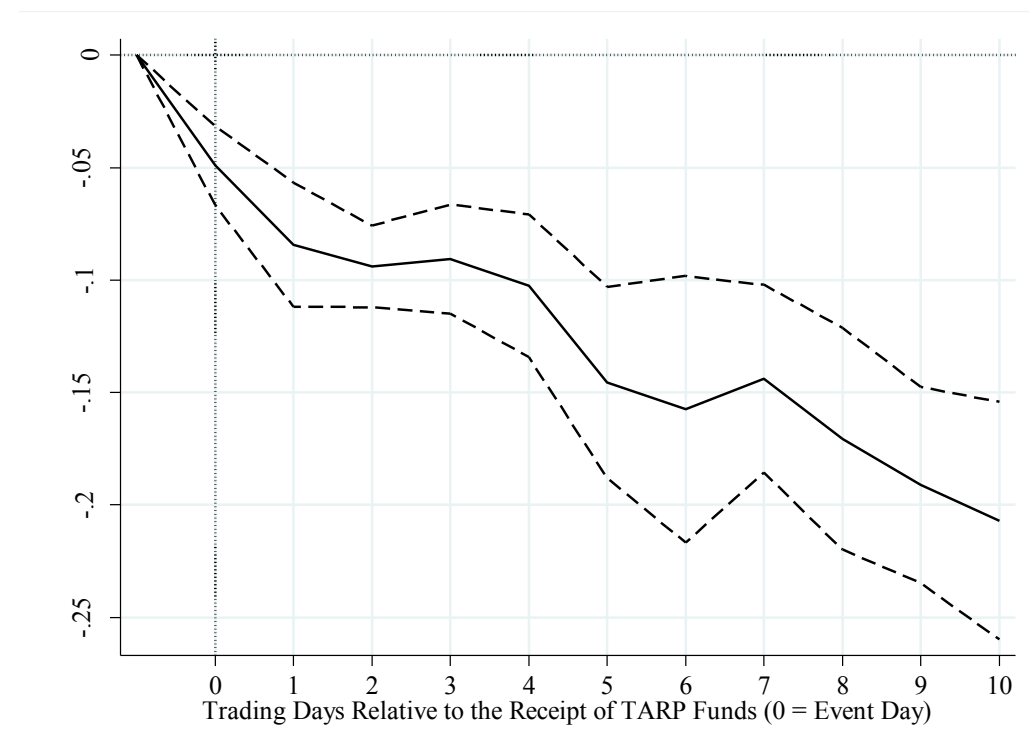
**Table 14:** Point and Cumulative Relative Abnormal Differential Returns of Banks with Large and Small Bailouts (Simple Specification)

| Event Day | Relative Point Estimation (scaled) |           | CAR Estimation |           |
|-----------|------------------------------------|-----------|----------------|-----------|
|           | Mean                               | Std. Dev. | Mean           | Std. Dev. |
| 0         | -0.0491***                         | 0.0106    | -0.0491***     | 0.0106    |
| 1         | -0.0352***                         | 0.0102    | -0.0843***     | 0.0167    |
| 2         | -0.0097                            | 0.0182    | -0.0939***     | 0.0110    |
| 3         | 0.0032                             | 0.0101    | -0.0907***     | 0.0147    |
| 4         | -0.0118                            | 0.0152    | -0.1024***     | 0.0192    |
| 5         | -0.0430***                         | 0.0098    | -0.1455***     | 0.0258    |
| 6         | -0.0119                            | 0.0132    | -0.1574***     | 0.0359    |

|    |            |        |            |        |
|----|------------|--------|------------|--------|
| 7  | 0.0136     | 0.0170 | -0.1438*** | 0.0253 |
| 8  | -0.0267*** | 0.0087 | -0.1705*** | 0.0299 |
| 9  | -0.0206*   | 0.0123 | -0.1911*** | 0.0264 |
| 10 | -0.0159    | 0.0154 | -0.2070*** | 0.0320 |

Notes: The table shows the point and cumulative relative abnormal returns estimated using Markowitz market model in a window of ten days after the day of the receipt of TARP funds (the event day is specific to each bailout bank). The point and cumulative estimate of the average returns for the event are reported along their standard error. Standard errors are adjusted for heteroskedasticity. The return variables are defined in the text. The scaled relative point estimates are defined as  $(B^{Large} - B^{Small}) \times (\hat{\delta}_{1T} - \hat{\delta}_{1PRE})$ . \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

Figure 8: Cumulative Abnormal Differential Returns Relative to Pre-Event Trend (Simple Specification)



Notes: The figure shows the cumulative abnormal differential returns of the banks with large and small bailout (25th and 75th percentile of the amount of bailout funds that a bank accepted in the sample) relative to the pre-event trend in a window ten days after the bailout banks in the sample received the TARP funds (the event day is specific to each bank), along their 90% confidence bands. *R-CADRs* plotted in this figure are estimated using a simple version of equation (10) that include only a bank's bailout size  $B_i$ .

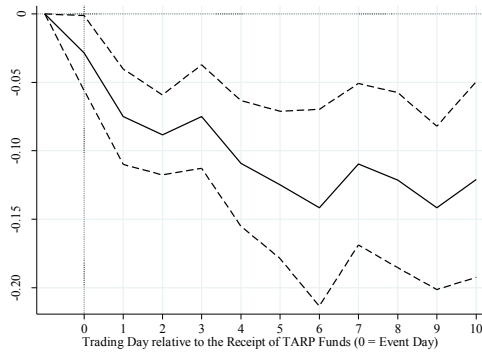
The concern with the results obtained from the simple specification of Equation 12 is that banks with different size of bailout funds may be systematically different in other characteristics that are the true determinants of their differential response to the event. To discard this possibility, we include in  $X_i$



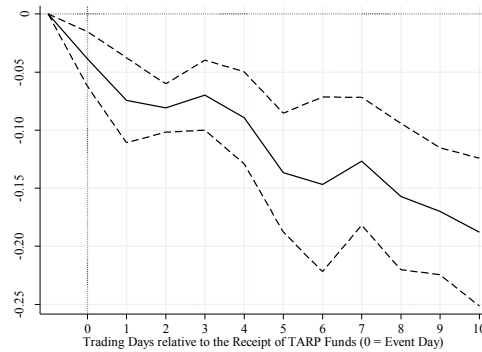
several important bank level characteristics that could be the differential response of banks to the receipt of TARP funds. The results, presented in Figure 9, control for the potential role of a bank's size, age, capital adequacy, asset quality, management quality, earnings, liquidity, and sensitivity to market risk, respectively. Bank size is defined as the natural logarithm of total asset at the end of the corresponding quarter; age is the number of years since establishment; capital adequacy is the ratio of tier 1 capital to total risk-weighted assets; asset quality is the ratio of noncurrent loans and leases to total loans and leases; management quality is the ratio of non-interest cost to net income; earnings is the ratio of net income to total assets; liquidity is the ratio of cash to deposits; and sensitivity to market (interest rate) risk is defined as the absolute difference (gap) between earning assets and interest-bearing deposit liabilities that are repricable within one year or mature within one year. The results presented in Figure 8 provide a graphical view that the relative cumulative abnormal differential returns remain uniformly and significantly negative after controlling for the potential role of bank's size, age, and other characteristics such as CAMELS.

