Investor Recognition of Bankruptcy Costs: Evidence from the 1987 Market Crash*

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In this paper, we examine the behavior of stock prices of individual firms with different bond ratings surrounding the October market crash of 1987 and therefrom make inferences about the significance of bankruptcy costs borne by stockholders. The key findings are as follows: Immediately following the crash, stock prices of firms with different bond ratings display dramatically divergent behavior. Specifically, stocks with speculative bond ratings exhibit significantly negative cumulative abnormal returns (*CAR*) in the wake of crash; the more speculative a firm's bond is, the more negative is the *CAR* of the firm's stock. Regression analysis confirms that there indeed exists a significantly negative relationship between the post-crash *CAR*s and individual firms' bankruptcy risk proxied by their bond ratings, a variable that measures the likelihood of financial distress *ex ante*. These results indicate that the bankruptcy costs borne by stockholders are significant and investors recognize it as such, especially during a period of market turbulence.

I. Introduction

The issue of whether or not bankruptcy costs are significant has important bearings on the firm's choice of optimal capital structure. If bankruptcy costs are significant, it will then work as a countervailing factor against the tax advantage of debt financing, making optimal capital structure more apt to occur at an interior point. Despite the obvious importance of the issue, researchers so far failed to reach a

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consensus on the significance of bankruptcy costs at a theoretical level.[1] On the empirical front where the issue should be settled ultimately, there still exists a dearth of information. As is well known, this situation is due to the inherent difficulty associated with measuring bankruptcy costs.

By convention, bankruptcy costs are divided into direct and indirect costs. The direct costs cover such items as legal/accounting fees, filing fees, trustee expenses, etc. that are deducted from the net asset value of the bankrupt firm. These direct costs are borne by bondholders. The indirect costs, on the other hand, represent lost profits stemming from lost sales, loss of personnel, a higher capital costs, foregone investment opportunities, etc., all of which can arise from the prospect of bankruptcy. These indirect costs are mostly borne by stockholders. Many previous studies, e.g., Warner (1977) and Ang. Chua and McConnell (1982), measured the direct costs of bankruptcy and generally found that these costs are relatively insignificant. In contrast, reflecting the difficulties in measurement, there exist only two studies, i.e., Altman (1984) and Opler and Titman (1994), that attempted to measure the indirect costs. By estimating the total bankruptcy costs including the indirect cost based on the foregone sales and profits concepts, Altman tried to determine the significance of the bankruptcy costs using a sample of 19 firms that actually went bankrupt. He found that bankruptcy costs averaged from 11% to 17% of the total firm value up to three years prior to bankruptcy. Although his estimation method for indirect costs may be debatable, his results suggest that the bankruptcy costs can be significant enough to offset the tax benefits from leverage. Opler and Titman, on the other hand, found that highly leveraged firms lose substantial product market share as well as market value of equity in economic downturns, implying that the bankruptcy costs borne by stockholders are significant.

It is pointed out that the resolution of bankruptcy cost issue ultimately rests on whether or not and to what extent security prices are influenced by the prospect of bankruptcy. If bankruptcy costs are perceived by investors to be significant, then security prices should adjust to the prospect of bankruptcy by discounting the expected future bankruptcy costs. Otherwise, bankruptcy costs can be justifiably regarded as

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1. For various theoretical arguments relating to the significance of bankruptcy costs, refer to Kim (1978), Haugen and Senbet (1978; 1988), Titman (1984), and Maksimovic and Titman (1991).

neither significant nor relevant. Although some studies, e.g., Janosi, Jarrow, and Yildirim (2000), relate the default probability to the overall stock market condition, few existing studies, with the sole exception of Opler and Titman (1994), purposefully examine this linkage between security prices and bankruptcy costs. In this paper, we investigate the significance of bankruptcy costs based on the stock price behavior immediately following the 1987 market crash, an unexpected event that led many observers to expect a major economic downturn. In this study, we use firms' bond ratings as an *ex ante* measure of the likelihood of financial distress. As we will show later, firms' bond ratings prove be a more effective measure than their financial leverage (used by Opler and Titman) in measuring financial distress.

To implement our market-based approach, it is essential to identify an 'unexpected' event that alters the probability of bankruptcy. This is so because the previously assessed bankruptcy risk must already have been discounted in the current security prices. Ideally, we need an unexpected cataclysmic event, which leads to a major reassessment of the bankruptcy probability. Fortunately, we believe that the October stock market crash of 1987 provides one such occasion. On October 19, 1987, which became subsequently known as *Black Monday,* the Dow-Jones Industrial Average fell by 22%, eclipsing the 12% drop on *Black Tuesday* in 1929. Although it did not subsequently materialize partly owing to the Federal Reserve's aggressive intervention, most observers had expected a major economic downturn in the wake of the October market crash. Reflecting this widespread view, the *Wall Street Journal* reported in October 23, 1987: "Monday's stock market collapse has turned the nation's economists decidedly bearish…..Between August and now, nearly $1 trillion has been wiped out of consumer wealth. The shock to consumer spending is enough to send the economy down". In light of the widespread pessimistic view of the economy, the overall likelihood of financial distress and bankruptcy of firms is likely to have increased considerably following the crash.

When the probability of bankruptcy is reassessed due to a major deterioration of economic prospect, the magnitude of reassessment is not likely to be the same across firms. While the risk may sharply increase for the firms with marginal financial conditions, it may remain relatively unaffected for those firms that are financially strong. Thus, if the bankruptcy costs are indeed significant, stock prices for the high bankruptcy risk firms can be expected to depreciate more than those for the low risk firms at a major downturn.

