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Bond Market Response to the Collapse of Prominent Investment Banks

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Abstract

We find that the Bear Stearns rescue in March 2008 elicited a neutral or moderately favorable impact on bond prices. Conversely, we find that the Lehman Brothers failure (combined with news about Merrill Lynch and American International Group) in September 2008 elicited a pronounced negative impact. Bond prices of financial firms suffered more than bonds of nonfinancial firms following the Lehman failure. Our multivariate analysis shows that bonds issued by financial institutions that were previously presumed to be protected (based on bond rating and firm size) suffered more pronounced losses in response to the Lehman failure.

Keywords: bonds, event study, market efficiency, credit spreads

JEL Classifications: G12, G14

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1. Introduction

Investment banks serve as key financial intermediaries to facilitate the flow of funds. The financial problems of large investment banks could signal potential contagion effects and, therefore, may have major consequences in the bond market. We examine the effects on corporate debt markets in response to two notable credit events regarding investment banks—the rescue of Bear Stearns and the subsequent failure of Lehman Brothers. Although both events were triggered by similar underlying financial problems for the firms, the signals were distinctly different.

1.1. Rescue of Bear Stearns

Bear Stearns was a major intermediary for securitizing mortgage-backed securities, and was particularly active in mortgage-backed securities representing subprime mortgages. It relied heavily on repurchase agreements for short-term funding to finance its operations. In 2007 and early 2008, Bear Stearns experienced financial problems because of its heavy exposure to the mortgage market and its excessive financial leverage. Due to Bear Stearns' questionable asset quality and creditworthiness in early 2008, many of the financial institutions that provided short-term loans refused to renew the loans. On March 13, 2008, Bear Stearns secretly notified the Federal Reserve that it was experiencing liquidity problems and would have to file for bankruptcy the next day if it could not access funds. On Friday, March 14, 2008, the Federal Reserve announced that it was providing financing to Bear Stearns through a commercial bank, J.P. Morgan Chase.

1.2. Failure of Lehman Brothers

Lehman Brothers was a major intermediary for fixed-income securities, and also made substantial investments in mortgage-backed securities representing subprime mortgages. Lehman Brothers experienced serious financial problems in 2008 because of its excessive holdings of subprime mortgages during the mortgage meltdown. Like Bear Stearns, it was highly levered and also relied heavily on short-term funding to finance its operations.

By September 2008, much of its funding was cut off as creditors became more concerned about its survival. Lehman Brothers also appealed to the U.S. government for financial support, but did not receive any. On September 15, 2008, a day described as one of the most dramatic days in the history of U.S. financial system, Lehman Brothers filed for bankruptcy.

On that same day, Merrill Lynch agreed to be acquired by Bank of America, and American International Group (AIG) was in the news because of concerns about its

describes the opacity of banks and the difficulty faced by credit rating agencies when evaluating banks.

Several studies document contagion effects triggered by financial problems, including those by Aharony and Swary (1996), Akhigbe and Madura (2001), Cowan and Power (2001), Calomiris and Mason (2003), Brunnermeier and Pedersen (2005), Diamond and Rajan (2005), Jorion and Zhang (2010), and Bemelech and Bergman (2011). Recent related studies offer insight into the credit problems during the financial crisis in 2008–2009. Sabry and Okongwu (2009) suggest that various linkages between firms caused contagion effects. Jorion and Zhang (2009) find that bankruptcy risk during the crisis caused abnormally negative equity returns. Dwyer and Tkac (2009) suggest that the crisis was partially due to the market's inability to properly value securities and to concerns about counterparty risk. Duffie (2010) suggests that impediments to capital formation cause distorted asset prices.

Related studies by Miankhel, Thangarelu and Kalirajan (2010) and Kim and Kim (2010) assess contagion due to the financial crisis from a global perspective. Additional related research has assessed effects of the financial crisis on credit markets. Jorion and Zhang (2009) determine that spreads on credit default swaps increased during the financial crisis. Dick-Nielsen, Feldhutter and Lando (2012) find that spreads increased during the crisis, especially for speculative grade bonds, and that the influence of illiquidity on spreads was more pronounced as the financial crisis intensified. We build on this literature by examining the impact of the Bear Stearns rescue and the Lehman Brothers failure on bond markets during the period surrounding the announcements. To the best of our knowledge, we are the first to use the bond event study methodology to examine the bond market reactions to these two bank failure events.

3. Hypotheses

We assess two credit events: (1) March 13, 2008 when Bear Stearns was rescued by regulators, and (2) September 15, 2008 when Lehman Brothers was not rescued by regulators and filed for bankruptcy. We develop hypotheses regarding the impact of these credit events in the bond markets.

3.1. Impact of credit events on access to credit in bond markets

In the months following these events, credit conditions became more restricted. Anecdotal evidence suggests that investors did not know how to value bonds in the secondary market, leading to a decline in bond market liquidity. We hypothesize that secondary market liquidity affected borrowers' access to capital markets following the failure of Lehman Brothers as measured by number of issuers and the number of new bond issues. However, because we expect that the rescue of Bear Stearns had a calming effect on the market, we expect the number of issuers and new issues to remain unchanged following the Bear Stearns credit event.

3.2. Impact of Bear Stearns rescue on bond prices

If information is continuous and complete in credit markets, then the pricing of each bond should be driven primarily by information about the underlying issuer. However, since information is neither continuous nor complete per issuer, bond markets may rely periodically on the creditworthiness of one firm to make inferences about prices of bonds issued by other firms. Since these credit events could relay a signal about the creditworthiness of other financial institutions, prices of other bonds may be affected.

The rescue of Bear Stearns contains conflicting signals. The fact that Bear Stearns needed to be rescued could have spread fear that other firms would soon experience problems that were not fully recognized by the market. This may cause a negative price response of bonds, especially those issued by financial firms. However, a counter argument is that the rescue of Bear Stearns may signal the government's willingness to rescue other financial firms that are experiencing problems. Such a perception may relieve existing creditors and cause a positive bond price response.

