Can Creditors Restrict Managerial Investment Behavior in Distressed Firms?*

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Abstract

While distressed firms should profit from shifting to more risky assets, there is so far little evidence documenting such behavior. We report that the weak evidence is consistent with creditors often being able to control the investment policies of distressed firms if distress is detected in a timely way. Using the number of years to future bankruptcy as a proxy for true distress and Altman's (1968) Z-score as a proxy for perceived distress, we show that only those firms managing to conceal their health issues risk-shift. We also document that the former firms are often not restricted by capital expenditure covenants, but require as much external capital as other distressed firms, in principle giving creditors leverage over their investments. International data further support our conclusions.

Keywords: Risk-shifting; firm investment; expected volatility

JEL classification: G32, G33.

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Abstract

While distressed firms should profit from shifting to more risky assets, there is so far little evidence documenting such behavior. We report that the weak evidence is consistent with creditors often being able to control the investment policies of distressed firms if distress is detected in a timely way. Using the number of years to future bankruptcy as a proxy for true distress and Altman's (1968) Z-score as a proxy for perceived distress, we show that only those firms managing to conceal their health issues risk-shift. We also document that the former firms are often not restricted by capital expenditure covenants, but require as much external capital as other distressed firms, in principle giving creditors leverage over their investments. International data further support our conclusions.

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1 Introduction

Neoclassical finance theory predicts that distressed firms have strong incentives to substitute low risk assets for highly risky ones due to the conflict of interest between stockholders and bondholders (e.g., Berk and DeMarzo (2011), Brealey, Myers, and Alan (2012)). In theory, such behavior can substantially increase the value of equity at the cost of that of debt (Jensen and Meckling (1976), Galai and Masulis (1976), Green and Talmor (1986)). Somewhat surprisingly therefore, Almeida, Campello, and Weisbach (2011, p.676) note that, "although this argument has been taken to be an important consideration [. . .], there has been very little direct evidence of risk-shifting in practice". The general lack of evidence may be attributable to risk-shifting being hard to measure or only creating negligible benefits (Andrade and Kaplan (1998), Parrino and Weisbach (1999)). Another, so far unstudied, possibility is that creditors can often engage in actions preventing the managers of distressed firms from risk-shifting.

In this study, we examine whether creditors can prevent risk-shifting from occurring. One major problem with our research question is that it is impossible to empirically measure all ways through which creditors could control the investment policies of distressed firms. For example, creditors may control investment behavior by imposing formal restrictions, such as capital expenditure covenants (Nini, Smith, and Sufi (2009)). However, formal restrictions are probably less effective than informal ones, such as, for example, the threat to not roll over existing short-term debt if the managers of a firm engage in actions detrimental to creditors' well-being. This threat should be taken seriously as most distressed firms require fresh capital on an ongoing basis (DeAngelo, DeAngelo, and Wruck (2002), Bhagat, Moyen, and Suh (2005)). To circumvent the above problem, we resort to an indirect method to test our hypothesis. Our method starts from the auxiliary assumption that creditors are only able to prevent risk-shifting if they can correctly identify a firm as distressed. If this were true, then an implication would be that the predictability of distress should condition risk-shifting behavior. In particular, only those firms for which distress was hard to detect ex-ante should have risk-shifted.

To facilitate our tests, we measure *true* distress using forward-looking variables indicating whether or not a firm files for bankruptcy in the next couple of years. Our proxy variables for

true distress are motivated by evidence in Westerfield (1971) and Clark and Weinstein (1983) suggesting that the performance of future bankrupt firms deteriorates long before their formal filing dates. In contrast, our measure of distress perceived by creditors at the time is Altman's (1968) Z-score. The Z-score is popular among market participants to measure distress risk, and it only relies on data known to market participants at the start of our sample period. Our approach is closely connected to studies forecasting corporate bankruptcy (Shumway (2001), Hillegeist, Keating, Cram, and Lundstedt (2004), Bharath and Shumway (2008)). In particular, we classify as distressed firms able (unable) to conceal their health issues those future bankrupt firms attracting large (small) errors in bankruptcy forecasting exercises. Our approach is also consistent with the market sometimes failing to timely identify distress due to earnings manipulation (Rosner (2003), Charitou, Lambertides, and Trigeorgis (2007)).

To analyze one specific case of risk-shifting, we follow the methodology of Eisdorfer (2008) and regress scaled capital expenditures on market or on industry volatility and controls. Using a real options model,Eisdorfer (2008) reports that, when aggregate uncertainty is high, healthy firms maximize shareholder value by slowing down investments and thus increasing total firm value (also, see McDonald and Siegel (1986)). In contrast, distressed firms maximize shareholder value by speeding up investments and thus creating a large wealth transfer from creditors to shareholders. An implication is that, while healthy firms should attract a negative, distressed firms should attract a zero or positive coefficient of capital expenditures on volatility. So far, Eisdorfer's (2008) method is the only one producing some evidence suggesting that firms risk-shift. It is thus interesting to examine whether, even when using his methodology, we find support for creditors sometimes being able to control risk-shifting problems.

If creditors' ability to correctly identify distress conditions risk-shifting, we would expect the results obtained from Eisdorfer's (2008) methodology to greatly vary across robustness tests implicitly emphasizing different sets of firms. Using different firm samples, proxy variables for capital expenditures and uncertainty, control variables and estimation methods, we document strong support for this conjecture. In particular, we show that both the sign and the significance level of the relation between capital expenditures and aggregate volatility for both

firms classified as healthy and distressed varies significantly across our robustness tests. More importantly, only in a minority of cases do firms classified as healthy attract a negative and significant, while firms classified as distressed attract a zero or positive and significant, coefficient. We then repeat the former tests explicitly allowing the relation to vary across healthy firms perceived as healthy, healthy firms perceived as distressed, distressed firms perceived as healthy and distressed firms perceived as distressed. Results are striking. While distressed firms perceived as distressed *never* produce evidence supporting risk-shifting, those perceived as healthy *always* do, with this result being extremely stable across the robustness tests.

Two concerns remain. First, we might not be able to correctly distinguish between distressed firms that were correctly identified as distressed by creditors at the time, and those that were not. To offer some support for our classification scheme, we show that the firms that we classify as distressed, but perceived as healthy, attract far more favorable analyst recommendations than those that we classify as distressed, and also perceived as distressed. Second, our analysis does not indicate how creditors are able to control the investment policies of distressed firms. To shed some more light on this issue, we show that distressed firms perceived as distressed are more strongly exposed to covenants restricting capital expenditures than those perceived as healthy. We also report that distressed firms raise far more external capital (both equity and debt) than healthy firms, implying that they should be more susceptible to creditor threats.

As a final step, we further corroborate our former results by showing that they continue to hold in non-US markets, namely Germany, Japan and the United Kingdom.

Our article contributes to a growing literature studying risk-shifting. Many studies report a negative relation between the capital expenditures of healthy firms and several proxies for uncertainty (Episcopos (1995), Leahy and Whited (1995), Kim and Kung (2011)). However, so far there was little evidence that distressed firms risk-shift (Andrade and Kaplan (1998), Parrino and Weisbach (1999)). This lack of evidence cannot be exclusively attributed to distressed firms lacking the capital necessary to invest. Bhagat, Moyen, and Suh (2005) find that, while around 60% of distressed firms with operating losses downsize their investments as their financial health deteriorates, the remaining firms increase their investments using new capital. Similarly,

Whited (1992) and Chava and Roberts (2008) show that financing constraints often force distressed firms to cut their capital expenditure, but not necessarily to zero. Another reason could be that, as health deteriorates, creditors impose capital expenditure covenants, thereby constraining managers' investment policies (Nini, Smith, and Sufi (2009)).

Our paper is organized as follows. In Section 2, we describe our methodology and data. In Section 3, we offer our empirical results. We conclude in Section 4.

2 Methodology & Data

2.1 Methodology

Eisdorfer (2008) uses the following regression model to test whether distressed firms risk-shift:

$$\begin{aligned} Investment_{it} &= \alpha_0 + \alpha_1 PercDistress_{i,t-1} + \beta_1 \sigma^e_{t-1} \\ &\quad + \beta_2 PercDistress_{i,t-1}\sigma^e_{t-1} + \gamma X_{i,t-1} + \theta Y_{t-1} + \epsilon_{it}, \end{aligned} \tag{1}$$

where $Investment_{it}$ is scaled capital expenditures, $PercDistress_{i,t-1}$ is the market's view of the firm's distress, σ^e_{t-1} is either anticipated market or industry volatility, $X_{i,t-1}$ and Y_{t-1} are, respectively, vectors containing firm-specific and macroeconomic control variables, and $[\alpha_0, \alpha_1]'$, $[\beta_0, \beta_1]'$, γ and θ are vectors containing the parameters. While investment is measured over the current fiscal year, all exogenous variables are measured at its start.

Following from real options considerations (McDonald and Siegel (1986), Dixit and Pindyck (1994)), unlevered firms should postpone investments when aggregate uncertainty is high, producing a negative relation between investment and uncertainty ($\beta_1 + \beta_2$) in model (1). Eisdorfer (2008) documents that leverage can reverse this conclusion. Using a real options model featuring debt, he reports that, when leverage is high, managers acting in the best interest of shareholders behave optimally by increasing investments as aggregate volatility rises. The intuition for this result follows from Mason and Merton's (1985) insight that the equity claim is a call option on firm value. While postponing the investment increases total firm value even when leverage is high, speeding it up leads to a large wealth transfer from creditors to shareholders, giving man-

agers incentives to risk-shift. As a result, sufficiently distressed firms should produce a zero (if the two opposing effects cancel out) or even a negative (if the wealth transfer dominates the increase in firm value) effect of uncertainty on investment in model (1).