Using the event-time methodology, we study the market reactions surrounding the October crash with a view to gaining insights into the issue of bankruptcy costs. By examining the behavior of risk premia for corporate bonds, we first document evidence showing that there was a drastic deterioration in the perceived economic prospect following the Black Monday. Then, based on the return behavior of stocks with different bankruptcy risks proxied by the firms' bond ratings, we make inferences concerning the significance of bankruptcy costs.

The empirical results show that immediately following the crash, the market-adjusted stock returns of firms with different bankruptcy risks display strikingly different behavior: The higher the bankruptcy risk of a firm is, the lower is its post-crash stock return. During the 7-day period following the crash, for example, the cumulative abnormal return (*CAR*) is about –20% for the stock group with speculative bond ratings (Ba and below) and –8% for the stock group with marginal bond rating (Baa), whereas the *CAR* is +7% for a low risk group with Aaa and Aa ratings. In addition, our regression analysis confirms that there exists a strong, significantly negative relationship between the post-crash *CAR*s of individual firms and their bankruptcy risks, proxied by the bond ratings that can be viewed as an *ex ante* measure of bankruptcy risk. We interpret these findings as indicating that the bankruptcy costs borne by stockholders are significant.

The rest of the paper is organized as follows. In Section 2, we examine the behavior of the risk premia for corporate bonds surrounding the October market crash with the view to documenting a drastic change in economic prospect in the wake of the crash. In Section 3, we describe sample selection, data and test methodology. Section 4 presents major empirical findings. In Section 5, we discuss competing hypotheses for the stock return behavior following the crash and the implication of our findings. Section 6 offers a summary and concluding remarks.

II The October Market Crash and the Risk Premium Behavior

As is well known, share prices plunged worldwide on "Black Monday," October 19, 1987. In the U.S., the Dow-Jones Industrial Average fell a record 508 points to 1738 with a trading volume of 604 million shares for the NYSE, an unprecedented volume at that time. This was preceded by a fall of 108 points of the average on the previous Friday. This two-day development was an event that came as a surprise to most, if not all, people. Following *Black Monday*, most observers sharply adjusted downward their forecasts of future economic activities. There were widespread talks of a possible recession, and some even compared the October crash with that of 1929, which ushered in the Great Depression. Many economists were concerned with the possibility that the huge reduction in the consumer wealth caused by the stock price decline, $500 billion on Monday alone, would induce a major retrench in consumption and capital spending, depressing the economy as a result. Reflecting this general sentiment, the Consumer Confidence Indexes complied by both the Conference Board and the University of Michigan nose-dived following the crash.

To confirm this post-crash change of economic prospect among investors, we examine the bond market reaction surrounding the October crash. If investors indeed reassessed downward the economic prospect, they must have revised the default risk of bonds upward. This increase in the default risk should have resulted in an increase in the risk premium of bonds. Thus, the risk premium of corporate bonds, which can be measured as the yield spread between the corporate bonds and the risk-free Treasury bonds with a comparable maturity, can serve as an indicator for the bond default risk and for the economic prospect perceived by investors.

Figure 1 shows the percentage yield spreads from 20 days before through 20 days after *Black Monday*[2] To facilitate interpretation, the yield spreads for long-term corporate bonds with five different ratings, ranging from Aaa to 'junk' grades, are plotted against the event day in the figure. A few things are noteworthy from the figure. First, regardless of bond grades, the yield spreads do not exhibit any particular movement during the pre-crash period (day –20 to day –2). Even during the event period, i.e., day –1 and day 0, the yield spreads do not display drastic movements. Second, on day 1, however, the day following the

2. In computing the yield spreads, we used the yields on the Merrill-Lynch long-term corporate bond indices and the Shearson-Lehman long-term government bond index.

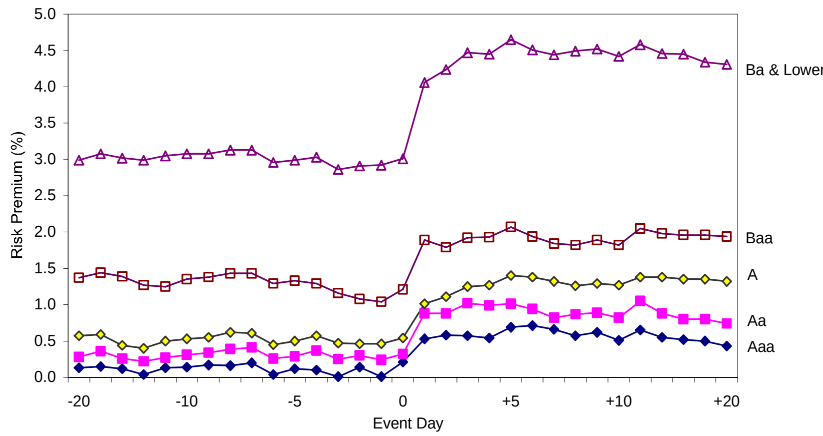

FIGURE 1.—The Behavior of Corporate Bond Yield Spreads Surrounding the October Market CrashThe yield spreads, representing the corporate bond yields minus the Treasury bond yield, are computed using the Merill Lynch long-term corporate bond indices and the Shearson Lehman long-term government bond index. Day 0 represents October 19, 1987 known as 'Black Monday'.

Black Monday, the spreads jump sharply for all bond groups, and thereafter generally drifted upward until leveling off at around day 6. The mean yield spread during the pre-crash (post-crash) period ranges from .12% (.57%) for Aaa bonds to 3.3% (4.44%) for speculative bonds. The yield spread increased most dramatically for the speculative bonds with Ba and lower ratings, about 140 basis, compared with 45 basis points for bonds with Aaa ratings. To check whether the increases in the yield spreads following the crash are statistically significant, we compute t-statistics for the two-sample mean difference test. T-statistics are very high for all bond groups especially for speculative bonds, rejecting the hypothesis that the yield spreads did not change following the market crash.