**Figure 9: Cumulative Abnormal Differential Returns Relative to Pre-Event Trend Controlling for Bank Characteristics (Baseline Results)**

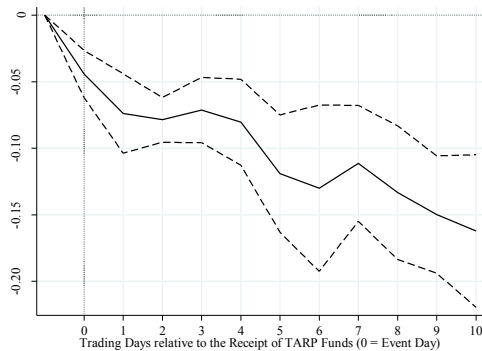
**Panel A: Controlling for Size**



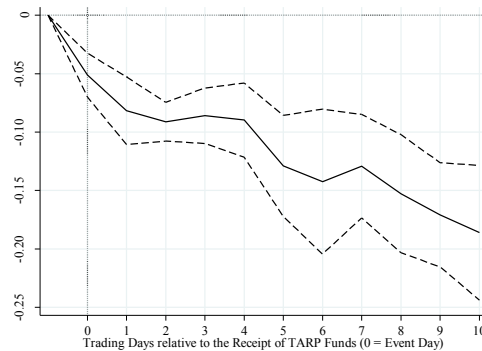
**Panel B: Controlling for Age**



**Panel C: Controlling for Capital Adequacy**

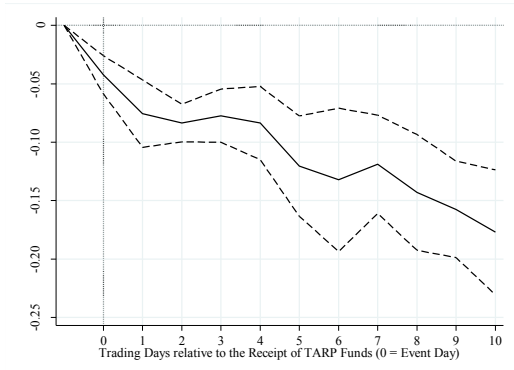
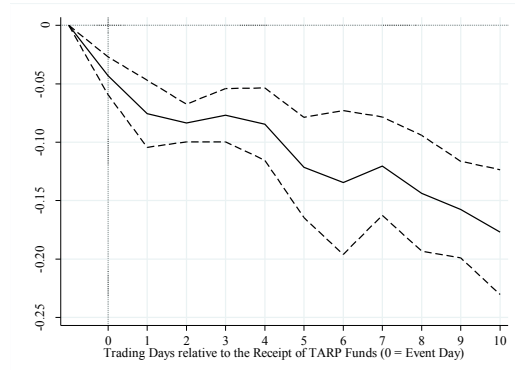


**Panel D: Controlling for Asset Quality**

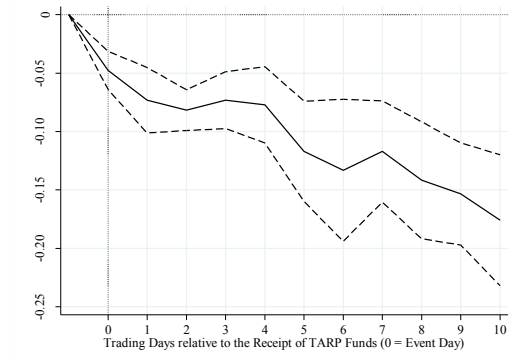


**Panel E: Controlling for Management Quality**

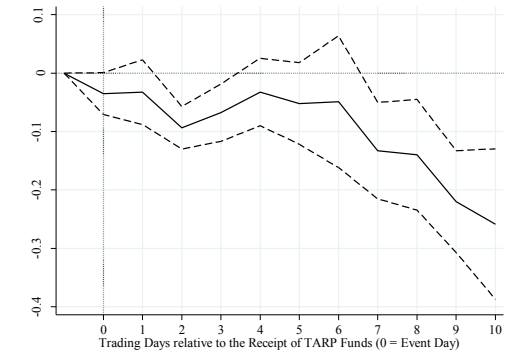
**Panel F: Controlling for Earnings**



**Panel G: Controlling for Liquidity**



**Panel H: Controlling for Sensitivity**



*Notes:* The figure shows the cumulative abnormal differential returns of the banks with large and small bailout (25th and 75th percentile of the amount of bailout funds that a bank accepted in the sample) in a window ten days after the bailout banks in the sample received the TARP funds (this event day is specific to each bank), along their 90% confidence bands. *R-CADRs* plotted in this figure are estimated using equation (10) and controlling for bank's size, age, capital adequacy, asset quality, management quality, earnings, liquidity, and sensitivity to market risk, respectively. Bank characteristics are defined in the text.

We also use the ratio of the amount of bailout funds received by a bank to the bank's tier 1 capital before the receipt as an alternative measure of bailout to estimate *CADR* and *R-CADR*, in order to investigate whether the absolute amount or the relative size of bailout funds had effect on banks' abnormal returns. The results are presented in Appendices 6 and 7. The scaled abnormal differential returns of banks with high and low bailout to tier 1 capital ratio  $BA_i$  is defined as  $(BA^{High} - BA^{Low}) \times \hat{\delta}_{1T}$ , where  $BA^{High}$  and  $BA^{Low}$  are 32.19% and 24.5% respectively. The estimated *CADRs* and *R-CADRs* suggest that there is no statistically significant evidence that banks at 75<sup>th</sup> percentile of bailout to tier 1 capital ratio performed differently from banks at the 25<sup>th</sup> percentile of bailout to tier 1 capital ratio within the event window of 10 days before and after they received their bailout funds.

## 6. Buy-and-Hold Returns of Bailout and Non-bailout Banks

In this section, we investigate the stock return performance of bailout banks relative to the non-bailout banks during the period from October 1, 2008 to March 31, 2009 (vast majority of the bailout banks received TARP funds during this period). The buy-and-hold returns (BHR) are computed in a manner used in Ng et al. (2010). More specifically, we compute buy-and-hold returns on the portfolios of bailout and non-bailout banks based on the daily returns from the first day of the period to the last day of the period (equally weighted). The percentage buy-and-hold return is calculated for bank  $i$  over the six calendar months as

$$BHR_i = \prod_{t=1}^T (1 + R_{it}) - 1 \quad (16)$$

Panel A of Table 15 presents descriptive statistics for the full sample of banks and for each of the two bank portfolios. We start with a univariate analysis of the buy-and-hold returns on the bailout bank portfolio relative to the return on the non-bailout bank portfolio. This comparison is equivalent to an analysis of industry-adjusted returns of the bailout bank portfolio. We find that the buy-and-hold returns of both bank groups are highly negative during the period from October 1, 2008 to March 31, 2009. For all 293 banks in the sample, the average buy-and-hold return is -42.68%, with bailout banks performing worse relative to non-bailout banks. For this period of six months, the buy-and-hold return on the bailout banks is 5.8% lower than that on the non-bailout banks on average. The difference in buy-and-hold returns on bailout and non-bailout banks is statistically significant at 5% significance level. The univariate results confirm that accepting the TARP bailout funds could have signaled to the market that the bailout banks admitted to larger future losses than they had previously disclosed (see Hoshi and Kashyap, 2010).

**Table 15:** Buy-and-Hold Returns of Bailout and Non-bailout Banks

| Panel A: Summary Statistics |         |           |         |             |            |              |
|-----------------------------|---------|-----------|---------|-------------|------------|--------------|
| Variable                    | Mean    | Std. Dev. | Bailout | Non-bailout | Difference | t- statistic |
| <i>BHR</i>                  | -0.4268 | 0.0141    | -0.4557 | -0.3977     | -0.0580    | -2.0656**    |
| <i>Beta</i>                 | 1.2240  | 0.3248    | 1.0633  | 1.3858      | -0.3225    | -0.4958      |
| <i>Size</i>                 | 12.5937 | 0.1069    | 12.9859 | 12.1989     | 0.7869     | 3.7608***    |
| <i>BTM</i>                  | 1.1650  | 0.0640    | 1.0310  | 1.3017      | -0.2707    | -2.1259**    |
| <i>Bailout-Dummy</i>        | 0.5017  | 0.0293    | 1.0000  | 0.0000      | N.A.       | N.A.         |
| <i>Bailout-Amount</i>       | 0.4997  | 0.1590    | 0.9960  | 0.0000      | N.A.       | N.A.         |
| <i>Bailout-ln(Amount)</i>   | 9.2562  | 0.5444    | 18.4494 | 0.0000      | N.A.       | N.A.         |
| <i>Bailout-Ratio</i>        | 0.1163  | 0.0084    | 0.2319  | 0.0000      | N.A.       | N.A.         |
| No. of Obs.                 | 293     | 0.0141    | 147     | 146         | N.A.       | N.A.         |

