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Contagion Effects in the Aftermath of *Lehman*'s Collapse: Evidence from the US Financial Services Industry

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Abstract: The spectacular failure of the 150-year old investment bank Lehman Brothers on September 15th, 2008 was a major turning point in the global financial crisis that broke out in the summer 2007. Through the use of stock market data and Credit Default Swap (CDS) spreads, this paper examines the investors' reaction to Lehman's collapse in an attempt to identify a spillover effect on the surviving financial institutions. The empirical analysis indicates that (*i*) the collateral damages were limited to the largest financial firms; (*ii*) the most affected institutions were the surviving "non-bank" financial services firms; (*iii*) the negative effect was correlated with financial conditions of the surviving institutions. We also detect significant abnormal jumps in the CDS spreads that we interpret as evidence of sudden upward revisions in the market assessment of future default probabilities assigned to the surviving financial firms.

Keywords: bank failures; systemic risk; bailout; too-big-to-fail; contagion; financial crisis; regulation; market discipline; Credit Default Swap

JEL Classification Codes: G21; G28

Résumé : La faillite spectaculaire de la banque d'investissement Lehman Brothers a été perçue par de nombreux analystes comme un véritable point de retournement dans la crise financière actuelle. Le spectre du risque systémique a semé la panique parmi les investisseurs, non seulement aux États-Unis, mais aussi sur les marchés financiers internationaux. À l'aide de séries boursières sur le cours des actions et le spread des swaps de défaut (CDS) des établissements financiers, nous analysons la perception de la faillite de Lehman Brothers aux États-Unis en étudiant la réaction des investisseurs à l'annonce de cet évènement spectaculaire et inattendu. Nos résultats montrent que les dommages collatéraux associés à la faillite de Lehman se sont fait sentir de manière significative dans plusieurs sous-groupes spécifiques d'institutions : (i) les entreprises spécialisées dans les services financiers proches du secteur d'activité de Lehman, mais aussi (ii) les plus grandes banques et entreprises financières, qui sont au cœur même du système financier, ainsi que (iii) les entreprises spécialisées dans les crédits immobiliers.

Mots-clés : faillites bancaires ; risque systémique ; crises financières ; too-big-to-fail ; contagion ; régulation prudentielle ; swap de défaut (CDS)

Classification JEL : G21; G28

1. Introduction

The spectacular failure of the 150-year old investment bank Lehman Brothers has been perceived by many to be a major turning point in the global financial crisis that broke out in the summer 2007. The specter of systemic risk raised widespread fears of a full-scale collapse of the US financial sector due to financial contagion and concerns about significant disturbances outside the US, in international financial markets. According to the bankruptcy petition #08-13555, filed on Monday, September 15th, 2008, Lehman's total assets of $639 billion made it the largest failure in US history, about six times larger than the largest previous failure (see Table 1).[3]

{Table 1}

Among academics and researchers, there was considerable debate about the nature, triggering events, and extent of systemic risk during the recent global financial crisis. This debate reflects undoubtedly more general difficulties to define properly the concept of systemic risk and the absence of a broad consensus in the financial literature.[4] The various definitions place at the core of the concept of systemic risk the notion of *contagion*, which describes the propagation mechanisms of the effects of shocks from one or more financial firms to others. The phenomenon of contagion is widely perceived as being more dangerous in the financial sector than in other industries because (*i*) it occurs generally faster; (*ii*) it spreads more broadly within the industry; (*iii*) it results in a greater number of failures and larger losses to

[3] Financial media extensively discussed the case during the week that followed the bankruptcy announcement, often using a broad array of metaphors and bombastic terms: "*a tsunami sweeping the financial industry*" and "*sending tremors worldwide*"; "*a financial Armageddon*" having "*a massive effect on hundreds of other businesses, from real estate to restaurants*"; "*a perfect storm*" sparking "*a chain reaction that sent credit markets into disarray*"; "*the biggest economic firestorm since the Great Depression*" that "*presented too great a threat to the financial system and the economy*" and "*set off a cascade of events around the globe*"; "*a devastating blow to the global financial world*" (excerpts from articles published by leading financial newspapers in the US on days following September 15th, 2008).

[4] Kaufman (1994, 2000), De Bandt and Hartmann (2002), and Kaufman and Scott (2003) propose excellent surveys on contagion and systemic risk in banking and financial systems. Taylor (2009a) provides an updated and interesting discussion of systemic risk in the context of the current financial crisis and highlights the urgent need for an *operational* definition of the concept.

creditors; (*iv*) it can affects otherwise solvent financial institutions (see Kaufman, 1994). For all these reasons, it is widely considered that systemic risk is the strongest argument justifying the intervention of public authorities in the financial sector.

Since the beginning of the global financial crisis in August 2007, many large institutions at the core of the financial systems in developed and developing countries have been bailed out by public authorities in the name of contagion and systemic risk. In the US, for instance, financial institutions (FIs) like Bear Stearns, Fannie Mae, Freddie Mac, American Insurance Group, and Citigroup were all considered systemically important or "too big (or interconnected) to fail" (TBTF) and the government decided to protect them from failure by injecting huge amounts of taxpayers' money. However, in the particular case of Lehman, the outcome was drastically different: the government allowed the nation's fourth-largest investment bank to collapse when no viable private-sector solution could be found.[5] The government justified its decision on the grounds that, unlike in the case of Bear Stearns, market participants have had sufficient time to prepare themselves to absorb the collateral damages eventually caused by the imminent collapse of Lehman. Moreover, in contrast to Bear Stearns, Lehman had direct access to short-term facilities from the Federal Reserve.[6] Top government officials also pointed out that they viewed Fannie Mae and Freddie Mac as

[5] During the days leading up to September 15th, 2008, there were a number of rescue packages being discussed for how to figure out an "industry solution" in an attempt to stabilize Lehman and calm the markets. For instance, on September 13th, Timothy F. Geithner, then president of the New York Federal Reserve, called a 6 p.m. meeting on the future of Lehman, which included the possibility that the government would need to orchestrate an orderly liquidation of its assets (*New York Times*, September 13th, 2008). The failure to find a white knight ready to assume Lehman's liabilities is clearly due to the government decision to refuse any financial facilities to potential interested parties, as was the case for instance in March 2008 when JP Morgan Chase acquired the troubled investment bank Bear Stearns.

[6] Immediately after the near-failure of Bear Stearns, on March 17th, 2008, the Federal Reserve created an exceptional lending facility (the Primary Dealer Credit Facility, PDCF) that enabled investment banks and other primary dealers for the first time to access liquidity in the overnight loans market for short-term needs. The PDCF was intended to mitigate adverse effects from future failures of investment banks (see Adrian et al., 2009, for further details).

far more systemically important than Lehman because the two mortgage giants own or guarantee about half of home loans originated in the US.[7]

For many observers, however, the failure of Lehman was an event triggering systemic risk and panic in financial markets. For instance, Acharya et al. (2009) mention Lehman's failure as a clear example of systemic risk that materialized during the global financial crisis of 2007-2009. They note, with the benefits of hindsight, that Lehman contained "*considerable systemic risk*" and led to "*the near collapse of the financial system.*" Portes (2008) takes a more sanguine view suggesting that the government decision not to rescue Lehman was a policy error that exacerbated the adverse effects of the financial crisis. The critics generally share the view that the systemic crisis that has emerged in the aftermath of Lehman's failure could have been mitigated if the government had intervened.

Other influential economists embraced the opposite view, arguing that it was not Lehman's failure but the uncertainty surrounding the ill-conceived 2½-page draft of legislation regarding the Troubled Asset Relief Program (TARP) released several days afterward that effectively trigger the global panic of the fall 2008 (see e.g. Taylor, 2009b, and Cochrane and Zingales, 2009). They use event studies based on graphical analysis to show that basic risk indicators of stress in the financial sector, such as the Libor-OIS and CDS spreads, reacted apathetically to Lehman's collapse. By contrast, the same stress indicators exhibited very strong and negative responses just after the Federal Reserve Board Chairman Ben Bernanke and Treasury Secretary Henry Paulson testified at the Senate Banking Committee about the TARP, several days later, on September 23rd and 24th, 2008. In the same vein, Rogoff (2008) contends that in the case of Lehman the government applied the right medicine at the right moment and approves its decision to deny taxpayers money to rescue the troubled investment

[7] In his press conference on Monday, September 15th 2008, the US Secretary of the Treasury Henry M. Paulson Jr. clearly stated: "*The actions with respect to Fannie Mae and Freddie Mac are so extraordinarily important, not only to our capital markets, but to making sure we have plenty of finance in housing, because that is going to be the key to turning the corner here.*" (*Dow Jones Newswire*, September 15th, 2008)

bank. Mishkin (2011) acknowledges that the collapse of Lehman was followed by other events, among which is the struggle to get the TARP approved by the US Congress, that were at least as important in causing the subprime crisis to go global. He also argues that the financial system would probably have imploded even if Lehman had been bailed out.

The main objective of the present study is to answer three research questions related to the systemic nature of the collapse of Lehman Brothers viewed as a turning point in the current financial crisis. First, by using variations of the conventional event study methodology applied to stock market and Credit Default Swap (CDS) data, we examine the investors' reaction to Lehman's failure in an attempt to identify an eventual spillover effect on the surviving financial institutions.[8] Our second research question is whether the spillover effect, if it was statistically significant, affected the other surviving financial firms *indiscriminately*, that is regardless of potential differences in their risk profiles, financial conditions or physical exposures to Lehman. Finally, our third research question is whether the release of the first draft of TARP legislation triggered a broader, more adverse, reaction compared with Lehman's collapse. The answers to these questions shed light on an unsolved debate about the nature of the shockwaves triggering systemic risk during the recent global financial crisis and are central to understanding how the largest failure in US history affected the survival financial firms.

It should be noted that absent a rigorous operational definition of systemic risk, it would be presumptuous to infer from an event study analysis whether Lehman was indeed "systemically important." However, a *necessary* condition for this special qualification is that the failure should have *significant* adverse knock-on effects on a large number of surviving

[8] As noted by Zingales (2008), Lehman's collapse also had a dramatic impact on money market funds industry, repo and interbank lending markets. For instance, the Reserve Primary Fund, a large US money market mutual fund, decided on September 16th to freeze redemptions because of its large exposure to Lehman debt. As the net asset value of its shares fell below $1, the fund "broke the buck" and contributed to the panic of October 2008. The idea to investigate the effects of Lehman's collapse on the mutual funds industry and other short-term markets is left for future work.

financial institutions. The empirical findings in this paper indicate that the collateral damages associated to Lehman's collapse were significant at least for several categories of firms: (*i*) the largest banks and financial institutions, presumably more likely to benefit from conjectural government guarantees after the Bear Stearns bailout; (*ii*) the financial services firms operating in the same product area as the failed investment bank; and (*iii*) firms providing mortgages, mortgage insurance, and other related services, i.e. operating in the most shaky sector after the summer 2007 and at the core of the current financial crisis. While the collateral damages were not generalized to *all* FIs, it is worth mentioning that the *biggest* firms, which play a crucial role in the financial system, were however the most affected by the Lehman crisis. Whether Lehman's collapse was a "systemic event" highly depends on how one defines the boundaries of the "systemic risk" concept.

Another interesting result reported in the present paper is that the *individual* abnormal stock returns are found to be strongly correlated with financial firms' fundamentals (risk profile, leverage, and profitability), suggesting that the market reaction to Lehman's failure was selective and informed, rather than random and indiscriminate. This result lends support to the so-called information-based contagion hypothesis and suggests that despite the relative opaqueness of financial firms' assets, empirically documented during the 2007–2009 financial crisis (see e.g. Flannery et al., 2013), market participants were able to discriminate among the surviving financial firms.

Finally, we also detect significant abnormal jumps in the CDS spreads indicating a sudden upward revision in the market assessment of future default probabilities assigned to the surviving financial firms, both after Lehman's failure and Ben Bernanke's and Henry Paulson's TARP speeches before the Senate Banking Committee several days later, on September 23–24, 2008. However, the reaction of the CDS market to Lehman's failure is significantly more adverse, from a statistical point of view, than the perceived impact of the

TARP testimony. The same result holds when we compare the stock market reaction to the two events of interest.

The rest of the paper is organized as follows. Section 2 reviews the related literature. Section 3 describes the main research hypotheses tested in the present paper. Section 4 presents the research methodology and Section 5 describes the data sources used in our study, as well as the sampling procedure. The main results concerning the market's reaction to Lehman's failure and the announcement of TARP are presented in Section 6. Finally, Section 7 concludes.