3.3. Impact of Lehman Brothers failure on bond prices

The failure of Lehman Brothers may have not only signaled limited access to debt markets in the future, but also negative credit information about individual bond issuers, potential contagion effects throughout the bond market, and that large bond issuers would no longer be protected in the case of default. That is, the Lehman event could be interpreted to have adverse effects for multiple reasons, without any reasonable argument for a counter effect. Therefore, we hypothesize that bond valuations weaken in response to the Lehman Brothers failure.

3.4. Influence of bond or issuer characteristics

To the extent that a credit event spreads fear in the bond market, we hypothesize that contagion effects in response to the credit events are conditioned on the following characteristics of bond issuers or of the bonds.

3.4.1. Financial classification of bond issuer

Since the two credit events focus on financial firms, we expect that they will emit more pronounced signals about the creditworthiness of other financial firms than about nonfinancial firms.

3.4.2. Size of bond issuer

Larger firms are commonly perceived to be more transparent, and are more closely monitored by creditors since they tend to have more outstanding debt.

Additionally, bonds issued by larger firms are more liquid than bonds issued by smaller firms because each new bond offering is likely to be large and because large firms are more likely to issue bonds more frequently than smaller firms. A counter argument is that large bank issuers might be more susceptible to the Lehman credit event than smaller banks because the event demonstrated that large financial firms might be allowed to fail. Furthermore, large banks tend to participate in the securitization and investment in mortgage-backed securities, and may be more exposed to the problems that triggered the collapse of Bear Stearns, Lehman Brothers, and AIG.

3.4.3. Bond rating

According to Standard & Poor's (S&P) documentation, "Ratings performance data show that lower ratings are less stable than higher ratings. This means a higher proportion of 'A'-rated issuers and issues retain their 'A' rating during a specified time period, compared with a smaller portion of 'B'-rated issuers and issues for that same period."[2] To the extent that investors rely on credit ratings, prices of bonds with weaker ratings should suffer a more pronounced decline in response to a credit event. However, since the credibility of bond ratings may have been questionable at the time of Lehman's failure (its own bonds were rated A or higher at that time), the rating effect may be diluted.

3.4.4. Financial leverage of bond issuer

Credit effects are further captured by the degree of financial leverage, which contributes to increased potential for financial distress and deteriorating credit quality. We hypothesize that bonds are more exposed to contagion effects if they are issued by firms with relatively high degrees of financial leverage.

3.4.5. Bond term

We expect that the bond's term to maturity exacerbates the impact of the credit event on bond valuations. The prices of bonds with longer terms to maturity may be more susceptible to credit events (all else equal) because the bonds cannot be redeemed in the near future. Thus, a favorable credit signal should have a more pronounced positive impact on longer term bonds. Conversely, an unfavorable signal will have a more pronounced negative impact, because bondholders can only escape from future credit problems by selling the bonds in the secondary market.

[2] See http://www.standardandpoors.com/aboutcreditratings/

Table 1

Number of new bond issues

The number of bonds issued and the number of issuers with new bond issues in the six months before the Bear Stearns failure of March 13, 2008, the six months between the Bear Stearns and the Lehman Brothers failure of September 15, 2008, and the six months following the Lehman Brothers failure are summarized. The Pre-Bear Stearns period is September 15, 2007 to March 13, 2008. The Post-Bear Stearns period is March 13, 2008 to September 15, 2008 and the Post-Lehman Brothers period is September 15, 2008 to March 15, 2009. The full sample total number of issuers may not be the sum of issuers in the three issue periods as some firms issued bonds in multiple periods.

	Pre-Bear Stearns		Post-Bear Stearns		Post-Lehman Brothers		Full sample period	
	Bonds	Issuers	Bonds	Issuers	Bonds	Issuers	Bonds	Issuers
Total	9,743	559	9,458	566	4,827	393	24,028	1,084
By industry group								
Industrial	549	280	552	291	306	174	1,407	591
Financial	3,837	182	4,806	163	1,870	116	10,513	295
Utilities	82	60	106	78	92	71	280	147
Government	5,271	34	3,993	33	2,559	32	11,823	48
Other	4	3	1	1	0	0	5	3
By Moody's rating category								
Aaa	2,108	32	2,588	29	2,299	59	6,995	59
Aa	649	46	866	47	482	36	1,997	47
A	462	102	641	111	311	97	1,414	190
Baa	458	115	516	132	161	91	1,135	258
Ba and below	223	117	156	118	55	45	425	234
Not rated	5,843	147	4,700	129	1,519	65	12,062	296
Financial bonds by Moody's rating category								
Aaa	142	8	93	6	159	39	394	39
Aa	603	31	812	36	431	21	1,846	24
A	361	43	539	50	178	21	1,078	60
Baa	200	20	204	20	17	5	421	35
Ba and below	78	20	18	11	4	4	100	29
Not rated	2,453	60	3,140	40	1,081	26	6,674	108

4. Data and summary statistics

We gather information about new bonds issues from the Mergent Fixed Income Securities Database (FISD), which is a comprehensive source for data about publicly traded corporate debt. We screen the newly issued bonds to eliminate all preferred securities, but retain equity-linked and pay-in-kind (PIK) bonds for the first stage of our analysis.

Our sample period is from September 15, 2007 through March 15, 2009 to capture six months before our first event (March 13, 2008 rescue of Bear Stearns) to six months after our second event (September 15, 2008 failure of Lehman Brothers). Table 1 shows that the total number of newly issued bonds in this 18-month sample

period declined over time, with 9,743 new issues before the Bear Stearns rescue, 9,458 new issues in the six months following the Bear Stearns rescue, and 4,827 in the six months following the Lehman Brothers failure. In terms of number of issuers accessing bond capital markets during these periods, our sample shows that 566 issuers were active following the Bear Stearns event, which is a slight increase from the 559 issuers during the six months prior to the Bear Stearns rescue. However, only 393 issuers accessed the market in the six months following the Lehman Brothers failure, which is consistent with our hypothesis that access to capital markets remained effectively unchanged following the Bear Stearns event but declined substantially following the Lehman Brothers failure.