**Panel B:** Stock Performance from 2008 Q4 to 2009 Q1

(1) (2) (3) (4)

|                           |                       |                       |                       |                       |
|---------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <i>Constant</i>           | -0.1470<br>(-1.41)    | -0.2496**<br>(-2.09)  | -0.1750*<br>(-1.67)   | -0.1401<br>(-1.34)    |
| <i>Beta</i>               | 0.0017<br>(0.69)      | 0.0019<br>(0.77)      | 0.0017<br>(0.68)      | 0.0018<br>(0.73)      |
| <i>Size</i>               | -0.0148*<br>(-1.86)   | -0.0093<br>(-1.01)    | -0.0122<br>(-1.50)    | -0.0164**<br>(-2.07)  |
| <i>BTM</i>                | -0.0518***<br>(-3.96) | -0.0469***<br>(-3.56) | -0.0514***<br>(-3.95) | -0.0511***<br>(-3.90) |
| <i>Bailout-Dummy</i>      | -0.0648**<br>(-2.30)  |                       |                       |                       |
| <i>Bailout-Amount</i>     |                       | -0.0115*<br>(-1.95)   |                       |                       |
| <i>Bailout-ln(Amount)</i> |                       |                       | -0.0041***<br>(-2.64) |                       |
| <i>Bailout-Ratio</i>      |                       |                       |                       | -0.1777*<br>(-1.83)   |
| <i>R-squared</i>          | 0.0723                | 0.0675                | 0.0777                | 0.0660                |
| <i>F-statistic</i>        | 5.57***               | 5.18***               | 6.02***               | 5.06***               |

*Notes:* The table shows the buy-and-hold returns of bailout banks relative to non-bailout banks, during the period from October 1, 2008 to March 31, 2009. Bailout banks are the banks that received TARP fund by March 31, 2009. Panel A provides summary statistics and a univariate analysis of the difference in the buy-and-hold stock returns between bailout banks and non-bailout banks. Panel B provides the results of regressions that examine the differences in the returns during the same period of time. More specifically, buy-and-hold return is regressed on a bailout variable and Fama-French (1992) risk factors. *Beta* is market beta from regression of daily stock returns on daily market return over the period from September 17, 2007 to September 17, 2008. *Size* is the logarithm of the market capitalization of the bank, and *BTM* is the ratio of the book value of equity to the market value of equity at the end of September 2008. In our primary specification presented in Column (1), *Bailout* is a dummy variable that is equal to 1 if the bank received TARP funds, and zero otherwise. In the alternative specifications, we substitute the bailout dummy variable by the amount of bailout funds (in \$billion) that received by the banks, the logarithm of the amount of bailout funds that received by the banks, or the ratio of the amount of bailout funds received by a bank to the bank's tier 1 capital. The alternative measure of Bailout take value of zero for non-bailout banks. The alternative specifications are presented in Columns (2) to (4) respectively as robustness analyses. *t*-statistic are in parentheses. \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

In Panel B of Table 15, we estimate multivariate regressions that control for the Fama-French (1992) risk factors. Specifically, the regression model is specified as follows,

$$BHR_i = \alpha_0 + \alpha_1 Bailout_i + \alpha_2 Beta_i + \alpha_3 Size_i + \alpha_4 BTM_i \quad (17)$$

where *Beta* is market beta from regression of daily stock returns on daily market return over the period from September 17, 2007 to September 17, 2008 (i.e. the normal period), *Size* is the logarithm of the market capitalization of the bank, and *BTM* is the ratio of the book value of equity to the market value of equity at the end of September 2008. In our primary specification presented in Column (1), the variable of interest, *Bailout*, is an dummy variable that is equal to 1 if the bank received TARP funds, and zero otherwise (*Bailout-Dummy*). The coefficient on the bailout indicator can be interpreted as the difference in the risk-adjusted returns between bailout and non-bailout bank portfolios. In the alternative specifications, we substitute the bailout dummy variable by the amount of bailout funds (in \$ billion) that received by the banks (*Bailout-Amount*), the logarithm of the amount of bailout funds that received by the banks (*Bailout-ln(Amount)*), or the ratio of the amount of bailout funds received by a bank to the bank's tier 1 capital (*Bailout-Ratio*). The alternative measures of Bailout take value of zero for non-bailout banks. The alternative specifications are presented in Columns (2) to (4) as robustness analyses. Our primary specification is presented in Column (1). We find that, controlling for market beta, bank size, and book-to-market ratio, the bailout banks on average significantly under-performed the non-bailout bank by 6.48%. The robustness analyses results presented in Columns (2) to (4) suggest that banks that received greater amount of bailout funds are likely to be associated with more negative returns. The coefficients on the bailout variables are uniformly negative and statistically significant across all the specifications.

## 7. The Impact of TARP Bailout on Tail Risk

### 7.1 Empirical Strategy

In this section, we examine whether the changes in tail risk are different between bailout and non-bailout banks. Our analysis is based on the tail risk measures proposed by Adrian and Brunnermeier (2011), i.e.  $VaR$  and  $\Delta CoVaR$ . Value at risk,  $VaR$ , is the most common measure of risk used by financial institutions. Following Adrian and Brunnermeier (2011), we estimate  $VaR$  for both individual institution  $i$  and  $CoVaR$  for the financial system as a whole via quantile regressions. More specifically, we run the following quantile regressions using weekly data from 2005 Q1 to 2010 Q4 (302 weeks),

$$X_{it} = \alpha_i + \gamma_i M_{t-1} + \varepsilon_{it} \quad (18)$$

$$X_{system,t} = \alpha_{system,t} + \beta_{system,i} X_{it} + \gamma_{system,i} M_{t-1} + \varepsilon_{system,t} \quad (19)$$

where  $X_{it}$  is the change in the assets value of bank  $i$  at time  $t$  as perceived by the market, i.e.  $X_{it} = (A_{it} - A_{it-1}) / A_{it-1}$ ;  $A_{it}$  is the market value of the bank's total assets which is defined as product of the bank's market capitalization and the bank's asset-to-equity ratio, i.e.  $A_{it} = ME_{it} \times LEV_{it}$ ; and  $M_{t-1}$  is a vector of lagged state variables, including VIX, liquidity spread, 3-month Treasury change, term spread change, credit spread change, equity return, and real estate excess return. The detailed definitions and the descriptive statistics for the state variables are provided in Table A.1. Similarly,  $X_{system,t}$  is the change in the asset value of the financial system, i.e.  $X_{system,t} = (A_{system,t} - A_{system,t-1}) / A_{system,t-1}$ , where  $A_{system,t} = \sum_{i=1}^N A_{it}$ . The parameters in Equations 30 and 31 are estimated by running  $q^{\text{th}}$ -quantile regression. We then obtain the measure of  $VaR$  and  $CoVaR$  by generating the predicted values from the quantile regressions,

$$VaR_{it}^q = \hat{\alpha}_i^q + \hat{\gamma}_i^q M_{t-1} \quad (20)$$

$$CoVaR_{it}^q = \hat{\alpha}_{system,i}^q + \hat{\beta}_{system,i} VaR_{it}^q + \hat{\gamma}_{system,i} M_{t-1} \quad (21)$$

Since  $VaR_{it}^q$  and  $CoVaR_{it}^q$  are estimated as functions of a vector of lagged state variables  $M_{t-1}$ , they are time-varying as indicated by a subscript  $t$ . Throughout our analysis, we focus on the 1<sup>st</sup>-quantile which corresponds to the 1%  $VaR$  and  $CoVaR$ . The 1%- $VaR$  of institution  $i$  at time  $t$ ,  $VaR_{it}^{1\%}$ , is the maximum loss of the individual institution within the 1%-confidence interval, and thus  $VaR_{it}^{1\%}$  is typically a negative number.  $CoVaR_{it}^{1\%}$  is the 1%  $VaR$  of the whole financial sector conditional on institution  $i$  being in distress at time  $t$ . Therefore, 1%-quantile regression of the financial system returns are run on the financial institution  $i$ 's asset returns and the lagged state variables to obtain  $CoVaR_{it}^{1\%}$ . Finally, we compute  $\Delta CoVaR_{it}$  for each institution as follows

$$\Delta CoVaR_{it}^q = CoVaR_{it}^q - CoVaR_{it}^{50\%} = \hat{\beta}_{system,t} (VaR_{it}^q - VaR_{it}^{50\%}) \quad (22)$$

$\Delta CoVaR_{it}^q$  measures the difference between  $VaR$  of the financial system conditional on the distress of a particular financial institution  $i$  and the  $VaR$  of the financial system conditional on the median state of the institution  $i$ . In other words,  $\Delta CoVaR_{it}^{1\%}$  is the percentage point change in the financial system's 1%  $VaR$  when a particular institution  $i$  realizes its own 1%  $VaR$  at time  $t$ . Therefore,  $\Delta CoVaR_{it}^{1\%}$  captures the marginal contribution of the particular institution  $i$  to the overall systemic risk.

