A Resolution of the Distress Risk and Leverage Puzzles in the Cross Section of Stock Returns

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Abstract

We revisit findings that returns are negatively related to financial distress intensity and leverage. These are puzzles under frictionless capital markets assumptions, but consistent with optimizing firms that differ in their exposure to financial distress costs. Firms with high costs choose low leverage to avoid distress, but retain exposure to the systematic risk of bearing such costs in low states. Empirical results are consistent with this explanation. The return premiums to low leverage and low distress are significant in raw returns, and even stronger in risk-adjusted returns. When in distress, low leverage firms suffer more than high leverage firms as measured by a deterioration in accounting operating performance and heightened exposure to systematic risk. The connection between return premiums and distress costs is apparent in subperiod evidence—both are small or insignificant prior to 1980 and larger and significant thereafter.

Introduction

Fama and French (1993) hypothesize that book-to-market equity ratios capture firms' sensitivities to a systematic distress factor. Consistent with this, Fama and French (1995) document that high book-to-market equity ratios predict poor future earnings, but they find little evidence that the book-to-market factor in returns is related to the book-to-market factor in earnings. Several studies examine whether *financial* distress risk is priced by using indexes that rank firms by default probability or intensity of distress to measure the sensitivities of firms to such risk [e.g., Dichev (1998), Griffin and Lemmon (2002), Vassalou and Xing (2004), Campbell, et.al. (2007), Garlappi, et.al. (2006), and Chava and Purnanandam (2007)]. These studies confirm such measures do predict defaults for individual firms and are, on average, larger during recessions. However, most of the evidence indicates that returns are actually *lower* for firms with greater distress intensities—the so-called distress risk puzzle.

This is a puzzle because high distress intensity or nearness to default means the firm has exhausted its capacity to issue low risk debt. Since leverage amplifies the exposure of equity to priced systematic risks, firms with high distress measures should be those for which equity exposures are most amplified. This idea dates back to Modigliani and Miller (1958), who show that the market beta of equity is equal to the firm's asset beta plus a factor proportional to the firm's leverage ratio. More recently, Penman, Richardson and Tuna (2007) show that a firm's book-to-market equity ratio can be decomposed into asset and leverage components. Their decomposition is analogous to Modigliani and Miller's because book-to-market equity ratios are treated as sensitivities to a priced systematic risk in the multi-factor model of Fama and French (1993). Penman, et.al. document that returns are positively related to the asset component of book-to-market, but *negatively* related to leverage. They conclude that this finding is anomalous—another puzzle.

These relations seem so obviously backward that most of the studies cited above conclude the puzzles are evidence of market mispricing. However, the idea that equity risk is increasing in leverage relies on the frictionless markets assumption that makes investment and financing decisions separable—i.e., firms' capital structure choices are unrelated to asset risk. It is possible that market frictions lead low leverage firms to have greater exposures to systematic risk, which dominates the amplification effect of leverage on equity risk. In this case, expected returns to low leverage firms should be greater than those to high leverage firms. Using a very simple model, we show that if financial distress is costly and firms make optimal capital structure decisions, low leverage firms will indeed be exposed to greater systematic risk than high leverage firms. This suggests the "puzzles" can be explained by a rational model, albeit one with market frictions.

Costs associated with financial distress are crucial to our explanation for two reasons. First, distress costs depress asset payoffs in low states. Since the occurrence of low states is at least partly systematic, distress costs heighten exposure to systematic risk. Second, firms with high distress costs optimally utilize less leverage than firms with low costs.[1] Since firms with high costs choose low leverage, *low* leverage firms will have the *greatest* exposure to systematic risk relating to distress costs. The cross section of expected returns will therefore be *negatively* related to leverage. Moreover, by choosing low leverage, high cost firms achieve low probabilities of financial distress, so expected returns will be *negatively* related to distress measures as well. This pair of negative relations constitutes the puzzles described above.

Even though firms with high financial distress costs scale back their leverage levels (and consequently their probabilities of financial distress), they still remain more exposed to bearing distress costs than low cost firms. This exposure remains because when firms balance the expected costs and benefits of leverage at the margin, it is not optimal for a high cost firm to reduce its debt so much that the resulting exposure to distress costs is as low as that of a low cost firm.

This explanation has several implications. First, the relation between returns and leverage should be negative, as should the relation between returns and distress intensity, especially after controlling for measures of systematic risk that are unrelated to distress costs. The relation will be negative in raw equity returns only if the risk associated with low leverage dominates the amplification effect of leverage on equity risk. Controlling for

[1] See Titman and Wessels (1988), Hovakimian, Opler and Titman (2001), Koraczyk and Levy (2003), Faulkender and Petersen (2006), Kayhan and Titman (2007).

systematic risk that is unrelated to leverage or distress costs should allow the negative relation to appear more clearly. We find there is indeed a strong negative relation between returns and leverage in raw returns, and an even stronger relation in returns adjusted for risk via the Fama-French (1993) three-factor model. The relation is negative between returns and measures of distress intensity also, and it is stronger in risk-adjusted returns. When leverage and distress are included in the same regression, leverage subsumes the explanatory power of distress in all but one of our specifications.

Second, tests designed to detect mispricing should reject mispricing as an explanation of the relation between returns and leverage. We conduct two such tests, and the results favor the risk premium explanation. In one of the tests, we examine whether the negative relation between returns and leverage is stronger among firms with low analyst coverage. If mispricing is the explanation, then it should be most severe for firms with relatively little public information available. In contrast, we find the negative relation between returns and leverage is no different (raw returns) or significantly *weaker* (risk-adjusted returns) for firms with low analyst coverage.

Third, since we hypothesize that firms choose low leverage to avoid high distress costs, we examine whether greater hardship is associated with distress for low leverage firms than high leverage firms. We find that accounting return on assets falls more, stays lower in subsequent years, and becomes less predictable in distress for low than high leverage firms. We also find the return premium is greatest among low leverage firms in distress. Not only does the earnings performance of assets suffer, but the forward looking exposure of low leverage firms to systematic risk increases. The consequences of distress are severe for these firms, and they appear to avoid leverage with good reason.

Finally, we examine subperiods for evidence of the connection our model predicts between the low leverage premium in returns and the more severe operating consequences of distress for low leverage firms. If significance of the return premium and poor operating performance relate to distinct time periods, the full sample evidence for our explanation would be questionable. Fama and French (1995) show that the earnings of small firms (regardless of book-to-market) drop in the 1980s and remain low throughout the rest of their sample period. Opler and Titman (1994) find that events of industry distress are rare between 1974 and 1980, but increase substantially thereafter. Those findings suggest changes in the properties of earnings and distress, which might also affect costs associated with leverage. Since those studies distinguish between pre- and post-1980 periods, we split our sample at January 1, 1980 and examine the pre- and post-1980 periods separately.

Our split sample results strongly support a connection between distress costs and the return premium to low leverage. After 1980, the deterioration in operating performance associated with distress for low versus high leverage firms is much larger than before 1980, as is the equity return premium associated with low versus high leverage. In fact, the return premium is insignificant in the pre-1980 period in both raw and risk-adjusted returns. The *coincident* increase in the severity of the consequences of distress for low leverage firms and the increase in the return premium after 1980 is consistent with our explanation that the return premium to low leverage firms is a reward for exposure to losses in asset value in financial distress.

Though we focus on how determinants of capital structure choices affect equity pricing, our results are consistent with studies that document direct support for trade-off theories [Titman and Wessels (1988), Graham and Harvey (2001), Hovakimian, et.al. (2001), Fama and French (2002), Koraczyk and Levy (2003), Fama and French (2005), Hennessy and Whited (2005), Faulkender and Petersen (2006), Leary and Roberts (2005), Kayhan and Titman (2007)]. We find that (i) firms with low (high) leverage suffer more (less) in financial distress, and (ii) equity markets price differences in leverage as though such differences capture exposure to financial distress costs. This suggests firms manage their capital structures to avoid financial distress costs, and participants in equity markets are aware that differences in capital structures reflect differences in exposures to such costs.

The next section presents a model to illustrate how differences in distress costs can generate differences in leverage, distress probabilities and return premiums that are consistent with the "puzzles" described above. Section 2 describes the data and the approach we use in empirical testing. Section 3 presents results and interpretations. Section 4 contains a brief conclusion.

1. Model

We consider a static tradeoff model of firms' capital structure choices. The model employs the functional forms and distributional assumptions of Berk, Green and Naik (1999) (hereafter BGN), and is intentionally simple to make the connection between systematic risk and distress costs as transparent as possible. The essential features are (i) payoffs to firms' real assets are correlated with the stochastic discount factor, (ii) firms bear costs (and lose benefits of leverage) in states of financial distress, and (iii) firms manage their capital structures to optimize the benefits and costs of leverage on their current market value. Items (i) and (ii) imply that whether firms incur distress costs is partly systematic and therefore contributes to priced risk. Item (iii) leads firms with greater exposure to this component of priced risk to choose low leverage. Together they imply that expected returns and leverage are negatively related, as are expected returns and the probability of financial distress, at the capital structures firms choose.

BGN consider an unlevered firm that invests I, which generates an after-tax end-of-period payoff of $Ie^{\tilde{a}}$, where $\tilde{a} \sim N(\mu_a - \frac{1}{2}\sigma_a^2, \sigma_a^2)$. The modification we make is to allow the firm to choose its debt level in the presence of tax shields and costs conditional on distress. The payoff to a levered firm is given by

$$\tilde{P} = Ie^{\tilde{a}+\tau(D)-[c+\tau(D)]\,\theta_{\{\tilde{a}<D\}}}, \tag{1}$$

where $\theta_{\{\tilde{a}<D\}}$ is an indicator function that takes the value of one if the firm is financially distressed and zero otherwise, $\tau(D)$ is the tax benefit as a function of the firm's debt D, and c is the deadweight loss the firm's assets suffer conditional on financial distress. We assume $\tau(\cdot)$ is a strictly increasing function, which captures the idea that greater leverage increases the firm's after-tax payoff provided the firm avoids distress. We also assume $\tau(\cdot)$ is weakly concave. If the firm becomes distressed, it bears deadweight costs of c and loses the tax benefit.[2]

If financial distress occurs only in default, the firm can be thought of as issuing debt with face value K, and defaulting if $Ie^{\tilde{a}} < K$. This is equivalent to default when $\tilde{a} < D$

[2]Direct costs of bankruptcy and loss of *non*-debt tax shields are examples of costs included in c in a static model. In a dynamic model, these costs would also include fire sale discounts in selling assets and future projects lost. See Andrade and Kaplan (1998) for empirical estimates of financial distress costs.

where $D = \ln(K/I)$, so D is the firm's debt level stated as a logarithmic leverage ratio. For simplicity, the exposition of the model follows this interpretation. However, the results do not require an equivalence between default and distress, provided the distress boundary is a strictly increasing function of leverage.