One issue with model (1) is that it implicitly assumes that firms having incentives to risk-shift can always act upon these. In other words, even when creditors are fully aware of the firm's poor health and thus the possibility of wealth being transferred from them to shareholders, they remain idle. In practice, creditors should likely find ways to protect their stake in the company either through formal or informal means. One informal means could be the threat to not lend more money to the firm. This threat is probably effective because most distressed firms require new capital on a continuous basis to survive (DeAngelo, DeAngelo, and Wruck (2002), Bhagat, Moyen, and Suh (2005)). To test whether creditors can keep managers from risk-shifting if they correctly identify a firm as distressed, we extent model (1) as follows:

$$\begin{aligned} Investment_{it} &= \alpha_0 + \alpha_1 PercDistress_{i,t-1} + \beta_1 \sigma^e_{t-1} + \beta_2 PercDistress_{i,t-1}\sigma^e_{t-1} \\ &\quad + \beta_3 TrueDistress_{i,t-1}\sigma^e_{t-1} + \beta_4 (TrueDistress_{i,t-1} \cdot \\ &\quad PercDistress_{i,t-1})\sigma^e_{t-1} + \gamma X_{i,t-1} + \theta Y_{t-1} + \epsilon_{it}, \end{aligned} \tag{2}$$

where $TrueDistress_{i,t-1}$ captures the firm's true distress. If creditors can control managerial investment behavior upon identifying a firm as distressed, the effect of uncertainty on investments ($\sum_{i=1}^{4} \beta_i$) should be negative, as for healthy firms. However, if they misclassify a distressed firm as healthy, then the managers of this firm should be able to risk-shift, leading to a positive effect of uncertainty on investments. Unfortunately, it is impossible to directly observe true distress, even ex-post. We thus indirectly proxy for true distress using dummy variables indicating how many (fiscal) years a future bankrupt firm is away from its filing date. Underlying this approximation is the assumption that distress builds up slowly over time, that is, that it is the result of a long

sequence of managerial errors and chance events. We can thus re-write model (2) as:

$$\begin{aligned} Investment_{it} &= \alpha_0 + \alpha_1 PercDistress_{i,t-1} + \beta_1 \sigma^e_{t-1} + \beta_2 PercDistress_{i,t-1}\sigma^e_{t-1} \\ &+\beta_3^{'} T_{[-1;-2]}\sigma^e_{t-1} + \beta_3^{''} T_{[-3;-6]}\sigma^e_{t-1} + \beta_3^{'''} T_{[-7;-10]}\sigma^e_{t-1} \\ &+\beta_4^{'} T_{[-1;-2]} PercDistress_{i,t-1}\sigma^e_{t-1} \\ &+\beta_4^{''} T_{[-3;-6]} PercDistress_{i,t-1}\sigma^e_{t-1} \\ &+\beta_4^{'''} T_{[-7;-10]} PercDistress_{i,t-1}\sigma^e_{t-1} + \gamma X_{i,t-1} + \theta Y_{t-1} + \epsilon_{it}, \end{aligned} \tag{3}$$

where $T_{[-1;-2]}$, $T_{[-3;-6]}$ and $T_{[-7;-10]}$ are dummy variables equal to one if a firm is two years, three to six years and seven to ten years, respectively, away from filing for bankruptcy and zero otherwise. On first thought, a problem of model (3) is that it incorrectly classifies distressed firms that manage to avoid filing for bankruptcy (e.g, due to risk-shifting) as healthy firms. However, if these incorrectly-classified distressed firms are also perceived as distressed, creditors should closely monitor their investments, implying no bias in the association between investments and uncertainty for healthy firms perceived to be distressed. If they are instead perceived as healthy, they are able to risk-shift, thereby probably biasing upward the relation between investments and uncertainty for healthy firms perceived to be healthy. This bias makes it less likely that we find any significant differences in investment behavior across healthy and distressed firms.

2.2 Proxy Variables

We use the following proxy variables in models (1) and (3). Consistent with Kaplan and Zingales (1997) and Hadlock and Pierce (2010), we measure investments ($Investment_{it}$) using the ratio of capital expenditures to start-of-period gross plant, property and equipment (capx/ppegt) or that of capital expenditures to start-of-period total assets (capx/at).[1] To measure aggregate uncertainty (σ^e_{t-1}), we use a GARCH(1,1) model to estimate the volatility of the CRSP value-weighted market index or 30 value-weighted industry indexes over the next (fiscal) year. The 30 industries are defined according to the classification scheme on Kenneth French's website. We

[1]The CRSP/COMPUSTAT data item identifiers are given in parentheses.

recursively estimate the GARCH(1,1) model over the sample period from June 1927 to December 2008, with the first recursive window ending in December 1979.

Figure 1 plots the GARCH volatility forecast for the market index and the average volatility forecast for the 30 industries. While differences in diversification imply that the average volatility forecast for the 30 industries is higher than the volatility forecast for the market index, the two series are strongly correlated. However, underlying the average volatility forecast for the 30 industries, there are great cross-sectional variations, implying that the market and the industry volatility forecasts should not always yield identical conclusions. To better judge the reasonability of the out-of-sample GARCH(1,1) estimates, we also plot the VIX volatility index and the NBER recession periods. Conforming to our expectations, the GARCH estimates and the VIX index are highly correlated (correlation around 0.60), and the GARCH estimates peak in economic recessions (the 1990 crisis, the burst of the Internet bubble, etc.).

As discussed, we use dummy variables indicating the distance-to-the filing date to measure true distress ($T_{[-1;-2]}$, $T_{[-3;-6]}$ and $T_{[-7;-10]}$). In contrast, we approximate the market's view of distress ($PercDistress_{i,t-1}$) using Altman's Z-score. The Z-score is defined as:

$$Zscore = 1.2(WC/TA) + 1.4(RE/TA) + 3.3(EBIT/TA) + 0.6(E/D) + 0.999(S/TA),$$

where WC is working capital (wcap), RE are retained earnings (re), $EBIT$ is earnings before interest and taxes (ebit), E is the market value of equity (prcc_f), D is the book value of total liabilities (csho), S is sales (sale) and TA is the book value of total assets (at). We then set *PercDistress* equal to one if the Z-score is below 1.81 (and the firm is perceived to be in financial difficulties) and zero otherwise. The cut-off point of 1.81 is taken from Altman (1968).[2] Setting *PercDistress* equal to the monotonic transformation of the Z-score used by Hillegeist, Keating, Cram, and Lundstedt (2004) does not materially affect our conclusions.

We use several firm-specific controls to capture other effects conditioning investment behav-

[2]Of the future bankrupt firms, more than 50% are not correctly identified as distressed by the Z-score up to two years prior to the bankruptcy filing date. This proportion decreases to 49% and 38% two and one year prior to the bankruptcy filing date, respectively. This result shows that many distressed firms are able to conceal their financial difficulties, at least in their accounting information.

ior. We measure firm size, $Size$, as the natural logarithm of total assets (at) deflated by the CPI and expressed in 2008 US dollars. *Market-to-Book* is the ratio of the market value of equity to the book value of equity (prcc_f×csho/ceq). *Market Leverage* is the ratio of total liabilities over the sum of total liabilities and market value of equity (lt/(lt+prcc_f×csho)). *Cash Flow* is the ratio of income before extraordinary items plus depreciation and amortization to the start-of-period gross property, plant, and equipment ((ibc+dpc)/ppegt). The market-to-book ratio is normally used to proxy for the marginal q, a theoretical measure of the firm's investment opportunities (Cleary (1999), Cleary, Povel, and Raith (2007)). The cash flow proxy is included to control for internal liquidity (Fazzari, Hubbard, and Petersen (1988)). The remaining firm control variables address potential omitted variables biases due to the market-to-book ratio being only a crude proxy for the marginal q (Chava and Roberts (2008, pp.2102-2103)).

We also use several macroeconomic measures likely determining investment policy, such as annual GDP growth (*GDP growth*), the three-month T-bill rate (*Interest*), the yield spread between Baa and Aaa-rated corporate bond portfolios (*Spread*) and the NBER recession dummy (*Recession*). Macroeconomic variables are included in investment models to control for the effect of business cycle fluctuations (see, e.g., Episcopos (1995)).

2.3 Data

We collect the names and filing dates of 1,610 public US firms that filed for Chapter 7 or 11 between 1983 and 2009 from bankruptcydata.com. Market data are from CRSP, and accounting data are from COMPUSTAT. We retrieve data on GDP growth (USWD3QBGR) and the T-bill rate (USDI91TBR) from DataStream. The yields on AAA and BBB-rated securities are from the website of the Board of Governors of the Federal Reserve Bank, and the recession periods are from the NBER website. To avoid that outliers affect our conclusions, we winsorize the firm-level analysis variables (including those used to construct the Z-score, but excluding the Z-score itself) at the top and bottom one percentiles constructed using the whole sample.