## 7.2 Changes in Tail Risk of Bailout and Non-bailout Banks

The summary statistics for the estimated risk measures are presented in Table 16. It provides the weekly measures of risk we obtained from estimating 1%-quantile regressions. On average, the weekly market-valued total asset return ( $X_{it}$ ) for the sample financial institutions is -0.05% during the period from 2005Q1 to 2010Q4, with a standard deviation of 6.64%. The mean of the maximum loss of the individual institutions within the 1% interval ( $VaR_{it}^{1\%}$ ) is -11.99% with the standard deviation of 8.12%, while those for the financial system as a whole are 6.27% and 6.92% respectively. The mean marginal contribution of the individual institutions to the overall systemic risk ( $\Delta CoVaR_{it}^{1\%}$ ) is -0.69%, and its standard deviation is 1.56%.

**Table 16:** Summary Statistics for Estimated Risk Measures

| Variable                  | Mean     | Std. Dev. | Observation |
|---------------------------|----------|-----------|-------------|
| $X_{it}$                  | -0.0464  | 6.6387    | 97002       |
| $VaR_{it}^{1\%}$          | -11.9855 | 8.1200    | 100288      |
| $\Delta CoVaR_{it}^{1\%}$ | -0.6861  | 1.5566    | 100288      |
| $VaR_{system,t}^{1\%}$    | -6.2683  | 6.9202    | 302         |

*Notes:* The table reports summary statistics for the asset returns and 1% risk measures of the bank holding companies for weekly data from 2005 Q1 to 2010 Q4.  $X_{it}$  denotes the weekly market-valued assets return for bank  $i$ , where market-valued total assets is defined as  $ME_{it} \times LEV_{it}$ , i.e. the product of market capitalization and the ratio of book total asset to book equity. The individual firm risk measures  $VaR_{it}$  and the system risk measure  $VaR_{system}$  are obtained by running 1% quantile regressions of returns on the one-week lag of the state variables and by computing the predicted value of the regression. The quantile regression is specified as  $X_{it} = \alpha_i + \gamma_i M_{t-1} + \varepsilon_{it}$ , where  $M_{t-1}$  is a vector of lagged state variables. The risk measure  $VaR_{it}$  is obtained from the predicted value of the quantile regression  $VaR_{it} = \hat{\alpha}_i + \hat{\gamma}_i M_{t-1}$ .  $\Delta CoVaR_{it}$  is the difference between 1%-  $CoVaR_{it}$  and the 50%-  $CoVaR_{it}$ , where  $q\%$ -  $CoVaR_{it}$  is the predicted value from a  $q\%$  quantile regression of the financial system asset returns on the institution assets returns and on the lagged state variable, i.e.  $X_{system} = \alpha_{system} + \beta_{system} X_{i,t} + \gamma_{system} M_{t-1} + \varepsilon_{system,t}$ . We clean the weekly

returns data by winsorising weekly returns at both top and bottom 1st percentile to correct for the unusual volatility that is caused by mergers, recapitalizations and other structural changes that is unrelated to the market perception of asset value. All quantities are expressed in units of weekly percentage returns.

To compare the changes in the tail risk of bailout and non-bailout banks, we calculate the changes in 1%- $VaR$  and  $\Delta CoVaR$  before and after the bailout banks received their TARP funds. We measure the change in 1- $VaR$ ,  $Ch\_VaR$ , as the difference between the average of 1%- $VaR$  before TARP initiation period (i.e. 2008Q3) and the average of 1%- $VaR$  after TARP initiation period (i.e. 2009Q2). Similarly, we measure the change in  $\Delta CoVaR$ ,  $Ch\_ \Delta CoVaR$ , as the difference between the average of  $\Delta CoVaR$  in the quarter before the TARP initiation (i.e. 2008Q3) and the average of  $\Delta CoVaR$  in the quarter after the TARP initiation (i.e. 2009Q2). More specifically, changes in the tail risk are computed as follows,

$$Ch\_VaR_i^{1\%} = VaR_{it}^{1\%}{}_{2009Q2} - VaR_{it}^{1\%}{}_{2008Q3} \quad (23)$$

$$Ch\_ \Delta CoVaR_i^{1\%} = \Delta CoVaR_{it}^{1\%}{}_{2009Q2} - \Delta CoVaR_{it}^{1\%}{}_{2008Q3} \quad (24)$$

Note that we define the TARP initiation period as 2008Q4 and 2009Q1 because only 3 bailout banks received their TARP funds after March 31, 2009.

Panel A of Table 17 provides univariate evidence on the changes in the two tail risk measures before and after the TARP initiation period for the full sample as well as the bailout and non-bailout bank partitions. We also provide the statistics for both  $VaR_{it}^{1\%}$  and  $\Delta CoVaR_{it}^{1\%}$  during different period, in order to show the movements in the two risk measures. It shows that, for both bailout and non-bailout banks, the average of the maximum loss of individual institutions ( $VaR_i^{1\%}$ ) increases significantly in absolute value from pre-TARP period to TARP initiation period, suggesting that the sample banks experience a greater tail risk from 2008Q4 to 2009Q1.  $VaR_i^{1\%}$  then becomes less negative in the post-TARP period. In each of the three periods, the difference in  $VaR_i^{1\%}$  between bailout and non-bailout banks is statistically insignificant. One average, the changes in  $VaR_i^{1\%}$  before and after TARP initiation ( $Ch\_VaR_i^{1\%}$ ) is -4.08% with no significant difference between bailout and non-bailout banks, although the point estimates indicate that there is a greater increase in the tail risk of the bailout banks. However, the marginal contribution of the individual institution to the overall systematic risk as measured by  $\Delta CoVaR_i^{1\%}$  are significantly different between bailout and non-bailout banks for all the three periods. The bailout banks contribute much more to the overall systematic risk than the non-bailout banks do. Although  $\Delta CoVaR_i^{1\%}$  for both bailout and non-bailout banks drop during the TARP initiation period, bailout banks experience a much more significant drop relative to non-bailout banks. The absolute difference in  $\Delta CoVaR_i^{1\%}$  between bailout and non-bailout banks increases from 0.76% in pre-TARP period to 1.31% in TARP initiation period. Even though the absolute difference in  $\Delta CoVaR_i^{1\%}$  reduces to 1.11%, it remains highly significant at the 1% significance level. The changes in the marginal contribution to the systematic risk before and after TARP initiation is also statistically significant. The mean  $Ch\_ \Delta CoVaR_i^{1\%}$  for bailout banks is -0.48%, and that for non-bailout banks is -0.13%, which means the



increase in marginal contribution to systematic risk is much more substantial for the banks who received TARP bailout fund during the period from 2008Q4 to 2009Q1.

**Table 17:** Difference in Changes in Tail Risk between Bailout and Non-bailout Banks

| <b>Panel A: Summary Statistics</b>          |          |           |          |             |            |              |
|---|----------|-----------|----------|-------------|------------|--------------|
| Variable                                    | Mean     | Std. Dev. | Bailout  | Non-bailout | Difference | t- statistic |
| Pre-TARP Period (2008 Q3)                   |          |           |          |             |            |              |
| $VaR_{it}^{1\%}$                            | -13.7152 | 0.2410    | -13.8335 | -13.5960    | -0.2375    | -0.4922      |
| $\Delta VaR_{it}^{1\%}$                     | -0.8138  | 0.0942    | -1.1933  | -0.4316     | -0.7617    | -4.1561***   |
| TARP Initiation Period (2008 Q4–2009 Q1)    |          |           |          |             |            |              |
| $VaR_{it}^{1\%}$                            | -23.6542 | 0.4938    | -24.3023 | -22.9833    | -1.3190    | -1.3372      |
| $\Delta VaR_{it}^{1\%}$                     | -1.2062  | 0.1543    | -1.8492  | -0.5406     | -1.3086    | -4.3714***   |
| Post-TARP Period (2009 Q2)                  |          |           |          |             |            |              |
| $VaR_{it}^{1\%}$                            | -17.7430 | 0.4385    | -17.9631 | -17.4959    | -0.4673    | -0.5313      |
| $\Delta VaR_{it}^{1\%}$                     | -1.1451  | 0.1330    | -1.6702  | -0.5559     | -1.1143    | -4.3111***   |
| Difference Before and After TARP Initiation |          |           |          |             |            |              |
| $Ch\_VaR_{it}^{1\%}$                        | -4.0770  | 0.3904    | -4.1296  | -4.0179     | -0.1117    | -0.1426      |
| $Ch\_ \Delta VaR_{it}^{1\%}$                | -0.3141  | 0.0584    | -0.4768  | -0.1314     | -0.3454    | -2.9963***   |
| No. of Obs.                                 | 293      |           | 147      | 146         |            |              |