Following BGN, we assume the pricing kernel is

$$\tilde{M} = e^{-r-\tilde{m}-\frac{1}{2}\sigma_m^2}, \tag{2}$$

where r is the risk-free rate of return and $\tilde{m}$ is jointly normally distributed with $\tilde{a}$. The mean and variance of $\tilde{m}$ are zero and σ_m^2, respectively. The market value of the firm is $V = E[\tilde{M}\tilde{P}]$, the (gross) return to the firm is $1 + \tilde{R} = \frac{\tilde{P}}{V}$, and the expected return is $1 + E[\tilde{R}] = \frac{E[\tilde{P}]}{V}$. The parameter $\beta \equiv \text{Cov}\,[\tilde{a}\,, \tilde{m}]$ captures the systematic risk of the firm's assets. To simplify the discussion, we assume that $\beta > 0$ to avoid having to distinguish between risk premiums and discounts.

1.a Expected Returns with Leverage

If a firm is unlevered, its expected return is of the form given in BGN:

$$1 + E[\tilde{R}] = e^{r+\beta}, \tag{3}$$

an exponential function of the risk-free return plus a premium relating to the systematic risk of the firm's assets. We show in the Appendix that if a firm is levered, its expected return is given by

$$1 + E[\tilde{R}] = e^{r+\beta} \left\{ \frac{1 - \psi(c, D)F_*(D)}{1 - \psi(c, D)\hat{F}(D)} \right\} \equiv e^{r+\beta}\ \Phi(c, D) \tag{4}$$

where $\psi(c, D) \equiv 1 - e^{-[c+\tau(D)]}$ measures the after-tax payoff lost in states of financial distress. $F_*(D)$ is the cumulative distribution function of the variate $\tilde{a}_* \sim N(\mu_a + \frac{1}{2}\sigma_a^2, \sigma_a^2)$, and $\hat{F}(D)$ is the cumulative distribution function of the variate $\hat{a} \sim N(\mu_a + \frac{1}{2}\sigma_a^2 - \beta, \sigma_a^2)$. The distribution functions $F_*(\cdot)$ and $\hat{F}(\cdot)$ correspond to the natural and pricing measures, respectively. Both are Gaussian. The only difference between them is the pricing measure is centered on a lower mean if $\beta > 0$, i.e.,

$$F_*(x) = \hat{F}(x - \beta) \quad \text{for all } x. \tag{5}$$

Comparing equations (3) and (4), the expected return to a levered firm is that of an unlevered firm times $\Phi(c, D)$. The function Φ will differ from one if distress is costly *and* systematic risk is priced. If there are no leverage related costs (lost debt tax shields or deadweight costs), $\psi = 0$ and Φ is unity for any leverage level. This is simply the idea that firm risk and expected return are independent of capital structure when markets are frictionless. Similarly, if the firm's assets have no systematic risk ($\beta = 0$), or if investors are risk neutral, then $\hat{F}(\cdot) = F_*(\cdot)$ and $\Phi = 1$. In these cases, expected returns are independent of firms' capital structures even if there are leverage related costs.[3]

To illustrate how costs and risk affect the premium, suppose all firms have identical leverage regardless of differences in costs. In this case, higher distress costs result in a greater leverage related premium. This is because $\hat{F}(D) > F_*(D)$ implies that the denominator of Φ is more sensitive to greater c than is the numerator. In other words, exposure of the firm's assets to *systematic* risk makes the effect of higher distress costs on the firm's market value exceed the effect on the firm's expected payoff. Moreover, the greater is the firm's systematic risk, the bigger is the difference between $\hat{F}$ and F_*, and the more sensitive is the premium to greater costs. This difference is why the return premium is increasing in distress costs at a given leverage level.

We show below that this conclusion holds even after accounting for how firms' capital structures adjust to different levels of distress costs. This is not obvious because when firms reduce the exposure of future payoffs to distress costs (the numerator in expected returns), they also reduce the discount associated with distress costs in market value (in the denominator). We derive firms' optimal leverage next. Then we show expected returns are increasing in distress costs along the locus of optimal leverage choices.

1.b Optimal Leverage

Each firm is assumed to choose D to maximize its current market value. We show in the Appendix that the first-order condition describing the optimal choice D_* is

$$\tau'(D_*) = \psi(c, D_*)\hat{h}(D_*), \tag{6}$$

[3] Almeida and Philippon (2007) provide empirical evidence on the difference between $\hat{F}(\cdot)$ and $F_*(\cdot)$ implied by credit spreads.

where $\tau'(D_*)$ is the derivative of $\tau(\cdot)$ evaluated at D_*, and $\hat{h}(D_*) = \hat{F}'(D_*)/(1-\hat{F}(D_*))$ is the hazard function for $\hat{F}(\cdot)$ evaluated at D_*. The hazard function measures the incremental probability of an event associated with increasing the argument slightly, conditional on the event not having occurred. In our case the event is financial distress and the argument is the firm's leverage choice. So $\hat{h}(D_*)$ is the incremental risk of distress at debt level D_*. The term on the left is the marginal tax benefit of debt and the term on the right is the cost of distress times the hazard of distress. Equation (6) equates the incremental benefit and cost at the optimal leverage choice.[4]

Leverage choices are easily characterized by expressing the first-order condition as

$$b(D_*) = \hat{h}(D_*) \qquad \text{where} \qquad b(x) \equiv \tau'(x)/\psi(c, x). \tag{7}$$

This segregates the exogenous parameters into those that determine the costs and benefits of debt on the left and those describing asset risk on the right. Specifically, c and $\tau(\cdot)$ affect only $b(\cdot)$, whereas μ_a, σ_a, and β affect only $\hat{h}(\cdot)$. Comparative statics follow directly from the fact that the hazard function for normal variates is monotone increasing (see Appendix). Any exogenous change in parameters that increases relative benefits, $b(\cdot)$, must be met with an increase in D_* to maintain equality in equation (7). Likewise, any exogenous change that increases the distress hazard, $\hat{h}(\cdot)$, decreases D_*.

For example, $b(\cdot)$ is greater for firms with lower costs, c, so low cost firms choose greater leverage than high cost firms, all else equal. Similarly, firms with high expected asset returns, μ_a, have lower hazards and choose greater leverage than firms with lower expected asset returns. These effects are familiar from the vast majority of trade off models wherein market pricing of the firm is risk neutral.

There is an additional dimension to the firm's choice in our model. Since systematic risk is priced, the hazard is defined with respect to the pricing distribution $\hat{F}(\cdot)$. Firms whose assets have greater systematic risk have greater "pricing hazards" and lower optimal leverage. This is because distress costs decrease value more for firms whose assets are exposed to greater systematic risk. The steeper the discounting, the less desirable is debt, and less is used.

[4] As long as the marginal tax benefit of debt is not infinite everywhere, a unique solution to equation (6) exists and satisfies the second-order condition for optimality (see Appendix).

1.c Expected Returns and Distress Probabilities with Optimal Leverage

We now examine how expected returns depend on variation in distress costs after accounting for firms' optimal leverage choices. As noted above, the direct effect of increasing costs is to increase the return premium. An indirect effect occurs through firms' leverage choices—higher cost firms optimally choose lower debt. As shown below, the direct effect dominates and expected returns are higher for firms with greater distress costs.

We use a first-order Taylor approximation to express the natural measure in terms of the pricing measure. From equation (5) we have

$$\begin{aligned} F_*(D) = \hat{F}(D-\beta) &\approx \hat{F}(D) + \hat{F}'(D)(D-\beta-D) \\ &= \hat{F}(D) - \beta\hat{F}'(D) \qquad \text{for all } D. \end{aligned} \tag{8}$$

This linearization in β preserves the feature that the pricing measure lies to the left of the natural measure, and the shift is greater the larger is β. It enables us to exploit the structure imposed by the first- and second-order conditions on the pricing measure to sign analytically the derivative of the risk premium.

We denote the optimal leverage choice for a firm with distress cost c as $D_*(c)$. Using equation (8), we can write the leverage risk premium at $D_*(c)$ in terms of the pricing measure alone. Substituting the right hand side of equation (8) for $F_*(D)$ in equation (4) evaluated at the optimal leverage choice yields

$$\Phi(c) = \frac{1-\psi(c, D_*(c))F_*(D_*(c))}{1-\psi(c, D_*(c))\hat{F}(D_*(c))} \approx 1 + \beta \left\{ \frac{\psi(c, D_*(c))\hat{F}'(D_*(c))}{1-\psi(c, D_*(c))\hat{F}(D_*(c))} \right\}. \tag{9}$$

We show in the Appendix that the total derivative of the fraction in curly brackets with respect to c is positive. Our main results are summarized in the following proposition.

<u>Proposition 1</u>. *If $\beta > 0$, a firm with high costs of financial distress optimally chooses lower leverage, has a lower probability of distress and a greater expected return than an otherwise identical firm with low distress costs.*

A firm with high costs chooses low leverage to reduce the probability of incurring those costs, so a high cost firm will have low leverage and a low probability of distress.

Even though firms adjust, it is too expensive in terms of lost current value for a high cost firm to reduce its exposure to distress costs down to the level of a low cost firm. (The tax benefits forgone to achieve such a low exposure are too large to justify that big an adjustment.) Therefore, even at optimal leverage choices, high cost firms retain greater exposure to systematic risk and have higher expected returns than low cost firms.

However, as noted earlier, if $\beta = 0$, then $\Phi = 1$ for all c. So even though high distress cost firms will choose low leverage, variation in distress costs will affect firm expected returns only if asset payoffs are exposed to systematic risk. Thus, the *coexistence* of distress costs and systematic risk implies a negative relation between returns and leverage (or a measure of distress). In a world with distress costs, these relations are not "puzzles."

The impact of variation in distress costs on the risk premium is unambiguous in the sense that greater distress costs imply higher risk premiums for any values of the other exogenous parameters. This is also true of systematic asset risk under reasonable assumptions on the magnitude of tax benefits.[5] In both cases, the direct effect on the risk premium of increasing c or β dominates the indirect effect associated with firms' choosing lower leverage.

This is not true of shifts in the other parameters that describe the assets, μ_a and σ_a. For example, a firm whose assets have a high expected payoff need not have a high expected return because it also has a high market value. These parameters have no effect on expected returns in a frictionless world or if systematic risk is absent (or not priced). If distress is costly and systematic risk is priced, their effect is ambiguous. What matters to the return premium is the interaction between value lost in financial distress and systematic risk. Variation in the assets' expected payoff or idiosyncratic risk can affect this interaction in either direction depending on the levels of tax benefits, distress costs, and the distress boundary.

The empirical tests focus mainly on predictions in Proposition 1 wherein distress costs vary and the other parameters are held fixed. If ignored, variation in the other parameters

[5] A sufficient condition is that tax benefits are smaller than two times the size of the firm's investment, which is large enough to capture any empirically relevant situation. We are grateful to the referee for pointing this out. A proof is available from the authors.

across firms could decrease the power of our tests to detect the relations predicted in Proposition 1. In the empirical work, we control for differences in exposures to systematic risk and, to some degree, growth opportunities by adjusting returns using the Fama-French factors. If our model's predictions are valid, they should appear more clearly in the risk-adjusted results than those based on raw returns. We also account for variation in tax benefits of debt by conditioning on estimates of firms' unlevered tax rates to identify firms with the highest and lowest distress costs. The empirical results are consistent with Proposition 1 whether or not these controls are included in the tests, but the results are stronger when they are included.