Unfortunately, our bankruptcy filing data are largely incomplete prior to 1990. For example, although Chava and Jarrow (2004) report 510 bankruptcies during the period from 1983 to 1989,

our data feature only 62 in the same period. As a result, while we study the sample period from 1980 to 2008, we exclude from our sample firms that disappear from CRSP/COMPUSTAT prior to 1990 without being classified as bankrupt according to our data source. This strategy ensures that our sample does not include firms that went bankrupt between 1980 and 1990, but that are missing from our bankruptcy filing list. For reasons of comparability, we also exclude financial firms (SIC codes 6000-6999) and utilities (SIC codes 4900-4999).

We have complete data on 6,906 firm-year observations (or 1,132 firm observations) for firms that are within ten years of filing for bankruptcy (the distressed firms) and 68,401 firm-year observations (or 6,157 firm observations) for firms that are more than ten years away from filing for bankruptcy (the healthy firms).

3 Empirical Results

3.1 Summary Statistics

In Panel A of Table I, we compare the properties of our main analysis variables across samples of firms filing for bankruptcy within the next ten years (the distressed firms) and those not filing for bankruptcy (the healthy firms). We use t-tests and Wilcoxon signed-rank tests to examine the difference in means and medians across these two groups. The samples differ in the expected way. The size of an average healthy firm is \$1.3 billion, as measured by the book value of assets, whereas it is \$0.64 billion for an average distressed firm. Thus, the average distressed firm is about two times smaller than the average healthy one. On average, the distressed firms command an investment ratio (using PP&E as deflator) of 25.5%, while the healthy firms only attract one of 21.5%. However, the difference is mainly attributable to skewness, that is, when considering the median, healthy and distressed firms invest to a similar degree (around 11-12%). The similar investment ratios are interesting, because they vividly show that distressed firms *do not* lack the capital to invest. Distressed firms also have higher average market leverage (45.7% compared to 33.0% for healthy firms) and experience larger operating losses (i.e., the average operating cash flow ratio is -0.85 and -0.02 for distressed and healthy firms, respectively).

[Please insert Table I about here]

Panel B reports the same descriptive statistics for firms with a Z-score above 1.81 (those perceived to be distressed) and those with one below 1.81 (those perceived to be healthy), with the Z-score measured at the start of the fiscal year. Comparing Panels A and B, we notice that firms perceived to be distressed do not perform as poorly as those later filing for bankruptcy (e.g., compare their operating cash flows). Nevertheless, they often have lower market-to-book, but higher leverage ratios than the firms in Panel A, probably because of more depressed equity values. Of great importance is also the finding that firms perceived to be distressed do not only invest far less than firms perceived to be healthy (0.149 versus 0.234), but also far less than those firms later filing for bankruptcy (0.255). This finding suggests creditors can successfully restrict the investment behavior of firms perceived to be distressed, but also that distressed firms managing to conceal their health issues can continue to invest aggressively.

To further contrast distressed firms able to conceal their health issues with those not able to, Table II splits the distressed firms into those correctly classified by the Z-score (Panel A) and those not (Panel B). For each group, it then offers median values for our analysis variables for each of the final ten years before the bankruptcy filing date. Similar to before, firms able to conceal their health issues invest significantly more than those unable to conceal them over the entire ten year period. The median investment ratio (using PP&E as deflator) of the distressed firms with a Z-score below 1.81 (the ones perceived as healthy) are about 6-7% higher than those of the distressed firms with a Z-score above 1.81 during the three years prior to the filing date. Again likely due to higher equity values, the incorrectly-classified distressed firms attract higher market-to-book ratios, a greater size and lower leverage ratios than the correctly-classified ones. The incorrectly-classified distressed firms also command relatively higher operating cash flows, suggesting that their health issues are not (yet) reflected in their performance. This may be one reason for why the market is unable to correctly classify these firms.

[Please insert Table II about here]

3.2 Regression Analysis

Estimation of Model (1)

Table III offers the results from estimating model (1). To avoid multi-collinearity problems arising from the fact that the macroeconomic controls are often extremely highly correlated, we only employ *GDP growth* in the current estimations, but use more comprehensive sets of macroeconomic controls later onwards.[3] We estimate model (1) using OLS and GLS with fixed industry effects (FEGLS). Using OLS, standard errors are clustered by four-digit SIC codes and year and thus account for cross-sectional dependence in residuals belonging to the same industry or year (Cameron, Gelbach, and Miller (2011)). The FEGLS method uses heteroscedasticity-robust (White) standard errors and has the advantage that parameter estimates are constructed taking account of the correlation structure of the residuals. Our discussions emphasize the results obtained from the FEGLS method, unless stated otherwise.

[Please insert Table III about here]

Panel A reports coefficient estimates and Panel B sums of coefficient estimates indicating the effect of volatility on investment for firms perceived to be healthy (β_1) and firms perceived to be distressed ($\beta_1 + \beta_2$). Using FEGLS and industry volatilities, the coefficient estimate on volatility is close to zero ($\beta_1 = -0.060$, $p\text{-}value = 0.40$), while the one on the interaction term between volatility and perceived distress is significantly negative ($\beta_2 = -0.477$, $p\text{-}value < 0.000$). Overall, the insignificant β_1 coefficient suggests that aggregate volatility does not affect the investment behavior of firms perceived to be healthy. However, the significantly negative sum of β_1 and β_2 (-0.536, $p\text{-}value < 0.000$) indicates that firms perceived to be distressed scale down investments when aggregate uncertainty increases (Panel B). Similarly, using OLS in combination with either market or industry volatilities, the β_1 coefficient is either close to zero or significantly positive, while the β_2 coefficient is always insignificantly negative.

Although real options models suggest that healthy firms should postpone, while distressed firms should speed up, investments when aggregate uncertainty increases, if anything at all, our

[3] In particular, the correlation coefficients between *Spread* and *Recession* is 0.64, that between *Spread* and *Interest* is -0.50 and that between *Spread* and $E[\sigma_{mkt}]$ is 0.62.

empirical results indicate that the opposite occurs in practice. Our findings may be seen as surprising, given that our estimations are similar to those reported in Eisdorfer (2008). Nevertheless, Eisdorfer (2008) finds a significant negative relation between investments and uncertainty for healthy firms, but a significant positive one for distressed firms.

To analyze whether variations in research design drive the different conclusions, we estimate five modified versions of model (1). Modification 1 replaces *GDP growth* by the macroeconomic controls originally employed in Eisdorfer (2008), *Interest*, *Spread* and *Recession*. In Modification 2, we include no macroeconomic controls. Modification 3-5 study alternative investment measures, advocated by, for example, Bloom, Bond, and Van Reenen (2007), and Coles, Daniel, and Naveen (2006). Modification 3 scales capital expenditures by total assets. Modification 4 subtracts cash receipts from PP&E sales from capital expenditures and thus considers net investments (capx−sppe). Modification 5 analyzes total investments, defined as the sum of capital expenditure, research and development (R&D) expense, and cash acquisition expenditure net of the cash receipts from PP&E sales (capx+xrd+acq−sppe). As before, we estimate the modifications using market or industry volatilities and OLS or FEGLS (only FEGLS estimates are reported). As no modification is major, favouring one of them above another should largely be at the empiricist's discretion.

Table IV reports the relation between investment and uncertainty for firms perceived to be healthy (β_1) and those perceived to be distressed ($\beta_1+\beta_2$), without repeating other coefficient estimates. Although the estimation specifications differ only slightly, they produce large variations in sign and significance level of the relation between investment and uncertainty for both healthy and distressed firms. Only modification 1 in conjunction with industry volatilities leads to results somewhat similar to those reported in Eisdorfer (2008) (in bold). This estimation generates a negative and significant relation for firms perceived as healthy ($\beta_1 = -0.224, p-value = 0.003$) and an insignificant relation for firms perceived as distressed ($\beta_1 + \beta_2 = -0.516, p-value$ close to 1). Not a single estimation produces a significantly positive effect for firms that are perceived to be distressed. More remarkable, firms perceived to be healthy generate effects ranging from significantly positive to significantly negative. Overall, the table suggests that minor modifica-

tions to (i) the investment measure, (ii) the aggregate uncertainty measure and (iii) the choice of macroeconomic controls can greatly affect conclusions.

[Please insert Table IV about here]

One possible reason for the unstable relation between investment and uncertainty is that there is an omitted variable conditioning this relation. We believe that creditors' ability to control managerial investment behavior upon correctly identifying a firm as distressed is this conditioning variable. The empirical evidence in Tables III and IV is consistent with this hypothesis. To see this, note that, although many academics view the Z-score as a poor measure of distress (Grice and Ingram (2001)), it is still extremely popular among practitioners.[4] An implication is that, although the Z-score may be a poor proxy for distress, it may efficiently capture the market's view of distress. In this case, the investment policies of firms perceived to be distressed should be closely monitored by creditors, leading to the negative or close to zero relation between investment and uncertainty reported in the tables. In contrast, distressed firms able to conceal their health issues should end up among the genuinely healthy firms, producing great variations in the relation between investment and uncertainty among firms perceived to be healthy because different estimation specifications put a different emphasize on these firms.