| <b>Panel B: Change in <math>VaR_{it}^{1\%}</math> Before and After TARP Initiation</b> |                      |                      |                      |                      |
|--|----------------------|----------------------|----------------------|----------------------|
|  | (1)                  | (2)                  | (3)                  | (4)                  |
| <i>Constant</i>  | -7.0305**<br>(-2.31) | -7.3675**<br>(-2.07) | -7.1676**<br>(-2.33) | -7.0718**<br>(-2.33) |
| <i>Beta</i>  | -0.0280<br>(-0.42)   | -0.0275<br>(-0.41)   | -0.0284<br>(-0.42)   | -0.0293<br>(-0.44)   |
| <i>Size</i>  | 0.2579<br>(1.12)     | 0.2782<br>(1.03)     | 0.2738<br>(1.15)     | 0.2774<br>(1.21)     |
| <i>BTM</i>   | -0.2539<br>(-0.65)   | -0.2402<br>(-0.61)   | -0.2514<br>(-0.64)   | -0.2584<br>(-0.66)   |
| <i>Bailout-Dummy</i>   | -0.1572<br>(-0.20)   |                      |                      |                      |
| <i>Bailout-Amount</i>  |                      | -0.0332<br>(-0.20)   |                      |                      |

|                            |        |        |                    |                    |
|----------------------------|--------|--------|--------------------|--------------------|
| <i>Bailout</i> -ln(Amount) |        |        | -0.0152<br>(-0.35) |                    |
| <i>Bailout</i> -Ratio      |        |        |                    | -2.2778<br>(-0.85) |
| <i>R</i> -squared          | 0.0089 | 0.0089 | 0.0092             | 0.0114             |
| F-statistic                | 0.61   | 0.61   | 0.63               | 0.78               |

**Panel C:** Change in  $\Delta CoVaR_{it}^{1\%}$  Before and After TARP Initiation

|                            | (1)                   | (2)                   | (3)                   | (4)                   |
|----------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| <i>Constant</i>            | 2.0978***<br>(4.82)   | 2.2386***<br>(4.39)   | 2.0140***<br>(4.58)   | 2.1198***<br>(4.88)   |
| <i>Beta</i>                | 0.0023<br>(0.24)      | 0.0031<br>(0.32)      | 0.0024<br>(0.24)      | 0.0025<br>(0.26)      |
| <i>Size</i>                | -0.1826***<br>(-5.53) | -0.2026***<br>(-5.22) | -0.1759***<br>(-5.18) | -0.1861***<br>(-5.70) |
| <i>BTM</i>                 | -0.0042<br>(-0.07)    | -0.0057<br>(-0.10)    | -0.0016<br>(-0.03)    | -0.0043<br>(-0.08)    |
| <i>Bailout</i> -Dummy      | -0.2011*<br>(-1.78)   |                       |                       |                       |
| <i>Bailout</i> -Amount     |                       | 0.0085<br>(0.36)      |                       |                       |
| <i>Bailout</i> -ln(Amount) |                       |                       | -0.0114*<br>(-1.82)   |                       |
| <i>Bailout</i> -Ratio      |                       |                       |                       | -0.6883*<br>(-1.79)   |
| <i>R</i> -squared          | 0.1379                | 0.1282                | 0.1384                | 0.1380                |
| F-statistic                | 10.84***              | 9.96***               | 10.88***              | 10.85***              |

*Notes:* The table shows the changes in tail risk of bailout banks relative to non-bailout banks, before and after the TARP initiation period. Bailout banks are the banks that received TARP fund by March 31, 2009. Panel A provides summary statistics and a univariate analysis of the difference in the buy-and-hold stock returns between bailout banks and non-bailout banks. Panel B provides the results of regressions that examine the differences in the returns during the same period of time. More specifically, buy-and-hold return is regressed on a bailout variable and Fama-French (1992) risk factors. *Beta* is market beta from regression of daily stock returns on daily market return over the period from September 17, 2007 to September 17, 2008. *Size* is the logarithm of the market capitalization of the bank, and *BTM* is the ratio of the book value of equity to the market value of equity at the end of September 2008. In our primary specification presented in Column (1), *Bailout* is a dummy variable that is equal to 1 if the bank received TARP funds, and zero otherwise. In the alternative specifications, we substitute the bailout dummy variable by the amount of bailout funds (in \$billion) that received by the banks, the logarithm of the amount of bailout funds that received by the banks, or the ratio of the amount of bailout funds received

by a bank to the bank's tier 1 capital. The alternative measure of Bailout take value of zero for non-bailout banks. The alternative specifications are presented in Columns (2) to (4) respectively as robustness analyses. *t*-statistic are in parentheses. \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

Panels B and C of Table 17, provide multivariate regression analysis of the changes in tail risk measures before and after TARP initiation. We regress the changes in tail risk measures on bailout variables and control for the Fama-French (1992) risk factors. Specifically, the regression models are specified as follows,

$$Ch\_VaR_i^{1\%} = \alpha_0 + \alpha_1 Bailout_i + \alpha_2 Beta_i + \alpha_3 Size_i + \alpha_4 BTM_i \quad (25)$$

$$Ch\_ \Delta CoVaR_i^{1\%} = \alpha_0 + \alpha_1 Bailout_i + \alpha_2 Beta_i + \alpha_3 Size_i + \alpha_4 BTM_i \quad (26)$$

where *Beta* is market beta from regression of daily stock returns on daily market return over the period from September 17, 2007 to September 17, 2008 (i.e. the normal period), *Size* is the logarithm of the market capitalization of the bank, and *BTM* is the ratio of the book value of equity to the market value of equity at the end of September 2008. In our primary specification presented in Column (1), the variable of interest, *Bailout*, is a dummy variable that is equal to 1 if the bank received TARP funds, and zero otherwise (*Bailout-Dummy*). In the alternative specifications, we substitute the bailout dummy variable by the amount of bailout funds (in \$ billion) that received by the banks (*Bailout-Amount*), the logarithm of the amount of bailout funds that received by the banks (*Bailout-ln(Amount)*), or the ratio of the amount of bailout funds received by a bank to the bank's tier 1 capital (*Bailout-Ratio*). The alternative measures of Bailout take value of zero for non-bailout banks. The alternative specifications are presented in Columns (2) to (4) as robustness analyses.

Panel B of Table 17 presents the regression analysis of the changes in  $VaR_i^{1\%}$  before and after TARP initiation period. The coefficients on the bailout variables are not statistically significant, but they are uniformly negative, suggesting a greater increase in the maximum loss within 1% confidence interval for the bailout banks relative to the non-bailout banks. In general, none of the regressions in Panel B is statistically significant, as indicated by the low R-squared and insignificant *F*-statistic.

Panel C of Table 17 presents the regression analysis of the changes in  $\Delta CoVaR_i^{1\%}$  before and after TARP initiation period. The bailout variables turn out to be negative and significant at 10% level, except *Bailout-Amount* in specification (2). Relative to the non-bailout banks, bailout banks contribute more to the overall systemic risk after they received their TARP funds. Besides, the coefficients *Size* are negative and highly significant across all the specifications, showing that there is a substantial increase in the marginal contribution to the systemic risk of large banks. The regressions presented in Panel C are statistically significant at 1% significance level. Our findings suggest that the changes in the maximum loss of the individual institutions ( $Ch\_VaR_i^{1\%}$ ) are unlikely to be caused by the initiation of TARP, while the increases in the marginal contribution of individual institution to the overall systemic risk as indicated by  $Ch\_ \Delta CoVaR_i^{1\%}$  are more substantial for the banks that received TARP funds.

## 8. Conclusion

In the face of the worst global financial shock in a century, the US government launched a number of bailout plans to fix the financial system, but none has proven to be as controversial as the Troubled Assets Relief Program, or TARP, which authorized the US Treasury to make injections of capital into banks, as well as unlimited deposit insurance (for non-interest-bearing accounts), and guarantees of new senior debt. TARP, was highly unpopular with the public, a punching bag for congressional opponents and baggage for its supporters, even as a new data indicated the program would cost a small fraction of its original price tag.