2. Related literature

This paper relates to several strands of literature. First, it relates to the earlier literature investigating the effects of a large FI's failure on the performance of the surviving financial firms (see e.g. Swary, 1986; Peavy and Hempel, 1988; Wall and Peterson, 1990; Aharony and Swary, 1996) and the pricing of risk in the financial markets after releases of "bad news," such as loan-loss reserve announcements, dividend cuts or LDC debt payment moratoria (see e.g. Cornell and Shapiro, 1986; Docking et al., 1997; Slovin et al., 1999). Kaufman (1994) and Flannery (1998) survey the earlier literature and conclude their assessment of equity studies by emphasizing a positive implication for the functioning of market discipline in the financial services industry. Investors seem to incorporate relevant information promptly into stock prices and financial firms that are most adversely affected by other financial firms' failures tend to be somewhat "similar" to the failed firms.[9]

[9] De Bandt and Hartmann (2002) note at the end of their review of the event studies on stock price reactions that the earlier literature investigates "weak" systemic events, as stock price fluctuations (negative abnormal returns) do not necessarily imply actual failures. According to their terminology, a systemic event is "strong" if the financial institutions affected by the initial shock actually fail or crash. Otherwise, i.e. if the consequence of the initial shock is less than a failure or a crash, the systemic event is said to be "weak."

These results also tend to hold in financial systems with relatively poor financial transparency and characterized by a hostile environment for effective market discipline. For instance, during the so-called "lost decade" in Japan, banks and securities firms experienced severe long-lasting difficulties, which were not fully reflected in their financial statements. Brewer et al. (2003) examine the response in equity returns of Japanese banks to the failure of four commercial banks and two securities firms during the second half of the nineties. They find that, despite the alleged lack of transparency, large inefficiencies in the Japanese stock market and poor behavior of financial regulators, stock prices of surviving banks reacted negatively to the failure announcements. Moreover, the most adversely affected institutions were the survivors in poor financial health.

Flannery (1998) also discusses in his survey several earlier contagion studies from other industries (*viz*. utilities, real estate, and insurance) and concludes that investors drew in most cases rational inferences about the implications of one firm's experience for the value of other similar firms operating in the same industry. One recent study related to our paper investigates the effect of AIG's bailout, and the events leading up to it, on its insurance industry rivals. Egginton et al. (2010) employ the event study methodology to test the relevance of two competing effects: a contagion effect, implying that rival returns decrease following negative events affecting AIG, and a competitive effect occurring if investors expect that rivals are able to benefit from AIG's downfall. The results, based on a sample of 101 insurers (excluding AIG), indicate that for the entire period of the study (February 11, 2008 to October 9, 2008), the positive competitive effects dominate any negative contagion effects. However, when examining each of the key events, Egginton et al. (2010) find evidence of net contagion effects around the February 11th CDS write-down and the October 9th bailout extension.

Before reviewing at length the recent studies directly related to Lehman's failure, we would like to mention an interesting paper by Veronesi and Zingales (2010) that estimates the costs

and benefits of the US Treasury-Federal Deposit Insurance Corporation (FDIC) joint plan, announced on Monday, October 13, 2008. The plan included a large preferred equity infusion in the ten largest US banks, as part of the TARP, and a three-year government guarantee on new unsecured bank debt issues. Veronesi and Zingales (2010) assess through an event study analysis the effect of the plan announcement on the value of various banks' financial claims (bonds/CDS; common/preferred stocks). They conclude that the plan increased the value of banks' financial claims at a taxpayers' cost and led to a large drop in the perceived probability of default implied in the bank CDS rates.[10] In contrast to Veronesi and Zingales (2010), we focus our attention on the first draft of TARP legislation, testified before the Senate Banking Committee several days after Lehman's failure and compare the market reaction to both events (Lehman's collapse and TARP release).

Finally, and most directly, our study also contributes to the growing literature investigating a number of topics related to Lehman's bankruptcy, the largest ever in US history. Ivashina and Scharfstein (2010) examine bank lending behavior during the crisis and document an original form of "run" on banks, triggered by corporate borrowers, who drew on their credit lines, leading to a spike in commercial and industrial loans reported on US banks' balance sheets. An interesting finding is that banks that co-syndicated more of their credit lines with Lehman experienced larger credit-line drawdowns after the failure of the investment bank and hence reduced their lending more. The intuition behind this finding is that commitments that would normally have been met by Lehman would have to be met by the other members of the syndicate, increasing the likelihood that more firms would draw on their credit lines.

[10] Pop and Pop (2009) also document significant downward revisions of the market prices of risk, as measured by the largest banks CDS spreads, after the bailout of the fifth largest financial group in Japan in May 2003.Other previous studies attempted to determine the extent to which financial markets reflect the subsidy provided by governmental guarantees to large banks considered TBTF. In their seminal article on the Continental Illinois crisis, O'Hara and Shaw (1990) find that after the bailout announcement the largest US banks experienced significantly positive abnormal returns in the stock market and the magnitude of such wealth effects was related with bank fundamentals.

Another category of market players likely to be harmed by Lehman's demise was the hedge funds using the failed investment bank as their prime broker. Aragon and Strahan (2012) estimate semi-parametric Cox proportional hazard models of the time to hedge-fund failure as a function of performance and prime-brokerage affiliation. As expected, the hazard rate increased significantly more in 2008 for Lehman's hedge-fund clients than for other funds. The explanation is that Lehman's demise hampered the ability of some hedge funds to trade their positions, leading to an increase in their failure rates.

In a related study, Fernando et al. (2012) investigate the impact of the Lehman collapse on the industrial firms that received underwriting, advisory, analyst, and market-making services from Lehman. They conduct an event study analysis and show that Lehman's equity underwriting clients experienced an abnormal return of around –5%, on average, on several days surrounding the bankruptcy announcement.[11] The negative wealth effects were especially severe for companies that had stronger security underwriting relationships with Lehman or were smaller, younger, and more financially constrained. Fernando et al. (2012) conclude their article by suggesting an interesting interpretation of their findings from a TBTF perspective: the negative effects of a large (investment) bank failure on its clients – industrial firms may offer an alternative rationale for the government intervention besides the classical systemic risk (financial contagion) argument. As we focus on the effects of Lehman's failure on a different set of firms (*viz*. the surviving *financial* firms), our findings complement the results reported in Ivashina and Scharfstein (2010), Aragon and Strahan (2012) and Fernando et al. (2012), and significantly extend the TBTF / systemic risk interpretation of the event of interest.

[11] In a related study, Kovner (2012) extends this result by focusing on the post-IPO importance of equity underwriters. She considers all troubled investment banks during the recent financial crisis (*viz*. Bear Stearns, Lehman Brothers, Merrill Lynch, and Wachovia), not just Lehman, as in Fernando et al. (2012).

Eichengreen et al. (2012) examine the role of common factors in the movement of CDS spreads of the 45 largest financial institutions in nine developed countries and relate their estimated factors to several potential causes of crisis transmission. They find that the share of variance of CDS spreads explained by common factors is typically large and increased during the crisis. More importantly, they also reveal that the mentioned share suddenly increased after the failure of Lehman. In contrast to Eichengreen et al. (2012), Raddatz (2010) focuses on differences in stock returns across individual banks to identify a specific transmission mechanism rather than focusing on common factors and their determinants. He conducts an event study to estimate the impact of Lehman's failure on the stock price returns of a broad set of financial institutions across 44 countries, and tests whether differences in abnormal returns relate to these firms' ex-ante reliance on wholesale funding. The results show that financial firms that before the crisis relied more heavily on wholesale funding experienced a significantly larger abnormal return decline in response to Lehman's demise.

Immediately after Lehman' failure, several industrial and financial firms disclosed their physical exposure (or lack thereof) to the troubled investment bank. Chakrabarty and Zhang (2012) exploit this unique opportunity to test two credit contagion channels through which Lehman's bankruptcy affected other firms: "counterparty risk" and "information transmission" channels.[12] They construct market microstructure variables from high frequency (tick-by-tick) data to measure the various dimensions of contagion effects and provide robust evidence supporting the relevance of counterparty risk. After controlling for counterparty relationships, they find mixed support for the information transmission hypothesis. However, they provide direct evidence that investors are more likely to sell stocks

[12] The "counterparty risk" channel hypothesizes that survivors having identifiable financial exposures to the failed firm should be negatively affected because of fundamental business linkages. By contrast, the "information transmission" channel predicts that the failure of a large firm causes investors to update their beliefs, leading to the financial distress of other firms, irrespective of their business links with the failed firm. Jorion and Zhang (2007, 2009) also investigate the credit contagion channel via direct counterparty effects, but few of their sample firms are in the financial sector.

of exposed firms after their counterparty risk to Lehman is disclosed to the public. In particular, exposed firms suffered more adverse effects (wider bid-ask spread; higher price impact; greater information asymmetry; and greater selling pressure) than unexposed firms.[13] As the authors convincingly argue, these findings are relevant from a public policy perspective. Specifically, if counterparty contagion is the major contagion channel, government bail-out of the failed firm is likely to be a better policy response, whereas financial support to one distressed firm is of little use to boost confidence in the entire market if information is the major channel (see also Taylor, 2009b, and Helwege, 2010, on this last point). While similar in spirit, our study extends the analysis in Chakrabarty and Zhang (2012) in several important ways by testing a number of complementary hypotheses describing the impact of Lehman's failure on other financial firms and relating the responses of the survivors to their fundamentals, business models, and other specific characteristics. These hypotheses are described in the next section.

3. Hypotheses

The alternative research hypotheses tested in the paper are presented in this section by type of event. One set of hypotheses focuses on the effect of Lehman's demise on the surviving financial firms. Another set of hypotheses is related to the announcement of the first draft of TARP legislation. Finally, we describe two additional competing hypotheses based on the comparison of the market reaction to the two events of interest.

3.1. Hypotheses related to Lehman's demise

[13] The final sample used in Chakrabarty and Zhang (2012) includes 86 firms, 60 of which are financial institutions in the finance, insurance, and real estate sector, with 47 exposed firms and 13 unexposed firms. Interestingly, 53 of the 60 financial firms (i.e. over 88% of the sample) announced their exposure (zero or positive) in the first three days after Lehman's failure.

The first and most obvious (null) hypothesis to be tested is that Lehman's failure had no impact on the surviving financial firms. The literature provides several reasons to explain why the failure of a financial firm may have no effect on the survivors, i.e. the "irrelevance" or "no-impact" hypothesis (see e.g. Brewer et al., 2003): (*i*) market inefficiencies; (*ii*) market anticipation of the event; (*iii*) failure explanations based on pure idiosyncratic factors.[14] If the null hypothesis of no impact is rejected, we may formulate two alternative hypotheses. First, if investors perceive the exit of a large competitor as positive news for the remaining firms, either because of improved competitive conditions or increased market shares for the survivors, the impact of Lehman's failure should be positive (see Lang and Stultz, 1992; Kaufman, 1994; Flannery, 1998; Slovin et al., 1999; De Bandt and Hartmann, 2002). Second, if the failure revealed previously undisclosed problems in the financial system or investors updated their beliefs about the conditions of similar financial firms, *à la* Collin-Dufresne et al. (2003), the impact of Lehman's demise should be negative.[15]

In addition to these three hypotheses, we are also interested in testing the so-called pure or undifferentiated contagion hypothesis, according to which investors perceived Lehman's failure to affect all survivors similarly, i.e. irrespective of significant differences in their business models, financial conditions, and other specific characteristics. Under the pure contagion hypothesis, we expect a weak or inexistent correlation between the impact on individual financial firms and their financial conditions. The ability of market participants to discriminate among financial firms in the aftermath of Lehman's demise should not be taken for granted. Indeed, as Flannery et al. (2013) convincingly argue, the opaqueness of financial firms' assets is a time-varying concept that intrinsically depends on the state of the financial

[14] As we have already explained in the introduction section, there are strong reasons to believe that Lehman's failure was an *unexpected* event; moreover, the US stock and CDS markets are highly liquid and efficient, at least for the largest financial firms included in our sample.
[15] The "positive effect" (competitive) and "negative effect" (contagion) hypotheses described here are also explained and tested by Egginton et al. (2010) within the particular context of events leading to AIG's demise.

system. By comparing equity market trading patterns of banks / matched nonbanking firms and various micro-structure proxies for opacity, they show a sharp increase in banking firms' relative opacity during the 2007–2009 financial crisis. By contrast, empirical evidence about the banks' relative opacity is somewhat mixed for normal, relatively tranquil, time periods (see also Morgan, 2002; Flannery et al., 2004; Jones et al., 2012). One testable implication of the undifferentiated contagion hypothesis is that its rejection would imply that the surviving financial firms in weaker conditions should be more adversely affected.

Finally, we formulate a last hypothesis related to Lehman's failure focused on the changes in TBTF expectations characterizing the largest financial firms in the post-Lehman financial world. Namely, Lehman's failure caused investors to reconsider their expectations that some financial institutions were too systemically important to be allowed to fail.[16] According to this hypothesis, we should find a more adverse impact on the set of firms that were thought to be TBTF after the Bear Stearns bailout in March 2008 but prior to Lehman's failure.