The above analysis shows that the yield spreads between the long-term corporate bonds and T-bonds increased significantly after the crash. This implies that there was indeed a major upward revision of the default risk of bonds as well as a downward revision of the economic prospect. It is also noteworthy from the behavior of yield spreads that the market's perception of the economic conditions and the corporate default risks apparently began to change from day 1, right after the *Black Monday*. It is against this backdrop that we examine the stock price behavior surrounding the *Black Monday*.

III. Sample Selection and Test Methodology

A. Bankruptcy Risk Proxies and Sample Selection

As previously mentioned, the primary goal of this study is to examine the stock price behavior of firms with different bankruptcy risk exposure surrounding the October stock market crash of 1987, and therefrom draw inferences concerning the significance of bankruptcy costs borne by stockholders. In this study, as the primary proxy for bankruptcy risk, we use bond ratings that measure the defaults risk of firms. Since defaults often precede bankruptcy filings, we feel that bond ratings can serve as a reasonably good indicator for the bankruptcy prospect.

There can be a few cases, however, where bankruptcy risk may be somewhat different from default risk. One is related to the firm size. Firms that are "too large to let fail" are more likely to receive government bailout (e.g., Chrysler and Continental Illinois for historical examples) than small firms when they are under financial distress. Also, large firms are likely to have more clout than small firms to renegotiate or reschedule debt payments with the creditors. Thus, *ceteris paribus*, the size of the firm may provide protection against the bankruptcy. We consider this possibility later. The other case is related to the types of bonds. When bonds are issued with various protective covenants, such as sinking fund provisions and negative pledge clauses, the bond rating may underestimate the actual bankruptcy risk facing the firm. However, since our results reported in this study are not sensitive to these provisions, this particular problem with bond ratings does not appear to be serious.[3] In view of the fact that the firm's debt ratio is often used

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3. To check the sensitivity of our results with regard to these bond provisions, we excluded, from the total sample, the firms whose bonds have either sinking fund requirements or properties pledged or both (*N*=165). We found that the results with the new sample (*N*=163) are very similar to those with the total sample. For example, Spearman rank correlation between the 7-day *CAR* after crash and the bond rating is .45 with the overall sample and .47 with the new sample.

as an indicator of the bankruptcy risk, we consider this ratio as another proxy for bankruptcy risk.

In selecting sample firms, we wish to control any potential industry effect in our study. In addition, daily return and bond rating data must be available. Our sample firms are chosen from those for which (i) bond ratings are available from Moody's Bond Record, (ii) belong to one of the eight industries with the largest membership in Compustat Industrial tape,[4] (iii) daily return data are available from the CRSP tape. Our sample comprises 328 firms whose distribution by industry and bond rating is presented in table 1.

As we have seen from table 1, our sample firms have diverse bond ratings ranging from Aaa to Ca and represent eight major industries. To facilitate our analysis, we assign a numerical value to each bond rating, such as 1 for Aaa, 2 for Aa and so on. Thus, a higher score is associated with a greater default risk. Our sample firms are found to have the overall mean bond rating score of 3.6 which falls between ratings A and Baa. Industry groups are found to have substantially different mean rating scores, ranging from 2.96 for food industry to 4.52 for machinery industry.

In carrying out our empirical analysis, we classify 328 sample firms into four groups by their bond ratings. The characteristics of these groups are summarized in table 2. Group 1 comprises those firms whose bonds are rated either Aaa or Aa. These firms have a very strong capacity to fulfill its financial obligations. Group 2 includes firms, with the bond rating of A, that have relatively strong financial capacity but may be more susceptible to adverse changes in the economic conditions than group 1. Firms belonging to group 3 have the bond rating of Baa, which is generally regarded as the minimum investment grade. Lastly, group 4 comprises those firms, with such bond ratings as Ba, B, Caa and Ca, that face substantial default risk. These bonds are regarded as highly speculative and referred to as 'high yield' or 'junk' bonds.

B. Test Methodology

In implementing event-time analysis with our sample firms, we use the

4. The eight industries with the largest membership in the Compustat are energy (SIC codes 13 & 29). Food (SIC code 20), chemicals (28), metals (34), machinery (35), electrical equipment (36), transportation equipment (37) and utilities industry (49).

TABLE 1. Distribution of Sample Firms by Industry and Bond Rating

Industry	Aaa (1)	Aa (2)	A (3)	Baa (4)	Ba (5)	B (6)	Caa (7)	Ca (8)	Total	Mean Score [a]
Energy	2	5	6	7	4	4	5	1	34	4.26
Food	2	8	7	3	1	2	0	0	23	2.96
Chemicals	4	11	8	6	8	4	0	0	41	3.37
Metals	0	0	5	5	4	5	0	0	19	4.47
Machinery	0	1	7	10	3	5	1	2	29	4.52
Electrical & Instruments	5	5	15	7	5	8	2	0	47	3.72
Transportation Equipment	1	5	11	6	5	3	1	0	32	3.69
Utilities	3	25	39	32	3	1	0	0	103	3.10
Total	17	60	98	76	33	32	9	3	328	3.60

Note: [a]Mean score is computed as the frequency-weighted average of the scores assigned to various bond ratings. The scores are provided in parentheses below bond ratings. Bond ratings were obtained from the September 1987 issue of Moody's Bond Record