Table 1 shows that the greatest decline for all industries was in the post-Lehman period, with financial issues declining by more than one-half. Aaa-rated bonds following the failure of Lehman Brothers declined to 2,299 from 2,588 in the six months between the Bear Stearns rescue and the Lehman Brothers failure, approximately 13%. For lower rated issues, however, the decline was more pronounced. For example, Baa-rated bonds declined to 161 new issues compared with 516 before the Lehman Brothers failure, which is a decline of 69%.

In the financial industry, the number of new issues of Aa and A-rated bonds increased after the Lehman Brothers failure, but the number of new issues rated Baa or below declined. The results lend preliminary support for the notion that access to capital markets declined for borrowers with lower credit ratings after these credit events.

To perform the event study described below, we merge the FISD issuer data with the corporate bond transaction data from the Trade Reporting and Compliance Engine (TRACE) maintained by the Financial Market Regulatory Authority[3] and we include all corporate bond trades, whether the bonds are newly issued during the sample period or not. The TRACE system is one of the most comprehensive sources of bond transaction detail available today. It was established by the NASD in 2002 to increase market transparency in the over-the-counter bond market. TRACE reports transaction detail in investment grade, high-yield, and convertible corporate bonds, but does not include mortgage-backed securities or government bonds. We gather all reported bond transactions from September 15, 2007 through March 15, 2009 for a total of 2,368,391 transactions.

Following Edwards, Harris and Piwowar (2007) we screen the bond transaction sample to keep all trades with a minimum trade size of $100,000. Bond markets are typically institutional markets and any trade less than $100,000 is considered an "odd-lot" that does not represent the fair market price. The average trade size for this sample is approximately $1.1 million. We also exclude all canceled and

[3] Though FISD reports 127,956 bonds outstanding as of September 15, 2007, not all bonds that were issued or outstanding in the months surrounding the events are recorded in the TRACE database. Moreover, unlike stocks, bonds may not necessarily trade during the event period.

corrected trades, whether the cancellation is entered on the same trade date or on a different trade date.[4] We eliminate "when-issue" trades and all trades that do not settle "regular way," and we select trades where the price excludes commission. To estimate a daily price, we use the mid-point of all trades during that day. We exclude any equity-linked securities and PIK bonds. Finally, we exclude all bonds issued by Bear Stearns, Lehman Brothers, and AIG.

We gather firm financial statement data from Compustat for use in the cross-sectional regressions. We obtain U.S. Treasury constant maturity treasury (CMT) rates from the Federal Reserve FRED II website, and these rates are used to calculate corporate bond returns in excess of Treasury bond returns in the bond event study analysis.

Table 2 Panel A presents the summary statistics for the final sample of firms. For the 18-month period from September 15, 2007 through March 15, 2009, our sample includes 309 firms with an average of 2.23 bonds per firm. These bonds have an average coupon rate of 6.66% and an average term to maturity of 9.41 years. The mean Moody's rating corresponds to Baa3 and the mean S&P rating corresponds to approximately BBB−. The total assets of our sample firms are $125.5 billion on average, and the average total debt to total asset ratio is 39%. To control for the differences in financial leverage across industries, we compute the adjusted financial leverage which is total debt to total assets less the median ratio for the two-digit Standard Industrial Classification (SIC) code.

The descriptive statistics are partitioned for financial firms in Panel B and nonfinancial firms in Panel C. Our sample includes 68 financial firms compared with 241 nonfinancial firms.[5] The financial firms issue more bonds per firm at 3.49 compared with 1.88 bonds per nonfinancial firm. A total of 689 bonds in the final sample have enough daily observations to be included in the event study described below. The average coupon rate is lower for financial firms, which is consistent with the shorter average maturity relative to nonfinancial firm bonds. The financial firms in our sample have an average Moody's rating and S&P rating of A3 and BBB+, respectively, while the nonfinancial firms have lower ratings on average of approximately Baa3/BB+. The financial firms in our sample are substantially larger than their nonfinancial counterparts at $470 billion in assets versus $34 billion.

[4] Based on TRACE documentation, trade errors that are caught the same trading day are corrected by entering a TRC_ST of C (cancellation) or W (correction or "was"). These corrections are coded with the original message sequence number to identify the trade being corrected. If a trade error is caught after the trade date, then it is corrected by entering an ASOF_CD of R (reversal) and an A (as of trade). These corrections are not linked to the original message sequence number so they must be matched based on trade date, time, price, and volume. Occasionally, there is more than one original trade that matches a reversal, and occasionally there is more than one reversal trade for which no original trade can be found. We select the first matching original trade for each reversal and if no original trade can be found, then the reversal is assumed to be entered in error and is eliminated.

[5] Listing of sample financial firms is available from the authors on request.

Table 2

Sample descriptive statistics

Summary statistics for 2007 of the firms included in the event study analysis. Coupon rate, term remaining, Moody's and Standard & Poor's (S&P) ratings are the average of all outstanding bonds by the same firm traded between September 15, 2007 and March 15, 2008. Total number of bonds is 689.

	Mean	Median	Std Dev	Minimum	Maximum	Number of firms
Panel A: Full sample						
Number of bonds per firm	2.23	1.00	2.38	1.00	24.00	309
Average coupon rate (%)	6.66	6.25	1.64	1.26	11.25	309
Average term remaining (years)	9.41	7.61	5.91	0.74	30.05	309
Average Moody's rating	12.35	14.00	4.98	2.00	22.00	292
Average S&P rating	12.86	14.00	4.49	4.00	22.00	294
Total assets ($ millions)	125,586	22,816	357,070	381	2,950,316	266
Total debt to total asset ratio	39.00	33.98	24.16	0.29	136.19	266
Adjusted financial leverage	3.03	0.00	20.75	–59.70	100.18	264
Panel B: Financial firms						
Number of bonds per firm	3.49	2.00	4.06	1.00	24.00	68
Average coupon rate (%)	5.64	5.50	1.36	1.26	10.50	68
Average term remaining (years)	7.02	5.19	5.35	1.62	30.03	68
Average Moody's rating	15.08	17.00	5.11	2.00	22.00	65
Average S&P rating	15.30	16.50	4.53	4.00	22.00	66
Total assets ($ millions)	470,010	153,078	665,706	6,855	2,950,316	56
Total debt to total asset ratio	31.77	27.72	21.40	0.81	94.52	56
Adjusted financial leverage	0.57	0.00	15.92	–59.70	43.88	55
Panel C: Nonfinancial firms						
Number of bonds per firm	1.88	1.00	1.45	1.00	12.00	241
Average coupon rate (%)	6.95	6.95	1.60	3.83	11.25	241
Average term remaining (years)	10.08	8.07	5.89	0.74	30.03	241
Average Moody's rating	11.57	12.00	4.67	2.00	22.00	227
Average S&P rating	12.15	13.00	4.23	4.00	22.00	228
Total assets ($ millions)	33,739	14,666	69,121	381	795,337	210
Total debt to total asset ratio	40.92	35.32	24.53	0.29	136.19	210
Adjusted financial leverage	3.68	0.00	21.83	–45.78	100.18	209