3.2. Hypotheses related to TARP announcement

The TARP, in its original form, would have allowed the US Treasury, with no accountability to the Congress, to spend $700 billion purchasing illiquid, difficult-to-value, subprime mortgage-related assets from troubled financial institutions. Veronesi and Zingales (2010) observe that a bailout announcement may have conflicting effects. Investors should react positively if the bailout announcement is credible and induces a downward shift in the probability of bankruptcy. However, because the bailout announcement may be interpreted as bad news about the true value of the firms' assets or investors expect future government

[16] We are grateful to an anonymous referee for suggesting this additional hypothesis. Exactly which firms were thought to be TBTF after the Bear Stearns bailout in March 2008 but prior to Lehman's failure is an open question. We know ex-post that all of the financial firms with over $100 billion in assets that were included in the Supervisory Capital Assessment Program (SCAP) were told that if they could not raise enough capital on their own, the federal government would inject capital. Thus, we use the SCAP list in conjunction with Fitch and Capital Intelligence support ratings to determine the set of financial firms that were most likely to be perceived to benefit from implicit government guarantees (see Section 6 for additional details).

interference with the firms' management, it may result in a negative reaction. Additionally, it is worth noting that the original ill-conceived 2½-page draft proposal raised, at that time, serious doubts that the US government had the capability to manage the crisis (see Taylor, 2009b; Mishkin, 2011). The TARP package was put together over the first weekend after Lehman's failure and on September 23rd and 24th, 2008, Federal Reserve Board Chairman B. Bernanke and Treasury Secretary H. Paulson testified at the Senate Banking Committee. Taylor (2009b) notices that the two government officials were questioned intensely in this testimony and the perception was quite negative, judging by the large volume of critical mail received by many members of the US Congress. After a contentious debate, the US House of Representatives rejected the initial TARP bill by vote several days afterwards. We conjecture that the net effect of the TARP announcement depends on the relative strength of each of the above-mentioned individual effects (positive *vs*. negative).

3.3. Lehman vs. TARP

We conclude this section by mentioning two additional hypotheses based on the comparison of the market reaction to the two events of interest. Following Taylor (2009b), Cochrane and Zingales (2009) and in accordance with our discussion in the introduction section, we hypothesize that the negative net effect of the TARP testimony was broader and more adverse than the perceived impact of Lehman's failure. The alternative hypothesis predicts that, in relative terms, compared with the perception of TARP, the negative industry reaction to Lehman's failure was significantly larger and more detrimental to the surviving financial institutions.

4. Methodology

To assess the various specific and, at times, competing hypotheses described in the previous section, we begin by investigating the reaction of the stock market to the two events of interest. For that purpose, we use variations of the conventional event study methodology. This section briefly describes our choices for estimating abnormal stock returns and compares the benefits and drawbacks of each method within the context of Lehman's failure.

The first modeling choice has been commonly employed in the financial literature to examine the reaction of the stock market to a significant event, such as a regulatory change, affecting *all* firms in the same industry (see e.g. Binder, 1985; Schipper and Thompson, 1983; Cornett and Tehranian, 1990; Karafiath et al., 1991; Brewer et al., 2003; Egginton et al., 2010). Since all firms in our sample come from the financial services industry and share common event dates, we have to avoid the well-known misspecification problems in the conventional event study methodology due to extreme clustering. Indeed, failure to take into account the cross-sectional dependence might induce a systematic underestimation of the standard deviation of the mean abnormal returns, implying that the standardized test statistic is no longer applicable.[17]

According to the first method, the impact of the two events of interest is quantified within a multivariate regression framework that takes the following form:

$$\tilde{R}_{it} = \alpha_{i0} + \beta_{im} R_{mt} + \sum_e \sum_{\tau=0}^{1} \beta_{i\tau,e} \mathcal{D}_{\tau t,e} + \tilde{\varepsilon}_{it} \qquad (1)$$

where $\tilde{R}_{it}$ is the stock return of financial institution i ($i = 1, 2, \dots, N$) on day t ($t = 1, 2, \dots, T$); R_{mt} is the corresponding broad market index (S&P 500) return for day t; α_{i0} is the intercept coefficient, an event-independent constant term for financial firm i; β_{im} is the

[17] According to Schwert (1981), the cross-sectional dependence in returns around the underlying event date is mainly due to the fact that firms in the same industry tend to react in the same way to the event of interest. This would imply that spillover effects are generally associated with a positive default correlation between firms. However, Jorion and Zhang (2007) observe that there could be cases of industrial firm failures in which there is negative default correlation among competing firms. Traditional event study methodology assumes independent abnormal returns. An alternative solution to deal with this issue would have been to adopt a portfolio approach as in Wall and Peterson (1990).

systematic risk coefficient or the sensitivity of the firm i's rate of return to changes in the market's rate of return; $\mathcal{D}_{\tau t,e}$ is a binary variable that equals 1 if the event of interest (e) occurred on day τ or during the window τ ($\tau \in [0,+1]$) and zero otherwise; $\beta_{i\tau,e}$ is the event coefficient or the sensitivity of bank i's rate of return to the event of interest (e); e stands for the type of event, i.e. Lehman's failure ($e = 1$) or TARP testimony ($e = 2$); $\tilde{\varepsilon}_{it}$ is a random error which is assumed to be independent of the market return, serially independent and normally distributed.

The regression model assumes that the coefficient vector is the same for all panels and the matrix of independent variables is the same for each equation in the system. We also assume that the error terms are i.i.d. within each equation (firm), in addition to having different scale variance, i.e. we allow the disturbance variance to differ *across* equations. Finally, following the discussion at the beginning of this section, we assume that the contemporaneous covariance of the error terms can differ from zero, $Cov[\tilde{\varepsilon}_{it}, \tilde{\varepsilon}_{jt}] \neq 0$ if $i \neq j$, although the noncontemporaneous covariances are all zero, $Cov[\tilde{\varepsilon}_{it}, \tilde{\varepsilon}_{js}] = 0$ if $t \neq s$.

Equation (1) can be viewed as a linear system of equations in which a separate equation is estimated for each financial institution i included in the final sample. The regression parameters are estimated based on Zellner's (1962) seemingly unrelated regression (SUR) model using the generalized least squares (GLS) estimation method. The values of the parameters $\beta_{i\tau,e}$ in equation (1) capture the individual banks' estimated "abnormal" returns associated with the event e on day τ or during the window $\tau \in [0,+1]$. They are estimated using daily data before and after the event date over an estimation period sufficiently long to obtain meaningful statistical inferences. Precisely, we use stock market data for 235 days prior to the event date (t = –235 to t = –1) to 18 days after the event date (t = +18), i.e. from October 9th, 2007 to October 9th, 2008.

In an alternative setting, we followed Brewer et al. (2003) and expanded equation (1) *supra* to include interaction terms between event dummy variables and additional explanatory variables that reflect the financial health of each firm, as well as other control variables. However, as some of our key right-hand-side variables are binary variables, the estimated variance-covariance matrix of the disturbance in the expanded SUR equation is singular and thus not invertible. Consequently, to further examine our main hypotheses we analyze the cross-sectional variation in standardized abnormal returns for each of the two events as in Egginton et al. (2010):[18]

$$SAR_i = b_0 + b_1 COND_i + b_2 LEV_i + b_3 TOBIN\_Q_i + b_4 CTRL_i + \epsilon_i \qquad (2)$$

where SAR_i is the event-day standardized abnormal return for firm *i*; $COND_i$ is a variable describing the financial conditions of firm *i* at the time of the event; LEV_i and $TOBIN\_Q_i$ controls for the leverage and expected profitability of firm *i*; and $CTRL_i$ stands for other control variables. We estimate equation (2) by ordinary least squares (standard Breusch–Pagan tests indicate that the degree of heteroskedasticity in each regression model is insignificant).

The financial conditions ($COND_i$) are proxied by the ratio of loan loss reserves to total loans, the loan loss provisions divided by the total loans, and the ratio of non-performing assets as a fraction of total assets. All balance-sheet variables are measured by using accounting data reported in the interim financial statements disclosed by each firm in our sample at the end of June 2008. Higher values of these ratios indicate a deteriorated credit risk profile.

[18] Brewer et al. (2003) is the only reference in our review of the literature that uses an extended SUR framework, but none of the considered independent variables is binary in their setting. Note that among the independent variables used in Egginton et al. (2010), two are dummy variables. Earlier papers employ SUR models similar to our equation 1 (e.g. Schwert, 1981; Schipper and Thompson, 1983; Binder, 1985; Cornell and Shapiro, 1986; Cornett and Tehranian, 1990; Karafiath et al., 1991; Egginton et al., 2010) or variations of the standard market model to generate abnormal stock returns (Swary, 1986; Peavy and Hempel, 1988; O'Hara and Shaw, 1990; Wall and Peterson, 1990; Lang and Stulz, 1992; Aharony and Swary, 1996; Dockin et al., 1997; Slovin et al., 1999; Jorion and Zhang, 2007, 2009; Pop and Pop, 2009; Raddatz, 2010; Chakrabarty and Zhang, 2012; Fernando et al., 2012).

Alternatively, as a broad market measure of the risk profile and financial conditions, we also use the credit ratings assigned by the two main rating agencies (Moody's and S&P) during the week preceding the Lehman failure announcement. The credit ratings are converted to cardinal value according to the following scale: AAA/Aaa = 1, AA+/Aa1 = 2, AA/Aa2=3 etc., and then averaged across the two rating agencies. Hence, a lower cardinal value corresponds to a higher credit quality. Finally, an alternative risk proxy we use is the market measure of the probability of failure, computed as the ratio of the variance of equity returns over the 250-day estimation window divided by one plus the average equity return over the same window, squared (see Blair and Heggestad, 1978; Koehn and Santomero, 1980). To minimize multicollinearity problems, we estimate equation (2) separately for each of the five proxies for financial conditions.

The degree of operating leverage (LEV_i) is measured by the total debt / total assets ratio, while the expected profitability is proxied by Tobin's Q ($TOBIN\_Q_i$), computed as the market value of equity plus the book value of liabilities divided by the book value of assets.[19] Finally, we consider two additional control variables ($CTRL_i$). The first one, "exposure" dummy, takes the value of 1 if the firm is on the Epiq System list of the largest reported claims and 0 otherwise.[20] It is worth noting that the physical exposures to Lehman were disclosed progressively, in some cases after the end of our short event window. Consequently, we are implicitly assuming that information on exposures was distilled in stock market prices during

[19] In place of the ratio of total debt to total assets ratio we also evaluate two other leverage measures that take into account the debt maturity structure: the ratio of long-term debt to total assets and short-term borrowings divided by the total liabilities and equity. We expect that FIs whose financing model is similar to Lehman, i.e. relying on rolling-over substantial amounts of short-term debt on a long-term basis, would be more affected by the failure. Also, the profitability dimension is proxied by the price-to-book ratio and two other conventional ratios: the return on equity (ROE) and return on assets (ROA). We also considered an efficiency ratio computed as the cost to income ratio, expressed in percentages. Our conjecture is that FIs in better shape than their peers may have an improved shock-absorbing capacity and would be less affected by the Lehman failure. See *infra* Section 6 for more details.

[20] We consider the total amount of exposure, including different kinds of claims: loans, letters of credit, derivative and swap contracts, commercial papers obligations, bonds etc. The mass of Lehman's creditors filed more than 60,000 claims against the failed investment bank before the deadline imposed by the bankruptcy court, September 22nd, 2009.

the several days surrounding the bankruptcy announcement date.[21] The second control variable, "TBTF" dummy, equals 1 for the financial firms that were thought to be TBTF after the Bear Stearns bailout but prior to Lehman's failure. We include on the TBTF list all of the financial firms with over $100 billion in assets subsequently included in the SCAP, as well as those firms that are assigned with a Fitch / Capital Intelligence Support rating equal to 1 or 2.[22]

The alternative to the null, undifferentiated contagion, hypothesis would imply negative estimated coefficients on financial condition variables ($COND_i$), operating leverage (LEV_i) and "exposure" dummy. Moreover, if Lehman's failure triggered a significant shift in TBTF expectations characterizing the largest financial firms, we expect the sign of the "TBTF" dummy variable to be negative.

While the SUR methodology takes into account the cross-sectional dependence in returns and results in more efficient estimates than ordinary least squares (OLS) estimation, it has its own drawbacks. Particularly, estimating abnormal returns with SUR requires that the time dimension (i.e. the number of days in the estimation period) be *larger* than the number of firms for the large-sample approximations to be reliable. In addition, for computational reasons, the number of observations per firm should exceed the total number of firms, to render the variance matrix of the disturbance terms of full rank and invertible. Consequently, when applying SUR the number of firms included in the estimation sample is limited to 250; for that reason, when estimating SUR regressions we selected the 250 *largest* US financial institutions among the 380 firms included in our final sample.

[21] This is a relatively strong assumption, analogous to a stock market that is strong-form efficient. To the extent that investors had incomplete information on exposures, our results should be *de facto* biased against finding evidence of significant exposure effects. For a more comprehensive discussion of the exposure effect, the reader should refer to Chakrabarty and Zhang (2012). In their study, the event day 0 is defined with respect to the date on which each sample firm disclosed, for the first time, its exposure (or lack thereof) to Lehman.

[22] The Fitch / Capital Intelligence Support ratings represent credit rating agencies' judgment of a potential outside supporter's (either a sovereign state's or an institutional owner's) propensity to support a financial firm and of its ability to support it. The ratings are assigned according to a scale going from 1 (indicating an extremely high probability of external support) to 5 (very weak probability of outside intervention).