TABLE 2. **Characteristics of Stock Groups**

Stock Group	No. of Firms	Moody's Bond Rating	Characteristics of Bond	Mean Bond Rating Score[a]
Group 1	77	Aaa, Aa	Superior Investment Grade	1.78
Group 2	98	A	Investment Grade	3
Group 3	76	Baa	Marginal Investment Grade	4
Group 4	77	Ba, B, Caa, Ca	Speculative (Junk) Grade	5.77

Note: [a]Mean bond rating score is computed as the frequency-weighted average of the scores assigned to various bond ratings shown in table 1.

standard market model to describe the return-generating process:

$$R_{i,t} = \alpha_i + \beta_i R_{M,t} + \varepsilon_{i,t}, \quad i = 1, \ldots, N \ , \tag{1}$$

where $R_{i,t}$ and $R_{M,t}$ are, respectively, the daily stock return of firm i and the daily return on the market, proxied by the CRSP value-weighted index in this study; *t* denotes a trading day. The market model is parameterized using 250 daily returns from the period preceding the observation period.

For a sample firm *i*, daily abnormal returns ($AR_{i,t}$) are estimated over the observation period covering from four weeks, or 20 trading days, before the event day (day 0), which is taken to be the *Black Monday*, through four weeks after the event day:

$$AR_{i,t} = R_{i,t} - \left(\alpha_i + \beta_i R_{M,t}\right), \quad -20 \le t \le 20 \ . \tag{2}$$

The daily abnormal returns are then summed over particular time intervals to obtain a cumulative abnormal return of the stock (*CAR*):

$$CAR_i = \sum_{i=a}^{b} AR_{i,t}, \tag{3}$$

where *a* and *b* are, respectively, the beginning day and the ending day of the summation.

For a portfolio *p*, the daily abnormal returns ($AR_{p,t}$) are estimated over the observation period as follows:

$$AR_{p,t} = (1/N_p)\sum_i AR_{i,t} \ , \tag{4}$$

where N_p is the number of the sample firms in portfolio p. A cumulative abnormal return for the portfolio (CAR_p) is computed by summing the daily abnormal returns of the portfolio over a particular period.

$$CAR_p = \sum_{i=a}^{b} AR_{p,t} . \tag{5}$$

The statistical testing of the significance of CAR_p is based on the time series variance of portfolio abnormal returns for the 250 days, i.e., $t = -21$ to -270, proceeding the observation period. The variance of this series is estimated as follows:

$$\hat{\sigma}^2_{AR} = \frac{1}{249}\sum_{t=-21}^{-270}\left(AR_t - MAR\right)^2 \ , \tag{6}$$

where *MAR* is the mean portfolio return for the 250 days. The significance of *CAR* during an observation period covering $t = a$ to $t = b$ is estimated using the following test statistic:

$$t = CAR\big/(b - a + 1)^{1/2}\,\hat{\sigma}_{AR} , \tag{7}$$

which has a Student-*t* distribution with 249 degrees of freedom and incorporates possible cross-sectional dependence in the abnormal returns.

IV. Empirical Results

A. Abnormal Stock Returns Surrounding the Market Crash

Table 3 provides the cumulative abnormal returns (*CAR*) for the four

TABLE 3. Significance Tests of Cumulative Abnormal Returns

	CAR	*t*-statistic[a]
A. Pre-Crash Period (*t* = –20 to –2)		
Group 1	.0155	2.18*
Group 2	.0134	1.33
Group 3	–.0081	–.61
Group 4	–.0419	–1.85
B. Crash Period (*t* = –1 to 0)		
Group 1	.0106	4.68**
Group 2	–.0054	–1.66
Group 3	–.0154	–3.63**
Group 4	–.0219	–2.97**
C. Post-Crash Period (*t* = +1 to +20)		
Group 1	.0587	8.2**
Group 2	.0079	.76
Group 3	–.0303	–2.26**
Group 4	–.1162	–4.99**

Note: The *t*-statistics reflect two-tailed tests. *CAR is significantly different from zero at the 5-percent level. **CAR is significantly different from zero at the 1-percent level.

bankruptcy risk groups. To facilitate interpretation, the *CAR* of each of the four groups is plotted against the event day, from day –20 through day +20, in figure 2. During the pre-crash period (day –20- to day –2), the *CAR* of group 4 slowly drifts downward and on day –2 it reached –.042.[5] On the other hand, the *CAR*s of the other groups virtually remain around zero. During the crash period (day –1 and day 0), the *CAR* spreads among the groups began to emerge. The *CAR* of group 1 for this 2-day period is .011, compared with –.022 for group 4.

5. Although the downward drift of group 4 during the pre-crash period, –4.2%, is found to be statistically insignificant due to very high stock return volatility for this group, this negative return seems to reflect a slow deterioration of underlying economic conditions, which first affects the firms with the most precarious financial conditions.