5. Event study

5.1. Bond event study methodology

We perform the bond event study using a mean-adjusted model, following Bessembinder, Kahle, Maxwell and Xu (2009). To begin, we estimate a daily holding period bond return (BR) excluding accrued interest as

$$BR_t = \frac{(P_t - P_{t-1})}{P_{t-1}}. \quad (1)$$

Though accrued interest can be a large component of bond return, over a small sampling period such as a day, this is negligible. We then adjust the bond return for the comparable U.S. Treasury note return over the same day, where the U.S. Treasury return (TR) is estimated as

$$TR_t = -D^* \times (CMT_t - CMT_{t-1}). \tag{2}$$

D^* is the modified duration of a par bond with the comparable maturity and a coupon rate equal to the average CMT rate over the sample period. The daily CMT rates are gathered for the 1-year, 2-year, 3-year, 5-year, 7-year, 10-year, 20-year, and 30-year maturities. The corporate bonds are then matched based on the closest CMT maturity and following a half-year convention.[6] The premium bond return (PBR) is estimated to be

$$PBR_t = BR_t - TR_t. \tag{3}$$

The expected bond return is defined as the mean PBR of "n" nonmissing observations over the estimation window of $t = -30$ to $t = -6$, and is shown as

$$E(R) = \sum_{t=-30}^{-6} \frac{PBR_t}{n}. \tag{4}$$

During our sample period, TRACE reported an average of three transactions per bond per day with some bonds experiencing only one transaction and others experiencing 514 trades. In addition, not all bonds trade every day, which complicates the estimation period in a bond event study. To deal with the frequency of trading, a minimum five-day estimation period is required to estimate the expected return. Bessembinder, Kahle, Maxwell and Xu (2009) require a minimum estimation period of 10 days. We use the shorter constraint in order to maintain a larger sample. However, we also try a 10-day minimum estimation period and our results are similar. The abnormal return (AR) is estimated from $t = -5$ through $t = +5$ and represents the difference between the actual PBR and the E(R) for each event date. The cumulative abnormal return (CAR) is the sum of the AR over various event windows.

A complicating factor in bond research is that one firm could have multiple bond issues. Bessembinder, Kahle, Maxwell and Xu (2009) describe a bond-level approach where each bond is included as a separate observation and a firm-level approach where all ARs per firm are averaged into one single observation per firm per day. The mean firm-level AR can be estimated by equally weighting all bonds per day or by value-weighting based on the outstanding amount of each bond. The amount outstanding is missing for several bonds in our sample. We estimate both firm-level methods and find that the results are similar to the bond-level results, so we report the results of the bond-level analysis only.

[6] For example, corporate bonds with maturities >1.5 and ≤2.5 would be matched to the two-year U.S. Treasury.

5.2. Event study results

Table 3 displays the results of the time series analysis designed to estimate the mean ARs of bonds. The ARs are estimated using a bond-level approach where all bonds are included as individual observations. The bond price effects in response to the Bear Stearns rescue are shown in Panel A, while the effects in response to the Lehman Brothers failure are in Panel B. For each credit event, bond price effects are estimated for the full sample and for the subsamples of bonds representing financial issuers and nonfinancial issuers. Since there were rumors about financial problems of Bear Stearns and Lehman Brothers shortly before their respective credit event dates, we also review bond price effects over a five-day period prior to the events.

Table 3, Panel A shows that on the day of the announced rescue of Bear Stearns ($t = 0$), the mean AR of all bonds was –0.80%, significant at the 0.1% level. The negative effect was slightly stronger for bonds in the nonfinancial subsample than for bonds in the financial subsample. The number of bonds experiencing negative price effects on this day in the full sample, financial sample, and nonfinancial sample clearly outweigh the number of bonds experiencing positive price effects. On the day following the announcement, bonds recovered with a 1.05% AR. During four of the five days following the announcement, the mean AR of the full sample is positive and significant. It appears that the bond market stabilized after absorbing the initial shock due to the Bear Stearns rescue. The investors initially reacted to the Bear Stearns event negatively, but seemed to interpret the rescue as a positive signal over the following five-day period.

Table 3, Panel B shows that on the day that Lehman Brothers filed for bankruptcy ($t = 0$), the mean AR of all bonds was negligible (–0.01%), but was –2.57% (significant at the 0.1% level) the next day. About 79% of the bonds experienced a negative AR on this day. A closer review shows a marked difference between the price response of bonds issued by financial versus nonfinancial firms. The subsample of bonds issued by financial firms experienced a mean AR of –1.65% (significant at the 0.1% level) on day $t = 0$, followed by a mean AR of –4.41% (significant at the 0.1% level) the next day. Conversely, the subsample of bonds issued by nonfinancial firms experienced a mean abnormal bond return of 1.45% (significant at the 0.1% level) on day $t = 0$, followed by an offsetting mean AR of –1.04% (significant at the 0.1% level) the next day.

The ARs for full sample, financial, and nonfinancial subsamples are significantly negative over the three days before the Lehman failure ($t = -3$ to -1), suggesting negative market sentiment and possible information leakage prior to the announcement. Over the three days after the announcement, the mean ARs for the full sample and the financial and nonfinancial subsamples continued to be negative and significant. Overall, the results indicate a severe negative impact of the Lehman failure event, with more pronounced negative effects for financial firms.