To capture the behavior of the entire universe of financial firms included in our final sample, we also estimate the abnormal returns for firm security *i* on event day *t*, AR_{it}, as the difference between actual returns R_{it} and the returns predicted by the market model, $\mathrm{E}[R_{it}|\Phi_t]$, where $\Phi_t = \{R_{mt}\}$ and R_{mt} is the stock market return (S&P500) for day *t*:

$$AR_{it} = R_{it} - \mathrm{E}[R_{it}|\Phi_t] \tag{3}$$

where $\mathrm{E}[R_{it}|\Phi_t] = \hat{\alpha}_i + \hat{\beta}_i R_{mt}$. The market model parameters, $\hat{\alpha}_i$ and $\hat{\beta}_i$, are estimated by regressing the daily (log-differenced) stock return for the relevant financial firm security, R_{it}, upon the corresponding broad market return, R_{mt}, using ordinary least squares. The market model is estimated over a 250-day "estimation window" beginning *t* = –260 through *t* = –11. Lehman filed for Chapter 11 bankruptcy protection on September 15th, 2008, which is defined as the "event day" *t* = 0 (*e* = "Lehman's failure"). The TARP was presented by H. Paulson and B. Bernanke on September 23rd, 2008 (*t* = 0, *e* = "TARP testimony") to the Senate Banking Committee, who rejected it as unacceptable and labeled it as "stunning and unprecedented in its scope and lack of detail" (*New York Times*, September 23rd, 2008).

To avoid misspecification problems due to extreme clustering, we use the test statistic recommended by Brown and Warner (1985) and also used by O'Hara and Shaw (1990), which is free of cross-sectional dependence in the security-specific excess returns. Since the market-model parameters were estimated over the estimation period, the abnormal returns are in fact prediction errors. Consequently, the standard deviation estimator used in the definition of the test statistic is appropriately adjusted in order not to overstate the significance levels (the correction factor is computed as in Wall and Peterson, 1990). The test statistic described above can be easily adjusted to investigate the significance of the average abnormal returns aggregated over various event windows.

Finally, as a robustness check we also consider an alternative procedure for the estimation of excess returns, which is less sensitive to the reliance on past returns. Precisely, for each security the expected return is defined to be equal to the return of the market portfolio. Thus, abnormal returns are defined as the difference between the daily returns of security *i* on day *t*, R_{it}, and the daily returns of the market portfolio on day *t*, R_{mt} (the market portfolio returns are proxied as previously by the total returns of the S&P 500 Index). The results discussed at length in Section 6 are based on abnormal stock returns derived from the SUR framework or the market model. For the sake of comparison, we mention the estimations obtained using alternative methods, particularly when the results obtained by applying different modeling choices improve the overall interpretation.

5. Data description

Our dataset is built using financial information reported in Bloomberg database. We collect daily stock price data from January 1st, 2008, to December 31st, 2008, for all *large* publicly traded *financial* firms. By "large" we mean every institution that reported total assets higher than US$ 1 billion in the last audited financial report before the event date. By "financial" we mean every institution operating in the same industry as Lehman's (Finance-Investment, SIC code 6211) or primarily in other fields of finance (banking; equity investment instruments; asset management; consumer finance; investment services; mortgage finance; specialty finance…). Bloomberg reports daily opening, closing, high/low, bid/ask prices, as well as historical series of trading volumes. The price data are adjusted to reflect major capital events that include scrip issues/rights offerings, open offers, stock splits and consolidations, reductions of capital, scrip (stock) dividends etc. Our initial sample includes 413 financial institutions. However, our final sample satisfies the following additional selection criteria:

- using Dow Jones Factiva database, we imposed that major capital events such as stock splits, stock dividends, and other significant news did not occur on the event day;
- we dropped all banks that had "thinly" traded stocks during the sample period, defined as those for which daily stock price data were missing for more than six consecutive trading days;
- finally, for a financial firm to be included in our sample, it must have no missing stock return data on the event day.

These selection criteria reduced our final sample to 380 surviving financial institutions: 305 "banks" (of which 60 S&Ls) and 75 "non-bank" financial services firms (excluding Lehman). To explain better the stock market reaction to the failure event, we also collected financial information from Bloomberg for each firm included in our final sample. Credit rating information for a sub-sample of rated financial institutions was collected from Reuters and Bloomberg, while the list of the largest physical exposures to Lehman and its subsidiaries is obtained from Epiq Systems, the corporate restructuring company that administrate Lehman's bankruptcy.[23]

6. Empirical results

6.1. Preliminary evidence of a differentiated stock market reaction

Did the failure announcement have a significant impact on the surviving financial firm stock returns? Did the shareholder reactions to Lehman's collapse or TARP testimony vary across individual financial firms? To answer these questions, Table 2 reports the standard asymptotic χ^2 test statistic and the small sample *F*-statistic for the following two hypotheses:

[23] We are grateful to Tina Wheelon (*Epiq System*) for help with data.

- H_0^1: $\beta_1=\ldots=\beta_N=0$, i.e. the individual abnormal returns are jointly equal to zero for each day in the event window [0; +1] and each sub-sample of financial firms;
- H_0^2: $\beta_1=\ldots=\beta_N$, i.e. the individual abnormal returns are jointly equal to each other.

The abnormal returns for a two-day period surrounding the failure announcement date (day 0 or September 15th, 2008) are derived from the SUR framework described in the methodology section. The full sample of US financial firms was partitioned into various sub-samples with respect to the type of activity. Inspecting Table 2, in the vast majority of cases, both hypotheses are soundly rejected: the individual abnormal returns are jointly statistically distinguishable from zero and shareholder responses varied substantially across individual financial firms.

{Table 2}

6.2. Further evidence of spillover effects in stock market prices

To refine these preliminary findings, we also report in Table 3 the results of the event study analysis applied to Lehman's failure, separately for the global sample (N = 380) and various subsamples defined with respect to the type of activity. Specifically, we partition the full sample into eight subsamples according to the Industry Classification Benchmark (ICB) and Bloomberg Industry Group classifications: (*i*) banks and savings and loans (N = 305); (*ii*) commercial banks (N = 249); (*iii*) savings and loans (N = 60); (*iv*) "non-bank" financial institutions (N = 75); (*v*) diversified financial services firms (N = 53); (*vi*) investment services firms (N = 24); (*vii*) mortgage and specialty finance (N = 18); and (*viii*) consumer finance (N = 14). According to these classifications, Lehman belongs to three categories of FIs, namely "non-bank" FIs (*iv*); "diversified financial services" (*v*); and "investment services" (*vi*).

{Table 3}

On average, the abnormal returns calculated over the event window [–2 ; +2] are not statistically significant for the entire sample of FIs: the average abnormal return across *all* the surviving FIs on day $t = 0$ is *positive* (+0.24%), albeit not statistically distinguishable from zero.[24] One may be tempted to infer that the bankruptcy filing did not trigger any significant reaction in the stock market (the "irrelevance" or "no-impact" hypothesis). However, aggregating all data into a single global sample could mask significant heterogeneity among listed FIs. Scrutinizing Table 3, we can observe that the highest and most significant *negative* abnormal returns are observed for the surviving financial firms providing mortgages, mortgage insurance, and other related services (–7.41%, significant at the 5% level) or operating in the same subsectors as Lehman: diversified financial services (–4.58%, p-value < 0.01); non-bank financial activities (–4.06%, p-value < 0.05); and investment services (–3.94%, p-value < 0.05).[25] To strengthen the results reported in Table 3, we perform standard (two-tailed) tests of the hypothesis that the average responses of various categories of FIs were equal in pairwise comparisons.[26] The results of these statistical tests, unreported for space reasons, indicate that FIs providing mortgage-related services or operating in the same subsectors as Lehman (diversified financial services; non-bank financial activities; and investment services) had significantly *more negative* returns than commercial banks or S&Ls had (significance at the 5% or better statistical level in all cases). However, the results do not

[24] This result is confirmed when we employ alternative modeling choices for estimating abnormal returns, e.g. based on the SUR methodology. We select relatively short windows surrounding the event date because outside these short windows there were other significant events that may have affected the perception of Lehman's failure in the stock market. Particularly, on Tuesday, September 16th, at 9 p.m., after the market closed, the US Federal Reserve agrees to lend the American International Group (AIG) $85 billion in return for a 79.9% equity stake. Consequently, the abnormal return on day +2 (September 17th) should be interpreted as the *net* effect of two *opposite* regulatory policies: a *laissez-faire* approach (Lehman) and a bailout decision (AIG). The next day (September 18th, day +3), the Securities and Exchange Commission restricted short selling in an attempt to decelerate the rapid fall of the largest FIs' share value. On September 19th (day +4), the US Treasury announced its decision to guarantee money market mutual funds up to an amount of $50 billion to ensure their viability.

[25] Among the firms operating in the banking sector (commercial banks and S&Ls), only the largest ones, with more than $50 billion in total assets, show significant *negative* abnormal returns (–5.14%, significant at the 5% level, unreported result).

[26] We are grateful to an anonymous referee for suggesting these additional tests. Basically, we performed mean tests and two non-parametric tests: a chi-square two-sample test on the equality of medians and a two-sample Wilcoxon rank-sum test for the hypothesis that two independent samples are from populations with the same distribution.

indicate an equally strong (and significant) difference across various "non-bank" subsamples (non-bank financial activities; diversified financial services; investment services; and mortgage-related activities).

The results reported in Table 3 also lend support to the hypothesis according to which Lehman's failure caused investors to reconsider their expectations that some financial institutions were too systemically important to be allowed to fail. Indeed, the surviving FIs included in the TBTF sample show a *negative* abnormal return of –7.77%, significant at the 1% level.[27] The results are reinforced by the analysis of the cumulative abnormal returns (CAR). The CARs computed over whatever window are not significantly different from zero for the full sample. Yet, the firms that were thought to be TBTF after the Bear Stearns bailout, as well as the other "non-bank" FIs, show significant *negative* CARs over various short windows surrounding the event date (see Table 3).

After providing evidence that at least some specific sets of FIs were hit by Lehman's failure, we turn now to the question whether the TARP testimony had similar effects on the surviving financial firms. The results reported in Table 4 for the global sample and various subsamples indicate that this was clearly not the case. We find no support for the hypothesis that uncertainty surrounding the flimsy 2½-page draft of TARP legislation triggered, in the short-run at least, a generalized adverse reaction in the stock market.

{Table 4}

[27] In an earlier version of the paper, we conducted an additional test to answer the question: *how many of the largest US financial firms, taken together as a portfolio, exhibit a significant negative abnormal return in the aftermath of Lehman's collapse?* For that purpose, we implemented the following iterative procedure. First, we classified the entire population of FIs according to their size. Second, we conducted *iteratively* the significance tests described in Section 2 for various portfolios including the k largest FIs, where k goes successively from 2 to 380 firms. The iterative procedure stops when the test indicates for the first time a switch from significant to non-significant abnormal returns on the event day 0 at the conventional statistical levels. Finally, we retained the cut-off value of k^*, as well as the corresponding test statistics and associated p-values. The algorithm indicates that an equally weighted portfolio including the Top 35 largest FIs exhibit, on average, a significant abnormal return of –6.32% (p-value < 0.01) on day 0.

To strengthen our argument, we also test for statistical significance of the difference in the stock market reaction between the two events of interest (Lehman's failure *vs*. TARP testimony). The results, reported in Table 5, are based on simple paired (samples) *t*-tests and Wilcoxon signed rank sum tests. They clearly indicate that, in relative terms, compared with the perception of TARP, the negative industry reaction to Lehman's failure was significantly larger and more damaging to the surviving FIs.

{Table 5}

Overall, the preliminary findings discussed in this section indicates that the collateral damages associated to Lehman's collapse were limited to (*i*) the largest financial institutions that were perceived to benefit from conjectural government guarantees after the Bear Stearns bailout; (*ii*) the financial services firms operating in the same product area as the failed investment bank (non-bank activities, diversified financial services, and investment services); and (*iii*) firms providing mortgages, mortgage insurance, and other related services. Moreover, compared with the apathetic market reaction to the TARP announcement, the negative industry reaction to Lehman's failure was significantly stronger. In the next section, we attempt to refine these findings by investigating more deeply the link between individual abnormal returns and various proxies for the FIs' financial conditions.

6.3. Firm-specific vs. industry-wide effects

To gain further insights into the previously reported results, we examine in this section the determinants of the stock market reaction to Lehman's failure. In this respect, we focus our analysis on a set of financial variables capturing three main dimensions of financial firms' performance, namely, risk profile, leverage, and (expected) profitability. All balance-sheet variables, described in the methodological section, are measured by using accounting data

reported in the interim financial statements disclosed by each firm in our sample at the end of June 2008.

Table 6 shows descriptive statistics for key financial-condition proxies and other control variables: firm size (total assets and total market value, expressed in million US dollars), the fraction of the core banking activities (net loans to total assets ratio), and the extent to which the asset portfolio contains large amounts of market securities (the ratio of market securities to total assets). We also report in Table 6 the results of bivariate comparisons of the distribution of each variable in two sub-samples of FIs (banks *vs*. "non-bank" FIs), based on a conventional mean test, a chi-square two-sample test on the equality of medians and a Wilcoxon-Mann-Whitney test.