This paper uses innovative methodologies to examine the market responses to the launch of TARP and the receipt of bailout funds as reflected in returns and tail risk. More prominently, we allow for non-random selection into the TARP bailout program by using propensity score matching methods. This strategy permits a counterfactual interpretation of the data and provides the first credible empirical evidence to answer the research question “what would have happened to those banks that did in fact receive bailout funds if they had not received the bailout”.

The empirical evidence presented in this paper shows favorable market response to the announcement of TARP, which suggests that the launch of the bailout program indeed helped restore investors’ confidence in the financial system. However, the market seemed to react negatively to the receipt of TARP bailout funds. Banks that received larger bailouts experienced greater stock price declines. This indicate that, instead of creating a certification effect, the receipt of bailout funds conveyed an adverse signal to the market. Besides, our empirical evidence suggests that TARP did not make any meaningful change in tail risk.

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## Appendices

### Appendix 1: History of US Government Bailouts

| Year | Target                 | Event  | Size          |
|------|------------------------|--|---------------|
| 1970 | Penn Central Railroad  | In May 1970, Penn Central Railroad, then on the verge of bankruptcy, appealed to the Federal Reserve for aid on the grounds that it provided crucial national defense transportation services. The Nixon administration and the Federal Reserve supported providing financial assistance to Penn Central, but Congress refused to adopt the measure. Penn Central declared bankruptcy on June 21, 1970, which freed the corporation from its commercial paper obligations. To counteract the devastating ripple effects to the money market, the Federal Reserve Board told commercial banks it would provide the reserves needed to allow them to meet the credit needs of their customers. | \$3.2 billion |
| 1971 | Lockheed               | In August 1971, Congress passed the Emergency Loan Guarantee Act, which could provide funds to any major business enterprise in crisis. Lockheed was the first recipient. Its failure would have meant significant job loss in California, a loss to the GNP and an impact on national defense.  | \$1.4 billion |
| 1974 | Franklin National Bank | In the first five months of 1974, Franklin National Bank lost \$63.6 million. The Federal Reserve stepped in with a loan of \$1.75 billion.  | \$7.8 billion |
| 1975 | New York City          | During the 1970s, New York City became over-extended and entered a period of financial crisis. In 1975 President Ford signed the New York City Seasonal Financing Act, which   | \$9.4 billion |

|      |  |   |                 |
|------|--|---|-----------------|
|      |  | released \$2.3 billion in loans to the city.  |                 |
| 1980 | Chrysler   | In 1979 Chrysler suffered a loss of \$1.1 billion. That year the corporation requested aid from the government. In 1980 the Chrysler Loan Guarantee Act was passed, which provided \$1.5 billion in loans to rescue Chrysler from insolvency.   | \$4.0 billion   |
| 1984 | Continental Illinois National Bank and Trust Company | Then the nation's eighth largest bank, Continental Illinois had suffered significant losses after purchasing \$1 billion in energy loans from the failed Penn Square Bank of Oklahoma. The FDIC and Federal Reserve devised a plan to rescue the bank that included replacing the bank's top executives.  | \$9.5 billion   |
| 1989 | Savings & Loan                                       | After the widespread failure of savings and loan institutions, President George H.W. Bush signed and Congress enacted the Financial Institutions Reform Recovery and Enforcement Act in 1989.   | \$293.3 billion |
| 2001 | Airline Industry                                     | The terrorist attacks of September 11 crippled an already financially troubled industry. To bail out the airlines, President George W. Bush signed into law the Air Transportation Safety and Stabilization Act, which compensated airlines for the mandatory grounding of aircraft after the attacks. The act released \$5 billion in compensation and an additional \$10 billion in loan guarantees or other federal credit instruments.  | \$18.6 billion  |
| 2008 | Bear Stearns   | JP Morgan Chase and the federal government bailed out Bear Stearns when the financial giant neared collapse. JP Morgan purchased Bear Stearns for \$236 million; the Federal Reserve provided a \$30 billion credit line to ensure the sale could move forward.   | \$30 billion    |
| 2008 | Fannie Mae / Freddie Mac                             | On September 7, 2008, Fannie and Freddie were essentially nationalized: placed under the conservatorship of the Federal Housing Finance Agency. Under the terms of the rescue, the Treasury has invested billions to cover the companies' losses. Initially, Treasury Secretary Henry Paulson put a ceiling of \$100 billion for investments in each company. In February 2009, Tim Geithner raised it to \$200 billion. The money was authorized by the Housing and Economic Recovery Act of 2008. | \$400 billion   |
| 2008 | American International Group                         | On four separate occasions, the government offered aid to AIG to keep it from collapsing, rising from an initial \$85 billion credit line from the Federal Reserve to a combined \$180 billion effort between the Treasury (\$70 billion) and Fed (\$110 billion). \$40 billion of the Treasury's commitment is also included in the TARP total.  | \$180 billion   |
| 2008 | Auto Industry  | In late September 2008, Congress approved a more than \$630 billion spending bill, which included a measure for \$25 billion in   | \$25 billion    |

|      |                               |  |                 |
|------|-------------------------------|--|-----------------|
|      |                               | loans to the auto industry. These low-interest loans are intended to aid the industry in its push to build more fuel-efficient, environmentally-friendly vehicles. The Detroit 3, i.e. General Motors, Ford and Chrysler, were the primary beneficiaries.  |                 |
| 2008 | Troubled Asset Relief Program | In October 2008, Congress passed the Emergency Economic Stabilization Act, which authorized the Treasury Department to spend \$700 billion to combat the financial crisis. Treasury doled out the money via an alphabet soup of different programs.  | \$700 billion   |
| 2008 | Citigroup                     | Citigroup received a \$25 billion investment through the TARP in October and another \$20 billion in November. Additional aid came in the form of government guarantees to limit losses from a \$301 billion pool of toxic assets. In addition to the Treasury's \$5 billion commitment, the FDIC has committed \$10 billion and the Federal Reserve up to about \$220 billion.  | \$280 billion   |
| 2009 | Bank of America               | Bank of America received \$45 billion through the TARP, which includes \$10 billion originally meant for Merrill Lynch. In addition, the government has made guarantees to limit losses from a \$118 billion pool of troubled assets. In addition to the Treasury's \$7.5 billion commitment, the FDIC has committed \$2.5 billion and the Federal Reserve up to \$87.2 billion. | \$142.2 billion |

*Notes:* Adopted from ProPublica website <http://www.propublica.org/special/government-bailouts#tarp>. The relative size of each US government bailout is calculated in 2008 dollars.



**Appendix 2: Summary Statistics for State Variables**

| <b>Variable</b>                  | <b>Mean</b> | <b>Min.</b> | <b>1%</b> | <b>99%</b> | <b>Max.</b> | <b>Std. Dev.</b> |
|----------------------------------|-------------|-------------|-----------|------------|-------------|------------------|
| <i>VIX</i>                       | 21.08       | 10.02       | 10.08     | 69.95      | 79.13       | 11.48            |
| <i>Liquidity Spread</i>          | 12.11       | -10.00      | -6.00     | 73.00      | 116.00      | 17.27            |
| <i>3-month Treasury Change</i>   | -0.23       | -100.00     | -55.00    | 26.00      | 59.00       | 12.52            |
| <i>Term Spread Change</i>        | 0.12        | -87.00      | -41.00    | 51.00      | 88.00       | 15.20            |
| <i>Credit Spread Change</i>      | 0.10        | -34.00      | -30.00    | 35.00      | 51.00       | 8.98             |
| <i>Equity Return</i>             | 0.15        | -18.39      | -7.72     | 7.43       | 13.04       | 2.81             |
| <i>Real Estate Excess Return</i> | -0.21       | -11.00      | -8.09     | 6.79       | 9.50        | 2.47             |

*Notes:* Summary statistics are presented for the state variables used to estimate the time-varying  $CoVaR_t$ . Following Adrian and Brunnermeier (2011), we include a set of state variables  $M_t$  that are well known to capture time variation in conditional moments of asset returns, and liquid and easily tradable. The factors are: (i) *VIX*, which captures the implied volatility in the stock market reported by the Chicago Board Options Exchange. (ii) A short term “*Liquidity Spread*”, defined as the difference between the three-month repo rate and the three-month bill rate. This liquidity spread measures short-term liquidity risk. (iii) The change in the three-month Treasury bill rate. The change in the three-month Treasury bill rate because the change, not the level, is found to be the most significant in explaining the tails of financial sector market-valued asset return. (iv) The change in the *slope of the yield curve*, measured by the yield spread between the ten-year Treasury rate and the three-month bill rate. (v) The change in the *Credit Spread* between BAA-rated bonds and the Treasury rate with the same maturity of ten years. (vi) The weekly equity market returns from CRSP. (vii) The weekly real estate sector returns in excess of the market returns (from the real estate companies with SIC code 65-66). *VIX* index and the three-month repo rate are obtained from Bloomberg; the three-month Treasury bill rate, the ten-year Treasury rate, and BAA-rated bond rate are available from the Federal Reserve Board’s H.15 release; the return on CRSP index and the return on real estate sector are obtained from CRSP US Stock database. The spreads and spread changes are expressed in basis points, returns in percentage. Reported are the mean, minimum, 1st percentile, 99th percentile, maximum and standard deviation of each state variable defined above over the period of 2005 to 2010.