In our model, the scale of investment is exogenous and leverage is not necessary to fund investment, so the only interaction between assets and liabilities is that the asset payoff determines whether the firm becomes distressed. This channel alone is sufficient to explain the "puzzles." Another way to approach relaxing the frictionless markets assumption is to endogenize investment and link it to leverage. The results of that approach can be either similar or dissimilar to ours.

Sundaresan and Wang (2006) consider a dynamic model with endogenous investment. In their model, a firm makes sequential investment decisions that are distorted by the agency costs of debt. Future investment distortions are a cost borne by equity holders ex-ante, which can be mitigated by utilizing less leverage. The firm faces a tradeoff between current tax benefits of debt and the future benefit of reducing investment distortions. Sundaresan and Wang show that the firm's optimal debt choice is decreasing in the value of future growth options. Since growth options are risky, this reasoning links greater asset risk to lower levels of leverage—a prediction similar to ours.

Obreja (2006) and Gomes and Schmid (2007) construct dynamic models in which highly levered firms are those that have grown and currently have substantial levels of installed capital. Since investment is irreversible or costly to reverse, large highly levered firms are more risky than small less levered firms. Depending on parameter values, those studies can predict that the relation between returns and leverage is insignificant or even positive. Their predictions are consistent with the empirical evidence in Bhandari (1988), who documents a positive relation between returns and leverage after controlling for beta.

However, his sample is quite limited (average of 728 stocks and ending in 1981). Both raw and risk-adjusted returns are negatively related to leverage in the larger cross section and time series of our sample.

2. Data and Methods

The data consist of monthly prices, returns and other characteristics of all NYSE, AMEX and NASDAQ companies covered by CRSP from 1965 through 2003. We exclude stocks with share prices below $5 to minimize the impact of microstructure frictions on returns [see Amihud (2002)]. We also exclude stocks of financial companies because their leverage is constrained by regulations that do not apply to non-financial companies. Price and returns data are obtained from CRSP, financial information is obtained from Compustat.

We follow the Fama-MacBeth (1973) style regression approach in George and Hwang (2004) and Grinblatt and Moskowitz (2004) to measure and compare the returns to different investment strategies. This approach has the advantage of isolating the return to a particular strategy by hedging (zeroing out) the impact of other strategies and other variables known to affect returns. In addition, all the data are used to draw inferences, and not just stocks with high and low leverage or distress intensity.

Suppose an investor forms equity portfolios of high and low leverage firms and/or high and low distress firms every month and holds these portfolios for the next T months. The return earned in a given month t is the equal-weighted average of the returns to T portfolios, each formed in one of the T past months $t-j$ (for $j=1$ to $j=T$). The contribution of the portfolio formed in month $t-j$ to the month-t return can be obtained by estimating a cross sectional regression of the form:

$$\begin{aligned} R_{it} = {} & b_{0jt} + b_{1jt}R_{i,t-1} + b_{2jt}(book_{i,t-1}/mkt_{i,t-1}) + b_{3jt}size_{i,t-1} \\ & + b_{4jt}52wkW_{i,t-j} + b_{5jt}52wkL_{i,t-j} + b_{6jt}LevH_{i,t-j} + b_{7jt}LevL_{i,t-j} \\ & + b_{8jt}OscH_{i,t-j} + b_{9jt}OscL_{i,t-j} + e_{ijt} \end{aligned} \quad (11)$$

where R_{it} is the return to stock i in month t, and $LevH_{i,t-j}$ ($LevL_{i,t-j}$) equals one if stock i is among the top (bottom) 20% of stocks in month $t-j$ when ranked by the ratio of the book value of long term debt to the book value of assets.[6] Dummies $OscH_{i,t-j}$ and $OscL_{i,t-j}$ are defined similarly based on a ranking of Ohlson's (1980) O-score, which uses accounting information to estimate an index of distress intensity.

Existing studies of distress risk and equity pricing have used O-score and other indexes of distress as explanatory variables. Dichev (1998) examines Altman's (1968) Z and Ohlson's O-score, and shows that both have good out-of-sample predictive power for bankruptcy. Garlappi, et.al. (2006) use Merton's (1974) option-theoretic measure constructed by Moody's KMV and replicate Dichev's results. Bharath and Shumway (2004) show that top quintile Merton versus hazard model predictors are equally good at predicting defaults. Campbell, et.al. (2007) use a hazard model that incorporates accounting and market variables as covariates in the spirit of Shumway (2001). Their model predicts bankruptcy better than O-score, but the asset pricing results using their measure are similar to those using O-score. Chava and Purnanandam (2007) construct indexes based on accounting numbers, option and hazard models. The negative relation between stock returns and distress is robust across these alternatives, indicating that the distress risk puzzle does not depend on the details of the method used to estimate distress intensity.

Much of our analysis follows Griffin and Lemmon (2002) in focusing on O-score so our results can be compared directly with theirs. Accordingly, we compute O-score as described in footnote 6 of Griffin and Lemmon (2002), which is identified as "model 1" in Ohlson (1980).[7] O-score is a linear combination of nine variables constructed from accounting data. The variables are measures of assets and liabilities, and levels and changes in earnings. Those that receive the greatest weight are (i) the ratio of total liabilities to total assets, (ii) net income to total assets and (iii) funds from operations divided by total liabilities. Since the same weights are used for all firms when combining these variables, low leverage

[6] If a stock disappears from CRSP, its delisting return is used in the month after its last month of reported returns. The book leverage ratio is defined as (data9+data34)/data6 where Compustat data9 is long-term debt, data34 is long-term debt in current liabilities and data6 is total assets.

[7] Franzen, Rodgers and Simin (2007) show that Ohlson's O-score can be improved as a predictor of bankruptcy by treating R&D expenditures as though they are investments rather than expenses. They examine whether adjusting O-scores in this manner eliminates the distress risk puzzle. It does not. Their adjusted O-scores reduce the strength of the negative relation for large firms and intensify it among small firms.

firms with high O-scores generally have lower earnings than high leverage firms with high O-scores.

We also use the index computed by Vassolou and Xing (2004), based on Merton (1974), because their study is the only one that documents an equity return *premium* to distress risk. Their measure also contrasts with O-score in depending primarily on information in stock prices rather than the accounting data upon which O-score is based. We consider these separately in the regressions because the accounting based measure is shown later to have no explanatory power for return premiums after controlling for leverage.

We include the ratio of the book and market values of equity, $book_{i,t-1}/mkt_{i,t-1}$, equity market capitalization, $size_{i,t-1}$, and previous month return, $R_{i,t-1}$, in the regression to control for the effects of book-to-market and size on returns, and to control for bid-ask bounce. These variables are included as deviations from cross sectional means to facilitate the interpretation of the intercept.

We control for momentum by including the 52-week high momentum measures identified in George and Hwang (2004). These measures dominate others used in the literature in capturing momentum effects. Their definitions are as follows: $52wkW_{i,t-j}$ ($52wkL_{i,t-j}$) equals one if $P_{i,t-j}/high_{i,t-j}$ is ranked among the top (bottom) 20% of all stocks in month $t-j$, and zero otherwise; where $P_{i,t-j}$ is the price of stock i at the end of month $t-j$ and $high_{i,t-j}$ is the highest month-end price of stock i during the 12-month period that ends on the last day of month $t-j$. Both $P_{i,t-j}$ and $high_{i,t-j}$ are adjusted for stock splits and stock dividends.

All right hand side variables in equation (11) are computed using information available prior to when returns on the left are measured to avoid look-ahead bias. We assume that market prices are observable in real time, but accounting variables are observed with at least a 6-month lag. Thus, $R_{i,t-1}$, $size_{i,t-1}$, and the prices that determine $52wkW_{i,t-j}$ and $52wkL_{i,t-j}$ are based on market values at the end of month $t-1$ and $t-j$, respectively. For variables such as $book_{i,t-1}/mkt_{i,t-1}$, the book values of leverage and assets that determine $LevH_{i,t-j}$ and $LevL_{i,t-j}$, and the determinants of O-score are based on the most recent fiscal year end financial statements whose closing date is at least six months prior to the end of month $t-1$ and $t-j$, respectively. Consistent with the model in section 1, the

O-score and leverage variables in the regressions are contemporaneous, all based on the most recent observable information about firms' assets, leverage and earnings.

Estimates of the coefficient b_{0jt} can be interpreted as the return in month t to a neutral portfolio that was formed in month $t-j$ that has hedged (zeroed out) the effects of deviations from average book-to-market, size, and past return; and also hedged the effects of momentum, leverage and O-score dummies in predicting returns. The sum of the coefficient estimates $b_{0jt} + b_{7jt}$ is the month-t return to a portfolio formed in month $t-j$ that is long low leverage stocks and that has hedged out all other effects. Consequently, b_{7jt} can be viewed as the return in month t in excess of b_{0jt} earned by taking a position j months ago in a pure low leverage portfolio. The difference $b_{7jt} - b_{6jt}$ is the return in month t to a zero investment portfolio formed j months ago by taking a long position in a pure low leverage portfolio and shorting a pure high leverage portfolio. The remaining coefficients have similar interpretations [see Fama (1976)].

The coefficients in equation (11) are estimated from cross sectional regressions. The *total* month-t returns involve portfolios formed over the prior T months. Using the low and high leverage portfolios as examples, the total month-t return to the pure portfolios can be expressed as sums $S_{6t} = \frac{1}{T}\sum_{j=1}^{T} b_{6jt}$ and $S_{7t} = \frac{1}{T}\sum_{j=1}^{T} b_{7jt}$ where the individual coefficients are computed from separate cross sectional regressions for each $j = 1, \ldots, T$. Dividing by T rescales the sums to be monthly returns. For each explanatory variable, time series means of the month-by-month estimates of such sums, (e.g., $\overline{S}_6$ and $\overline{S}_7$) and associated t-statistics, computed from the temporal distribution of sums, are reported in the tables as raw returns. risk-adjusted returns are defined below. Results for a horizon of $T = 12$ months are presented in the tables.

Proposition 1 views leverage as an inverse measure of exposure to financial distress costs. Firms' leverage choices depend on the benefits of leverage as well. To account for this, we incorporate the unlevered tax rates used in Graham (2000) and updated in Binsbergen, Graham, and Yang (2008) as measures of the potential tax benefits of leverage to individual firms.[8] These estimates are lagged in our tests as described above for accounting data. We also examine whether the relation between returns and leverage is

[8] We are grateful to John Graham and Jie Yang for providing us with these data.

explained by mispricing. One of these tests uses the number of analysts covering firms as a proxy for the availability of information about securities' fundamental values. These data are drawn from IBES monthly. Since analysts disseminate information upon initiating coverage of a stock, this variable is not lagged.

The returns data used in most of the regressions cover the period June 1966 to December 2003, which allows us to construct accounting data from 1965 that are lagged 6 months to avoid look-ahead bias. Tests involving Vassalou and Xing's (2004) index begin in January 1971 because the index is not available earlier.[9] Similarly, Graham's estimates of unlevered tax rates are available beginning in 1980. Analyst coverage data begins in 1976, but is available for a large portion of the cross section beginning only in 1983. Table captions indicate the time period from which data are drawn for the tests. The number of firms in each regression varies by month. With each specification, the average number of firms that appears in the monthly cross sectional regressions is reported in the tables.