Estimation of Model (3)

Table V offers the results from estimating model (3). We estimate the model employing the same techniques as those used in Table III. Panel A offers coefficient estimates, and Panel B sums of coefficient estimates indicating the effect of uncertainty on investment for different groups of firms. In particular, β_1 now shows this effect for healthy firms that were perceived as healthy by creditors at the time, while the sum of β_1 and β_2 shows that for healthy firms that were perceived as distressed. More importantly, the sum of $\beta_1, \beta_2, \beta_3'$ (or β_3'' or β_3''') and β_4' (or β_4'' or β_4''') measures the effect of uncertainty on the investment behavior of distressed firms perceived as distressed at

[4]For example, a recent article in the *Financial Times* states that the Z-score is "a powerful, professional-grade measure." (Stevenson (2012)). Similarly, the *Wall Street Journal* refers to the Z-score as "the market standard for predicting bankruptcy." (McCracken (2008)).

the time, and the sum of β_1 and $\beta_3^{'}$ (or $\beta_3^{''}$ or $\beta_3^{'''}$) that of distressed firms that were perceived as healthy. The prime indicates the distance-to-the bankruptcy filing date.

Healthy firms should optimally postpone investments when aggregate uncertainty is high, implying that both β_1 and the sum of β_1 and β_2 should be negative. In contrast, distressed firms that were perceived as distressed have strong incentives to speed up investments when aggregate uncertainty is high. However, if creditors correctly identify a firm as distressed, they may be able to force managers to invest in a way that maximizes total firm value, and not only shareholder value. If this were true, the sum of β_1, β_2, $\beta_3^{'}$ (or $\beta_3^{''}$ or $\beta_3^{'''}$) and $\beta_4^{'}$ (or $\beta_4^{''}$ or $\beta_4^{'''}$) should be negative, as for healthy firms.[5] Finally, distressed firms that were not perceived as distressed both have incentives to risk-shift and should be able to act upon these. As a result, the sum of β_1 and $\beta_3^{'}$ (or $\beta_3^{''}$ or $\beta_3^{'''}$) should be positive. Also, if risk-shifting incentives increase with the proximity to the bankruptcy filing date, β_3 should decrease with the number of its primes.

Using FEGLS combined with industry volatilities, we find an insignificantly negative effect of aggregate uncertainty on investments for healthy firms perceived to be healthy (β_1). However, because β_2 is strongly negative and large in magnitude, the sum of β_1 and β_2 is negative and significant (-0.614, *p-value*$<$ 0.000). The significant sum indicates that healthy firms perceived to be distressed significantly decrease their investments as aggregate uncertainty increases. More importantly, the $\beta_3^{'}$, $\beta_3^{''}$ and $\beta_3^{'''}$ coefficients are positive and significant. Adding β_1, the combined coefficients are also positive and significant, with the magnitude of the combined coefficients decreasing with the distance-to-the filing date. This is strong evidence indicating that distressed firms perceived as healthy risk-shift and that risk-shifting becomes more prevalent the closer the firm moves to the filing date. In contrast, the $\beta_4^{'}$, $\beta_4^{''}$ and $\beta_4^{'''}$ coefficients are always negative and significant, implying that their sums with β_1, β_2 and β_3 are either close to zero or are significantly negative. As a result, distressed firms that were correctly identified as distressed do not risk-shift, probably due to creditors monitoring their investment behavior. Using OLS and/or market volatility does not materially affect any of these conclusions.

[Please insert Table V about here]

[5] Alternatively, they may force managers to not invest at all, leading to an insignificant relation. However, the summary statistics in Table II make this option unlikely.

It is interesting to analyze whether explicitly controlling for the ability of creditors to prevent risk-shifting renders the relation between investment policy and aggregate uncertainty more stable. Table VI thus offers the results from estimating model (3) subject to the five modifications used before. Across all of the five modifications, healthy firms always significantly postpone investing when uncertainty is high, with the healthy firms perceived to be distressed in modification 1 being the only exception. Not only are these results more consistent with the predictions of real options model, they are also more consistent with the existing evidence on healthy firms (e.g., Leahy and Whited (1995), Kim and Kung (2011)). We also always find strong evidence indicating that distressed firms perceived to be healthy risk-shift, while those perceived to be distressed do not risk-shift. Model (3) thus produces far more stable relations than model (1).

[Please insert Table VI about here]

3.3 Further Tests

Analyst Recommendations

Our conclusions depend crucially on our ability to classify distressed firms into those perceived as healthy and those perceived as distressed at the time. To analyze the accuracy of our classification scheme, we thus next compare analyst recommendations across these two groups over the final ten years before bankruptcy. We examine analyst recommendations because they reflect, and sometimes even influence, the market's view about a firm's health (Womack (1996), Loh and Stulz (2011)). If our classification scheme is efficient, we would expect that distressed firms perceived to be healthy (those with low Z-scores) attract more favorable analyst recommendations than those perceived to be distressed (those with high Z-scores). We obtain the analyst data over the period from 1993 to 2008 from I/B/E/S. Analyst recommendations are coded on a five-point scale, with a lower value indicating a better recommendation. In particular, values of 1, 2, 3, 4 and 5 indicate a 'strong buy', a 'buy', a 'hold', a 'sell' and a 'strong sell', respectively.

Table VII shows that the mean and median analyst recommendations (the I/B/E/S consensus estimates) averaged over the entire ten year period (All) are more favorable for distressed firms with high Z-scores (2.32 and 2.33, respectively) than for distressed firms with low Z-scores (2.11

and 2.10, respectively), with these differences all being significant. Seven to ten years prior to their bankruptcy, both groups of distressed firms attract analyst recommendations similar to those of the healthy firms. However, from then to three to six years prior to the filing date, the mean analyst recommendations of the correctly-identified firms worsen from 2.10 to 2.34, while those of the incorrectly-identified firms change only marginally from 2.02 to 2.12. Even one to two years prior to the filing date, the mean recommendation for incorrectly-identified distressed firms does not exceed 2.18. The one of the correctly-identified firms also remains fairly stable over the last seven years, implying that news about these firms' health is incorporated into analyst recommendations long before their actual bankruptcy. Similarly, the proportion of buy (sell) recommendations is 51.52% (7.04%) for distressed firms with low Z-scores, while it is 62.31% (3.52%) for distressed firms with high Z-scores, and these numbers evolve in a similar way as the analyst recommendations over the ten year period prior to bankruptcy.

Although the analyst data provide some support for the notion that we can correctly distinguish between distressed firms that were perceived as healthy and those that were perceived as distressed, the table reveals two surprising facts. First, even correctly-identified distressed firms attract on average a more optimistic than pessimistic recommendation somewhere between 'buy' and 'hold'. However, the optimistic bias might be due to analysts being in general reluctant to issue negative recommendations, for example, to improve management access (Kim (2001)). Second, even shortly before bankruptcy, analysts seem to be unable to correctly identify all distressed firms. However, this evidence is consistent with the results in Jones and Johnstone (forthcoming 2012), who examine a sample of large international bankruptcies and document that analyst recommendations can be upwardly biased during the whole pre-bankruptcy period.

[Please insert Table VII about here]

Capital Expenditure Covenants

Our empirical results illustrate that, if a distressed firm can ex-ante be correctly identified as distressed using the Z-score, then the firm does not engage in risk-shifting. However, they so far do not show that it is creditors that keep these firms from risk-shifting. In this section, we offer some

evidence supporting this notion. To this end, we now study the number of capital expenditure covenants that distressed firms are exposed to. If creditors employ capital expenditure covenants to restrict managerial investment behavior, we would expect that correctly-identified distressed firms are more exposed to such covenants than incorrectly-identified ones. The covenant data used in these tests is retrieved from DealScan and cover the period 1996 to 2008.[6]

Table VIII reports the average number of capital expenditure covenants contained in the debt contracts of the different groups of firms. Averaged over the ten year period prior to bankruptcy, the distressed firms perceived as healthy were subject to an average of 0.126 capital expenditure covenants, whereas those perceived as distressed were subject to an average of 0.218 ones. The difference, 0.092, is highly significant. Seven to ten years before the filing date, the correctly-identified distressed firms are already exposed to an average of 0.194 restrictions, and this average shoots up markedly to 0.244 during the final two years. In contrast, the incorrectly-identified distressed firms are only exposed to an average of 0.096 restrictions seven to ten years before the final date, which is lower than the average of healthy firms. Until two years before the filing date, this average remains fairly constant, but then increases to 0.178. Interestingly, healthy firms perceived as distressed are most exposed to capital expenditure restrictions (0.288). While this evidence could be interpreted as creditors often restricting the investment policies of the wrong type of firms, it is also consistent with capital expenditure restrictions preventing genuinely distressed firms from risk-shifting and thereby increasing their survival chances.

Our results show that creditors use capital expenditure covenants to restrict the investment policies of firms perceived as distressed. One caveat is that even firms identified as distressed are only exposed to a small number of covenants. An explanation could be that creditors use other, possibly informal, means to prevent risk-shifting. We turn to this possibility next.

External Capital

Creditors may control the investment behavior of firms perceived as distressed through threatening to not lend further capital in the future. Such threats should only be effective if distressed

[6]The covenant data are often not comprehensive in DealScan before 1996. More details on DealScan and the capital expenditure covenants are in Chava and Roberts (2008) and Nini, Smith, and Sufi (2009).

firms have large capital requirements that cannot be completely met through raising equity. To examine this possibility, Table IX offers evidence on the equity and debt issuances of our sample firms. We compute *Net Equity Issued* as the difference between the sale and the purchase of common and preferred stock (sstk-prstkc) and *Net Debt Issued* as the difference between the issuance and the redemption of long-term debt (dltis-dltr). We follow Frank and Goyal (2003) and scale both variables by beginning-of-period net assets, defined as total assets less current liabilities (at-lct). The data used to create these variables are from COMPUSTAT.