{Table 6}

As far as the risk profile is concerned, it is apparent that the credit quality is significantly more deteriorated in the "non-bank" sub-sample.[28] As revealed by the data, the non-bank financial firms are also more leveraged, on average, than their peers operating in the banking sector. Finally, the bivariate analysis of the various profitability measures does not allow us to infer clear conclusions, except that the non-bank FIs have slightly higher Tobin's Q and price-to-book ratios. The "non-bank" FIs are also significantly larger than their "bank" peers ($92-93 billion against $33-34 billion). Not surprisingly, the fraction of net loans is higher for firms operating in the banking sector, while at the other extreme the "non-bank" financial firms invest a higher fraction of their asset portfolios in marketable securities.

Table 7 provides a preliminary assessment of the hypothesis that the observed spillover effects were discriminating rather than undifferentiated. It reports pairwise correlation

[28] Note that the number of "non-bank" FIs reporting bank-specific variables, such as loan loss reserves and provisions, is quite low, rendering the cross-sector comparisons less informative; however, credit ratings and probability of failure do not suffer from this shortcoming.

coefficients between standardized (cumulative) abnormal returns on day $t = 0$ (over the window [0; +1]), on one side, and a group of factors that could explain the market reaction to Lehman's failure, on the other. The correlation coefficients are computed for the global sample and the two sub-samples defined with respect to the industry classification: banks *vs*. "non-bank" FIs. Generally, both measures of abnormal returns are *negatively* correlated with the various risk measures and *positively* correlated with the profitability variables. That is, the more deteriorated the banking performance, the more negative and stronger the reaction of stock market prices to the bankruptcy announcement. We also find strong correlations between the degree of operating leverage and abnormal returns: the higher the leverage, the more negative the reaction of the stock market, regardless the (sub)sample used in the analysis.

{Table 7}

As previously anticipated, the two proxies for firm size are strongly and negatively correlated with both measures of abnormal returns. Interestingly, the fraction of total assets invested in marketable securities is positively correlated with abnormal returns in the "bank" sample and negatively correlated in the "non-bank" sample. We interpret this finding as evidence that for banks the portfolio of marketable securities is viewed (favorably) as a liquidity cushion, while in the case of non-bank FIs, the marketable securities are perceived (negatively) as a significant source of concern and uncertainty.

To further investigate the pure or undifferentiated contagion hypothesis, we perform a cross-sectional analysis of the stock price reaction to Lehman's failure by regressing the standardized abnormal returns on day 0 on *individual* financial-condition and other control variables. Regression results for the cross-sectional analysis, reported in Table 8 (Panel A), strengthen our preliminary assessment based on pairwise correlations. The significantly

negative coefficient estimates for all financial-condition variables provide evidence of a differentiated market reaction to Lehman's failure. FIs reporting higher loan loss reserves, provisions or nonperforming assets were more adversely affected by the bankruptcy than the other survivors. The market reaction was also stronger and more adverse for those FIs that were highly levered, had lower credit ratings or exhibited higher probabilities of failure.

{Table 8}

Regarding our control variables, firms with higher growth opportunities (or overvalued) appear to be less affected by the failure. The "exposure" dummy enters with the expected negative sign in all specifications, thus complementing the microstructure evidence of a significant counterparty risk effect associated with Lehman's bankruptcy, reported in Chakrabarty and Zhang (2012). Finally, the significantly negative coefficients for TBTF suggest the existence of a more adverse impact on the set of firms that were thought to benefit from conjectural government protection after the Bear Stearns bailout but prior to Lehman's failure.[29]

For the sake of comparability, we replicate the above cross-sectional analysis of abnormal returns for the other event of interest, the announcement of TARP. The results, reported in Table 8 (Panel B), show a very weak explanatory power of the same set of variables in explaining the individual standardized abnormal returns on September 23rd.

[29] As a robustness check, we rerun all the regressions reported in Table 8 on the whole sample of FIs (in this case we use the market-model specification to generate the abnormal returns) and/or using as a dependent variable the standardized cumulative abnormal return over the event window [0;+1]. The results, unreported for space reasons, are quite similar to those presented in Table 8. In addition, we replace the leverage (Total debt/Total assets) variable by alternative measures that take into account the debt maturity structure (the ratio of long-term debt to total assets or short-term borrowings divided by the total liabilities and equity). We also used the price-to-book ratio and two other profitability ratios (the return on equity, ROE, and return on assets, ROA) as substitutes for Tobin's Q. By performing these additional regression tests, we obtain reasonably similar results for the main variables of interest, although the levels of significance are somewhat weaker than those reported in Table 8. The robustness results not included in the present version are available upon request from the authors.

Overall, the results presented in this section lend empirical support to the thesis that the observed spillover effects in the aftermath of Lehman's collapse were consistent with a discriminating pricing and the information-based contagion effect hypothesis. Put differently, the contagion was firm-specific and discriminating rather than industry-wide or undifferentiated: the most affected financial firms were those having common characteristics with Lehman, i.e. operating in the same market, subsector or product area. More importantly, the individual abnormal stock returns are found to be correlated with financial firms' fundamentals (risk profile, leverage, and expected profitability).

6.4. Additional inferences from abnormal jumps in CDS prices

To detect significant abnormal jumps in the pricing of risk in the credit derivatives market, we employ two straightforward statistical procedures: (*i*) a classical mean test and (*ii*) a constant mean model. In the first case, our conjecture is that the mean of changes in CDS spreads should be *positive* in the aftermath of Lehman's collapse, indicating a sudden *upward* revision in the market assessment of future default probabilities for the surviving financial firms. In the second case, the test consists of comparing the spread levels before and after the event date in order to detect a material break (or "jump") in CDS pricing.

For our mean test (*i*), we calculate the average spread changes for each day of the combined period (estimation and event windows) and then we sum over several days in the event window to obtain a measure of the cumulative average CDS spread change. The statistical significance of these measures can be judged by estimating the standard deviation of CDS spread changes over the estimation period.

Following the previous literature (see e.g. Hull et al., 2004; Norden and Weber, 2004; Jorion and Zhang, 2007), we control for market-wide systematic factors by computing CDS spread changes that are adjusted by changes of a CDS index:[30]

$$\delta s_{i,t} = \left(CDS_{i,t} - CDS_{i,t-1}\right) - (I_t - I_{t-1}) \quad (4)$$

where $CDS_{i,t}$ is the CDS spread level, expressed in basis points, for the financial obligor *i* on a given day *t* and I_t is the CDS index level on day *t*.

The constant mean model (*ii*) is similar to the constant mean return model used in stock market event studies. The CDS spread is modeled in this case as $CDS_{i,t} = \mu_i + \xi_{i,t}$, where μ_i is the mean of the CDS spread and $\xi_{i,t}$ the time period *t* disturbance term for financial obligor *i* with an expectation $\mathrm{E}[\xi_{i,t}] = 0$ and variance $\mathrm{Var}[\xi_{i,t}] = \sigma^2_{\xi_i}$. For each day of the event window, the abnormal CDS spread is estimated as $\hat{\xi}_{i,t} = CDS_{i,t} - \hat{\mu}_i$, where $\hat{\mu}_i$ designates the sample mean of the CDS spread over the estimation period. The cumulative abnormal CDS spread for event windows composed of days τ_1 through τ_2 is naturally defined as $CAS_{i,[\tau_1;\tau_2]} = \sum_{t=\tau_1}^{\tau_2} \hat{\xi}_{i,t}$. The test statistics used to investigate whether the events of interest have a significant impact on CDS pricing are constructed in a similar way as those commonly used in stock market event studies.

Figure 1a illustrates, in some basic way, Taylor's (2009b) and Cochrane and Zingales's (2009) idea that risk indicators of stress in the financial sector, such as the Libor-OIS spread

[30] The CDS index's source data as well as all the CDS composite spreads used in our analysis comes from Thomson Reuters. Based on the most liquid (i.e. 5-year) CDS contracts, the CDS index is equally weighted and reflect an average mid-spread calculation of the index's constituents. Thomson Reuters proprietary indices are rebalanced every six months to better reflect liquidity in the CDS market. Note that as broad indices for the CDS market (e.g. TracX, CDX, iTraxx, S&P/ISDA CDS Indices) have only recently been launched, Hull et al. (2004), Norden and Weber (2004), and Jorion and Zhang (2007) among others, compute "rating-adjusted CDS spreads" by subtracting an index of spreads for a given rating from each CDS spread with the same rating. Specifically, daily CDS spread index level is computed by those authors as the equally-weighted cross-sectional mean of all CDS spreads for a certain broad rating class (AAA and AA, A, and BBB) in their samples. In this paper, we don't use rating-adjusted spreads because our CDS dataset contains a relatively small number of reference entities (18 banks and 67 non-bank FIs) and broad market CDS indices exist and are actively traded since 2003.

and 1-year CDS spreads for Citigroup Inc., reacted much strongly after the TARP testimony on September 23–24, 2008 than in the aftermath of Lehman's collapse.[31] However, if we focus on 5-year Citi-CDS quotes (Figure 1b), as this is the benchmark maturity in the CDS market, or longer maturity contracts (e.g. 10-year CDS as in Figure 1c), the reaction to Lehman's failure appears of the same order of magnitude, if not larger, than the perceived impact of the TARP testimony.

{Figure 1}

To further investigate the effects of Lehman's collapse in the credit derivatives market, we collect Thomson Reuters CDS data over the period from January 1st, 2008, through December 31st, 2008, for *all* US reference entities belonging to the financial sector. We remove from our initial sample Lehman Brothers Holdings Inc. in order not to overstate the results, as well as those reference entities for which no CDS prices were available on the event date or CDS spread changes were zero over the 5-day event window [–2; +2]. Our final CDS sample includes 85 obligors (18 banks and 67 non-bank FIs).

We present in Table 9 the average changes in the adjusted CDS spreads (expressed in basis points) on various periods surrounding the event date, separately for the 1-year CDS contracts (Panel A) and 5-year CDS contracts (Panel B).[32] For the sake of comparison, we also report in the same table the results obtained when the statistical tests are conducted on days surrounding Ben Bernanke's and Henry Paulson's TARP speeches before the Senate Banking Committee on September 23rd and 24th, 2008 ("TARP testimony", day 0 and +1 respectively).

{Table 9}

[31] In their WSJ article, published on September 15th, 2009, Cochrane and Zingales (2009) don't mention the tenor of the CDS contract for Citigroup used to draw their chart suggestively titled "*When concern turned to panic*." By comparing Citi-CDS spreads of different maturities reported by various data providers (MarkIT, Credit Market Analysis, Bloomberg and Thomson Reuters), we infer that the CDS depicted in Cochrane and Zingales's (2009) chart is the 1-year contract.

[32] To save space, we do not report the average changes in the adjusted CDS spreads for the 10-year contracts as they are similar with those reported in Table 7 (Panel B).

On average, the adjusted CDS change is significant and positive on September 15th for the reference entities included in the whole sample: +60.50 bps ($p < 0.01$) and +87.58 bps ($p < 0.01$), depending on the maturity (one and five years, respectively). If we follow previous empirical studies on CDS pricing and focus our analysis on the 5-year CDSs (Panel B), which are the most popular contracts among market participants and, hence, the most liquid ones, we observe a stronger reaction for non-bank FIs (+91.64 bps) compared with banks (+72.24 bps). Moreover, the cumulative change over the various windows surrounding the failure announcement is also significant, even if no significant change is detected before the event day.[33]

The results reported in Table 9 also indicate an abnormal upward revision of default probabilities for the surviving financial firms after the TARP testimony (+43.55 bps, $p < 0.05$), consistent with the intuition in Taylor (2009b) and Cochrane and Zingales (2009). However, compared to Lehman's collapse, the reaction of the CDS market to the TARP speeches is weaker, not stronger, both in terms of magnitude and statistical significance. The last three columns of Table 9 support this assertion by resuming the results of a paired samples *t*-test, a Wilcoxon matched-pairs signed-ranks test and a sign test of matched pairs.[34]

7. Conclusion

After the spectacular failure of the 150-year old investment bank Lehman Brothers on September 15th 2008, a broad debate about the nature, triggering events, and extent of systemic risk during the recent global financial crisis has sharply divided economists and

[33] We confirm these findings using the alternative statistical test based on the constant mean model described in this section (unreported result). We also repeat all the statistical tests without adjusting CDS spreads for general market conditions and find that the results, including the levels of significance, are quite similar: +98.14 bps ($p < 0.01$) for the global sample; +79.52 bps ($p < 0.01$) for the "bank" sample; +103.34 bps ($p < 0.01$) for the "non-bank" sample on day 0 (Lehman's failure) and using 5-year CDS contracts.

[34] We acknowledge the suggestion of an anonymous referee for these additional tests showing that the Lehman changes are significantly different from the TARP testimony changes.

underlined the urgent need for an operational framework to analyze and assess systemic events. For many observers, the failure of Lehman was a clear example of systemic risk that materialized during the current global financial crisis. The critics generally share the view that the government decision not to rescue the troubled investment bank was a big mistake that exacerbated the adverse effects of the financial crisis. Other influential economists embraced the opposite view, arguing that it was not Lehman's failure but the uncertainty surrounding the first draft of legislation regarding the TARP released several days afterward that effectively trigger the global panic of the fall 2008. The defenders of the no-bail-out thesis contend that the government applied in the case of Lehman the right medicine at the right moment and approved its decision to deny taxpayers money to rescue the nation's fourth-largest investment bank.