2.1 Descriptive Statistics

Table 1 is a correlation matrix for the indicator variables used in the regressions. *High Leverage* refers to the high leverage dummy *LevH* in equation (11). *Low Tax* and *High Tax* refer to dummies defined with respect to the highest and lowest 20% as ranked by unlevered tax rates. *Low VX* and *High VX* refer to similar dummies constructed for Vassalou and Xing's (2004) estimate of distress. *Low Coverage* refers to a dummy defined to be unity if the number of analysts covering the firm is two or less, which captures about 50% of sample firms.

Reading from the *Leverage* columns, both O-scores and VX indexes are greater for firms with greater leverage. However, the relation is stronger for O-score than the VX index (0.483 versus 0.283 for the low value dummies, for example). This is consistent with a finding later that O-score reflects information in the cross sectional distribution of leverage to a greater degree than the VX index. These distress measures are somewhat similar but far from identical in how they vary across firms; the correlations between their high and low dummies in columns six and seven range from 0.151 to 0.327 in absolute

[9] We are grateful to Maria Vassalou for making their measures available on her website.

value.

The relation between leverage and unlevered tax rates is positive, as expected if firms with greater tax benefits choose higher leverage. However this relation is weak, consistent with Graham's (2000) findings that firms substantially underutilize debt tax shields. The figures in columns four and five indicate a weak negative relation between tax rates and distress as measured by both O-score and the VX index (between 0.049 and 0.154 in absolute value). Somewhat lower unlevered tax rates for firms near or in distress is consistent with progressivity in corporate tax rates. Finally, distressed firms are more likely to have low analyst coverage than are firms in the middle or lowest level of distress by both O-score and VX measures, with correlations (column one) between 0.100 and 0.194 in absolute value.

Table 2 reports attributes of the sample firms sorted by O-score and leverage. The panels are constructed as follows. In June of each year, attributes are computed for every firm having sufficient data to compute all attributes in the table. These are ranked *independently* into quintiles by O-score, and into high (30%) medium (40%) and low (30%) categories by leverage; size adjusted medians are then computed within each cell as in Griffin and Lemmon (2002) to avoid potential firm size biases on our inferences.[10] The numbers reported in the table are time series averages of the annual size adjusted medians.

The panel labeled *Number of Firms per Year* provides the distribution of firms across categories. In the outer columns, firms are concentrated in the upper left (low leverage and O-score) and lower right (high leverage and O-score) cells. Firms are also clustered at the center of the middle column. This means there is a positive association between leverage and distress as measured by O-score, and low leverage firms are relatively infrequent members of the high distress groups. This is consistent with firms controlling the likelihood of financial distress by choosing low leverage.[11]

The panel labeled *Market Capitalization* indicates that firms with low distress intensity

[10] We first break each year's cell group into small and large firms by median market equity at the prior December end. A given year's median is the midpoint of the medians of the large and small groups computed separately. If a cell-year contains only large or small firms, then that group's median is used. This is not applied to the sorting variables (leverage, O-score, VX index) or to the panels labeled *Market Capitalization* and *Number of Firms*.

[11] This is true in relation to the VX index as well (see the bottom left panel of Table 9).

and high debt are larger than those with low distress intensity and low debt. Despite this, the last row (unconditional on O-score) indicates that low and high leverage firms do not differ much in median market capitalization. Big firms might have greater capacity (as a percentage of assets) to issue low risk debt but do not utilize debt more than small firms overall. The last row of the panel labeled *Debt/Assets* indicates that the median book leverage ratio for the lowest 20% of firms is very low averaging 0.03. The average is 0.19 for the middle leverage group and 0.38 for the high group.

3. Results

The results are organized into four subsections. First, we show the relation between returns and leverage is significantly negative, and more strongly so in risk-adjusted than in raw returns. The relation between returns and distress intensity is negative also, but including leverage subsumes this relation in all cases except when the VX index is used with risk-adjusted returns. Second, we report two tests that reject the notion that the negative relation between returns and leverage is due to mispricing. This is important because the earlier literature argues that mispricing explains the negative relation between returns and distress. Third, we examine whether firms that choose low leverage have high distress costs. We find that operating performance deteriorates more, and becomes less predictable in distress for low leverage firms than high leverage firms. Exposure to systematic risk is greatest for low leverage firms in distress as well.

Finally, we show that subperiod evidence is consistent with the explanation given in Proposition 1. We split the sample at 1980 and show both the dramatic difference in the impact of distress on the operating performance of low versus high leverage firms, and the negative relation between returns and leverage, are post-1980 phenomena. The coincident appearance of these relations supports the hypothesis that firms use leverage choices to manage distress costs, which affect firms' exposures to priced risk.

3.a The Cross Section of Returns, Leverage and Distress Risk

<u>3.a.1 The Return Premium to Low Leverage</u>

If market frictions such as distress costs have no impact on firms' systematic risk, then raw equity returns will be positively related to leverage because levered equity has greater sensitivity to priced risks than unlevered equity. Alternatively, the effect described in Proposition 1 could dominate. Specifically, financial distress costs heighten exposure to systematic risk that is priced, and firms with high distress costs choose low leverage but still have greater exposure to systematic risk than firms with high leverage. In this case, expected returns are greater for firms with low leverage than firms with high leverage.

Column (1) of Table 3 documents a strong and highly significant *negative* relation between raw returns and leverage. The coefficient on the high leverage indicator is -0.21% per month, and the coefficient on the low leverage indicator is 0.11%. A zero investment pure portfolio consisting of a long position in low leverage stocks and a short position in high leverage stocks, which has hedged out the effects of the other variables, earns an average annual return of 3.84%. Furthermore, the return to this zero investment portfolio is persistent. In results that are omitted for brevity, we examine windows of two to five years after portfolio formation. The average return to the high (low) debt portfolio is consistently lower (higher) than that of the benchmark neutral portfolio in each of these tests. Persistence favors a risk based explanation as outlined earlier rather than an explanation based on temporary mispricing. Nevertheless, we do examine mispricing as a possible explanation below.[12]

Fama and French (1992) also investigate the explanatory power of leverage for returns. They use the natural logarithms of the ratios of assets to market equity and assets to book equity as explanatory variables. The book-to-market equity ratio is not included in their regression, however. They find that both asset to equity ratios are significant, opposite in sign, and with coefficients of similar magnitudes. Since the sum of their log asset to equity ratios equals the log of book-to-market equity, they conclude that their leverage variables are important *only* because they proxy for a true relation between returns and book-to-market equity. Their conclusion is clearly not supported by the results in Table 3. Returns are negatively related to leverage *even after* controlling for book-to-market equity.

Our findings are consistent with Proposition 1 even though we have not controlled for

[12] Whited and Wu (2006) document that financially constrained firms utilize leverage less than unconstrained firms. This relation could cause us to find a spurious negative relation between leverage and returns. In untabulated results, we control for this by replacing O-score with their financing constraints index in equation (11). The significant negative leverage-return relation remains intact.

differences in exposures to known sources of systematic risk that are unrelated to distress costs. To the extent that the Fama-French (1993) model captures such differences, the statistical evidence on the importance of leverage should be clearer after adjusting returns using their model. We examine this next.

Each coefficient in columns (1)-(3) of Table 3 is a time series average of monthly coefficients obtained from cross sectional regressions. For the leverage and O-score dummies, the monthly coefficients are excess returns to particular portfolios. To compute risk-adjusted returns, we estimate the intercept of a time series regression of that particular portfolio's returns on the Fama-French (1993) factor realizations.[13] The intercepts in these regressions are risk-adjusted returns to the pure portfolios described above, and are reported in columns (4) - (6) of Table 3 along with their regression t-statistics.

Column (4) of Table 3 confirms that risk-adjusted returns to the high (low) leverage portfolio are even *more* negative (positive) and significant than are raw returns. The risk-adjusted return to buying a low debt portfolio and selling a high debt portfolio is 5.16% per year.[14] Either the argument in Proposition 1 has merit or investors make mistakes in pricing the impact of leverage on equity values, or both. We attempt to distinguish between these explanations later. First, we examine whether the negative relation between leverage and returns is distinct from the relation between returns and distress.

3.a.2 Leverage versus Distress in Explaining the Return Premium

Dichev (1998), Griffin and Lemmon (2002), Campbell et.al. (2007) and Garlappi, et.al. (2006) find that portfolios of stocks of firms having high distress measures earn low returns. We confirm this via regressions in columns (2) and (5) of Table 3. The bottom panel reports returns and *t*-statistics to "long-short" portfolios. The average raw return to a zero-investment portfolio that is long high distress (O-score) firms and short low distress firms earns -0.23% per month which is highly significant (*t*-statistic = -2.64). On

[13] We are grateful to Ken French for providing the Fama-French factors on his website.

[14] A spurious relation between risk-adjusted returns and leverage could arise because of mismeasurement of systematic risk. Ferguson and Shockley (2003) argue that leverage captures differences in the sensitivity of equity returns to assets that are excluded from the market proxy in estimating beta. Therefore, firms with greater leverage appear riskier than firms with less leverage but the same estimate of market beta. This is the reverse of what we find.

an annual basis, this is a 2.88% return *discount* to high versus low distress risk stocks. The distress risk puzzle is even stronger in magnitude and significance in risk-adjusted returns [Campbell, et.al. (2007) document this also] at -4.44% per year (-0.37% per month with a t-statistic of -4.43). This is consistent with Proposition 1, but anomalous from a frictionless markets perspective. This seemingly backward result led most of these authors to conclude that distress risk is mispriced.[15]

Since leverage is a determinant of distress intensity, leverage and measures of distress are related (by definition). Referring to the panel labeled *Number of Firms per Year* in Table 2, high leverage firms tend to be concentrated in the high O-Score group. On average, almost half (i.e., 271 per year) of the firms in the high leverage group are in the highest quintile of distress intensity. The others are distributed across the remaining quintiles with monotonically decreasing numbers in lower risk quintiles. This is not surprising because debt/assets is one of the determinants of O-score. It is, therefore, natural to ask whether the negative relation between returns and leverage is simply a reflection of the negative relation between returns and distress. To address this, we include both leverage and O-Score dummies in the regressions.

The results are reported in columns (3) and (6) of Table 3. In these regressions, the coefficient on the high (low) leverage dummy is the return to a high (low) leverage portfolio in excess of that of a benchmark portfolio that has neither high nor low distress risk. A similar interpretation applies to the coefficients of high and low distress dummies. The bottom panel of Table 3 reports returns of -0.42% per month that is highly significant (t-statistic = -5.27) for the portfolio long low leverage stocks and short high leverage stocks. The return to a long-short distress intensity portfolio is -0.10% and not significant. The negative leverage-return relation remains, while the association between returns and distress disappears in both raw and risk-adjusted returns. This means that distress inten-

[15] The exception is Garlappi, et.al. (2006) who attribute the relation to shareholder bargaining power in distress. They argue that renegotiation in distress prevents inefficient liquidation and transfers wealth from bondholders to shareholders, so greater distress intensities are associated with higher equity prices and lower expected returns to equity. Their story explains the distress risk puzzle, but not the negative relation between returns and leverage conditional on distress intensity as documented below. Zhang (2007) reexamines their hypothesis and finds no evidence of wealth transfers in either the equity returns or bond yields of firms that have bonds outstanding. Like the others, Zhang concludes that distress risk is mispriced in equity markets.

sity, as measured by O-score, is related neither to a priced risk nor a source of mispricing beyond what is captured by leverage.[16]

According to Proposition 1, leverage and distress probability are inverse proxies for distress costs because firms choose low leverage to avoid distress costs. The significance of leverage is consistent with this, but the total disappearance of the significance of O-score is somewhat surprising. Since O-score is based entirely on accounting numbers, it might simply proxy for leverage and contain no additional information about how the probability of distress affects equity returns that is not contained in leverage alone. The results below are consistent with this. Our findings for risk-adjusted returns are less extreme with Vassalou and Xing's (2004) index, which we examine next.