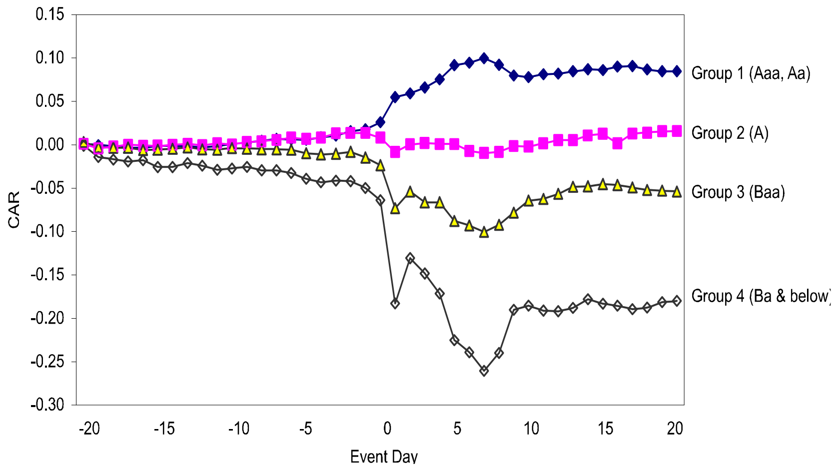

FIGURE 2.—Cumulative Abnormal Stock Returns by Bond Ratings. The cumulative abnormal returns (*CAR*) are plotted against the event days measured relative to day 0 (i.e., October 19, 1987) when the Dow-Jones Industrial Average fell by 22%. *CAR* is plotted for each group of firms with particular bond ratings specified in parentheses.

The most striking feature of figure 2 is the drastically divergent behavior of *CAR* across stock groups in the post-crash period. In the immediate aftermath of the crash, the *CAR* of group 1 drifts upward steadily until it reaches the maximum value of .1 on day 7. In contrast, the *CAR*s of groups 3 and 4 generally drift downward to reach their respective minimum values, i.e., –.1 and –.26, on the same day. The *CAR* of group 2, on the other hand, generally hovers around zero, without displaying any noticeable systematic movement. Also noteworthy from figure 2 is the fact that throughout the post-crash period the *CAR* is strictly inversely related to the bond rating score of the groups; the higher the bankruptcy risk is, the lower is the *CAR*. In particular, the difference in *CAR* between group 1 and group 4 reaches .36 (or 36%) on day 7. Beyond day 7, *CAR*s don't show any systematic drift, implying that there are no more significant abnormal returns.

As mentioned previously, when the probability of bankruptcy is reassessed due to a deterioration of economic prospect, those firms with marginal financial conditions will be affected the most and the financially strong firms the least. This implies that the expected market adjusted return at the economic downturn will be the lowest for the highest bankruptcy risk stocks and the highest for the lowest risk stocks if the bankruptcy costs are significant. Thus, the observed relationship between the bond rating and the *CAR*, particularly, the *CAR* after the crash, is fully consistent with the hypothesis that the bankruptcy costs are significant.

It is important to note that although the market crash occurred mainly on days –1 and 0, the sharp spreads among the group *CAR*s emerged on day +1, the same day when the sharp increase in the risk premia for bonds was observed (see figure 1). This indicates that the stock return spreads from day 1 are related to the changes in economic prospect and bankruptcy risk. The synchronized reactions observed in the bond and stock markets reinforce our interpretation that the post-crash *CAR*s indeed reflect the significance of bankruptcy costs and financial distress costs, more broadly.

The significance tests of *CAR*s for the observation period are provided in table 3. The pre-crash *CAR* is insignificant for groups 2, 3, and 4, but significant for group1.[6] During the post-crash as well as the crash periods, the *CAR* for group 1 is positively significant and the *CAR*s for groups 3 and 4 are negatively significant. On the contrary, the *CAR* for group 2 is not significant at all in any period. The observed behavior of *CAR*s can be reasonably well explained by the differential bankruptcy risk. As mentioned before, the expected (market-adjusted) return at an economic downturn will be the lowest for the highest risk group and the highest for the lowest risk group. Since the bankruptcy risk of an average firm is approximately that of group 2,[7] the group 1 is expected to outperform the market whereas groups 3 and 4 are expected to under-perform the market. In other words, the abnormal returns are expected to be positive for group 1, about zero for group 2 and negative for groups 3 and 4 if the bankruptcy costs are significant. This, of course, is exactly what we observe in table 3. This also implies that the cross-sectional dispersion of stock returns may be higher during

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6. The *t*-statistics reported in Table 3 reflect different return variances of portfolios during the estimation period. The standard deviation of portfolio abnormal returns is .0016 for group 1, .0023 for group 2, .003 for group 3, and .0052 for group 4.

7. During the period 1978-1987, the median bond rating available in the quarterly Compustat is A.

turbulent periods than in tranquil periods.

B. Regression Analysis of Individual Stock Returns

Our analysis of the stock market as well as the bond market reactions surrounding the October crash suggests a direct link between the post-crash stock returns and the bankruptcy risk. In order to further investigate the relationship between stock returns and bankruptcy risk, we conduct a regression analysis of individual stock returns as in eq. (8):

$$CAR_i = a_0 + a_1 BR_i + e_i, \tag{8}$$

where CAR_i is the cumulative abnormal return during the post-crash period from day 1 through day 7, BR_i is the bond rating score, i.e., 1 with Aaa, 2 with Aa and so on, and subscript i denotes a firm. In equation 8, we focus on this 7-day period when the *CAR* spreads reach its maximum.

The first panel of table 4 presents the regression results.[8] A few things are noteworthy. First, the slope coefficient, a_1, is invariably negative and highly significant for most of industry sub-samples as well as the overall sample, confirming that there indeed exists a strong negative relationship between the post-crash stock returns and the bankruptcy risk. Second, the constant term, a_0, is found to be mostly positive and generally significant. This suggests that there may be other explanatory variables for the post-crash *CAR*s. Third, the coefficient of determination for the overall sample is 34%, which is quite high for a cross-sectional regression with individual stock returns. This high R^2 implies that the bankruptcy risk is an important factor for stock returns during this period.

Considering that the firm's debt ratio is often used as a proxy for the bankruptcy risk, we also investigate the relationship between the post-crash *CAR* and this variable. Specifically, we estimate the following regression equation:

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8. Using the heteroscedasticity-consistent covariance matrix (White method), we checked the possible heteroscedasticity problem for the regressions run in this study and found no serious problem.