[Please insert Table IX about here]

The table reports that distressed firms perceived as distressed are the largest issuer of equity, raising an average of 18.43% of their net assets in equity over the ten-year period prior to bankruptcy. However, these firms also raise a large amount of debt capital, similar to that of distressed firms perceived as healthy and larger than that of healthy firms. This result suggests that the new equity raised by distressed firms perceived as distressed is not sufficient to completely cover their financing needs. Seven to ten years prior to bankruptcy, correctly-identified distressed firms raise an average of 18.16% in equity. This average increases to 21.91% three to six years prior to the filing date, but drops substantially to 14.77% over the final two years. The drop from 21.91% to 14.77% could signal that it becomes more difficult to raise equity capital shortly before bankruptcy. In contrast, the average amount of debt raised increases monotonically from 2.65% to 6.78%, suggesting that debt capital becomes relatively more important as the filing date approaches. The incorrectly-identified distressed firms raise 11.33% of their assets in equity and 5.25% in debt seven to ten years prior to bankruptcy, and these values increase monotonically to 15.13% and 10.67%, respectively, in the final two years.

Overall, distressed firms depend more strongly on external funding than healthy firms. In general, equityholders and debtholders are willing to provide this funding, although equityholders seem to become slightly less willing shortly before bankruptcy. Distressed firms hence depend strongly on their creditors, with this dependence increasing as the filing date approaches. As a result, creditors may be able to force managers to invest in a way that maximizes their stake in

the company. The ability of creditors to influence managerial investment behavior may be one reason for why creditors are still willing to lend money to distressed firms.

Non-US Markets

We finally study risk-shifting in three non-US markets, Germany, Japan and the UK. These tests serve two purposes. First, they show that our results are robust out-of-sample. Second, they allow us to analyze whether there are cross-sectional variations in risk-shifting due to, for example, bankruptcy law and/or financing regime. Bankruptcy codes favouring the interests of creditors over those of stockholders (the German and UK codes) might possibly produce greater incentives to risk-shift and thus more risk-shifting. Also, creditors in bank-orientated systems (Germany and Japan) are often reasoned to be more knowledgeable about their clients than those in capital market-orientated systems (the UK and the US). It is possible that this greater knowledge allows them to identify distress more timely, leading to less risk-shifting. The German, Japanese and UK bankruptcy filing data are collected from the website of the Frankfurter Börse, the Teikoku Database and the London Business School Share Price Database, respectively.[7] We obtain the non-US market and accounting data from DataStream and WorldScope, respectively.[8]

Table X shows the results of estimating model (3) on non-US data. In these tests, we analyze the sample period from 1990 to 2008, first because our non-US bankruptcy data start in 1996 and second because 1990 is the earliest year for which a large number of non-US firms have complete data. We again remove all firms that dropped out of the sample prior to 1996. For comparison, the table also reports the results obtained from US data over the same period. Using FEGLS and industry volatilities, the non-US results are very similar to the US ones. In each country, the β_3', β_3'', β_3''' coefficients are always positive and often significant, while the β_4', β_4'',

[7] We have verified that the German filing data are consistent with the data contained in the Hoppenstedt Database. We are very grateful to Cindy Y. Shirata from the Department of Accounting and Finance at the University of Tsukuba Tokio for providing us with the Japanese data. The UK data has been extended using hand-collected data from the London Stock Exchange website.

[8] We use the following DataStream/Worldscope data items: Capital Expenditures (WC04601), PP&E (WC02301), Total Assets (WC02999), Working Capital (WC03151), Retained Earnings (WC03495), EBIT (WC18191); the market value of equity (MV), the book value of debt (WC03351), Sales (WC01001), the book value of assets (WC03501), the book value of long-term debt (WC03351) and the cash flow (WC01551+WC01151).

β_4''' coefficients are almost always negative and significant (Panel A). Adding slope coefficients, it becomes obvious that distressed firms perceived as healthy show some signs of risk-shifting in all countries, whereas distressed firms perceived as distressed hardly ever risk-shift (Panel B). Our results do not materially change when industry volatilities are substituted for market volatility or when the models are estimated using OLS (unreported).

Overall, our evidence suggests that risk-shifting does not vary across countries with different bankruptcy codes and/or financing regimes. This evidence could be interpreted as indicating that neither do stronger creditor rights increase risk-shifting incentives, nor do closer lending relations allow creditors to more effectively prevent risk-shifting.

[Please insert Table X about here]

4 Conclusion

Although neoclassical finance theory argues that distressed firms have incentives to substitute low risk assets for high risk ones, there is so far little evidence documenting such behavior in practice (Andrade and Kaplan (1998), Parrino and Weisbach (1999)). One possible reason for this lack of evidence could be that creditors can sometimes control the investment behavior of distressed firms. For example, creditors could use debt covenants as a formal means to restrict managerial behavior. However, they could also use more subtle means, such as the threat to not roll over short-term debt if managers tried to risk-shift. Our empirical evidence is consistent with this hypothesis. Assuming that creditors are only able to prevent risk-shifting if they correctly identify a firm as distressed, we use ex-post bankruptcy filings as a proxy for distress and Altman's (1968) Z-score as a proxy for creditors' perception of distress. Supporting our proxy variables, the firms that we classify as correctly identified distressed firms obtain significantly worse analyst recommendations than those that we classify as incorrectly identified. We next show that only those distressed firms that were not identified as distressed speed up investments as uncertainty increases, which is one specific case of risk-shifting (Eisdorfer (2008)). Also consistent with our hypothesis, we show that the non-correctly identified distressed firms are less restricted by debt

covenants than the incorrectly identified ones, but that both types of distressed firms require large amounts of external capital, making them susceptible to creditor threats.

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Table I
Descriptive Statistics

This table offers summary statistics for healthy and distressed firms (Panel A) and firms perceived as healthy and as distressed (Panel B). The healthy (distressed) firm sample includes firms that do not file (do file) for bankruptcy within the next ten years. The sample containing firms perceived as healthy (distressed) includes those firms with Altman's Z-score above (below) 1.81 at the start of the period. *Total Assets* is the book value of total assets, reported in millions of 2008 dollars. *Investment* is measured as the ratio of annual capital expenditures to PP&E at the start of the period. *Z-score* is Altman's Z-score. *Market-to-book* is the ratio of the book value of equity to its market value. *Market Leverage* is the ratio of total liabilities over the sum of total liabilities and the market value of equity. *Cash Flow* is the ratio of income before extraordinary items plus depreciation and amortization to PP&E at the start of the period. All variables are winsorized at the top and the bottom one percentile. 'Diff' shows the difference between the mean or median analysis variables across the different groups of firms. * indicates that the difference in means (based on the t-test) or medians (based on the Wilcoxon signed-rank test) is significant at the 1%-level (two-sided tests).

	Means			Medians			Standard Deviations		
	Healthy	Distressed	Diff	Healthy	Distressed	Diff	Healthy	Distressed	Diff
Panel A: Healthy versus Distressed Firms									
Total Assets	1,269.120	644.160	624.958*	194.218	118.697	75.521*	3,440.377	2,119.650	1,040.320
Investment	0.215	0.255	−0.040*	0.124	0.113	0.011*	0.324	0.439	−0.115
Z-score	5.758	3.327	2.431*	3.777	2.463	1.314*	8.124	7.990	0.134
Market-to-Book	2.967	2.716	0.251*	1.993	1.567	0.426*	4.136	5.500	−1.364
Market Leverage	0.330	0.457	−0.127*	0.292	0.462	−0.170*	0.228	0.276	−0.048
Cash Flow	−0.020	−0.845	0.825*	0.180	0.035	0.145*	1.927	3.206	−1.279
Firm-Year Observations:		68,401 (Healthy) / 6,906 (Distressed)							
Firms:		6,157 (Healthy) / 1,132 (Distressed)							
Panel B: Firms Perceived as Healthy versus Firms Perceived as Distressed									
Total Assets	1,144.332	1,507.155	−362.823*	190.110	158.536	31.574*	3,159.970	4,047.816	-887.846
Investment	0.234	0.149	0.086*	0.134	0.077	0.057*	0.345	0.285	0.060
Z-score	6.899	−0.436	7.335*	4.308	0.902	3.406*	8.275	3.600	4.675
Market-to-Book	3.101	2.257	0.844*	2.079	1.344	0.735*	3.807	5.872	-2.065
Market Leverage	0.297	0.536	−0.239*	0.258	0.551	−0.293*	0.211	0.237	−0.026
Cash Flow	0.017	−0.587	0.604*	0.200	0.040	0.160*	1.973	2.484	−0.511
Firm-Year Observations:		61,302 (Healthy) / 14,005 (Distressed)							
Firms:		6,511 (Healthy) / 3,275 (Distressed)							

Table II
Summary Statistics for Distressed Firms Over The Final Ten Years

This table offers the median analysis variables for the sample of distressed (future bankrupt) firms over the final ten year prior to bankruptcy. The medians are computed separately for those firms with a Z-score below 1.81 (firms perceived as distressed, Panel A) and those with one above 1.81 (firms perceived as healthy, Panel B). Panels C and D present the median analysis variables for non-bankrupt healthy (Z-score above 1.81) and non-bankrupt distressed (Z-score below 1.81) firms. All variables are defined as indicated in the caption of Table I and winsorized at the top and the bottom one percentile. ^{a} $^{(b)}$ indicates that the difference in medians across the samples in Panels A and B (C and D) is significant at the 1%-level according to the Wilcoxon signed-rank test.