The present paper contributes to the debate by focusing on three main research questions related to the systemic nature of the collapse of Lehman Brothers. First, through the use of stock market and CDS data, we examine the investors' reaction to Lehman's failure in an attempt to identify spillover effects on the surviving financial institutions. Second, we wonder whether the failure affected the surviving financial firms indiscriminately, i.e. irrespective of potential differences in their business models, risk profiles, financial conditions or physical exposures to Lehman. Third, we compare the market response to two shockwaves: Lehman's collapse and the release of the first draft of TARP.

While we are able to infer robust results indicating negative spillover effects of Lehman's failure on some specific categories of surviving financial firms, we find no *prima facie* evidence supporting the thesis that uncertainty surrounding the ill-conceived 2½-page draft of TARP legislation triggered, in the short-run at least, a generalized adverse reaction in financial markets. In fact, the perceived negative impact of Lehman's failure on both CDS and stock market is found to be significantly larger than the reaction to the TARP testimony.

Our findings also indicate that the most affected financial firms were those having common characteristics with Lehman, i.e. operating in the same market, subsector or product area. More importantly, the individual abnormal stock returns are found to be strongly correlated with financial firms' fundamentals, lending empirical support to the so-called information-based contagion effect hypothesis. Said slightly differently, despite the common assessment that financial firms were unusually opaque during the recent financial crisis, the market reaction to Lehman's failure was selective and informed, rather than random and indiscriminate. Overall, the results reported in the present paper contribute to a better understanding of the financial markets' reaction to the largest failure in US history.

Several caveats are warranted when interpreting our results and, more generally, the event study results reported in some other related papers on Lehman's failure. First, all the event studies investigating the effects of Lehman's failure, including ours, are based on *short-term* movements in market prices, which may reflect speculation by sophisticated investors rather than long-term performance. Second, the event studies on market price reactions to Lehman's failure investigate a "systemic event" in a *weak* sense, according to the vernacular of De Bandt and Hartmann (2002). Indeed, stock price and CDS rate fluctuations (negative abnormal returns or positive abnormal changes) do not *necessarily* imply actual failures or crashes among the surviving financial firms. Third, absent a rigorous operational definition of systemic risk, it would be presumptuous to infer from an event study analysis whether Lehman was indeed "systemically important." As Eichengreen et al. (2012) correctly pointed out, whether the decision to let Lehman fail was a critical policy error that triggered a global economic and financial tsunami will be debated for years. We conclude by reaffirming the urgent need for a rigorous operational framework to analyze and assess systemic risk in the financial services industry. The recent proposals put forward by the Financial Stability Board

and the Basel Committee on Banking Supervision (BCBS, 2011, 2012) represent encouraging steps in the right direction.

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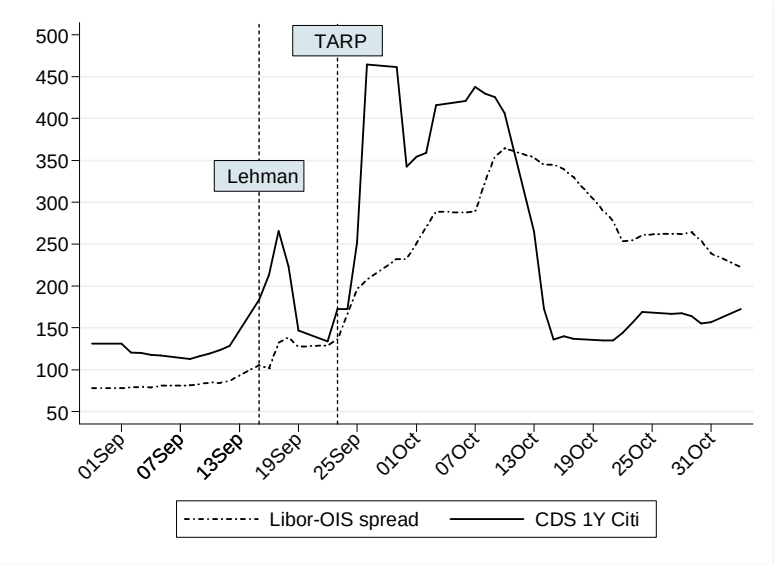
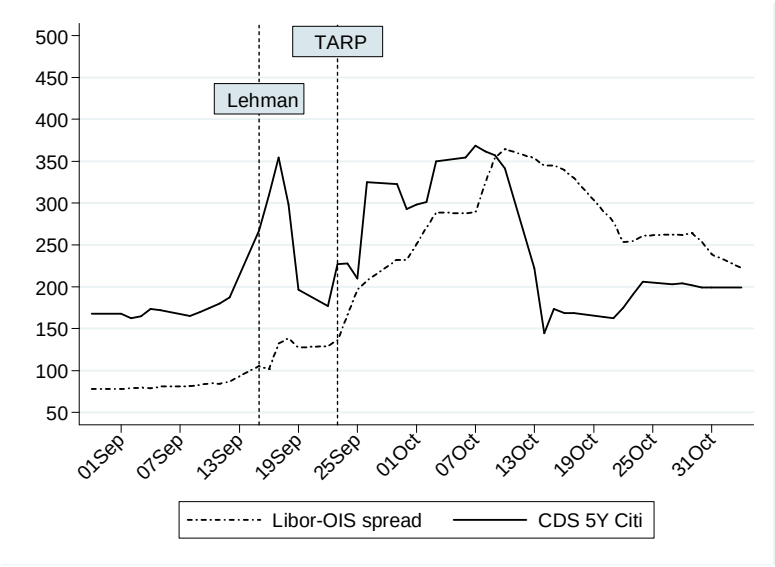
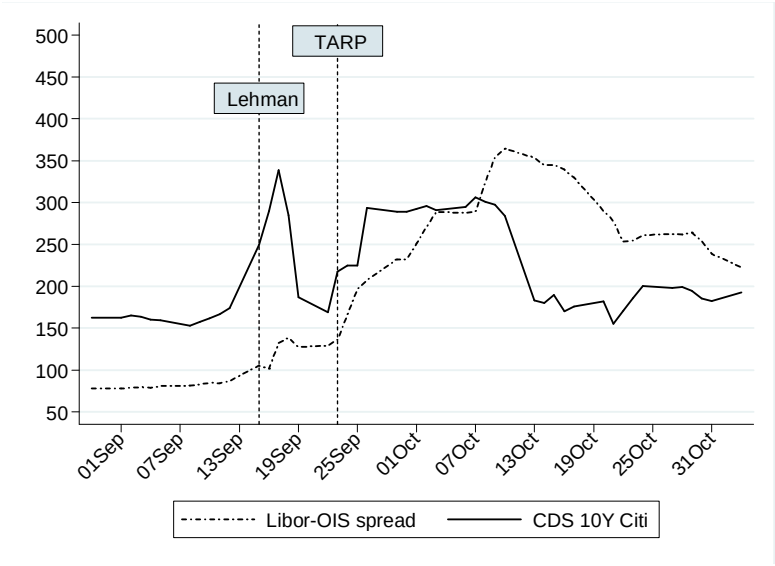
Figure 1: Libor-OIS and Citigroup CDS spread (various tenors) around Lehman's failure



a. CDS 1-year contract



b. CDS 5-year contract



c. CDS 10-year contract

Table 1: The largest US public company bankruptcy filings (1980--2009)

No.	Company name[a]	Description	Bankruptcy date	Assets[b]
1	*Lehman Brothers Holdings Inc.*	Investment Bank	09/15/2008	691,063
2	*Washington Mutual, Inc.*	Savings & Loan Holding Co.	09/26/2008	327,913
3	WorldCom, Inc.	Telecommunications	07/21/2002	103,914
4	General Motors Corporation	Manufactures & Sells Cars	06/01/2009	91,047
5	*CIT Group Inc.*	Banking Holding Company	11/01/2009	80,448
6	Enron Corp.	Energy Trading, Natural Gas	12/02/2001	65,503
7	*Conseco, Inc.*	Financial Services Holding Co.	12/17/2002	61,392
8	Chrysler LLC	Manufactures & Sells Cars	04/30/2009	39,300
9	*Thornburg Mortgage, Inc.*	Residential Mortgage Lending Co.	05/01/2009	36,521
10	Pacific Gas and Electric Company	Electricity & Natural Gas	04/06/2001	36,152
11	Texaco, Inc.	Petroleum & Petrochemicals	04/12/1987	34,940
12	*Financial Corp. of America*	Financial Services & Savings and Loans	09/09/1988	33,864
13	*Refco Inc.*	Brokerage Services	10/17/2005	33,333
14	*IndyMac Bancorp, Inc.*	Bank Holding Company	07/31/2008	32,734
15	Global Crossing, Ltd.	Global Telecommunications Carrier	01/28/2002	30,185
16	*Bank of New England Corp.*	Interstate Bank Holding Company	01/07/1991	29,773
17	*General Growth Properties, Inc.*	Real Estate Investment Company	04/16/2009	29,557
18	Lyondell Chemical Company	Global Manufacturer of Chemicals	01/06/2009	27,392
19	Calpine Corporation	Integrated Power Company	12/20/2005	27,216
20	*New Century Financial Corporation*	Real Estate Investment Trust	04/02/2007	26,147

[a] financial services firms in italic text

[b] pre-petition total assets, expressed in US$ million

Source: New Generation Research, Inc. Boston, MA

Table 2: Testing the nullity and equality of abnormal returns within the SUR framework

	Lehman failure (Day 0 = Sept. 15th, 2008)			*TARP announcement (Day 0 = Sept. 23rd, 2008)*		
	Day 0	Day +1	[0;+1]	Day 0	Day +1	[0;+1]
			Banks and S&Ls (N=250)			
H_0^1:β_1=…=β_N=0						
χ^2-statistic	2185.1***	1318.4***	1028.1***	1867.7***	2411.5***	826.6***
F-statistic	85.4***	51.5***	40.5***	73.0***	94.3***	32.5***
H_0^2: β_1=…=β_N						
χ^2-statistic	1595.3***	1244.4***	965.9***	1850.6***	2036.9***	672.6***
F-statistic	62.6***	48.8***	38.2***	72.6***	79.9***	26.6***
			Commercial banks (N=249)			
H_0^1:β_1=…=β_N=0						
χ^2-statistic	1258.2***	1364.4***	1122.1***	1458.7***	2504.0***	1075.2***
F-statistic	49.4***	53.5***	44.4***	57.2***	98.3***	42.5***
H_0^2: β_1=…=β_N						
χ^2-statistic	1204.9***	1362.2***	1112.4***	1378.0***	2300.2***	1074.9***
F-statistic	47.5***	53.7***	44.2***	54.3***	90.6***	42.6***
			S&Ls (N=60)			
H_0^1:β_1=…=β_N=0						
χ^2-statistic	122.9***	204.0***	156.0***	227.0***	206.1***	254.6***
F-statistic	2.0***	3.3***	2.6***	3.7***	3.4***	4.2***
H_0^2: β_1=…=β_N						
χ^2-statistic	116.9***	200.5***	155.5***	224.9***	203.8***	251.5***
F-statistic	1.9***	3.3***	2.6***	3.7***	3.4***	4.2***
			Non-bank financial institutions (N=75)			
H_0^1:β_1=…=β_N=0						
χ^2-statistic	1864.4***	564.2***	782.3***	602.6***	667.5***	561.1***
F-statistic	23.7***	7.2***	10.0***	7.7***	8.5***	7.2***
H_0^2: β_1=…=β_N						
χ^2-statistic	1809.0***	562.2***	778.9***	602.2***	667.0***	561.1***
F-statistic	23.3***	7.2***	10.1***	7.8***	8.6***	7.3***
			Diversified financial services firms (N=53)			
H_0^1:β_1=…=β_N=0						
χ^2-statistic	1243.2***	310.7***	668.1***	319.5***	331.5***	302.1***
F-statistic	22.5***	5.6***	12.2***	5.8***	6.0***	5.5***
H_0^2: β_1=…=β_N						
χ^2-statistic	1231.4***	310.6***	665.7***	313.5***	331.5***	299.0***
F-statistic	22.7***	5.7***	12.4***	5.78***	6.1***	5.6***
			Investment services firms (N=24)			
H_0^1:β_1=…=β_N=0						
χ^2-statistic	882.5***	296.3***	439.7***	141.8***	185.6***	110.9***
F-statistic	34.5***	11.6***	17.3***	5.6***	7.3***	4.4***
H_0^2: β_1=…=β_N						
χ^2-statistic	830.8***	283.3***	439.7***	141.7***	182.9***	109.9***
F-statistic	33.9***	11.5***	18.1***	5.8***	7.5***	4.5***
			Mortgage & specialty finance firms (N=18)			
H_0^1:β_1=…=β_N=0						
χ^2-statistic	46.0***	65.5***	82.3***	32.7**	41.1***	56.5***
F-statistic	2.5***	3.6***	4.5***	1.8**	2.2***	3.1***
H_0^2: β_1=…=β_N						
χ^2-statistic	41.5***	65.2***	80.9***	27.6*	40.6***	52.5***
F-statistic	2.4***	3.8***	4.7***	1.59*	2.3***	3.1***
			Consumer finance firms (N=14)			
H_0^1:β_1=…=β_N=0						
χ^2-statistic	26.6**	20.3	27.6**	41.9***	21.8*	32.4***
F-statistic	1.9**	1.4	1.9**	2.9***	1.5*	2.3***
H_0^2: β_1=…=β_N						
χ^2-statistic	24.9**	18.4	27.6**	41.7***	21.2*	31.6***
F-statistic	1.9**	1.4	2.1**	3.1***	1.6*	2.4***