Vassalou and Xing (2004) estimate the probability of default using Merton's (1974) model and reach a conclusion different from Dichev (1998), Griffin and Lemmon (2002), Campbell, et.al. (2007) and Garlappi et.al. (2006). Vassalou and Xing document a *positive* relation between returns and default probability, and show that this relation is strongest among small firms. We are able to replicate their results in raw returns when all stocks are included in the sample (not tabulated). However, when stocks with prices below $5 are excluded, their result reverses and returns are negatively related to their measure of distress intensity.[17]

The first two columns of Table 4 report regression estimates for raw returns where

[16]To check robustness, we also estimate Table 3 without some and all of the control variables, and the results are very similar to those reported. We also replace book leverage with market leverage. The results are similar except that market leverage is a weaker explanatory variable than book leverage, and O-score still maintains marginal significance, but not when January is excluded. Since Griffin and Lemmon (2002) find the distress risk puzzle is significant only among low book-to-market stocks, we estimate Table 3 using stocks ranked in the bottom third of book-to-market. The relation between returns and O-score is stronger among low book-to-market stocks than the sample as a whole, but leverage is stronger as well. When both leverage and O-score are included, only leverage is significant in raw returns. In risk-adjusted returns, both are significant though leverage dominates in magnitude (low minus high return is -0.46% per month for leverage versus -0.26% for O-score) and significance (the t-statistics are -3.79 and -2.02, respectively). We also examine the results for the top two thirds of stocks ranked by book-to-market. The evidence for a relation between returns and O-score is weak to non-existent among these firms, yet the relation between returns and leverage remains strong. Consistent with Griffin and Lemmon, the difference in returns between high and low O-score portfolios are insignificant in all cases. In contrast, the t-statistics for differences between high and low leverage portfolios are significant and in excess of three in all cases.

[17]This is consistent with Da and Gao (2005) who find that Vassalou and Xing's results are sensitive to controls for bid-ask bounce and measures of illiquidity of small firms' stocks.

dummies for the Vassalou-Xing (VX) measure are used in place of O-score. Raw returns are lower for high distress stocks. As with O-score, significance disappears when leverage is included. However, the third column indicates that low distress stocks earn a significant *risk-adjusted* return premium. When the leverage and VX dummies are both included, risk-adjusted returns are significantly negatively related to both leverage and distress. This is consistent with Proposition 1. Finding the VX index retains some explanatory power in the presence of leverage suggests the market prices upon which the VX index is based contain cross sectional information regarding exposure to distress costs not captured by leverage alone.

3.a.3. Using Unlevered Tax Rates to Identify High and Low Distress Costs

We consider next whether the return-leverage relation is robust to using variation in tax benefits of leverage to identify high and low cost firms. If firms with high marginal tax benefits at zero debt choose low leverage, then financial distress costs must be very high because marginal benefit equals marginal cost at firms' optimal choices. Similarly, if firms with low marginal tax benefits even at zero debt choose high leverage, then financial distress costs must be very low. If the leverage-return relation exists because distress costs determine firms' sensitivities to priced risk, expected returns should be more extreme for the firms with very high versus very low distress costs. We use Binsbergen, Graham and Yang's (2008) estimates of unlevered tax rates as measures of the marginal tax benefits of leverage at zero debt to identify firms with very high and very low distress costs.

Table 5 reports regressions that include interactions between leverage and tax dummy variables. The results are consistent with the predictions described above. Firms with high leverage have risk-adjusted returns that are 0.24% per month lower than middle leverage firms, and low leverage firms have returns 0.21% higher than middle leverage firms. Those with high leverage *and* low tax benefits (the lowest distress cost firms) have even lower and significant returns, both raw and risk-adjusted. Risk-adjusted returns are 0.69% (-0.45% - 0.24%) per month lower for these firms than for middle leverage firms, a striking 8.28% per year. Those with low leverage and high tax benefits (highest distress cost firms) have risk-adjusted returns that are 0.25% (0.21% + 0.04%) per month higher than middle leverage firms, though the interaction dummy is insignificant.

3.b Tests of the Mispricing Hypothesis

Earlier studies attribute the negative relation between returns and measures of distress to mispricing. Our results suggest the more robust effect is the negative relation between returns and leverage. So in this section, we consider whether the negative relation between returns and *leverage* can be explained by mispricing. We use two tests.

3.b.1 Leverage Return Premium Stronger With Analyst Coverage

The first test is based on the assumption that if stocks are mispriced, the mispricing should be most severe for firms where public information is relatively scarce. To capture this, we look at the number of analysts covering the firm. If the negative relation between returns and leverage is mispricing, then it should be strongest for firms with low analyst coverage. Table 6 reports regressions that include interactions between the leverage and low analyst coverage dummies. The results are not consistent with mispricing. In both raw and risk-adjusted returns, the signs of all coefficients are opposite to those predicted by the mispricing hypothesis. The negative relation between returns and leverage is either no different or significantly weaker for stocks with low analyst coverage, with significant relations when using risk-adjusted returns.

3.b.2 Earnings Announcement Returns for Low- versus High-Leverage Firms

The second test follows the approach of Chopra et.al. (1992), La Porta (1996), and La Porta et.al. (1997). These studies examine whether low returns to low book-to-market stocks are related to mispricing. They hypothesize that investors mistakenly extrapolate the past success of low book-to-market firms into the future, and realize their mistakes when earnings are announced. The implications are that prices are too high, and returns too low, for low book-to-market stocks; and that such stocks have large negative earnings announcement returns that reflect investors' correction of prior over optimism about earnings.

This logic could explain the negative relation between returns and *leverage.* If high leverage occurs partially as a result of managers' or investors' excessive optimism about future earnings prospects, the equity of high leverage firms will be overpriced and returns abnormally low, with downward corrections to prices occurring at earnings announcements. If the negative relation between returns and leverage is due to this sort of mispricing, then it should result in more negative earnings announcement returns for high leverage firms than low leverage firms.

Following La Porta et.al. (1997), we benchmark each earnings announcement return by the return to the firm with median book-to-market in the same size decile as the announcer. Every June, we sort firms independently into quintiles by O-score and three groups by book leverage (top 30%, middle 40% and bottom 30% by debt/asset ratio), and form portfolios based on these groupings. For each firm, we then compute the average cumulative three day abnormal return over the four quarterly announcement returns following portfolio formation and "annualize" this number by multiplying by four. Table 7 presents equally weighted average annualized earnings announcement abnormal returns, and p-values for difference in means tests between high and low leverage groups. The results are not consistent with the mispricing hypothesis. Earnings announcement abnormal returns are not significantly different between high and low leverage firms. In the single case that is nearly significant (p-value 0.13) the difference is *positive.*

Results of both tests are inconsistent with mispricing as an explanation of the negative relation between returns and leverage. In fact, the first test offers results that are consistent with a risk based story since, with better coverage, investors can assess better their exposures to risk. Investors in high leverage firms with high coverage appear to understand better (than when coverage is low) that these firms have less systematic risk and require lower expected returns.

3.c High Distress Costs of Low Leverage Firms

The prediction that returns are negatively related to leverage in Proposition 1 is based on the idea that firms with high distress costs choose low leverage. This is established using ex-ante proxies for distress costs in Titman and Wessels (1988), Hovakimian, Opler and Titman (2001), Koraczyk and Levy (2003), Faulkender and Petersen (2006), Kayhan and Titman (2007) among others. Here, we examine whether distress has a bigger ex-post impact on low versus high leverage firms.

We find that distress is associated with a deeper deterioration in performance of low versus high leverage firms on two dimensions. First, return on assets drops and remains depressed and less predictable for low than high leverage firms. Second, the return premium is greatest among low leverage firms that are distressed. This suggests that when low leverage firms get into trouble, not only does the earnings performance of assets suffer, but exposure to systematic risk increases thus increasing the cost of capital more than that of high leverage firms. These findings indicate that the real effects of financial distress are more severe for low leverage firms than high leverage firms, supporting the idea that severe consequences of distress lead firms to use debt conservatively.

3.c.1 Accounting Return on Assets - Levels

Table 8 is constructed in the same manner as Table 2. We focus first on the panels labeled *Return on Assets.*[18] By the construction of O-score, low leverage firms that are classified as having high distress will typically have lower earnings than high leverage firms classifed as high distress. In the portfolio sorting year (panel labeled Year 0), the ROA for low leverage high distress firms -5.34%, which is lower than 2.53% for high leverage high distress firms.

What is striking is the range of ROA *within* leverage categories, which measures how differences in distress affect firms with a given leverage policy. The differences in return on assets across O-score categories is much smaller for high leverage firms than low leverage firms. For example in the portfolio sorting year, the return on assets for high leverage firms ranges from 5.87% in the lowest distress group to 2.53% in the highest distress group—a difference of 3.34%. The difference for low leverage firms is 15.98%. Low leverage firms experience a reversal of fortunes when transitioning from low to high distress intensity that is more than four times that of high leverage firms.[19]

The panels titled *Return on Assets Year 1* and *Return on Assets Year 2* show that significant deterioration in performance associated with distress continues for years. These

[18]ROA is defined as income before extraordinary items divided by total assets.

[19]The results are similar when distressed firms' ROAs are compared to their own ROAs in years prior to their appearance in the high distress group rather than contemporaneous ROAs of non-distressed firms.

patterns are not simply a consequence of the fact that ROA is a component of the O-score calculation. The same analysis using the VX index appears in Table 9 and the results are similar in Years 1 and 2. The difference in Year 0 is not significant, but this makes sense because the VX index is based on market prices and should be more forward looking in its detection of distress than O-score.

Our findings for stocks as a whole are somewhat different from Opler and Titman's (1994), which are stratified by industry. They find, within industries, that firms with high leverage suffer most in industry downturns. The difference between their results and ours means that our high leverage group is not dominated by firms with the highest leverage in their industries. This indicates that distress costs (and leverage choices) vary more across industries than within.