T	Obs	Total Assets	Investment	Z-score	Mkt-to-Bk	Leverage	Cash Flow
Panel A: Distressed Firms Correctly Identified by Z-Score							
-10	89	101.540	0.064^{a}	0.865^{a}	1.204^{a}	0.656^{a}	0.058^{a}
-9	109	83.166	0.074^{a}	0.938^{a}	1.273^{a}	0.586^{a}	0.040^{a}
-8	127	144.900	0.067^{a}	0.922^{a}	0.986^{a}	0.629^{a}	0.044^{a}
-7	161	105.499	0.074^{a}	0.908^{a}	1.257^{a}	0.590^{a}	0.019^{a}
-6	182	93.827	0.061^{a}	0.689^{a}	1.333^{a}	0.606^{a}	-0.068^{a}
-5	244	80.194^{a}	0.079^{a}	0.471^{a}	1.087^{a}	0.594^{a}	-0.026^{a}
-4	303	86.159^{a}	0.088^{a}	0.631^{a}	1.239^{a}	0.598^{a}	-0.009^{a}
-3	355	94.926	0.070^{a}	0.548^{a}	0.948^{a}	0.646^{a}	-0.082^{a}
-2	483	92.007	0.069^{a}	0.534^{a}	0.991^{a}	0.622^{a}	-0.168^{a}
-1	536	124.255	0.054^{a}	0.273^{a}	0.779^{a}	0.688^{a}	-0.330
Average		89.000^{a}	0.068^{a}	0.684^{a}	1.084^{a}	0.624^{a}	-0.065^{a}
Panel B: Distressed Firms Not Correctly Identified by Z-Score							
-10	322	102.473	0.151	3.745	1.708	0.349	0.171
-9	340	117.288	0.139	3.788	1.728	0.341	0.178
-8	393	109.154	0.150	3.960	1.887	0.324	0.165
-7	426	110.833	0.155	3.926	1.987	0.317	0.152
-6	469	110.021	0.167	3.813	1.839	0.335	0.139
-5	493	133.478	0.138	3.547	1.710	0.374	0.113
-4	505	144.566	0.141	3.359	1.771	0.357	0.091
-3	525	138.148	0.134	3.283	1.856	0.360	0.059
-2	488	149.415	0.138	3.362	1.722	0.411	-0.044
-1	356	137.846	0.140	3.217	1.886	0.431	-0.272
Average		124.400	0.142	3.632	1.716	0.367	0.123
Panel C: Healthy Firms Correctly Identified by the Z-Score							
NA	5,868	197.008^{b}	0.134^{b}	4.369^{b}	2.094^{b}	0.253^{b}	0.207^{b}
Panel D: Healthy Firms Not Correctly Identified by the Z-Score							
NA	2,663	173.916	0.079	0.948	1.395	0.538	0.056

Table III
The Relation Between Investment and Expected Volatility

The table reports the results of regressions of investment on expected volatility and controls (model (1)). The dependent variable is capital expenditures scaled by start-of-period gross plant, property and equipment. Parameter estimates (in bold) and standard errors (in parentheses) are reported in Panel A. Panel B reports the sum of various combinations of slope coefficients indicating the effect of volatility on investment for either firms perceived to be healthy (Z-score above 1.81) or firms perceived to be distressed (Z-score below 1.81). 'Industry (Market) Volatility' indicates that expected volatility is measured at the industry (market) level. FEGLS reports the results of industry fixed effects regressions with heteroscedasticity-robust (White) standard errors. OLS reports the results of OLS regressions with standard errors clustered at the industry and year levels. All variables are defined as in the caption of Table I. While investment is measured over the fiscal year, all exogenous variables are measured at its start, with the exception of Cash Flow, which is contemporaneous with investment. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	Industry Volatility		Market Volatility	
	FEGLS	OLS	FEGLS	OLS
Panel A: Full Regressions				
PercDistress	−0.014*	0.011	−0.035***	−0.022
	(0.008)	(0.048)	(0.010)	(0.034)
Expected Volatlity (β_1)	−0.060	0.228	0.253**	0.233
	(0.070)	(0.434)	(0.104)	(0.501)
PercDistress x Exp. Volatility (β_2)	−0.477***	−0.660	−0.196	−0.185
	(0.119)	(0.471)	(0.215)	(0.164)
LN(Total Assets)	−0.017***	−0.015***	−0.017***	−0.015***
	(0.001)	(0.003)	(0.001)	(0.004)
Market-to-Book	0.009***	0.010***	0.009***	0.010*
	(0.001)	(0.003)	(0.001)	(0.005)
Market Leverage	−0.278***	−0.259***	−0.280***	−0.260***
	(0.006)	(0.030)	(0.006)	(0.036)
Cash Flow	−0.022***	−0.020***	−0.022***	−0.020***
	(0.002)	(0.005)	(0.002)	(0.005)
GDP Growth	0.011***	0.011**	0.011***	0.011**
	(0.001)	(0.005)	(0.001)	(0.006)
Constant	0.306***	0.314***	0.295***	0.318***
	(0.009)	(0.034)	(0.010)	(0.045)
Observations	75,307	75,307	75,307	75,307
Adjusted R-squared	0.137	0.120	0.139	0.120
Panel B: Risk-Shifting Behavior Across Groups of Firms				
Perceived as healthy:				
β_1	−0.060	0.228	0.253**	0.233
Perceived as distressed:				
$\beta_1 + \beta_2$	−0.536***	−0.431	0.057	0.048

Table IV
The Relation Between Investment and Expected Volatility - Robustness Tests

This table reports the slope coefficients from regressions of investment on expected volatility and controls (model (1)) for firms perceived to be healthy (Z-score above 1.81) and those perceived to be distressed (Z-score below 1.81). Regressions are performed with industry fixed effects (FEGLS). 'Industry (Market) Volatility' indicates that expected volatility is measured at the industry (market) level. 'Base model' repeats the results from Table 3. In Variations 1 ('3 MacroControls') and 2 ('No MacroControls'), we substitute *GDP growth* for *Interest*, *Spread* and *Recession* or we omit the macroeconomic control variables. In Variation 3 ('Capex/TA'), investment is measured as the ratio of annual capital expenditures to book value of total assets at the start of the period. In Variation 4 ('Net Inv'), investment is measured as the ratio of capital expenditures net of sale of assets divided by lagged PP&E. In Variation 5 ('Total Inv'), investment is measured as the sum of capital expenditures, R&D expenditures and acquisitions minus sales of PP&E, divided by lagged PP&E. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	Industry Volatility		Market Volatility	
	Perceived as Healthy	Perceived as Distressed	Perceived as Healthy	Perceived as Distressed
	β_1	$\beta_1 + \beta_2$	β_1	$\beta_1 + \beta_2$
Base Model	−0.060	−0.536***	0.253**	0.057
Var 1: 3 MacroControls	**−0.224*** **	**−0.516**	0.027	0.175
Var 2: No MacroControls	−0.142**	−0.652***	0.055	−0.106
Var 3: CAPEX/TA	−0.060	−0.536	0.253**	0.057
Var 4: Net Inv	−0.119***	−0.454***	0.129*	−0.076
Var 5: Total Inv	−1.004***	−3.588***	−1.041***	−1.807**

Table V
Firm's Investment, Distress Risk and Risk-Shifting

The table reports results for regressions of the investment on expected volatility, distress dummy and second- and third-level interaction effects of distress and pre-bankruptcy years (regression specification II). Panel A reports full regression results where the same control variables as in the original model in equation (2) are included but not reported. Panel B reports the slope coefficient on expected volatility from regression specification II for different types of firms. FEGLS corresponds to industry fixed effects regressions with heteroskedasticity-robust (White) standard errors. OLS corresponds to OLS regressions with robust standard errors clustered at the industry and year levels. Levels of significance are indicated by *, **, and *** for 10%, 5%, and 1%, respectively.