TABLE 4. Regression Analyses of the Post-Crash *CARs*[a]

	$CAR_j = a_0 + a_1BR_i + e_i$			$CAR_j = b_0 + b_1LAR_i + v_i$		
	a_0 (*t*-stat)	a_1 (*t*-stat)	R^2	b_0 (*t*-stat)	b_1 (*t*-stat)	R^2
Energy	.1077	–.0468	.3146	.1003	–.4498	.1118
	(1.89)	(–3.83)		(1.01)	(–2.01)	
Food	.2275	–.0615	.2406	.2187	–.473	.1387
	(2.94)	(–2.58)		(2.19)	(–1.84)	
Chemicals	.1655	–.0657	.3793	.1322	–.4814	.1655
	(3.32)	(-4.88)		(1.85)	(–2.78)	
Metals	.121	–.0657	.2729	.1088	–.5742	.4236
	(1.01)	(–2.52)		(1.29)	(–3.54)	
Machinery	–.0273	–.0305	.1214	–.2566	.1981	.0396
	(–.36)	(–1.93)		(–2.86)	(1.06)	
Electrical &	.1101	–.0619	.4447	.0029	–.2862	.0463
Instruments	(2.61)	(–6.00)		(.03)	(–1.48)	
Transport.	.1473	–.068	.3072	.0334	–.2901	.0428
Equipment	(2.00)	(–3.65)		(.27)	(–1.16)	
Utilities	.1732	–.0421	.1377	.4544	–.7323	.1661
	(5.11)	(–4.02)		(.49)	(–4.49)	
Overall	.1814	–.0649	.3447	.0066	–.1239	.0098
	(9.41)	(–13.09)		(.19)	(–1.8)	

Note: The cumulative abnormal returns (CAR_i) of individual firms during the period of t = +1 to +7 are regressed on the bond rating scores (BR_i) of the firms in the first panel and on the liability-to-assets ratio (LAR_i) in the second panel.

$$CAR_i = b_0 + b_1LAR_i + u_i, \qquad (9)$$

where LAR_i denotes the liability-to-asset ratio of firm *i*. As can be seen from the second panel of Table 4, the slope coefficient b_1 is significant for the overall sample as well as five out of eight industry sub-samples at the 10% level. The coefficient of determination ranges from 4.3% for auto industry to 42.4% for metal industry. From comparing the regression results presented in the two panels of table 4, it is evident that the *CAR*s during the 7-day period are much better explained by the bond rating than by the debt ratio.[9]

As mentioned previously, given the bond rating, the size of the firm may provide protection against bankruptcy. To investigate this possibility, we estimate the following multiple regression equation:

$$CAR_i = c_0 + c_1 AS_i + c_2 BR_i + v_i \ , \tag{10}$$

where AS_i denotes the natural log of asset size of firm *i*.

Estimation results are provided in table 5. First, by including the firm size variable, the coefficient of determination has increased from 34% to 39% for the overall sample.[10] And the intercept term becomes insignificant. Second, as expected, the coefficient of the firm size variable is invariably positive and significant for several industries such as energy, transportation equipment and utilities industries, as well as the overall sample. Third, although the coefficient for the bond rating variable generally remains significant for the industry sub-samples as well as the overall sample, it has weakened considerably. However, due to the high correlation between the firm size and bond rating and hence

Table 6 presents the *CAR*s for the sub-groups as well as the overall sample. Consistent with the previous results, the last row of the table the possible multi-collinearity problem in the above regression (10), *t*-statistics may not be accurate.[11] As an alternative way of analyzing the influence of the firm size on the post-crash stock returns, we group our sample firms into quintiles based on the asset size and each size sample is further divided into the four bond rating groups. We then compute

9. While the simple regression model with *LAR* appears to explain *CAR* reasonably well for most of the industry groups, it fails to do so for the overall sample due to disparate debt ratios among industries (e.g., 56% for the utility and 36% for the chemical industry). In the case of utility industry, for example, despite lower bankruptcy risk shown by good bond ratings (see Table 2), the debt ratio is generally very high. This suggests that the debt ratio may be used as a proxy for bankruptcy risk within an industry, but not across industries.

10. Since the firm size can alternatively be measured by the market value of common shares, we also ran the regression with the market value. While the results are similar, the asset size is found to have a somewhat greater explanatory power (39% vs. 36% for the overall sample). Also, the asset size is found to have a higher Spearman rank correlation with the *CAR* than the market value (.45 vs..36).

11. Although the correlation between firm size and bond rating is different among industries, the Pearson correlation is around 60%, on average.

TABLE 5. Regression of the Post-Crash *CAR*s on the Asset Size and Bond Rating[a]

$$CAR_i = c_0 + c_iAS_i + c_2BR_i + v_i$$

Industry	c_0 (t-stat)	c_1 (t-stat)	c_2 (t-stat)	R^2
Energy	–.2545	.0386	–.0157	.5041
	(–.19)	(3.44)	(–1.13)	
Food	–.1838	.0584	–.0365	.3221
	(–.67)	(1.55)	(–1.3)	
Chemicals	.1299	.0049	–.0636	.3807
	(.99)	(.29)	(–4.15)	
Metals	.1088	.0018	–.0647	.2730
	(.44)	(.06)	(–2.04)	
Machinery	–.2017	.0277	–.0237	.1874
	(–1.43)	(1.45)	(–1.46)	
Electrical &	–.0496	.0211	–.0480	.4886
Instruments	(–.54)	(1.94)	(–3.88)	
Transportation	–.2109	.0432	–.0422	.3988
Equipment	(–1.14)	(2.1)	(–1.96)	
Utilities	.038	.0244	–.045	.1971
	(.63)	(2.71)	(–4.4)	
Overall	–.0141	.0265	–.0522	.3943
	(–.33)	(5.15)	(–9.72)	

Note: The cumulative abnormal returns (CAR_i) of individual firms during the period of t = +1 to +7 are regressed on the asset size (AS_i) and bond rating scores (BR_i) of the firms.