3.c.2 Accounting Return on Assets - Predictability

We now examine how sensitive to distress is the *predictability* of return on assets, where predictability is measured relative to the same quarter in the prior year. The more predictable is return on assets, the less disruptive is financial distress to the firm's ability to generate value from its assets. Unlike the other variables in this table, we use quarterly Compustat data. The additional observations increase the precision of the estimates. For each firm, we estimate the expected return on assets under the assumption that it follows a seasonal random walk with drift:

$$E\left[Q_{it}\right] = \delta_i + Q_{i,t-4},$$

where Q_{it} is the return on book value of assets of firm i in quarter t. The standard deviations reported in the table are those of the prediction errors. Relative to the ranking month, we use 20 future quarters (with a minimum of ten) to estimate the drift parameter and the standard deviation of the prediction error for each firm. Results are reported in the panels of Tables 8 and 9 labeled *STD of Return on Assets.*

Distress has a bigger impact on the predictability of return on assets for low than high leverage firms. Using O-score, Table 8 reports that the standard deviation of prediction errors for low leverage firms in the high distress group is more than double that of low leverage firms in the low distress risk group (7.73% versus 2.98%). The difference is highly significant. In contrast, among high leverage firms, return on assets is *more* predictable for those in the high distress group than the low distress group, though the difference is not significant. Using the VX index, Table 9 reports that high versus low distress is associated with less predictable return on assets for firms in all three leverage categories, with p-values ranging from 0.06 to 0.08. The difference is again greatest for low leverage firms (more than double for high distress at 2.22% versus low distress at 1.00%).

3.c.3 Exposure to Systematic Risk

Tables 8 and 9 indicate that distress has a more negative impact on the operating performance of the assets of low versus high leverage stocks. Table 10 examines whether distress affects differently their exposures to systematic risk, and therefore the cost of raising additional equity capital. We add to the regressions in Table 4 interactions between the leverage dummies and the distress dummies. We use the VX index for these tests because it is forward looking in its assessment of distress risk and monthly estimates are available.

Since distress is rare for low leverage firms, not all months are represented, so the interpretation of the coefficients in this table is that of returns to strategies employed in months when high-distress-low-leverage stocks exist.[20] On average across such months, high distress adds a return premium of 0.92% raw (1.27% risk-adjusted) per month to low leverage stocks, both highly significant. This is not true of the high-distress-high-leverage dummy, whose premium is insignificant. These findings suggest that distress further increases the already elevated exposure of low leverage stocks to systematic risk.

How do low leverage firms become financially distressed? A review of news reports on Proquest for the firms in our sample with low leverage and high O-scores provides some qualitative impressions. About 70% are in the business services, manufacturing or pharmaceutical industries, and many are in the computers and software business. The news stories commonly highlight reliance on a single product with specific and limited

[20]Table 2 indicates that on average 30 stocks per month fall into this category. Such stocks exist in about 65% of months (258 out of 408 between 1970 and 2003).

applications and one or a few major customers. Also mentioned are large R&D expenses, high probabilities of experimental failures, and in the case of pharmaceuticals, government approval processes and regulation. Intense industry competition, losses of key scientific personnel, technological obsolescence of products, and poorly executed acquisitions are frequently cited as factors contributing to firms' financial troubles. These news reports convey the impression that shocks to operations such as failed R&D efforts, departures of key personnel or innovations by competitors leads to financial distress when firms are not diversified across business lines or customers. The tables above suggest such shocks are not easily recovered from, leading to protracted poor earnings performance and elevated exposure to systematic risk.

Summarizing, the assets of low leverage firms are more negatively impacted by financial distress than those of high leverage firms. If this impact were entirely idiosyncratic, and not priced, there should be a positive relation between raw stock returns and leverage because levered equity is more sensitive to priced risks than unlevered equity. Raw returns are *negatively* related to leverage, however, suggesting that leverage measures sensitivity to priced risk. If this risk were captured by the Fama-French (1993) three factor model, leverage would not explain risk-adjusted returns. However, in all the tables, risk-adjusted returns are negatively related to leverage and more strongly so than are raw returns. Taken together, these results are consistent with greater return premiums to firms that are exposed to greater financial distress costs as predicted in Proposition 1.

3.d Pre- and Post-1980 Subsamples

Fama and French (1995) document that the earnings of small firms deteriorated steadily beginning in 1980 and extending through the end of their sample period in 1992. A downward shift in average earnings for small firms raises the possibility that the impact of financial distress could also be different in the pre- and post-1980 periods for these firms. This creates an opportunity to examine the time series for a connection between the negative relation between returns and leverage, and the differences in operating performance between low and high leverage firms in distress. If such a connection exists, then the negative relation between returns and leverage should be stronger in the subperiod in which the operating performance of low leverage firms suffers more in distress relative to high leverage firms. This is indeed what we find.

We recompute the panels in Table 8 that describe the performance of firms across distress and leverage categories for the pre- and post-1980 subperiods. These results are presented in Table 11. The distributions of the numbers of firms across cells and their O-scores are similar across the sub-periods, but with about twice as many firms in the post-1980 sample (i.e., beginning January, 1980). The differences in the sensitivity of accounting measures of performance to distress observed in Table 8 are much stronger in the post-1980 period than before. The difference in low leverage ROA between the low and high distress groups is 6.37% in the pre-1980 period and 22.97% in the post-1980 period, both significant. Even in the two years after ranking, the differences are large and significant in the post-1980 period, and smaller and insignificant in the pre-1980 period. The same is true of the predictability of ROA in the pre- and post-1980 periods.

These numbers indicate that the degree to which assets of low versus high leverage firms suffer in distress is less prior to 1980 than after. If the effects documented in the regressions thus far reflect costs of financial distress giving rise to heightened exposure to systematic risk, then leverage should better explain the cross section of returns after 1980 than before. To examine this, we re-estimate the regressions in Table 3 by subperiod. The results are reported in Table 12.

The relation between returns and leverage is indeed stronger in the post-1980 period than the pre-1980 period for both raw and risk-adjusted returns. In fact, the leverage coefficients are *insignificant* for both raw *and risk-adjusted* returns in the pre-1980 period. In contrast, a strategy of buying low leverage firms and selling high leverage firms yields a risk-adjusted return of 6.84% per year in the post-1980 period. This very strong relation is driving the significant negative relation between returns and leverage documented earlier for the sample as a whole. In the pre-1980 period, neither leverage nor O-score dummies are significant.[21] The *coincident* widening of the operating performance gap between low and

[21]We tabulate results using O-score because we have O-score measures back to 1965. However, we conducted subperiod analyses using the VX index during the 1971-1979 and post-1980 periods and the conclusions are qualitatively similar to those reported for O-score, but weaker in magnitude.

high leverage firms in financial distress and the increase in the return premium associated with low leverage after 1980 is consistent with the interpretation that the return premium to low leverage firms is a reward for systematic risk relating to costs of financial distress.

4. Conclusion

We examine a possible explanation for the negative cross sectional relations between returns and leverage, and returns and measures of distress intensity that others have deemed puzzling or anomalous. Our explanation is based on difference in financial distress costs across firms. Since the occurrence of low asset payoffs is partly systematic, financial distress costs born in low payoff states contribute to systematic risk. Firms' capital structure choices depend on distress costs also—firms with high costs choose low leverage and have low probabilities of default. This does not entirely neutralize the effect of high costs on systematic risk, however. Therefore, low leverage firms have low distress probabilities and greater exposures to systematic risk than high leverage firms. This implies expected returns are negatively related to leverage and the probability of distress. In addition, since leverage amplifies equity's exposure to priced risks, the negative relation between returns and leverage should appear stronger in returns that are adjusted for exposure to other measures of priced risk.

The empirical evidence is consistent with this explanation. The relation between returns and leverage is significantly negative, and more strongly so in risk-adjusted than in raw returns. The relation is even stronger among stocks identified as having very low (high) distress costs by virtue of their having high (low) leverage despite low (high) tax benefits. The relation between returns and distress intensity is negative also, but including leverage subsumes or weakens this relation. We examine whether the negative relation between returns and leverage is due to mispricing, and the evidence is inconsistent with this hypothesis.

Operating performance deteriorates dramatically more, and becomes less predictable, for low leverage firms in distress than high leverage firms in distress. In addition, we find the return premium is greatest for low leverage films in distress. This indicates that operating performance suffers severely and exposure to systematic risk increases more for low leverage firms than high leverage firms when in distress.

Finally, subperiod evidence is consistent with our explanation. We split the sample at 1980 and show that both the dramatic effect of distress on the operating performance of low versus high leverage firms and the negative relation between returns and leverage are post-1980 phenomena. The *coincident* appearance of these relations supports the hypothesis that firms use leverage choices to manage financial distress costs, and distress costs are an important determinant of exposure to priced risk.

Dichev (1988), Griffin and Lemmon (2002) and the other studies that examine distress risk set out to clarify whether exposure to *financial* distress is priced, and to test whether such measures of distress subsume the significance of book-to-market in explaining the cross section of returns. Since the negative relation between returns and financial distress they documented was puzzling, it could not serve as a basis for concluding whether book-to-market's significance is attributable to financial distress risk. We believe our results explain the puzzle—what matters is financial distress *costs,* and both leverage and the probability of default are inverse measures of costs when firms choose capital structures optimally. We find that even with leverage and distress probability included in cross sectional regressions, book-to-market retains its significance in explaining returns. Our interpretation of these findings is that book-to-market is not a measure of *financial* distress risk, but instead captures exposure to priced risk that is unrelated to capital structure. The possibilities include differences in risk that develop as projects are adopted and retired as modeled in Berk, Green and Naik (1999) and Gomes, Kogan and Zhang (2003), and irreversibility of investment in economic or operating distress as modeled in Zhang (2005).

APPENDIX

<u>LEMMA 1</u>. *If i is a (2×1) constant vector and $X = (X_1, X_2)'$ is bivariate normal with mean vector μ and covariance matrix Σ then*

$$E\left[e^{X'i}|a < X_2 < b\right] = e^{\mu' i + \frac{1}{2} i' \Sigma i} \int_{-\infty}^{\infty} \int_a^b f(x_1, x_2; \mu_*, \Sigma) dx_2 \, dx_1$$

where $f(\cdot; \mu_*, \Sigma)$ is the bivariate normal density function with mean vector $\mu_* = \mu + \Sigma i$ and covariance matrix Σ.

A sketch of the proof is as follows. Write the expectation in terms of the normal probability density function, collect the terms in the exponential, complete the square, and re-write the result as a product of an exponential function of μ and Σ and a normal probability density function with mean vector μ_* and covariance matrix Σ. The expression in the statement of the lemma follows.

<u>LEMMA 2</u>. *The hazard function $h(x) \equiv F_X'(x)/(1 - F_X(x))$ is monotone increasing where $F_X(\cdot)$ is the cumulative distribution function of an arbitrary normally distributed random variable $\tilde{X} \sim N(\mu_X, \sigma_x^2)$.*

A sketch of the proof is as follows. Differentiation implies that $h'(x) > 0$ if and only if $h(x) > \frac{x - \mu_X}{\sigma_X^2}$. Since $\lim_{x \to -\infty} h(x) = 0$, $h(\cdot)$ is increasing for x sufficiently small. Contrary to the statement in the lemma, suppose there is at least one finite value of x at which $h(\cdot)$ is non-increasing, and let x_o be the smallest such value. Since $h(\cdot)$ is non-increasing at x_o, and $\frac{x - \mu_X}{\sigma_X^2}$ is strictly increasing over its entire range, then $h'(x) < 0$ for all $x > x_o$. Since $h(\cdot)$ is continuous, it attains a global maximum in a neighborhood of x_o. This maximum is finite because $h(\cdot)$ is finite in a neighborhood of any finite x_o. However the implication that $h(\cdot)$ has a finite global maximum contradicts the fact that $\lim_{x \to \infty} h(x) = \infty$. Conclude that no x_o as defined above exists, and that $h(\cdot)$ is mononotone increasing.