Three days after the Lehman Brothers failure and the acquisition of Merrill Lynch by Bank of America, government officials initiated discussions to resolve concerns

Table 3

Bond-level abnormal returns

Abnormal returns (ARs) are estimated using a mean-adjusted returns model where all reported bond trades for each firm are included as individual observations. Estimation period is 30 days ending six days prior to each event. The minimum estimation period is five days. Event 1 is the Bear Stearns rescue date of March

about the U.S. credit markets. On September 18, 2008, Fed chairman Bernanke and Treasury Secretary Paulson proposed to members of Congress that emergency assistance be provided by the government to ensure the liquidity in the credit markets. On September 19, 2008, Paulson stated a broadly proposed plan in which the U.S. government would purchase troubled illiquid assets held by financial institutions. We attribute the favorable bond market return of 3.62% for financial institutions on day $t+4$ (September 19, 2008) to the government proposal, which attenuates the effects that accumulated up to that point.

Table 4 shows the CAR representing various windows for the full sample and the same subsamples of bonds in response to each credit event. Panel A shows that the CAR (–5,–1) for the full sample just prior to the Bear Stearns rescue is not statistically significant. However, financial firms experienced negative ARs, while nonfinancial firms experienced positive ARs. The bond price effects at the time of the event (as measured by CAR (0,+1)) are not significant. For most other windows following the event, the CAR for the full sample and both subsamples is positive and significant, reflecting favorable bond price effects after the event date. For example, the full sample CAR (+1,+5) is 1.30%, and this is significant at the 0.1% level.

Table 4, Panel B shows that the CAR (–5,–1) for the full sample as well as the financial and nonfinancial subsamples just prior to the Lehman Brothers failure is negative and significant. At the time of the Lehman Brothers failure, the ARs (CAR (0,+1)) of the financial subsample is –4.87% (significant at the 0.1% level), while the nonfinancial subsample experienced a negligible AR of 0.31%. The CARs of almost all the windows representing the period before and after the Lehman failure event date for the full sample and both subsamples are negative and significant. Overall, the financial market interpreted the Bear Stearns rescue as a positive signal, but interpreted the Lehman Brothers failure as a negative signal.

6. Cross-sectional analysis

To examine the cross-sectional variation in bond ARs, we pool the samples of bonds used to assess the Bear Stearns and Lehman Brothers event effects. We apply a multivariate model to explain the variation in the ARs among bonds and use a dummy variable called *LEHMAN* that is equal to 1 for the credit event representing the Lehman Brothers bankruptcy and 0 for the credit event representing the Bear Stearns rescue. To account for differences associated with financial versus nonfinancial bonds, we use a dummy variable *FIN* that is equal to 1 for bonds issued by financial firms. We capture the liquidity and size effects by using the variable *SIZE*, which is measured as the natural logarithm of the issuing firm's total assets in the year prior to the event. We attempt to capture credit effects using a variable called *RATING* that represents Moody's credit rating on the bond prior to the credit event converted into a numerical scale where Aaa = 22 through D = 1. The higher the rating, the higher the number assigned.

Table 4

Bond-level cumulative abnormal returns

Cumulative abnormal returns CARs are estimated as the sum of the abnormal returns over the window (−1, +2). Abnormal returns are estimated using a mean-adjusted returns model where all reported bond trades for each firm are included as individual observations. Estimation period is 30 days ending six days prior to each event. Event 1 is the Bear Stearns rescue date of March 13, 2008 and Event 2 is the Lehman Brothers failure date of September 15, 2008.

CAR (−5,−1)	CAR (−5,0)	CAR (−1,+1)	CAR (−1,+2)	CAR (0,+1)	CAR (0,+2)	CAR (0,+5)	CAR (+1,+2)	CAR (+1,+5)
Panel A: Bear Stearns rescue date of March 13, 2008								
Full sample								
0.18%	−0.32%	0.75%	0.90%	0.08%	0.29%	0.69%	1.21%	1.30%
−1.07	(−1.84)**	(5.85)****	(5.77)****	−0.76	(2.14)**	(3.61)****	(7.84)****	(6.65)****
245:194	*216:234*	*251:125*	*260:134*	*173:145*	*195:154*	*247:179*	*205:61*	*267:130*
Financial bonds								
−0.87%	−1.35%	0.46%	0.22%	0.13%	−0.12%	0.10%	0.61%	0.68%
(−2.93)***	(−4.60)****	(2.01)**	(0.81)	(0.68)	(−0.48)	−0.26	(2.34)***	(1.67)**
64:81	*57:95*	*87:48*	*84:56*	*74:45*	*73:56*	*84:65*	*71:33*	*84:54*
Nonfinancial bonds								
0.70%	0.21%	0.91%	1.28%	0.05%	0.53%	1.01%	1.60%	1.63%
(3.55)****	−101.00%	(5.97)****	(6.85)****	(0.40)	(3.28)****	(5.04)****	(8.64)****	(7.96)****
181:113	*159:139*	*164:77*	*176:78*	*99:100*	*122:98*	*163:114*	*134:28*	*183:76*
Panel B: Lehman Brothers failure date of September 15, 2008								
Full sample								
−1.31%	−1.29%	−2.30%	−2.82%	−2.00%	−2.32%	−2.76%	−2.77%	−2.85%
(−10.77)****	(−6.75)****	(−7.58)****	(−8.93)****	(−4.57)****	(−6.50)****	(−13.28)****	(−8.57)****	(−11.09)****
81:335	*134:288*	*97:248*	*101:281*	*103:135*	*120:207*	*75:349*	*59:215*	*57:354*
Financial bonds								
−1.18%	−2.11%	−4.43%	−5.63%	−4.87%	−5.76%	−2.79%	−5.57%	−1.92%
(−4.87)****	(−4.68)****	(−6.66)****	(−7.80)****	(−5.78)****	(−7.28)****	(−6.25)****	(−7.46)****	(−3.15)****
34:121	*43:113*	*29:109*	*25:119*	*28:78*	*26:98*	*34:118*	*13:89*	*31:114*
Nonfinancial bonds								
−1.38%	−0.81%	−0.88%	−1.12%	0.31%	−0.22%	−2.75%	−1.10%	−3.35%
(−10.70)****	(−5.75)****	(−4.65)****	(−6.00)****	−111.00%	(−1.10)	(−13.22)****	(−6.81)****	(−15.78)****
47:214	*91:175*	*68:139*	*76:162*	*75:57*	*94:109*	*41:231*	*46:126*	*26:240*

Cross-sectional *t*-statistics in parentheses and the number of positive observations to number of negative observations in italics. *, **, ***, **** indicate statistical significance using a one-tail test of significance at the 0.10, 0.05, 0.01 and 0.001 level, respectively.