*CAR*s for each subgroup during the 7-day post-crash period. shows that the *CAR* monotonically changes with the bond rating. Whereas the 7-day *CAR* is 7.4% for the best rating group, it is –19.7% for the lowest rating group. This tendency is also present within each size quintile. That is, if the two subgroups with the smallest observations, 3 and 6, are excluded, the *CAR* changes monotonically with the bond rating within any size group. This attests to a strong effect of the bond rating variable on the post-crash return even when the size effect is controlled. This also suggests that the relationship between the *CAR* and the bankruptcy risk is not caused by the potential beta estimation problem

TABLE 6. The Post-Crash *CAR*s by the Firm Size and Bond Rating[a]

	Bond Rating				
Asset size	Aaa & Aa	A	Baa	Ba & Below	Overall
*Q*5	.106	.015	–.066	–.059	.021
	(24)	(18)	(17)	(6)	(65)
*Q*4	.082	–.011	–.017	–.088	.007
	(21)	(23)	(13)	(9)	(66)
*Q*3	.095	.008	–.064	–.223	–.009
	(20)	(22)	(17)	(7)	(66)
*Q*2	–.009	–.046	–.112	–.202	–.091
	(9)	(23)	(22)	(12)	(66)
*Q*1	–.138	–.071	–.132	–.233	–.189
	(3)	(12)	(7)	(43)	(65)
Overall	.074	–.018	–.077	–.197	–.052
	(77)	(98)	(76)	(77)	(328)

Note: Each entry represents the *CAR* during the post-crash period of day 1 through day 7. The sample size for each subgroup is shown in parentheses.

related to possible infrequent trading.[12]

Table 6 also confirms the influence of the size variable on the *CAR*s. As can be seen from the last column of the table, the *CAR* increases strictly with the firm size. The *CAR*s for the largest and smallest firms are 2.1% and –18.9%, respectively. This tendency generally holds even within each bond-rating group. This result is consistent with the argument that the firm size has additional information concerning the bankruptcy prospect, independent of the bond rating.

V. Discussions

So far, we have documented the evidence that the post-crash stock

12. As discussed by some researchers, e.g., Dimson (1979) and Roll (1981), betas for the firms whose stocks are traded infrequently may be under-estimated, so that the abnormal return estimation for these firms may be biased. This beta estimation problem is mainly for small firms. As can be seen from Table 6, the relationship between the *CAR* and the bond rating among large firms is as strong as among small firms, ruling out any potential problem related to the beta underestimation.

returns are significantly influenced by the bankruptcy risk proxied by the bond ratings. However, there might be other factors that can explain the observed relationship. One is the industry effect. It is conceivable that stocks in some industries such as automobile industry may be more sensitive to the changes in economic prospect than those, say, in food industry. However, our regression analyses indicate that the relationship between the *CAR* and the bond rating holds for each industry sample as well as for the overall sample. This implies that the industry effect is not responsible for the relationship.

Next, let us consider another competing hypothesis, i.e., the leverage effect hypothesis. Suppose there are two firms that are identical to each other in every respect except the leverage ratio and the exposure to bankruptcy risk. When the economic prospect deteriorates, the values of both firms may decrease by the same amount due to the reduced future benefits from the stock ownership. Since the value of debt may not change very much, the decrease in the firm value may largely reflect a decrease in the equity value. At a downturn, the stock price thus may decrease more for the high leverage firm than for the low leverage firm. Due to a high correlation between the bankruptcy risk (bond rating) and the leverage ratio, the relationship (between post-crash *CAR*s and the bond ratings) reported in this study can be observed. If the observed post-crash returns are driven by the leverage effect, rather than the bankruptcy risk, the debt ratio should be able to explain the returns better than the bond ratings. As was shown in table 4, however, this is not the case. The debt ratio, in fact, has much less explanatory power for the *CAR*s than the bond rating.

One might yet argue that the post-crash *CAR*s may simply reflect the effect of time-varying betas surrounding the crash, rather than the effect of increased bankruptcy risk. Although we cannot completely rule out the possibility of changing betas, it is unlikely that the *CAR*s are predominantly driven by the changing betas. If this were the case, there is no reason whatever to expect a strong negative relationship between the post-crash *CAR*s and the bankruptcy risk proxied by the bond ratings. As previously reported, the post-crash *CAR* changes *monotonically* with the bond rating, a variable that we expect *ex ante* measure the bankruptcy risk. If the reported *CAR*s were simply a result of time-varying betas, we would not be able to explain the observed relationship between the *CAR*s and the bond rating. It is also recalled that the *CAR*s began to diverge sharply across different stock groups not during the event period when the market was most volatile, but from day 1 when the bond risk premiums (proxying the bankruptcy risk) began to rise sharply. This synchronized movements of bond and stock prices add credence to our interpretation that the post-crash *CAR*s reflect the increased bankruptcy risk.[13]

To recapitulate, although our search for alternative hypotheses is not exhaustive, the possibility that factors other than the bankruptcy risk have caused the stock return spread after the market crash seems rather slim when the following two facts are considered. First, the bond rating explains about 35% of the cross-sectional variation of the individual stock returns for the 7-day period following the crash. One would be hard pressed to find another variable with a comparable influence on the stock returns. Second, as previously emphasized, the sharp stock return spread among different bond rating groups has started on day 1, which is the day when the risk premium of bonds increased sharply as well. This synchronism suggests that, based on the revised economic prospect and hence the revised default and bankruptcy risks of firms, investors reassessed the values of bonds as well as stocks starting from day 1. Thus, unless the bankruptcy costs are significant, it is difficult to offer a convincing explanation for the observed stock returns during the post-crash period.