Notes: This table reports the chi-squared and *F*-statistics for the following two hypotheses: H_0^1: β_1=…=β_N=0 according to which the individual abnormal returns are jointly equal to zero for each day in the event window [0; +1] and each sub-sample of financial firms; H_0^2: β_1=…=β_N according to which the individual abnormal returns are jointly equal to each other. The abnormal returns for a two-day period surrounding Lehman's failure announcement date (day 0 = September

15th, 2008) and TARP release (day 0 = September 23rd, 2008) are derived from the SUR framework described in the text.
***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively, in two-tailed tests

Table 3: Abnormal returns on days surrounding Lehman's collapse, surviving US FIs – various samples

	Global sample (N=380)		TBTF FIs (N=25)		Banks and S&Ls (N=305)		Commercial Banks (N=249)		S&Ls (N=60)	
Day	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)
–2	–1.13	65.79	0.99	30.77	–0.87	65.90	–0.83	62.65	–0.87	76.67
–1	0.05	46.84	–0.78	53.85	0.11	46.56	0.23	44.58	–0.62	60.00
0	0.24	40.26	–7.77***	76.92	0.98	38.03	1.04	38.55	0.49	36.67
+1	1.49	33.68	0.25	26.92	2.30*	28.85	2.29*	29.32	1.90	28.33
+2	0.53	51.58	–5.79**	84.62	0.87	48.52	0.69	51.41	0.89	40.00
Window										
[–1; 0]	0.29	43.55	–8.56**	65.38	1.09	42.30	1.27	41.57	–0.13	48.33
[0; +1]	1.73	36.97	–7.52**	51.92	3.28**	33.44	3.33*	33.94	2.39	32.50
[0; +2]	2.26	41.84	–13.32***	62.82	4.15**	38.47	4.01**	39.76	3.29*	35.00
[–1; +1]	1.78	40.26	–8.31**	52.56	3.40*	37.81	3.56*	37.48	1.77	41.67
[–2; +2]	1.18	47.63	–13.11**	54.62	3.39	45.57	3.41	45.30	1.80	48.33

	Non-bank FIs (N=75)		Diversified Financial Services (N=53)		Investment Services (N=24)		Mortgage & Specialty Finance (N=18)		Consumer Finance (N=14)	
Day	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)
–2	–0.88	52.00	–1.52	55.77	–0.14	43.48	–1.99	61.11	–1.12	57.14
–1	–1.79	69.33	–2.73	69.23	–1.03	69.57	–5.23*	66.67	0.58	64.29
0	–4.06**	68.00	–4.58***	71.15	–3.94**	78.26	–7.41**	61.11	–2.58	64.29
+1	–0.87	46.67	–1.11	44.23	0.38	47.83	–5.05*	50.00	–0.78	64.29
+2	–2.19	73.33	–1.02	69.23	–2.81*	65.22	3.57	55.56	–5.42**	92.86
Window										
[–1; 0]	–5.85**	68.67	–7.32***	70.19	–4.97*	73.91	–12.64***	63.89	–2.01	64.29
[0; +1]	–4.93**	57.33	–5.70**	57.69	–3.55	63.04	–12.46***	55.56	–3.36	64.29
[0; +2]	–7.12**	62.67	–6.71**	61.54	–6.36**	63.77	–8.88*	55.56	–8.78**	73.81
[–1; +1]	–6.72**	61.33	–8.43***	61.54	–4.58	65.22	–17.68***	59.26	–2.78	64.29
[–2; +2]	–9.79***	61.87	–10.97***	61.92	–7.53**	60.87	–16.11**	58.89	–9.32*	68.57

Notes: This table presents the abnormal returns for a five-day period surrounding Lehman's failure announcement date (day 0 = September 15th, 2008), derived from the market model described in the text. The full sample of US financial firms was partitioned into various sub-samples with respect to the type of activity. We also report the mean cumulative abnormal returns computed over various event windows, parametric test statistics, and percentage of negative abnormal returns.

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively, in two-tailed tests

Table 4: Abnormal returns on days surrounding TARP testimony, surviving US FIs – various samples

	Global sample (N=380)		TBTF FIs (N=25)		Banks and S&Ls (N=305)		Commercial Banks (N=249)		S&Ls (N=60)	
Day	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)
0	0.52	42.41	–0.98	50.00	0.43	40.98	0.10	41.77	1.78	36.67
+1	–0.44	54.45	–0.40	53.85	–0.66	54.43	–0.77	55.02	–0.54	53.33
+2	–0.97	66.75	–0.11	53.85	–1.19	69.18	–1.12	66.27	–3.07**	80.00
Window										
[0; +1]	0.08	48.43	–1.39	51.92	–0.23	47.70	–0.67	48.39	1.24	45.00
[0; +2]	–0.89	54.54	–1.49	52.56	–1.42	54.86	–1.79	54.35	–1.84	56.67

	Non–bank FIs (N=75)		Diversified Financial Services (N=53)		Investment Services (N=24)		Mortgage & Specialty Finance (N=18)		Consumer Finance (N=14)	
Day	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)	AR (%)	% (<0)
0	1.24	48.00	1.22	53.85	–1.19	60.00	0.31	38.89	–1.32	50.00
+1	–0.21	56.00	0.17	55.77	0.10	56.00	0.58	50.00	0.43	64.29
+2	–0.56	58.67	1.75	53.85	0.48	52.00	–2.02	83.33	0.18	50.00
Window										
[0; +1]	1.03	52.00	1.39	54.81	–1.09	58.00	0.90	44.44	–0.89	57.14
[0; +2]	0.47	54.22	3.14	54.49	–0.61	56.00	–1.12	57.41	–0.72	54.76

Notes: This table presents the abnormal returns for a two-day period surrounding TARP testimony (day 0 = September 23rd, 2008), derived from the market model described in the text. The full sample of US financial firms was partitioned into various sub-samples with respect to the type of activity. We also report the mean cumulative abnormal returns computed over two event windows, parametric test statistics, and percentage of negative abnormal returns.

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively, in two-tailed tests

Table 5: Tests of the equality of abnormal returns across events (Lehman *vs*. TARP)

	Non-bank FIs (N=75)		Diversified Financial Services (N=53)		Investment Services (N=24)		Mortgages & Spec. Finance (N=18)		TBTF FIs (N=25)	
	t-test	Wilcoxon	*t*-test	Wilcoxon	*t*-test	Wilcoxon	*t*-test	Wilcoxon	*t*-test	Wilcoxon
Day										
0	-3.18***	-3.10***	-2.56**	-2.51**	-2.26**	-2.06**	-2.54**	-2.15**	-2.96***	-2.95***
	(0.002)	(0.001)	(0.013)	(0.012)	(0.033)	(0.038)	(0.020)	(0.031)	(0.006)	(0.003)
+1	-0.52	1.24	-0.63	1.06	1.76*	1.64	-1.06	-0.06	0.10	1.91*
	(0.603)	(0.212)	(0.528)	(0.286)	(0.091)	(0.101)	(0.302)	(0.947)	(0.917)	(0.055)
+2	-2.33**	-1.96**	-1.56	-1.29	-1.54	-1.33	1.17	0.67	-2.56**	-2.47**
	(0.022)	(0.049)	(0.124)	(0.195)	(0.137)	(0.180)	(0.256)	(0.499)	(0.016)	(0.013)
Window										
[0; +1]	-2.98***	-2.46***	-2.55**	-2.02**	-1.75*	-1.36	-2.16**	-1.85*	-2.42**	-2.07**
	(0.003)	(0.013)	(0.013)	(0.043)	(0.093)	(0.171)	(0.044)	(0.064)	(0.022)	(0.038)
[0; +2]	-2.30**	-2.52***	-1.89*	-1.74*	-1.25	-1.06	-1.22	-1.06	-2.36**	-2.07**
	(0.024)	(0.011)	(0.063)	(0.080)	(0.221)	(0.287)	(0.236)	(0.286)	(0.026)	(0.038)

Notes: This table presents the results of two tests of the equality of abnormal returns across the two events of interest (Lehman's failure *vs*. TARP testimony). The results are based on a simple paired (samples) *t*-test and a Wilcoxon signed rank sum test. Two-tailed *p*-values are reported in parentheses.

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively, in two-tailed tests

Table 6: Bivariate comparisons of risk, leverage, and profitability measures

Variable	Global			Banks			Non-bank FIs			Banks *vs.* Non-bank FIs		
	N	Mean	Med.	N	Mean	Med.	N	Mean	Med.	*t*-stat[a]	Chi2[b]	*z*-stat[c]
Risk measures												
Loan loss res/Tot loans	329	1.62	1.28	302	1.40	1.28	27	4.06	0.88	–1.90*	0.34	0.92
Loan loss prov/Tot loans	324	0.48	0.20	303	0.36	0.20	21	2.24	0.88	–2.26**	4.12**	–3.41***
Non-perf assets/Tot assets	317	1.71	0.97	299	1.66	0.97	18	2.63	0.63	–0.77	0.22	0.41
Credit ratings	110	8.65	8.00	66	7.83	8.00	44	9.86	9.00	–2.23**	2.22	–1.64*
Probability of failure	380	0.19	0.12	305	0.16	0.11	75	0.29	0.15	–4.26***	8.86***	–2.98***
Leverage												
Total debt/Total assets	380	23.75	18.36	305	18.85	17.37	75	43.33	39.78	–6.40***	11.12***	–5.22***
LT debt/Total assets	380	14.52	11.19	305	11.90	11.08	75	24.97	13.17	–4.07***	0.59	–2.34**
ST borrowings/Total assets	366	9.57	6.12	295	7.08	5.78	71	20.06	9.25	–4.59***	1.77	–2.00**
(Expected) Profitability												
Tobin's Q	375	1.09	0.99	301	1.01	0.99	74	1.45	1.02	–6.71***	1.75	–2.75**
Price-to-book ratio	371	1.35	0.96	300	1.04	0.95	71	2.71	1.20	–5.34***	3.47*	–2.51**
Return on equity	370	2.59	7.45	301	4.01	7.47	69	–3.61	7.10	1.73*	0.02	0.77
Return on assets	377	0.17	0.68	302	0.37	0.70	75	–0.63	0.50	0.74	0.77	0.19
Efficiency ratio	362	66.35	63.32	303	63.73	62.89	59	79.75	67.00	–1.88*	1.64	–0.91
Other variables												
Total assets(†)	380	46.00	3.05	305	34.33	2.75	75	92.51	6.04	–1.89*	8.11***	–3.61***
Total market value(†)	380	45.17	3.06	305	33.01	2.82	75	93.64	6.08	–2.00**	11.30***	–3.96***
Net loans/Tot assets	349	66.80	71.57	305	70.60	72.21	44	40.63	30.58	6.11***	12.45***	5.20***
Mkt securities/Total assets	380	18.13	14.26	305	15.82	14.33	75	27.34	11.79	–3.31***	0.05	0.16

Notes: This table presents descriptive statistics for several key financial variables measuring three dimensions of firm performance (risk, operating leverage, and profitability), as well as other control variables (mean and median values), calculated separately for the full sample and two sub-samples of banks ("Banks" vs. "Non-bank" FIs). See text for the definition of variables.