**Appendix 3: Summary Statistics of Main Variables for Bailout Banks**

| <b>Variable</b>   | <b>Mean</b> | <b>25<sup>th</sup><br/>Percentile</b> | <b>Median</b> | <b>75<sup>th</sup><br/>Percentile</b> | <b>Standard<br/>Deviation</b> | <b>No. of<br/>Obs.</b> |
|---|-------------|---------------------------------------|---------------|---------------------------------------|-------------------------------|------------------------|
| <b>Panel A: Total Assets <math>\geq</math> \$10 billion</b>                               |             |                                       |               |                                       |                               |                        |
| <i>BA</i>   | 4.94        | 0.33                                  | 1.49          | 3.50                                  | 7.7040                        | 42                     |
| <i>BR</i>   | 29.88%      | 24.54%                                | 30.55%        | 34.05%                                | 0.1154                        | 42                     |
| <i>CA</i>   | 9.20%       | 8.15%                                 | 8.88%         | 9.43%                                 | 0.0167                        | 42                     |
| <i>AQ</i>   | 2.28%       | 1.40%                                 | 2.03%         | 3.03%                                 | 0.0118                        | 42                     |
| <i>MQ</i>   | 63.81%      | 53.63%                                | 62.47%        | 69.90%                                | 0.1445                        | 42                     |
| <i>EAR</i>  | 0.12%       | -0.14%                                | 0.26%         | 0.71%                                 | 0.0121                        | 42                     |
| <i>LIQ</i>  | 7.79%       | 2.72%                                 | 3.81%         | 5.18%                                 | 0.1262                        | 42                     |
| <i>SEN</i>  | 21.59%      | 13.88%                                | 23.94%        | 29.07%                                | 0.1085                        | 42                     |
| <i>BZ</i>   | 18.15       | 16.60                                 | 17.98         | 18.98                                 | 1.7415                        | 42                     |
| <i>AGE</i>  | 33.81       | 22.00                                 | 34.00         | 40.00                                 | 22.3893                       | 42                     |
| <b>Panel B: \$10 billion <math>\geq</math> Total Assets <math>\geq</math> \$3 billion</b> |             |                                       |               |                                       |                               |                        |
| <i>BA</i>   | 0.13        | 0.08                                  | 0.10          | 0.15                                  | 0.0538                        | 37                     |
| <i>BR</i>   | 29.00%      | 26.45%                                | 30.10%        | 32.15%                                | 0.0598                        | 37                     |
| <i>CA</i>   | 9.79%       | 9.23%                                 | 9.75%         | 10.13%                                | 0.0092                        | 37                     |
| <i>AQ</i>   | 1.82%       | 0.85%                                 | 1.54%         | 2.24%                                 | 0.0130                        | 37                     |
| <i>MQ</i>   | 79.95%      | 59.39%                                | 65.45%        | 75.42%                                | 0.4899                        | 37                     |
| <i>EAR</i>  | -0.58%      | -0.10%                                | 0.60%         | 0.88%                                 | 0.0328                        | 37                     |
| <i>LIQ</i>  | 3.07%       | 2.13%                                 | 2.91%         | 3.45%                                 | 0.0136                        | 37                     |
| <i>SEN</i>  | 16.01%      | 8.46%                                 | 16.53%        | 24.16%                                | 0.0970                        | 37                     |
| <i>BZ</i>   | 15.47       | 15.17                                 | 15.42         | 15.86                                 | 0.3845                        | 37                     |
| <i>AGE</i>  | 22.22       | 15.00                                 | 25.00         | 26.00                                 | 8.2568                        | 37                     |
| <b>Panel C: \$3 billion <math>\geq</math> Total Assets <math>\geq</math> \$1 billion</b>  |             |                                       |               |                                       |                               |                        |
| <i>BA</i>   | 0.04        | 0.03                                  | 0.04          | 0.05                                  | 0.0483                        | 70                     |
| <i>BR</i>   | 29.41%      | 23.12%                                | 28.60%        | 31.41%                                | 0.2298                        | 70                     |
| <i>CA</i>   | 10.32%      | 9.34%                                 | 10.17%        | 11.10%                                | 0.0162                        | 70                     |
| <i>AQ</i>   | 1.89%       | 1.00%                                 | 1.38%         | 2.19%                                 | 0.0167                        | 70                     |
| <i>MQ</i>   | 62.52%      | 59.29%                                | 66.35%        | 72.17%                                | 0.2852                        | 70                     |
| <i>EAR</i>  | 0.19%       | 0.07%                                 | 0.47%         | 0.71%                                 | 0.0111                        | 70                     |

|            |        |       |       |        |         |    |
|------------|--------|-------|-------|--------|---------|----|
| <i>LIQ</i> | 3.06%  | 2.36% | 2.82% | 3.42%  | 0.0139  | 70 |
| <i>SEN</i> | 12.29% | 4.73% | 9.37% | 17.48% | 0.0984  | 70 |
| <i>BZ</i>  | 14.36  | 14.11 | 14.31 | 14.62  | 0.3126  | 70 |
| <i>AGE</i> | 18.66  | 10.00 | 20.50 | 25.00  | 10.8252 | 70 |

**Panel D: \$1 billion  $\geq$  Total Assets**

|            |        |        |        |        |        |    |
|------------|--------|--------|--------|--------|--------|----|
| <i>BA</i>  | 0.02   | 0.01   | 0.02   | 0.02   | 0.0119 | 36 |
| <i>BR</i>  | 28.93% | 25.39% | 27.51% | 31.06% | 0.1347 | 36 |
| <i>CA</i>  | 10.61% | 9.38%  | 10.40% | 11.12% | 0.0168 | 36 |
| <i>AQ</i>  | 1.64%  | 0.83%  | 1.59%  | 2.12%  | 0.0113 | 36 |
| <i>MQ</i>  | 70.29% | 64.86% | 70.39% | 76.41% | 0.0856 | 36 |
| <i>EAR</i> | -0.02% | 0.16%  | 0.45%  | 0.77%  | 0.0160 | 36 |
| <i>LIQ</i> | 3.36%  | 2.46%  | 2.95%  | 3.57%  | 0.0211 | 36 |
| <i>SEN</i> | 13.70% | 4.92%  | 11.28% | 20.81% | 0.1133 | 36 |
| <i>BZ</i>  | 13.52  | 13.37  | 13.50  | 13.73  | 0.2211 | 36 |
| <i>AGE</i> | 12.92  | 7.00   | 12.50  | 16.50  | 7.6695 | 36 |

*Notes:* The table reports the summary statistics of the main variables used in the study. Reported are the mean, 25<sup>th</sup> percentile, median, 75<sup>th</sup> percentile, and standard deviation of each variable listed in Table II. The statistics for the financial variables are computed based on the Bank Holding Company Data released at the end of September 2008, the latest financial information available before the announcement of TARP on October 14, 2008. *BA* represents bailout amount (in billions \$), *BR* bailout ratio, *CA* capital adequacy, *AQ* asset quality, *MQ* management quality, *EAR* earnings, *LIQ* liquidity, *SEN* sensitivity, *SZ* bank size (natural log of total assets in thousands \$), and *AGE* bank age (number of years). The detailed definition and data source are available in Table 2.