	Industry Volatility		Market Volatility	
	FEGLS	OLS	FEGLS	OLS
Panel A: Full Regressions				
PercDistress	−0.009	0.017	−0.032***	−0.018
	(0.008)	(0.051)	(0.010)	(0.029)
Expected Volatlity (β_1)	−0.109	0.170	0.156	0.122
	(0.069)	(0.425)	(0.104)	(0.490)
PercDistress x Exp. Volatility (β_2)	−0.505***	−0.673	−0.214	−0.165
	(0.116)	(0.471)	(0.213)	(0.198)
T[-1;-2] x Exp. Volatility ($\beta_3^{'}$)	1.887***	2.108***	2.354***	2.672***
	(0.291)	(0.519)	(0.372)	(0.703)
T[-3;-6] x Exp. Volatility ($\beta_3^{''}$)	0.983***	1.122***	1.190***	1.396***
	(0.165)	(0.230)	(0.207)	(0.375)
T[-7;-10] x Exp. Volatility ($\beta_3^{'''}$)	0.711***	0.807**	0.976***	1.109**
	(0.156)	(0.316)	(0.213)	(0.447)
PercDistress x T[-1;-2] x Exp. Volatility ($\beta_4^{'}$)	−1.262***	−1.559***	−1.455***	−1.889***
	(0.339)	(0.480)	(0.444)	(0.647)
PercDistress x T[-3;-6] x Exp. Volatility ($\beta_4^{''}$)	−0.735***	−0.935**	−0.833***	−1.138**
	(0.240)	(0.376)	(0.314)	(0.537)
PercDistress x T[-7;-10] x Exp. Volatility ($\beta_4^{'''}$)	−0.640**	−0.743*	−0.815**	−0.976*
	(0.272)	(0.410)	(0.395)	(0.565)
Observations	75,307	75,307	75,307	75,307
Adjusted R-squared	0.139	0.124	0.139	0.123
Panel B: Risk-Shifting Behavior Across Groups of Firms				
Healthy firms perceived as healthy:				
β_1	−0.109	0.170	0.156	0.122
Healthy firms perceived as distressed:				
$\beta_1 + \beta_2$	−0.614***	−0.503	−0.059	−0.043
Distressed firms perceived as healthy:				
$\beta_1 + \beta_3^{'}$	1.778***	2.278***	2.510***	2.794***
$\beta_1 + \beta_3^{''}$	0.874***	1.292***	1.346***	1.518**
$\beta_1 + \beta_3^{'''}$	0.602***	0.977**	1.132***	1.231**
Distressed firms perceived as distressed:				
$\beta_1 + \beta_2 + \beta_3^{'} + \beta_4^{'}$	0.011	0.045	0.840***	0.740
$\beta_1 + \beta_2 + \beta_3^{''} + \beta_4^{''}$	−0.366*	−0.316	0.299	0.215
$\beta_1 + \beta_2 + \beta_3^{'''} + \beta_4^{'''}$	−0.543**	−0.440	0.102	0.090

Table VI
Firm's Investment, Distress Risk and Risk-Shifting - Robustness Checks

This table reports the slope coefficients of expected volatility from regressions of investment on expected volatility and controls (model (3)) for different groups of firms. The different groups of firms are healthy firms perceived as healthy, healthy firms perceived as distressed, distressed firms perceived as healthy and distressed firms perceived as distressed. The regressions are performed with industry fixed effects (FEGLS). In Panel A (B), expected volatility is measured at the industry (market) level. The model variations are defined in the caption of Table IV. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	Var 1	Var 2	Var 3	Var 4	Var 5
Panel A: Industry Volatility					
Healthy firms perceived as healthy:					
β_1	-0.296^{***}	-0.189^{***}	-0.070^{***}	-0.148^{***}	-1.085^{***}
Healthy firms perceived as distressed:					
$\beta_1 + \beta_2$	-0.618	-0.732^{***}	-0.087^{**}	-0.539^{***}	-3.488^{***}
Distressed firms perceived as healthy:					
$\beta_1 + \beta_3^{'}$	1.747^{***}	1.777^{***}	0.236^{***}	0.749^{***}	1.389^{*}
$\beta_1 + \beta_3^{''}$	0.784^{***}	0.856^{***}	0.084^{*}	0.483^{***}	0.654
$\beta_1 + \beta_3^{'''}$	0.329^{*}	0.522^{***}	0.079^{*}	0.650^{***}	0.872^{*}
Distressed firms perceived as distressed:					
$\beta_1 + \beta_2 + \beta_3^{'} + \beta_4^{'}$	0.087	-0.044	0.081	0.083	-4.085^{***}
$\beta_1 + \beta_2 + \beta_3^{''} + \beta_4^{''}$	-0.272	-0.446^{**}	-0.029	-0.207^{*}	-3.948^{***}
$\beta_1 + \beta_2 + \beta_3^{'''} + \beta_4^{'''}$	-0.705^{***}	-0.633^{**}	-0.133	-0.429^{**}	-3.921^{***}
Panel B: Market Volatility					
Healthy firms perceived as healthy:					
β_1	-0.114	-0.036	0.005	0.067	-1.241^{***}
Healthy firms perceived as distressed:					
$\beta_1 + \beta_2$	0.010	-0.227	-0.311^{***}	-0.201	-1.618^{**}
Distressed firms perceived as healthy:					
$\beta_1 + \beta_3^{'}$	2.479^{***}	2.445^{***}	0.362^{***}	1.157^{***}	2.535^{***}
$\beta_1 + \beta_3^{''}$	1.233^{***}	1.247^{***}	0.168^{***}	0.888^{***}	1.454^{**}
$\beta_1 + \beta_3^{'''}$	0.750^{***}	0.943^{***}	0.200^{***}	1.102^{***}	1.460^{**}
Distressed firms perceived as distressed:					
$\beta_1 + \beta_2 + \beta_3^{'} + \beta_4^{'}$	1.030^{***}	0.773^{**}	-0.061	0.660^{***}	-2.582^{***}
$\beta_1 + \beta_2 + \beta_3^{''} + \beta_4^{''}$	0.516^{*}	0.190	-0.233^{***}	0.285	-2.335^{***}
$\beta_1 + \beta_2 + \beta_3^{'''} + \beta_4^{'''}$	-0.030	-0.014	-0.377^{***}	0.001	-2.187^{*}

Table VII
Analyst Recommendations

The table compares consensus analyst recommendations across four different groups of firms. Panel A reports recommendations for distressed (future bankrupt) firms with a Z-score either below 1.81 ('low Z', firms perceived as distressed) or above 1.81 ('high Z', firms perceived as healthy). Panel B reports recommendations for healthy (non-bankrupt) firms with a Z-score either below 1.81 ('low Z', firms perceived as distressed) or above 1.81 ('high Z', firms perceived as healthy). Recommendations are coded as (1) - strong buy, (2)-buy, (3)-hold, (4)-underperform, (5)-sell. * indicates that the difference in means (based on the t-test) or medians (based on the Wilcoxon signed-rank test) across firms in Panels A and B or C and D is significant at the 1%-level (two-sided test).

T	Obs		Mean Recommendation			Median Recommendation			% Buy Recommendation			% Sell Recommendation		
	low Z	high Z	low Z	high Z	diff	low Z	high Z	diff	low Z	high Z	diff	low Z	high Z	diff
Panel A: Distressed Firms Correctly/Incorrectly Identified by the Z-Score														
-10 to -7	66	354	2.10	2.02	0.08***	2.13	2.00	0.13***	62.59	66.95	−4.36***	0.81	2.05	−1.24***
-6 to -3	233	690	2.34	2.12	0.22***	2.36	2.12	0.24***	50.33	61.67	−11.34***	7.56	3.77	3.79***
-2 to -1	331	379	2.34	2.18	0.16***	2.34	2.17	0.17***	50.32	59.37	−9.05***	7.82	4.36	3.46***
All	630	1,423	2.32	2.11	0.21***	2.33	2.10	0.23***	51.52	62.31	−10.79***	7.04	3.52	3.52***
Panel B: Healthy Firms Correctly/Incorrectly Identified by the Z-Score														
N/A	4,342	25,526	2.26	2.12	0.14***	2.29	2.15	0.14***	55.45	61.79	−6.34***	5.97	3.54	2.43***

Table VIII
Capital Expenditure Covenants and Risk-Shifting Behavior

The table studies the number of capital expenditure covenants contained in the debt covenants of four different groups of firms. Panel A analyzes the covenants of distressed (future bankrupt) firms with a Z-score either below 1.81 ('low Z', firms perceived as distressed) or above 1.81 ('high Z', firms perceived as healthy). Panel B analyzes the covenants of healthy (non-bankrupt) firms with a Z-score either below 1.81 ('low Z', firms perceived as distressed) or above 1.81 ('high Z', firms perceived as healthy). *, **, and *** indicate that the difference in means across high and low Z-score firms is greater than zero at the 1%-, 5%-, and 10% level, respectively (based on a one-sided t-test).

	Obs		Mean			Standard Deviations	
T	low Z	high Z	low Z	high Z	diff	low Z	high Z
Panel A: Distressed Firms Correctly/Incorrectly Identified by the Z-Score							
-10 to -7	62	229	0.194	0.096	0.098*	0.474	0.324
-6 to -3	278	508	0.194	0.112	0.082***	0.494	0.362
-2 to -1	312	269	0.244	0.178	0.066*	0.542	0.429
All	652	1,006	0.218	0.126	0.092***	0.516	0.375
Panel B: Healthy Firms Incorrectly/Correctly Identified by the Z-Score							
N/A	3,180	16,382	0.287	0.169	0.118***	0.644	0.499

Table IX
Equity and Debt Issuances of Healthy and Distressed Firms

The table reports the mean equity and debt issued by four different groups of firms. Panel A and B study issuances of bankrupt firms that have been and that have not been identified as distressed in any of the ten years prior to bankruptcy, respectively. Panels C and D study issuances of non-bankrupt firms that have been or have not been identified as distressed by the Z-Score, respectively. *Net Equity Issued* is defined as the difference between the sale and the purchase of common and preferred stock divided by net assets. *Net Debt Issued* is defined as the difference between the issuance and the reduction of long-term debt divided by net assets. Net assets is total assets minus current liabilities. The significance of the differences across Panels A and B (or C and D) at the 10%, 5%, and 1% level according to the Wilcoxon sign-rank test is indicated by *, **, and ***, respectively (two-sided test).