Table 5 (*continued*)

Results of full sample bond-level cross-sectional regressions

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
RATING	0.0026				0.0034	0.0029
	(3.91)****				(4.19)****	(5.39)****
LEV			−0.0004	−0.0002	−0.0002	
			(−1.14)	(−0.72)	(−0.60)	
TERM	0.0022	0.0020	0.0019	0.0025	0.0021	0.0021
	(3.51)****	(3.56)****	(3.20)***	(3.91)****	(2.97)***	(4.40)****
BANKDUM	0.0446	0.0156	0.0228	0.0406	0.0381	
	(1.34)	(0.46)	(0.63)	(3.73)****	(−1.00)	
CREDDUM	0.0562	0.0302	0.0401	0.0572	0.0565	
	(1.74)*	(0.94)	(1.19)	(6.11)****	(1.52)	
FINSERVDUM	0.0241	−0.0077	−0.0021	0.0170	0.0151	
	(0.73)	(−0.23)	(−0.06)	(1.47)	(−0.40)	
INSDUM	0.0800	0.0476	0.0520	0.0754	0.0733	
	(2.30)**	(−1.40)	(1.46)	(5.36)****	(1.87)*	
LEH_SIZE		−0.0198	−0.0220			−0.0165
		(−3.79)****	(−3.62)****			(−

Table 5 (*continued*)

Results of full sample bond-level cross-sectional regressions

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
LEH_TERM	−0.0028	−0.0027	−0.0027	−0.0030	−0.0028	−0.0027
	(−6.67)****	(−6.4)****	(−6.39)****	(−6.77)****	(−6.62)****	(−6.29)****
Adj R^2	0.3677	0.3898	0.3969	0.3561	0.4012	0.415
N	472	447	445	445	434	436

*, **, ***, **** indicate statistical significance at the 0.10, 0.05, 0.01 and 0.001 level, respectively.

variable is also contained within each of the interaction terms, the coefficient of the dummy variable should be interpreted in conjunction with the coefficients of the interaction terms. When considering the typical values of the variables represented by the interaction terms, the net effect of *LEHMAN* on abnormal bond returns is negative. This point will be given more attention following the discussion of the results for the interaction terms.

Table 5 shows that the coefficient of *FIN* is negative and significant in five of the six models, which implies a less favorable (or more unfavorable) effect of the credit events on ARs of bonds issued by financial firms than bonds issued by nonfinancial firms. The coefficient of *SIZE* is positive and significant in the three models in which it was estimated, which suggests a more favorable effect of the credit events on ARs of bonds issued by larger firms.

The coefficient of *RATING* is positive and significant in the three models in which it was estimated, which reflects a more favorable effect of the credit events on ARs of bonds that are assigned higher ratings. The coefficient of *LEV* is negative and significant in one of the three models in which it was included, which offers modest evidence of a less favorable effect of credit events on ARs of bonds issued by firms with higher financial leverage. The coefficient of *TERM* is positive and significant in all six models, which suggests a more favorable effect of the credit events on ARs of bonds with longer terms to maturity.

The results for the interaction terms in Table 5 show that the sensitivity of abnormal bond returns to characteristics of the bond or issuer is commonly conditioned on the specific credit event of concern. The interaction term *LEH_FIN* is negative and significant in five of the six models. This implies that the Lehman credit event has a more negative effect than the Bear Stearns credit event on ARs of bonds issued by financial firms, when controlling for other factors. Recall that the abnormal bond return over the (−1, 2) window is not significant for the Bear Stearns credit event, but is negative and significant for the Lehman credit event. Thus, the results for the *LEH_FIN* while controlling for other characteristics corroborate the findings when estimating ARs separately for the two credit events.

The interaction term *LEH_SIZE* is negative and significant in the three models in which it is estimated. This implies that for a given size of the issuing firm, the

Lehman credit event has a more negative effect than the Bear Stearns credit event on ARs of bonds issued, when controlling for other factors.

Since the actions of the government in the two credit events were distinctly different, so were the signals, which led to the disparate effects of the two credit events. The estimated positive coefficient of *SIZE,* by itself, is overwhelmed by the magnitude of the negative *LEH_SIZE* coefficient. These results indicate that while bonds issued by larger firms experienced more favorable ARs in response to the Bear Stearns credit event, bonds issued by larger firms are adversely affected to a greater degree in response to the Lehman credit event. While the Bear Stearns credit event may have indicated that large failing firms might be rescued, the Lehman failure signaled that large firms may not be rescued. Thus, the bonds of any large institutions that might have been protected by a government rescue in the past may have experienced a decline in their "too-big-to-fail" value premium in response to the Lehman credit event.

The interaction term *LEH_RATING* is negative and significant in two of the three models in which it was estimated. Recall that the estimated coefficient for the *RATING* variable by itself was positive and significant, which suggests that the Bear Stearns credit event resulted in more favorable ARs for bonds that are highly rated. The *LEH_RATING* coefficient is of a similar magnitude, but negative, which suggests an offsetting effect. Therefore, the impact of *RATING* on ARs in response to the Lehman credit event appears to be negligible. The influence of a high rating in response to the Lehman credit event could have been diluted because of a lack of perceived credibility in bond ratings at that time. In fact, bonds issued by Lehman Brothers were rated A or higher at the time that Lehman filed for bankruptcy, perhaps because of expectations that Lehman bonds would receive government protection in the same manner that the credit of Bear Stearns was protected by the government five months earlier.[7] The failure of Lehman with its highly rated bonds could have signaled that ratings on other bonds might also be distorted, which may have discouraged investors from relying on the ratings when repricing bonds in response to the Lehman credit event.