Derivation of equation (4): The expectation of equation (1) in the text is

$$E\left[\tilde{P}\right] = \int_{-\infty}^{D} I e^{a-c} f(a) da + \int_{D}^{\infty} I e^{a+\tau(D)} f(a) da$$

where $f(\cdot)$ is the probability density function of $\tilde{a} \sim N(\mu_a - \frac{1}{2}\sigma_a^2, \sigma_a^2)$. Applying a univariate version of Lemma 1 with $i = 1$ yields

$$E\left[\tilde{P}\right] = Ie^{\mu_a - c}\int_{-\infty}^{D} f_*(a)da + Ie^{\mu_a + \tau(D)}\int_{D}^{\infty} f_*(a)da$$

where $f_*(\cdot)$ is the probability density function of $\tilde{a}_* \sim N(\mu_a + \frac{1}{2}\sigma_a^2, \sigma_a^2)$. We write this as

$$\begin{aligned} E\left[\tilde{P}\right] &= Ie^{\mu_a - c}F_*(D) + Ie^{\mu_a + \tau(D)}(1 - F_*(D)) \\ &= Ie^{\mu_a + \tau(D)}\left\{1 - (1 - e^{-[c + \tau(D)]})F_*(D)\right\}. \end{aligned} \tag{A.1}$$

As noted in the text, $V = E\left[\tilde{M}\tilde{P}\right]$. Computing the expectation

$$\begin{aligned} V &= E\left[e^{-r-m-\frac{1}{2}\sigma_m^2} Ie^{\tilde{a} + \tau(D)(1-\theta) - c\theta}\right] \\ &= Ie^{-r-c-\frac{1}{2}\sigma_m^2}\int_{-\infty}^{\infty}\int_{-\infty}^{D} e^{a-m} f_{ma}(m,a)da\,dm \\ &\quad + Ie^{-r+\tau(D)-\frac{1}{2}\sigma_m^2}\int_{-\infty}^{\infty}\int_{D}^{\infty} e^{a-m} f_{ma}(m,a)da\,dm, \end{aligned}$$

where $f_{ma}(\cdot)$ is the joint density function of the random variables $(\tilde{m}, \tilde{a})$ defined in the text. Applying Lemma 1 with $i' = (-1, 1)$ yields

$$\begin{aligned} V &= Ie^{-r-c+\mu_a-\beta}\int_{-\infty}^{\infty}\int_{-\infty}^{D} \hat{f}_{ma}(m,a)da\,dm \\ &\quad + Ie^{-r+\tau(D)+\mu_a-\beta}\int_{-\infty}^{\infty}\int_{D}^{\infty} \hat{f}_{ma}(m,a)da\,dm \end{aligned}$$

where $\hat{f}_{ma}(\cdot)$ is the joint normal density of $(\hat{m}, \hat{a})$, which has mean vector and covariance matrix

$$\begin{bmatrix} -\sigma_m^2 + \beta \\ \mu_a + \frac{1}{2}\sigma_a^2 - \beta \end{bmatrix} \qquad \text{and} \qquad \begin{bmatrix} \sigma_m^2 & \beta \\ \beta & \sigma_a^2 \end{bmatrix},$$

respectively. The integrals are probabilities we compute by conditioning,

$$\begin{aligned} \int_{-\infty}^{\infty}\int_{-\infty}^{D} \hat{f}_{ma}(m,a)da\,dm &= \int_{-\infty}^{\infty}\int_{-\infty}^{D} \hat{f}_{m|a}(m|a)\hat{f}_a(a)da\,dm \\ &= \int_{-\infty}^{D} \hat{f}_a(a)\int_{-\infty}^{\infty} \hat{f}_{m|a}(m|a)dm\,da \\ &= \int_{-\infty}^{D} \hat{f}_a(a)da \equiv \hat{F}(D) \end{aligned}$$

where $\hat{F}(\cdot)$ is the cdf of a normal variate with mean $\mu_a + \frac{1}{2}\sigma_a^2 - \beta$ and variance σ_a^2. Using this we can write

$$
\begin{aligned}
V &= Ie^{-r+\mu_a-\beta-c}\hat{F}(D) + Ie^{-r+\mu_a-\beta+\tau(D)}(1-\hat{F}(D)) \\
&= Ie^{-r-\beta+\mu_a+\tau(D)}\left\{1-(1-e^{-[c+\tau(D)]})\hat{F}(D)\right\}. \qquad \text{(A.2)}
\end{aligned}
$$

Equation (4) in the text follows from simplifying the ratio of equations (A.1) and (A.2) using the definition $\psi(c,D) \equiv 1 - e^{-[c+\tau(D)]}$.

Derivation of equation (6): The firm chooses D to maximize equation (A.2) or, equivalently, the natural log of (A.2). Ignoring constants, the maximand is

$$J(D) \equiv \tau(D) + \ln\left(1-\psi(c,D)\hat{F}(D)\right).$$

Differentiating with respect to D yields

$$J' = \tau' - \frac{\psi_D\hat{F} + \psi\hat{F}'}{1-\psi\hat{F}}$$

where $\psi_D \equiv \frac{\partial\psi}{\partial D} = \tau' e^{-[c+\tau(D)]}$, so $\psi = 1 - \frac{1}{\tau'}\psi_D$ or $\psi_D = \tau'(1-\psi)$. Substituting for ψ_D, multiplying both sides by $(1-\psi\hat{F})$ and simplifying yields

$$
\begin{aligned}
(1-\psi\hat{F})J' &= \tau'(1-\hat{F}) - \psi\hat{F}' \\
\left\{\frac{1-\psi\hat{F}}{1-\hat{F}}\right\} J' &= \tau' - \psi\hat{h} \qquad \text{(A.3)}
\end{aligned}
$$

where $\hat{h} = \hat{F}'/(1-\hat{F})$. Since $\{\cdot\} > 0$ for all D, the first-order condition $J'(D_*) = 0$ is equivalent to $\tau'(D_*) - \psi(c,D_*)\hat{h}(D_*) = 0$, which is equation (6) in the text.

Existence, Uniqueness and Optimality: A solution to the first-order condition is D_* such that

$$G(D_*) - \hat{h}(D_*) = 0$$

where $G(x) = \frac{\tau'(x)}{1-e^{-[c+\tau(x)]}}$. Note that

$$Sgn\{G'(x)\} = Sgn\left\{[1-e^{-(c+\tau)}]\tau'' - (\tau')^2 e^{-(c+\tau)}\right\}.$$

This is strictly negative because $c > 0$ and $\tau(\cdot)$ is non-negative, increasing and weakly concave by assumption. By Lemma 2, $\hat{h}(\cdot)$ is monotone increasing, so $G(x) - \hat{h}(x)$ is monotone decreasing. If there is a solution to the first-order condition, it is unique.

We assume that $\tau'(x)$ is finite for some finite x.[22] This, and weak concavity of $\tau(\cdot)$,

[22] Economically, the marginal benefit of additional debt cannot be everywhere infinite.

imply that $\lim_{x\to\infty} \tau'(x) < k$ for some finite positive constant k. Thus,

$$\lim_{x\to\infty} G(x) - \hat{h}(x) > \frac{0}{1-e^{-c}} - 0 = 0$$
$$\lim_{x\to-\infty} G(x) - \hat{h}(x) < \frac{k}{1} - \infty < 0;$$

there is a solution to the first-order condition.

To verify that the unique solution to the first-order condition, D_*, is a maximum, differentiate both sides of equation (A.3) with respect to D:

$$\frac{d}{dD}\{\cdot\}\, J' + \{\cdot\}\, J'' = \tau'' - \psi_D \hat{h} - \psi \hat{h}'.$$

Since $J'(D_*) = 0$ and $\{\cdot\} > 0$ for all D, the sign of $J''(D_*)$ is the same as the sign of $\tau'' - \psi_D \hat{h} - \psi \hat{h}'$. This is negative because $\tau'' \le 0, \psi > 0, \psi_D > 0, \hat{h} > 0$ and $\hat{h}' > 0$ for all D, and in particular at D_*. Thus, D_* is a maximum.

Proof of Proposition 1: The first part of the proof demonstrates that D_* is decreasing in c. Regarding the first-order condition as an identity in c

$$\tau'(D_*(c)) = \psi(c, D_*(c))\ \hat{h}(D_*(c))$$

and totally differentiating with respect to c yields

$$\tau'' \frac{dD_*}{dc} = \left(\psi_c + \psi_D \frac{dD_*}{dc}\right) \hat{h} + \psi \hat{h}'\ \frac{dD_*}{dc}$$
$$\left(\tau'' - \psi_D \hat{h} - \psi \hat{h}'\right) \frac{dD_*}{dc} = \psi_c \hat{h}.$$

This implies that $\frac{dD_*}{dc} < 0$ because: $\tau'' \le 0$ by assumption, $\hat{h} > 0$ and $\hat{h}' > 0$ by Lemma 2, $\psi_c = e^{-(c+\tau)} = 1 - \psi > 0$ and $\psi_D > 0$.

The second part of the proof shows that high cost firms have lower distress probabilities than low cost firms. To see this, note that $F(D_*(c))$, where $F(x) = Pr\{\tilde{a} \le x\}$, is the probability of distress at the firm's optimal choice. The derivative $\frac{d}{dc}F(D_*(c)) = F'(D_*(c))\frac{dD_*}{dc}$ is negative because $F'(\cdot)$ is a probability density function (which is positive) and $\frac{dD_*}{dc}$ is negative as shown just above.

The third part of the proof demonstrates that the quantity in curly brackets in equation (9) is increasing in c. Substituting from equation (6) for the numerator in the term in curly brackets in equation (9) yields

$$\Phi(c) \approx 1 + \beta\, \tau'(D_*(c)) \left\{ \frac{1 - \hat{F}(D_*(c))}{1 - \psi(c, D_*(c))\hat{F}(D_*(c))} \right\}. \tag{A.4}$$

We wish to sign the total derivative of $\tau'(D_*(c))\,\{\cdot\}$ with respect to c. This derivative is $\tau''\, \frac{dD_*}{dc}\,\{\cdot\} + \frac{d}{dc}\,\{\cdot\}$. Since $\tau(\cdot)$ is weakly concave (by assumption) and $\frac{dD_*}{dc} < 0$ is shown above, the first term is positive. We now show that $\frac{d}{dc}\,\{\cdot\} > 0$.