Since the bankruptcy cost issue is mainly associated with the capital structure decision of the firm, it seems desirable to examine the direct effect of capital structure on the stock returns after the crash. The previous analysis of this capital structure effect shown in Table 4 is not very suggestive. Due to diverse capital structures among industries, the explanatory power of the debt ratio for the returns for the entire sample was trivial. To overcome this problem, we divide each industry sample by the firm's debt ratio into quartiles. Then, we compute the mean 7-day post-crash *CAR*s for the sub-samples.

The results reported in table 7 reveal the following: First, the mean debt ratio is quite different across industries. For example, the ratio for food industry is only 36.6% but 56.2% for utilities industry. Second, as discussed before, the *CAR* is also quite different among industries, ranging from 5.2% for utility industry to –16% for machinery industry. Third, within each industry, there is a tendency that the return for a high leverage firm is lower than that for a low leverage firm. Specifically, for

TABLE 7. The Post-Crash *CAR* for Industry/Debt Ratio Subgroups[a]

		Overall				
Industry	Mean *LAR*	Overall	*Q*1	*Q*2	*Q*3	*Q*4
Energy	.427	–.076	.027	–.114	–.091	–.119
		(34)	(8)	(9)	(9)	(8)
Food	.366	.089	.129	.112	.139	–.017
		(23)	(5)	(6)	(6)	(6)
Chemicals	.390	–.056	–.012	.001	–.080	–.129
		(41)	(10)	(10)	(11)	(10)
Metals	.491	–.152	–.109	–.109	–.125	–.256
		(19)	(4)	(5)	(5)	(5)
Machinery	.460	–.167	–.124	–.212	–.212	–.114
		(29)	(7)	(7)	(8)	(7)
Electrical &	.431	–.138	–.104	–.150	–.085	–.209
Instruments		(47)	(11)	(12)	(12)	(12)
Transportation	.473	–.119	–.076	–.097	–.105	–.199
Equipment		(32)	(8)	(8)	(8)	(8)
Utilities	.562	.052	.073	.087	.057	–.009
		(103)	(25)	(26)	(26)	(26)
Overall Mean[b]	.472	–.052	–.006	–.032	–.042	–.107
		(328)	(78)	(83)	(85)	(82)

Note: *CAR* = the cumulative abnormal return from day 1 to day 7, *LAR*= liability-to-asset ratio (total liabilities/ total assets). Each industry sample is divided by *LAR* into the four groups (*Q*1, *Q*2, *Q*3, and *Q*4). *Q*1 comprises the firms with the lowest 25% of *LAR* and *Q*4 with the highest 25%. The sample sizes for the subgroups are shown in parentheses. [b] The overall means are the weighted averages of the industry sub-samples..

seven out of the eight industries, the highest leverage group has the lowest abnormal return. This tendency is more prominent with the overall means, computed as the weighted averages of the industry sub-samples. As can be seen from the last row of table 7, the *CAR* monotonically decreases with its debt ratio; the difference in the *CAR* between the highest and the lowest leverage groups is about 10%. This means that, due to the increased bankruptcy risk following the market crash, the stocks of high leverage firms lost their values much more than those of low leverage firms.

VI. Summary and Concluding Remarks

Whether or not the bankruptcy costs are significant has important bearings on corporate finance, especially the firm's choice of capital structure. The bankruptcy costs include such direct costs as legal/accounting costs, trustee expenses, etc., as well as the indirect costs associated with the lost profit opportunities arising from the prospect of bankruptcy. This opportunity cost nature makes it difficult to measure the bankruptcy costs.

In this paper, we examined the investors' perception and recognition of these costs in the stock market, rather than measuring the bankruptcy costs for those firms that actually went bankrupt. If the bankruptcy costs are perceived to be significant, security prices should respond to the prospect of bankruptcy by discounting the expected future bankruptcy costs. Therefore, when there is a sudden change in the economic prospect and hence in the probability of bankruptcy, stock prices should change. For example, at an economic downturn, the bankruptcy risk may increase substantially for the financially weak firms, whereas it may change relatively little for the strong firms. This implies that the prices of high bankruptcy risk stocks will depreciate more than those of low risk stocks at a downturn if the bankruptcy costs are significant.

Since there existed a widespread expectation that a major economic downturn might result following the 1987 October market crash, we examined the market reactions surrounding the October crash. By examining the behavior of risk premia for corporate bonds, we first documented evidence for a drastic change in economic prospect immediately following the so-called the *Black Monday*. By investigating the behavior of stock prices with different bankruptcy risk, proxied by the firms' bond ratings, we then found that the market-adjusted returns during the post-crash period are strikingly different across firms with different exposure to bankruptcy risk; the higher the bankruptcy risk of a firm is, the lower is its post-crash stock return. Our regression analysis confirmed that there exists a significantly negative relationship between the post-crash *CAR*s and the bankruptcy risk. In addition, we found that the sharp stock return spread among different bond rating groups began to develop on the next day following the Black Monday, the same day when the risk premia of bonds jumped sharply. We interpret these results as implying that the bankruptcy costs borne by stockholders are significant.

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