The interaction term *LEH_LEV* is negative and significant in two of the three models in which it was estimated. Thus, the Lehman credit event is associated with a more pronounced adverse impact on ARs of bonds issued by firms with relatively high financial leverage.

The interaction term *LEH_TERM* is negative and is significant in all six models. While the estimated coefficient (ranging from 0.0018 to 0.0021) for the *TERM* variable by itself reflects a positive effect of *TERM* on the bond ARs in response to the Bear Stearns credit event, the estimated abnormal bond return in response to the Lehman credit event is based on the combination of the *TERM* and *LEH_TERM* coefficients. The negative *LEH_TERM* coefficient (ranging from −0.0032 to −0.0036)

more than offsets the positive *TERM* coefficient, which suggests that the ARs are worse for bonds with longer terms to maturity in response to the Lehman credit event. Thus, it appears that the longer term to maturity exacerbates the impact of the Lehman credit event on bond values.

Overall, bond ARs in response to the Lehman event relative to the Bear Stearns credit event are more negative when the bonds: (1) are issued by financial firms, (2) are issued by large firms, (3) have high ratings, and (4) have longer terms to maturity. When considering the typical size of the variables in the multivariate model, the Lehman effect on abnormal bond returns derived from the interaction terms is negative and more than offsets the positive *LEHMAN* dummy variable coefficient. Thus, the overall effect of the Lehman credit event on abnormal bond returns is negative even when controlling for other characteristics, which is consistent with the CARs displayed in Table 4.

Panel B of Table 5 reports the results from applying the six models to a subsample containing only the bonds issued by financial institutions. These models exclude the *FIN* variable, but include four dummy variables to signify the type of financial institution that issued the bond. The explained variation by the models ranges from 26% to 31%.

The *LEHMAN* dummy variable is positive and significant in five of the six models, and negative and significant (at the 0.10 level) in one model. As with the results in Panel A, the interpretation of the *LEHMAN* coefficient should be in conjunction with the interaction terms that contain the *LEHMAN* variable, which we discuss after covering the results for the interaction terms.

The results for *SIZE, RATING, TERM, LEH_SIZE, LEH_RATING,* and *LEH_TERM* are very similar to the results reported in Panel A. For the subsample of bonds issued by financial institutions, the bond AR in response to the Lehman event relative to the Bear Stearns credit event is weaker when the bonds are issued by large firms, have high ratings, and have longer times to maturity. As with the total sample, the net effect of the Lehman credit event on ARs of bonds issued by financial institutions is negative even when controlling for other characteristics, which is consistent with the CARs displayed in Table 4.

Panel C of Table 5 reports the same results from applying the six models to a subsample containing only the nonfinancial bonds. These models exclude the *FIN* variable, because all bonds in this subsample are nonfinancial firms. In addition, this model excludes the dummy variables that signify the type of financial institution that issued the bond, since bonds issued by financial institutions are not in this sample. The results in Panel C are very similar to the results for the entire sample.

6.2. Analysis of bond abnormal returns following the Bear Stearns rescue

We apply our multivariate models to separate subsamples representing the Bear Stearns credit event and Lehman credit event. For these analyses, the *LEHMAN*

dummy variable is removed. The explained variation by the models ranges from 31% to 42% when applied to the full sample, 21% to 38% when applied to bonds issued by financial institutions, and 35% to 44% when applied to bonds issued by nonfinancial firms. The estimated coefficients and statistical significance are similar to the pooled results in Table 5. Therefore, to conserve space, the results are not reported.

6.3. Analysis of bond abnormal returns following the Lehman Brothers failure

For the Lehman credit event, results of the multivariate analysis are disclosed in Table 6. Panel A presents the results for the full sample of bonds in response to the Lehman credit event, while Panels B and C present the results for subsamples of financial bonds and for nonfinancial bonds, respectively. A reduced set of financial industry dummy variables is included because the limited observations lead to a singular matrix. The explained variation by the models ranges from 15% to 18% when applied to the full sample, 5% to 17% when applied to bonds issued by financial institutions, and 6% to 10% when applied to bonds issued by nonfinancial firms.

In Table 6 Panel A, the coefficient of *FIN* is negative and significant across all six models, suggesting that the Lehman event has a more negative impact on financial firms than on nonfinancial firms. The coefficient of *SIZE* is negative and significant across all three models in which the variable is included. The *RATING* variable is generally insignificant for this subsample. The *LEV* variable is negative and significant in all three models, which suggests more adverse effects for bonds issued by highly levered firms. The coefficient of *TERM* in Panel A of Table 6 is negative and significant across all six models. All these results are consistent with the results on the interaction effects applied to the Lehman credit event in Panel A of Table 5.

For the subsample of bonds issued by financial institutions (Panel B of Table 6), the coefficient of *SIZE* is negative but only significant in one of the three models in which the *SIZE* variable is included. However, the *SIZE* variable is correlated with the *FINSERVDUM* variable, and when *SIZE* is included in a model without the *FINSERVDUM* variable, it is negative and significant, consistent with Panel A of Table 6. The *RATING* variable is not significant in PanelB, consistent with Panel A. The *LEV* variable is not significant in Panel B, while it was significant in Panel A. Thus, the influence of issuer leverage may be isolated on the subsample of nonfinancial firms. Regarding the dummy variables representing type of financial firm, the coefficient on *FINSERVDUM* is consistently negative and significant in the models in which it was included, suggesting that bonds issued by financial service firms experienced a more pronounced negative price response than bonds issued by other types of financial institutions in response to the Lehman credit event.