**Appendix 4:** Size-Group Summary Statistics for Cumulative Abnormal Returns around the Announcement of TARP

| <b>Total Assets</b> | <b>Variable</b>  | <b>Mean</b> | <b>Median</b> | <b>Std. Dev.</b> |
|---------------------|------------------|-------------|---------------|------------------|
| ≥ \$10 billion      | Market CARs      | 33.3835     | 28.2897       | 22.1362          |
|                     | Fama-French CARs | 44.0947     | 40.7852       | 23.4070          |
| ≤ \$10 billion &    | Market CARs      | 21.6413     | 21.3172       | 13.0647          |
| ≥ \$3 billion       | Fama-French CARs | 45.2512     | 44.8689       | 18.1609          |
| ≤ \$3 billion &     | Market CARs      | 4.7970      | 5.5016        | 17.0882          |
| ≥ \$1 billion       | Fama-French CARs | 17.9209     | 15.1201       | 25.7686          |
| ≤ \$1 billion       | Market CARs      | -2.4887     | -0.7948       | 15.0287          |
|                     | Fama-French CARs | -1.5640     | -0.6923       | 14.2551          |

*Notes:* Summary statistics are presented for the cumulative abnormal returns of the bailout banks in each of the sub-samples around October 14, 2008 (the day of the announcement of TARP). The sample of banks that accepted TARP bailout funds during this period is obtained from ProPublicas TARP database. Stock return data is retrieved from CRSP US Stock database. Following, FDIC and Federal Reserve Guidelines, the bailout banks in the sample are split into 4 subsamples based on their book value of total assets as of at the quarter-end of the announcement of TARP (December 31, 2008). Reported are mean, median, and standard deviations of market CARs, and Fama-French CARs in event windows of 10 trading days before and after the date that TARP was announced. The cumulative abnormal return variables are defined in the text.

**Appendix 5:** Size-Group Summary Statistics for Cumulative Abnormal Returns around the Receipt of TARP Funds

| <b>Total Assets</b>               | <b>Variable</b>  | <b>Mean</b> | <b>Median</b> | <b>Std. Dev.</b> |
|-----------------------------------|------------------|-------------|---------------|------------------|
| ≥ \$10 billion                    | Market CARs      | -9.5270     | -5.6087       | 20.0500          |
|                                   | Fama-French CARs | -1.4968     | 1.9461        | 18.4915          |
| ≤ \$10 billion &<br>≥ \$3 billion | Market CARs      | -9.9341     | -9.1864       | 20.6067          |
|                                   | Fama-French CARs | -4.5483     | -6.0440       | 20.2869          |
| ≤ \$3 billion &<br>≥ \$1 billion  | Market CARs      | -5.6314     | -5.7627       | 19.0473          |
|                                   | Fama-French CARs | -3.0392     | -4.0684       | 19.5482          |
| ≤ \$1 billion                     | Market CARs      | 5.3646      | 6.3623        | 21.0709          |
|                                   | Fama-French CARs | 6.9637      | 7.1343        | 20.8991          |

*Notes:* of the sub-samples around the day that each bank in the sample actually received the TARP funds. This event date is specific to each bailout bank, ranging from October 2008 to December 2009. The sample of banks that accepted TARP bailout funds during this period is obtained from ProPublicas TARP database. Stock return data is retrieved from CRSP US Stock database. Following, FDIC and Federal Reserve Guidelines, the bailout banks in the sample are split into 4 sub-samples based on their book value of total assets as of at the end of the quarter that they received TARP funds. Reported are mean, median, and standard deviations of market CARs, and Fama-French CARs in event windows of 10 trading days before and after the date that TARP was announced. The cumulative abnormal return variables are defined in the text.

**Appendix 6:** Point and Cumulative Abnormal Differential Returns of Banks with High and Low Bailout Ratios (Simple Specification)

| Event Day | Point Estimation (scaled) |           | CAR Estimation |           |
|-----------|---------------------------|-----------|----------------|-----------|
|           | Mean                      | Std. Dev. | Mean           | Std. Dev. |
| -10       | -0.4698***                | 0.1367    | -0.4698***     | 0.1367    |
| -9        | -0.0316                   | 0.1482    | -0.5014**      | 0.2420    |
| -8        | 0.2412**                  | 0.1168    | -0.2603        | 0.2649    |
| -7        | -0.0857                   | 0.1586    | -0.3460        | 0.2100    |
| -6        | 0.2471**                  | 0.1141    | -0.0989        | 0.2582    |
| -5        | -0.1609                   | 0.0992    | -0.2599        | 0.2339    |
| -4        | 0.1552                    | 0.1583    | -0.1046        | 0.2991    |
| -3        | 0.1403                    | 0.1260    | 0.0356         | 0.3952    |
| -2        | 0.0093                    | 0.1430    | 0.0449         | 0.3909    |
| -1        | 0.0764                    | 0.1872    | 0.1213         | 0.3691    |
| 0         | 0.1066                    | 0.2071    | 0.2279         | 0.4147    |
| 1         | -0.0908                   | 0.1589    | 0.1371         | 0.4352    |
| 2         | 0.0115                    | 0.2330    | 0.1487         | 0.2687    |
| 3         | -0.0379                   | 0.1431    | 0.1108         | 0.3540    |
| 4         | 0.0791                    | 0.0988    | 0.1899         | 0.3916    |
| 5         | 0.0810                    | 0.1147    | 0.2709         | 0.4564    |
| 6         | -0.0470                   | 0.1025    | 0.2239         | 0.5158    |
| 7         | -0.2758**                 | 0.1101    | -0.0519        | 0.4978    |
| 8         | 0.2721***                 | 0.0997    | 0.2201         | 0.5504    |
| 9         | 0.1337                    | 0.0858    | 0.3538         | 0.5690    |
| 10        | 0.2180                    | 0.1543    | 0.5718         | 0.5088    |

Notes: The table shows the point and cumulative abnormal returns between banks with high and low bailout to tier 1 capital ratio  $BA$  in a window of ten days before and ten days after the day of the receipt of TARP funds (the event day is specific to each bailout bank). The point and cumulative estimate of the average returns for the event are reported along their standard error. Standard errors are adjusted for heteroskedasticity. The return variables are defined in the text. The scaled point estimates are defined as  $(B^{Large} - B^{Small}) \times \hat{\delta}_{1r}$ . \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.

**Appendix 7: Point and Cumulative Abnormal Differential Returns of Banks with High and Low Bailout Ratios (Simple Specification)**

| Event Day | Point Estimation (scaled) |           | CAR Estimation |           |
|-----------|---------------------------|-----------|----------------|-----------|
|           | Mean                      | Std. Dev. | Mean           | Std. Dev. |
| 0         | -0.4698***                | 0.1367    | -0.4698***     | 0.1367    |
| 1         | -0.0908                   | 0.1589    | 0.1371         | 0.4352    |
| 2         | 0.0115                    | 0.2330    | 0.1487         | 0.2687    |
| 3         | -0.0379                   | 0.1431    | 0.1108         | 0.3540    |
| 4         | 0.0791                    | 0.0988    | 0.1899         | 0.3916    |
| 5         | 0.0810                    | 0.1147    | 0.2709         | 0.4564    |
| 6         | -0.0470                   | 0.1025    | 0.2239         | 0.5158    |
| 7         | -0.2758**                 | 0.1101    | -0.0519        | 0.4978    |
| 8         | 0.2721***                 | 0.0997    | 0.2201         | 0.5504    |
| 9         | 0.1337                    | 0.0858    | 0.3538         | 0.5690    |
| 10        | 0.2180                    | 0.1543    | 0.5718         | 0.5088    |

*Notes:* The table shows the point and cumulative relative abnormal returns between banks with high and low bailout to tier 1 capital ratios BA in a window of ten days after the day of the receipt of TARP funds (the event day is specific to each bailout bank). The point and cumulative estimate of the average returns for the event are reported along their standard error. Standard errors are adjusted for heteroskedasticity. The return variables are defined in the text. The scaled relative point estimates are defined as  $(B^{Large} - B^{Small}) \times (\hat{\delta}_{1T} - \hat{\delta}_{1PRE})$ . \*, \*\*, and \*\*\* represent statistical significance at the 10%, 5%, and 1% level, respectively.