		Firm-Year	Net Equity Issued		Net Debt Issued	
T	Obs	Obs	Mean	StDev	Mean	StDev
Panel A: Distressed Firms Correctly Identified by Z-Score (Low Z-score)						
-10 to -7	207	414	0.1816*	0.5241	0.0265*	0.2921
-6 to -3	431	914	0.2191***	0.5813	0.0640	0.3334
-2 to -1	588	842	0.1477	0.4684	0.0678**	0.3103
All	680	2,170	0.1843***	0.5297	0.0583*	0.3172
Panel B: Distressed Firms Not Correctly Identified by Z-Score (High Z-score)						
-10 to -7	466	1,132	0.1133*	0.3851	0.0525	0.2205
-6 to -3	643	1,449	0.1190***	0.3896	0.0768	0.2615
-2 to -1	499	603	0.1513	0.4332	0.1067**	0.2898
All	858	3,184	0.1231***	0.3968	0.0738*	0.2542
Panel C: Healthy Firms Not Correctly Identified by the Z-Score (Low Z-score)						
N/A	2,622	10,400	0.1411***	0.4298	0.0180***	0.2404
Panel D: Healthy Firms Correctly Identified by the Z-Score (High Z-score)						
N/A	5,751	50,700	0.0516***	0.2805	0.0324***	0.1762

Table X
Firm's Investment, Distress Risk and Risk-Shifting
Out-of-Sample Robustness Tests

The table reports results of regressions of investment on expected volatility and controls, allowing the relation between investment and volatility to vary across four groups of firms (model (3)) and using data from Germany, Japan, the UK and the US. The regressions are performed with industry fixed effects (FEGLS). Parameter estimates (in bold) and standard errors (in parentheses) are reported in Panel A. For the sake of brevity, the table does not report the slope coefficients of the control variables. Panel B reports the sum of various combinations of slope coefficients indicating the effect of volatility on investment for healthy firms perceived as healthy, healthy firms perceived as distressed, distressed firms perceived as healthy and distressed firms perceived as distressed. Expected volatility is measured at the industry level. All other variables are defined as in Table I. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

	GER	JPN	UK	US
Panel A: Full Regressions				
PercDistress	0.061***	0.000	0.009	−0.014
	(0.023)	(0.014)	(0.029)	(0.010)
Expected Volatlity (β_1)	0.126	0.165	−0.221	−0.575***
	(0.280)	(0.160)	(0.262)	(0.089)
PercDistress x Exp. Volatility (β_2)	−0.553*	0.112	−0.600	−0.322**
	(0.308)	(0.206)	(0.448)	(0.134)
T[-1;-2] x Exp. Volatility ($\beta_3^{'}$)	3.402***	1.367	1.300*	2.202***
	(1.102)	(0.952)	(0.676)	(0.331)
T[-3;-6] x Exp. Volatility ($\beta_3^{''}$)	0.624	2.600**	1.130***	0.885***
	(0.532)	(1.094)	(0.397)	(0.188)
T[-7;-10] x Exp. Volatility ($\beta_3^{'''}$)	0.431	0.116	0.654	0.586***
	(0.655)	(0.182)	(0.423)	(0.171)
PercDistress x T[-1;-2] x Exp. Volatility ($\beta_4^{'}$)	−2.503*	−1.177	−0.935	−1.597***
	(1.366)	(0.974)	(0.748)	(0.374)
PercDistress x T[-3;-6] x Exp. Volatility ($\beta_4^{''}$)	0.182	−2.558**	−0.633	−0.527*
	(0.844)	(1.105)	(0.630)	(0.276)
PercDistress x T[-7;-10] x Exp. Volatility ($\beta_4^{'''}$)	−0.036	0.138	−0.306	−0.722**
	(0.718)	(0.374)	(0.580)	(0.284)
Observations	3,024	7,371	19,966	55,762
Adjusted R-squared	0.142	0.284	0.182	0.163
Panel B: Risk-Shifting Behavior Across Different Groups of Firms				
Healthy firms perceived as healthy:				
β_1	0.126	0.165	−0.221	−0.575***
Healthy firms perceived as distressed:				
$\beta_1 + \beta_2$	−0.427	0.276	−0.822**	−0.898***
Distressed firms perceived as healthy:				
$\beta_1 + \beta_3^{'}$	3.529***	1.531	1.079	1.627***
$\beta_1 + \beta_3^{''}$	0.751	2.764**	0.909*	0.310
$\beta_1 + \beta_3^{'''}$	0.557	0.281	0.433	0.011
Distressed firms perceived as distressed:				
$\beta_1 + \beta_2 + \beta_3^{'} + \beta_4^{'}$	0.473	0.466*	−0.457	−0.293
$\beta_1 + \beta_2 + \beta_3^{''} + \beta_4^{''}$	0.380	0.318	−0.325	−0.539**
$\beta_1 + \beta_2 + \beta_3^{'''} + \beta_4^{'''}$	−0.032	0.531	−0.473	−1.033***

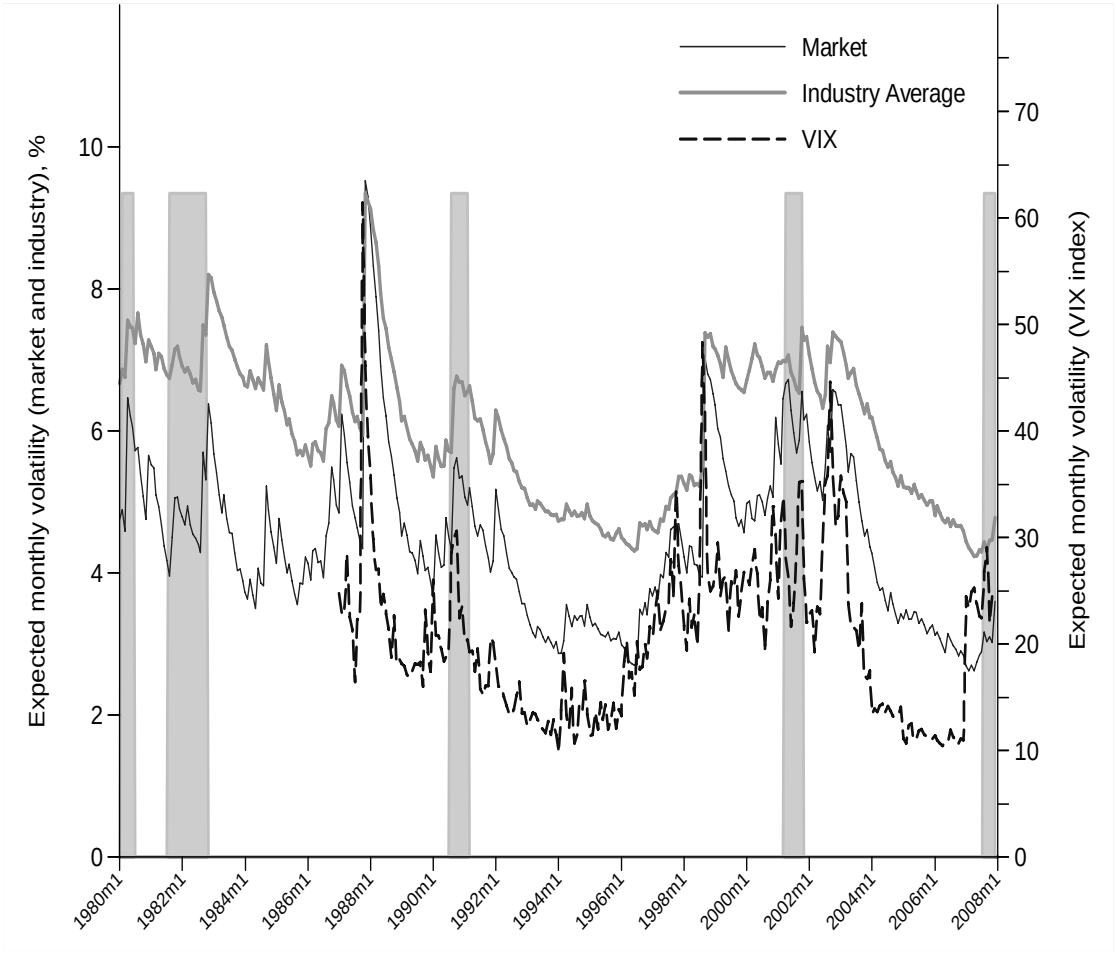

Figure 1. GARCH(1,1) expected volatility estimates. The solid black line represents expected volatility estimated at the market level using a GARCH(1,1) model on the monthly returns of the CRSP value-weighted US market index. The solid grey line represents the average of expected volatility estimated at the industry level using a GARCH(1,1) model on the monthly returns of thirty value-weighted industry portfolios. The values for the market and industry volatilities are plotted on the left y-axis. The industry portfolios are defined following the industry classification scheme of Kenneth French. The estimation is performed recursively over the 1927-2008 period, with recursion starting in 1979. The dashed black line represents expected volatility computed using the VIX index over the 1986-2008 period. The values for the VIX-volatility are plotted on the right y-axis. The shaded areas denote recession periods, as defined by the NBER.