For the subsample of bonds issued by nonfinancial firms (Panel C of Table 6), there is no evidence of a *SIZE* effect. Thus, the negative impact of *SIZE* on the bond price response to the Lehman credit event is isolated on the bonds issued by

Table 6

Results of bond-level cross-sectional regressions following Lehman Brothers failure

The ordinary least squares regression in Equation (5) is estimated where the dependent variable is the cumulative abnormal return from $t = -1$ to 2 and *FIN* is a dummy variable that takes a value of 1 for financial industry firms. *SIZE* is the natural logarithm of total assets for 2007. *RATING* is the Moody's rating converted to a numerical scale where Aaa = 22, Aa1 = 21 . . . D = 1. *LEV* is the total debt to total assets less the median for the two-digit SIC code. *TERM* is the maturity of the bonds in years. *BANKDUM and CREDDUM* are dummy variables that take a value of 1 if the issuer is a bank or finance company, respectively.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Panel A: Full sample bonds						
Intercept	0.0011	0.0419	0.0565	0.0039	0.0045	0.0592
	(0.15)	(2.28)**	(2.90)***	(1.10)	(0.62)	(2.98)***
FIN	−0.0517	−0.0409	−0.0338	−0.0510	−0.0517	−0.0365
	(−6.98)****	(−4.89)****	(−4.16)****	(−6.54)****	(−6.52)****	(−4.39)****
SIZE		−0.0037	−0.0053			−0.0074
		(−2.05)**	(−2.76)***			(−3.17)***
RATING	0.0003				−0.00004	0.0016
	(0.51)				(−0.09)	(2.66)***
LEV			−0.0004	−0.0004	−0.0004	
			(−3.23)***	(−2.76)***	(−2.83)***	
TERM	−0.0015	−0.0013	−0.0013	−0.0014	−0.0014	−0.0014
	(−4.15)****	(−3.69)****	(−3.58)****	(−4.09)****	(−4.01)****	(−3.87)****
Adj R^2	0.148	0.1650	0.1826	0.1742	0.1757	0.1735
N	368	356	347	347	339	348
Panel B: Financial bonds						
Intercept	0.0272	0.0201	0.0533	0.0080	0.0204	0.1617
	(0.90)	(0.28)	(0.64)	(0.44)	(0.61)	(2.39)**
SIZE		−0.0010	−0.0039			−0.0145
		(−0.18)	(−0.61)			(−2.98)***
RATING	−0.0013				−0.0009	−0.0003
	(−1.22)				(−0.72)	(−0.18)
LEV			−0.0005	−0.0006	−0.0007	
			(−0.96)	(−1.25)	(−1.42)	
TERM	−0.0037	−0.0038	−0.0036	−0.0037	−0.0035	−0.0032
	(−3.50)****	(−3.55)****	(−3.38)****	(−3.45)****	(−3.31)***	(−3.16)***
BANKDUM	−0.0343	−0.0380	−0.0319	−0.0391	−0.0360	
	(−1.46)	(−1.62)	(−1.33)	(−1.68)*	(−1.58)	
CREDDUM	−0.0034	−0.0025	0.0042	0.0019	0.0036	
	(−0.17)	(−0.14)	(0.24)	(0.10)	(0.19)	
FINSERVDUM	−0.0681	−0.0714	−0.0703	−0.0765	−0.0749	
	(−3.00)***	(−3.29)***	(−3.27)***	(−3.28)***	(−3.24)***	
Adj R^2	0.1288	0.1334	0.1603	0.1657	0.1607	0.0525
N	140	135	127	127	125	133

(*Continued*)

Table 6 (*continued*)

Results of bond-level cross-sectional regressions following Lehman Brothers failure

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Panel C: Nonfinancial bonds						
Intercept	−0.0169	−0.0093	−0.0027	−0.0013	−0.0111	−0.0111
	(−2.36)**	(−0.61)	(−0.18)	(−0.44)	(−1.84)*	(−1.84)*
SIZE		0.0009	0.0001			0.0008
		(0.58)	(0.10)			(2.21)**
RATING	0.0013				0.0008	−0.00010
	(2.77)***				(2.21)**	(−1.09)
LEV			−0.0002	−0.0002	−0.0001	
			(−2.07)**	(−2.08)**	(−1.09)	
TERM	−0.0010	−0.0009	−0.0009	−0.0009	−0.0001	−m.9701ETBT0.0002Tc/F31T

Brothers failure (combined with news about Merrill Lynch and AIG) in September 2008. We find that access to capital markets remained relatively unchanged following the Bear Stearns rescue but declined following the Lehman Brothers failure. Moreover, following these two credit events, the number of new bond offerings reflected a flight to quality as higher quality bonds did not experience the same decline in number of new issues that lower quality bonds experienced.

While both credit events represented the collapse of two prominent financial institutions, their effects in the bond market were distinctly different. The Bear Stearns rescue elicited a moderately favorable impact on bond prices, which may suggest that the regulatory intervention reduced fear and stabilized bond markets. Conversely, the Lehman Brothers failure elicited a pronounced negative impact on bond prices. While financial and nonfinancial bonds were affected, financial bonds suffered larger losses, especially bonds issued by financial services institutions, which are likely to be perceived as similar to Lehman Brothers. We attribute this effect to the greater exposure of financial firms to the underlying problems that triggered the collapse of Bear Stearns and Lehman Brothers, particularly financial services providers that are not protected by deposit insurance.

The Lehman Brothers failure was confounded by Bank of America's acquisition of Merrill Lynch on the same day, which may have been triggered by Merrill's effort to avoid failure. In addition, AIG was receiving attention in the financial markets at the same time, as its stock price lost 60% of its value over that night and was downgraded by ratings agencies the next day.

Two days after the Lehman Brothers failure, the government rescued AIG and followed over the next two days with proposals to calm concerns about the risk and illiquidity of assets held by financial institutions. While it is difficult to disentangle

bond rating. We attribute these distinct effects to the signal that the bond ratings of financial institutions could no longer be trusted, as they reflected a too-big-to-fail presumption that was no longer applicable.

Overall, our study suggests that credit events reflecting the collapse of prominent financial institutions can have a major effect on the bond market, and that the specific effects are conditioned on the characteristics of the credit event, the corresponding bond issuers, and the characteristics of the bonds that are exposed to the credit events.

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