(a) *t*-test on the equality of means

(b) nonparametric two-sample test on the equality of medians

(c) Wilcoxon-Mann-Whitney rank-sum test for the hypothesis that the two independent sub-samples (i.e., unmatched data) are from populations with the same distribution

(†) $x10^3$

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively, in two-tailed tests

Table 7: Correlation coefficients between abnormal returns and proxies for risk and performance

Variable	Global sample			Bank subsample			Non-bank subsample		
	N	SAR0	SCAR[0;+1]	N	SAR0	SCAR[0;+1]	N	SAR0	SCAR[0;+1]
Risk measures									
Loan loss reserves/Total loans	329	–0.116**	–0.153***	302	–0.187***	–0.184***	27	0.064	–0.044
Loan loss provisions/Total loans	324	–0.126**	–0.211***	303	–0.117**	–0.162***	21	0.101	–0.102
Non-performing assets/Tot assets	317	–0.070	–0.191***	299	–0.100*	–0.249***	18	0.218	0.116
Credit ratings	110	–0.350***	–0.430***	66	0.051	–0.028	44	–0.414***	–0.450***
Probability of failure	380	–0.176***	–0.244***	305	–0.168***	–0.241***	75	–0.216*	–0.316***
Leverage									
Total debt/Total assets	380	–0.299***	–0.352***	305	–0.252***	–0.120**	75	–0.200*	–0.299***
Long-term debt/Total assets	380	–0.130**	–0.194***	305	–0.157***	–0.122**	75	–0.020	–0.096
Short-term borrowings/Tot assets	366	–0.311***	–0.323***	295	–0.237***	–0.075	71	–0.249**	–0.308***
(Expected) Profitability									
Tobin's Q	375	0.002	–0.017	301	0.184***	0.227***	74	0.090	0.086
Price-to-book ratio	371	0.043	0.010	300	0.279***	0.344***	71	0.082	0.054
Return on equity	370	0.073	0.151***	301	0.093*	0.233***	69	0.018	0.044
Return on assets	377	0.069	0.116**	302	0.132**	0.232***	75	0.045	0.084
Efficiency ratio	362	–0.435***	–0.381***	303	–0.065	–0.183***	59	–0.498***	–0.411***
Other variables									
Total assets	380	–0.315***	–0.266***	305	–0.406***	–0.199***	75	–0.301***	–0.338***
Total market value	380	–0.318***	–0.270***	305	–0.405***	–0.197***	75	–0.298***	–0.336***
Net loans/Total assets	349	0.241***	0.243***	305	–0.008	–0.054	44	0.173	0.170
Market securities/Total assets	380	–0.227***	–0.199***	305	0.093*	0.114**	75	–0.257**	–0.235**

Notes: This table presents correlation coefficients between standardized abnormal returns on September 15th, day 0 (SAR0), and standardized cumulative abnormal returns over the event window [0;+1] (SCAR[0;+1]), on the one side, and several key financial variables measuring three dimensions of the banking performance (risk, operating leverage, and profitability) and other control variables, on the other side. The correlation coefficients are computed for the global sample, as well as for two sub-samples: "Banks" and "Non-bank" FIs. See text for the definition of variables.

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively, in two-tailed tests

Table 8: Cross-sectional analysis of the stock price reaction to Lehman's failure and TARP announcement

	Loan loss reserve		Loan loss provisions		Non-performing assets		Credit rating		Probability of failure	
	Panel A: Lehman Brothers' failure (dependent variable: standardized abnormal return on day 0, September 15th, 2008)									
Financial condition	–0.12**	–0.11**	–0.45***	–0.39***	–0.14***	–0.16***	–0.51***	–0.36***	–3.25***	–2.17**
	(0.021)	(0.028)	(0.000)	(0.000)	(0.004)	(0.001)	(0.000)	(0.001)	(0.009)	(0.045)
Leverage	–0.03***	–0.02***	–0.02***	–0.01***	–0.05***	–0.05***	–0.03	–0.06*	–0.03	–0.03***
	(0.000)	(0.000)	(0.001)	(0.002)	(0.000)	(0.000)	(0.356)	(0.063)	(0.106)	(0.002)
Tobin Q	4.74***	4.40***	7.56***	6.98***	8.06***	6.45***	0.00	–0.46	0.01	–0.27
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.510)	(0.561)	(0.321)	(0.477)
Exposure	–1.27***		–1.45***		–1.35***		–2.96**		–1.51*	
	(0.001)		(0.000)		(0.000)		(0.038)		(0.088)	
TBTF		–1.41***		–1.47***		–1.39***		–3.89***		–3.26***
		(0.000)		(0.000)		(0.000)		(0.001)		(0.000)
Constant	–4.10***	–3.75***	–7.18***	–6.59***	–7.54***	–5.79***	4.36***	4.74***	0.72*	1.59***
	(0.002)	(0.004)	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)	(0.002)	(0.057)	(0.007)
F-statistic	20.30***	24.95***	26.10***	31.19***	24.34***	27.96***	5.75***	9.46***	3.64***	12.21***
N	209	209	205	205	195	195	104	104	244	244
R2	0.28	0.33	0.34	0.38	0.34	0.37	0.19	0.28	0.06	0.17
Adjusted R2	0.27	0.32	0.33	0.37	0.32	0.36	0.16	0.25	0.04	0.16
	Panel B: TARP announcement (dependent variable: standardized abnormal return on day 0, September 23rd, 2008)									
Financial condition	–0.04	–0.04	0.07	0.08	0.07	0.07	0.05	0.03	0.21	0.16
	(0.518)	(0.488)	(0.606)	(0.595)	(0.128)	(0.181)	(0.232)	(0.445)	(0.684)	(0.752)
Leverage	0.01	0.01	0.01	–3.12	0.01	0.01	0.01	0.02	0.00	0.00
	(0.140)	(0.119)	(0.181)	(0.112)	(0.292)	(0.133)	(0.192)	(0.100)	(0.588)	(0.487)
Tobin Q	2.43	2.57*	2.67	2.93	2.35	2.51	–0.00	0.01	–0.24	–0.21
	(0.116)	(0.096)	(0.154)	(0.118)	(0.262)	(0.229)	(0.997)	(0.978)	(0.187)	(0.243)
Exposure	0.45		0.72		0.54		0.55		0.41	
	(0.319)		(0.124)		(0.234)		(0.273)		(0.295)	
TBTF		0.02		0.09		–0.40		–0.24		–0.02
		(0.955)		(0.812)		(0.271)		(0.592)		(0.952)
Constant	–2.52	–2.66	–2.86	0.01	–2.63	–2.77	–0.67	–0.47	0.25	0.24
	(0.121)	(0.102)	(0.144)	(0.149)	(0.238)	(0.211)	(0.235)	(0.415)	(0.370)	(0.397)
F-statistic	1.54	1.28	2.14*	1.54	1.44	1.38	1.80	1.55	0.87	0.59
N	209	209	205	205	195	195	104	104	244	244
R2	0.03	0.02	0.04	0.03	0.03	0.03	0.07	0.06	0.01	0.01
Adjusted R2	0.01	0.01	0.02	0.01	0.01	0.01	0.03	0.02	–0.00	–0.01

Notes: This table presents the results of the multivariate analysis of the stock market reaction to the two events of interest (Lehman's failure and TARP testimony). The dependent variable is the standardized abnormal return on day 0 (September 15, Lehman's failure, and September 23, TARP testimony), expressed in percentage. Abnormal returns are estimated using the SUR framework. The sample consists of the largest 250 surviving financial firms for which the various explanatory variables were available. See text for the definition of the explanatory variables. Equations are estimated by standard OLS. The *p*-values are reported in parentheses below each coefficient estimate.

Table 9: Adjusted CDS spread changes (in bps) around Lehman's failure and TARP testimony

Panel A: Senior 1-year Credit Default Swap (CDS) contracts

	Lehman's failure (Day 0 = September 15th, 2008)			*TARP testimony (Day 0 = September 23rd, 2008)*			*Lehman vs. TARP (all FIs)*		
Day	All FIs (N=85)	Banks (N=18)	Non-bank FIs (N=67)	All FIs (N=85)	Banks (N=18)	Non-bank FIs (N=67)	*t*-stat[a]	*z*-stat[b]	R+/R-[c]
–1	7.55	3.81	8.63	–26.94**	–27.96***	–26.65**	1.99**	3.51***	58/27***
	(65.88%)	(77.77%)	(62.68%)	(32.94%)	(5.55%)	(40.29%)	(0.04)	(0.00)	(0.00)
0	60.50***	79.71***	54.96***	39.01**	91.12***	24.01	2.09**	3.75***	56/29***
	(72.94%)	(88.88%)	(68.65%)	(70.58%)	(100.00%)	(62.68%)	(0.03)	(0.00)	(0.00)
+1	72.82***	79.36***	70.94***	19.31	39.67***	13.45	2.26**	3.99***	56/29***
	(75.29%)	(88.88%)	(71.64%)	(68.23%)	(72.22%)	(67.16%)	(0.02)	(0.00)	(0.00)
Window									
[–1; 0]	68.05***	83.52***	63.60**	–0.82	50.26**	–15.53	2.42**	4.42***	60/25***
	(69.41%)	(83.33%)	(65.67%)	(51.76%)	(52.77%)	(51.49%)	(0.01)	(0.00)	(0.00)
[0; +1]	133.33***	159.07***	125.91***	58.33**	130.80***	37.47	2.74***	5.19***	63/22***
	(74.11%)	(88.88%)	(70.14%)	(69.41%)	(86.11%)	(64.92%)	(0.00)	(0.00)	(0.00)
[0; +2]	136.41***	220.15***	112.30***	84.68***	194.53***	53.06*	2.50**	4.08***	57/28***
	(69.80%)	(85.18%)	(65.67%)	(67.05%)	(79.62%)	(63.68%)	(0.01)	(0.00)	(0.00)
[–1; +1]	140.88***	162.88***	134.55***	18.49	89.94***	–2.07	2.55**	5.36***	65/20***
	(71.37%)	(85.18%)	(67.66%)	(57.25%)	(59.25%)	(56.71%)	(0.01)	(0.00)	(0.00)
[–2; +2]	162.71***	235.00***	141.89***	–4.71	106.13***	–36.62	2.87***	5.44***	63/22***
	(69.41%)	(83.33%)	(65.67%)	(53.88%)	(51.11%)	(54.62%)	(0.00)	(0.00)	(0.00)

Panel B: Senior 5-year Credit Default Swap (CDS) contracts

	Lehman's failure (Day 0 = September 15th, 2008)			*TARP testimony (Day 0 = September 23rd, 2008)*			*Lehman vs. TARP (all FIs)*		
Day	All FIs (N=85)	Banks (N=18)	Non-bank FIs (N=67)	All FIs (N=85)	Banks (N=18)	Non-bank FIs (N=67)	*t*-stat	*z*-stat	R+/R-
–1	3.58	2.18	3.96	–10.54	8.31	–15.53	1.53	3.22***	55/30***
	(69.31%)	(73.68%)	(68.11%)	(40.90%)	(26.31%)	(44.92%)	(0.13)	(0.00)	(0.00)
0	87.58***	72.24***	91.64***	43.55**	64.17***	38.09*	1.47*	3.77***	57/28***
	(73.86%)	(84.21%)	(71.01%)	(71.59%)	(89.47%)	(66.66%)	(0.07)	(0.00)	(0.00)
+1	87.03***	53.66***	95.87***	52.18***	36.21***	56.40**	1.21	3.66***	57/28***
	(73.86%)	(73.68%)	(73.91%)	(60.22%)	(63.15%)	(59.42%)	(0.11)	(0.00)	(0.00)
Window									
[–1; 0]	91.17***	74.42***	95.60***	22.47	61.95***	12.01	1.68*	3.94***	60/25***
	(71.59%)	(78.94%)	(69.56%)	(56.25%)	(57.89%)	(55.79%)	(0.09)	(0.00)	(0.00)
[0; +1]	174.61***	125.90***	187.51***	95.73***	100.38***	94.50***	3.58***	5.06***	58/27***
	(73.86%)	(78.94%)	(72.46%)	(65.90%)	(76.31%)	(63.04%)	(0.00)	(0.00)	(0.00)
[0; +2]	142.77***	174.31***	134.43***	121.94***	163.81***	110.86***	0.81	3.40***	54/31***
	(67.42%)	(75.43%)	(65.21%)	(62.87%)	(66.66%)	(61.83%)	(0.42)	(0.00)	(0.00)
[–1; +1]	178.20***	128.08***	191.47***	74.65**	98.16***	68.42*	2.91***	5.35***	63/22***
	(72.34%)	(77.19%)	(71.01%)	(57.57%)	(59.64%)	(57.00%)	(0.00)	(0.00)	(0.00)
[–2; +2]	157.49***	186.70***	149.76***	51.95	84.76***	43.26	2.59**	4.53***	60/25***

(68.40%)	(74.73%)	(66.66%)	(52.95%)	(46.31%)	(54.78%)	(0.01)	(0.00)	(0.00)	

Notes: This table shows average changes in adjusted CDS spreads (expressed in basis points) on various periods around Lehman's bankruptcy date (day 0 = September 15th, 2008) and on several days surrounding Ben Bernanke's and Henry Paulson's TARP speeches before the Senate Banking Committee (day 0 = September 23rd, 2008). The full sample of US financial obligors (*N*=85) was partitioned into two sub-samples: "Banks" (*N*=18) and "Non-bank FIs" (*N*=67). We also report the mean cumulative change computed over various event windows, parametric test statistics, and percentage of positive abnormal adjusted CDS spread changes (in parentheses). The results are reported separately for the 1-year CDS contracts (Panel A) and 5-year CDS contracts (Panel B). Significance levels for adjusted CDS spread changes are determined with reference to the standard deviation of adjusted changes estimated over a 250-day estimation window.

(a) Paired samples *t*-test on the equality of means (the corresponding two-tailed *p*-values are reported in parentheses, below estimated *t*-statistics)

(b) Wilcoxon matched-pairs signed-ranks test on the equality of distributions (the corresponding two-tailed *p*-values are reported in parentheses, below *z*-scores)

(c) Two-sided sign test of matched pairs on the equality of medians (the corresponding *p*-values are reported in parentheses, below the number of plus signs (R+) / minus signs (R-))

***, **, * indicate statistical significance at the 1%, 5%, and 10% level, respectively, in two-tailed tests

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