We use the quotient rule to totally differentiate the term in curly brackets. The sign of this derivative is the same as the sign of the numerator, $\mathcal{N}$ that results from applying the quotient rule because the denominator is a square and is necessarily positive. The denominator is ignored in the calculation that follows. The numerator is

$$\begin{aligned}
\mathcal{N} &\equiv (1 - \psi\hat{F})(-\hat{F}'\dot{D}_*) - (1 - \hat{F})\left(-(\psi_c + \psi_D\dot{D}_*)\hat{F} - \psi\hat{F}'\dot{D}_*\right) \\
&= \psi(1 - \hat{F})F'\dot{D}_* - (1 - \psi\hat{F})\hat{F}'\dot{D}_* + (1 - \hat{F})(\psi_c + \psi_D\dot{D}_*)\hat{F} \\
&= -(1 - \psi)\hat{F}'\dot{D}_* + (1 - \hat{F})\hat{F}\psi_c + (1 - \hat{F})\hat{F}\psi_D\dot{D}_*
\end{aligned}$$

where $\dot{D}_* \equiv \frac{dD_*}{dc}$. Using the facts that $\psi_c = 1 - \psi$ and $\psi_D = \tau'(1 - \psi)$ we have

$$\begin{aligned}
\mathcal{N} &= -(1 - \psi)\hat{F}'\dot{D}_* + (1 - \hat{F})\hat{F}(1 - \psi) + (1 - \hat{F})\hat{F}(1 - \psi)\tau'\dot{D}_* \\
&= (1 - \psi)\left\{-\hat{F}'\dot{D}_* + (1 - \hat{F})\hat{F} + (1 - \hat{F})\hat{F}\tau'\dot{D}_*\right\} \\
&= (1 - \psi)\left\{-[\hat{F}' - (1 - \hat{F})\hat{F}\tau']\dot{D}_* + (1 - \hat{F})\hat{F}\right\}.
\end{aligned}$$

Since $0 < \psi < 1$, $(1 - \hat{F})\hat{F} > 0$ and $\dot{D}_* < 0$, a sufficient condition for $\mathcal{N} > 0$ is that $\hat{F}' - (1 - \hat{F})\hat{F}\tau' > 0$. By the first-order condition

$$\begin{aligned}
\hat{F}' + (1 - \hat{F})\hat{F}\tau' &= \hat{F}' + \frac{\psi}{\tau'}\hat{F}'\hat{F}\tau' \\
&= (1 - \psi\hat{F})\hat{F}' > 0
\end{aligned}$$

because $0 < \psi < 1$, $0 < \hat{F} < 1$ and $\hat{F}' > 0$. We conclude that the term in curly brackets in equation (A.4), and therefore equation (9), is increasing in c.

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Table 1
Correlations

Using monthly data from June 1966 to December 2003, we construct indicator variables for each of the measures described in the text. The *High* and *Low Leverage* variables are dummies for whether individual stocks are in the top and bottom 20% of leverage as measured by book value of total debt to book value of assets prior to the portfolio formation month. *High* and *Low Tax* are dummies for stocks ranked in the top and bottom 20% by the unlevered tax rates computed as in Graham (2000). *High* and *Low O-Score* are dummies for stocks ranked in the top and bottom 20% by Ohlson's (1980) O-Score. *High* and *Low VX Index* are dummies for stocks ranked in the top and bottom 20% default probability by the index of Vassalou and Xing (2004). Numbers reported in the table are time-series averages of the cross-sectional correlations in monthly data.

	Low Coverage	*Low Leverage*	*High Leverage*	*Low Tax*	*High Tax*	*Low O-Score*	*High O-Score*	*Low VX Index*	*High VX Index*
Low Coverage	1.000								
Low Leverage	0.029	1.000							
High Leverage	0.052	-0.250	1.000						
Low Tax	0.164	0.074	-0.029	1.000					
High Tax	-0.127	-0.035	-0.001	-0.567	1.000				
Low O-score	-0.100	0.483	-0.244	-0.071	0.049	1.000			
High O-score	0.194	-0.194	0.492	0.154	-0.105	-0.250	1.000		
Low VX Index	-0.142	0.283	-0.243	-0.124	0.108	0.327	-0.224	1.000	
High VX Index	0.147	-0.138	0.318	0.067	-0.074	-0.151	0.286	-0.282	1.000

Table 2
Company Attributes

Using annual Compustat data from 1966 to 2002, firms are independently ranked into three categories based on book value of leverage (debt/assets), and five groups by O-Score. Each panel reports the time-series average of annual size-adjusted medians. computed within each leverage-O-Score category. In this table, firms are included in a given year only if there is non-missing data for all attributes listed below. The panel labeled Number of Firms per year reports the time-series average of the number of firms included in the annual median computations.

	Debt/Assets			**Debt/Assets**		
	L	**M**	**H**	**L**	**M**	**H**
OScore	O-Score			Debt/Asset		
L	-3.42	-2.98	-2.83	0.02	0.14	0.32
2	-2.29	-2.14	-2.02	0.04	0.17	0.32
3	-1.49	-1.43	-1.31	0.05	0.21	0.33
4	-0.69	-0.70	-0.57	0.05	0.22	0.37
H	0.58	0.36	0.54	0.04	0.22	0.45
all	-2.73	-1.49	-0.25	0.03	0.19	0.38
	Past 12-Month Return (percent)			Book-to-market Equity		
L	11.49	12.59	8.86	0.53	19.55	23.55
2	13.78	12.49	11.69	0.59	0.76	7.46
3	15.33	13.35	10.43	0.58	0.77	0.93
4	16.02	14.10	10.90	0.56	0.74	0.85
H	12.97	9.55	8.16	0.49	0.57	0.65
all	12.34	11.82	9.25	0.54	0.73	0.75
	Market Capitalization (millions)			Number of Firms (per year)		
L	259.77	657.72	4290.14	296	85	2
2	187.74	385.13	1007.76	141	217	24
3	171.70	246.86	376.72	67	226	89
4	195.04	200.36	246.50	40	154	189
H	147.99	197.07	170.78	30	82	271
all	221.55	297.37	245.59	573	763	573

Table 3
Leverage and O-Score

Each month between June 1966 and December 2003, 12 (j=1,…,12) cross-sectional regressions of the following form are estimated:

$$R_{it} = b_{0jt} + b_{1jt} R_{i,t-1} + b_{2jt} (book_{i,t-1}/mkt_{i,t-1}) + b_{3jt}\, size_{i,t-1} + b_{4jt}\, 52wkW_{i,t-j} + b_{5jt}\, 52wkL_{i,t-j} + b_{6jt}\, LevL_{i,t-j} + b_{7jt}\, LevH_{i,t-j} + b_{8jt}\, OscL_{i,t-j} + b_{9jt}\, OscH_{i,t-j} + e_{ijt}$$

where $R_{i,t}$ and $size_{i,t}$ are the return and the market capitalization of stock i in month t; $52wkW_{i,t-j}$ ($52wkL_{i,t-j}$) is the 52-week high winner (loser) dummy that takes the value of 1 if the 52-week high measure for stock i is ranked in the top (bottom) 20% in month $t-j$, and zero otherwise. The 52-week high measure in month $t-j$ is the ratio of price level in month $t-j$ to the maximum price achieved in months $t-j$-12 to $t-j$. The $(book_{i,t-1}/mkt_{i,t-1})$ variable is computed from the book value of equity in the most recent annual financial statements whose closing date is at least six-months prior to month t, and market value of equity at the end of month $t-1$. The leverage and O-Score dummies are constructed based on highest and lowest 20% rankings by book leverage and O-Score. The accounting variables used to compute book leverage and O-Score are drawn from the most recent annual financial statements whose closing date is at least six-months prior to month t. The coefficient estimates of a given independent variable are averaged over j=1,…,12. For Raw Returns, the numbers reported in the table are the time-series averages of these averages, in percent per month. The accompanying t-statistics are calculated from the time series. For Risk Adjusted Returns, we further run times series regressions of these 12-month averages (one for each average) on the contemporaneous Fama-French factor realizations to hedge out the factor exposure. The numbers reported are intercepts from these time-series regressions. They are in percent per month and their t-statistics are in parentheses. Nobs is the time-series average number of cross-sectional observations in each monthly regression.

	Raw Monthly Returns			Risk Adjusted Monthly Returns		
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	1.21 (4.97)	1.18 (4.47)	1.19 (4.47)	-0.05 (-0.89)	-0.07 (-1.22)	-0.06 (-1.02)
$R_{i,t-1}$	-5.21 (-11.64)	-4.88 (11.14)	-4.95 (11.39)	-4.75 (-10.70)	-4.38 (-10.22)	-4.45 (-10.49)
Book-to-market	0.21 (3.66)	0.20 (3.28)	0.22 (3.60)	0.15 (4.20)	0.14 (3.93)	0.16 (4.41)
Size	-0.06 (-1.77)	-0.07 (1.68)	-0.05 (1.38)	-0.01 (-0.52)	-0.02 (-0.85)	0.00 (-0.18)
52 Wk High Loser	-0.53 (-3.99)	-0.50 (3.78)	-0.50 (3.78)	-0.69 (-5.99)	-0.65 (-5.59)	-0.64 (-5.58)
52 Wk High Winner	0.30 (5.61)	0.33 (5.63)	0.33 (5.79)	0.40 (7.92)	0.43 (7.94)	0.43 (8.08)
Low Leverage	0.11 (1.80)		0.12 (2.02)	0.20 (3.45)		0.21 (3.70)
High Leverage	-0.21 (-3.70)		-0.18 (2.71)	-0.23 (-4.24)		-0.21 (-3.39)
Low O-Score		0.10 (1.62)	0.01 (0.24)		0.20 (3.75)	0.08 (1.51)
High O-Score		-0.14 (-2.42)	-0.04 (0.62)		-0.17 (-2.92)	-0.04 (-0.62)
Nobs	2535	2065	2065	2535	2065	2065

High – Low Leverage	-0.32 (-3.90)		-0.32 (-3.57)	-0.43 (-6.28)		-0.42 (-5.27)
High – Low O-Score		-0.23 (-2.64)	-0.02 (-0.25)		-0.37 (-4.43)	-0.10 (-1.19)

Table 4
Leverage and VX Index of Default Risk

Each month between January 1971 and December 2003, 12 (j=1,…,12) cross-sectional regressions of the following form are estimated:

$$R_{it} = b_{0jt} + b_{1jt} R_{i,t-1} + b_{2jt} (book_{i,t-1}/mkt_{i,t-1}) + b_{3jt}\, size_{i,t-1} + b_{4jt}\, 52wkW_{i,t-j} + b_{5jt}\, 52wkL_{i,t-j} + b_{6jt}\, LevL_{i,t-j} + b_{7jt}\, LevH_{i,t-j} + b_{8jt}\, VXIndexL_{i,t-j} + b_{9jt}\, VXIndexH_{i,t-j} + e_{ijt}$$

where $R_{i,t}$ and $size_{i,t}$ are the return and the market capitalization of stock i in month t; $52wkW_{i,t-j}$ ($52wkL_{i,t-j}$) is the 52-week high winner (loser) dummy that takes the value of 1 if the 52-week high measure for stock i is ranked in the top (bottom) 20% in month t-j, and zero otherwise. The 52-week high measure in month t-j is the ratio of price level in month t-j to the maximum price achieved in months t-j-12 to t-j. The $(book_{i,t-1}/mkt_{i,t-1})$ variable is computed from the book value of equity in the most recent annual financial statements whose closing date is at least six-months prior to month t, and market value of equity at the end of month t-1. The leverage and VX Index dummies are constructed based on highest and lowest 20% rankings by book leverage and the default probability measure of Vassalou and Xing (2004). The accounting variables used to compute book leverage are drawn from the most recent annual financial statements whose closing date is at least six-months prior to month t. The coefficient estimates of a given independent variable are averaged over j=1,…,12. The numbers reported in the Raw Returns columns are the time-series averages of these averages. They are in percent per month. The accompanying t-statistics are calculated from the time series. To obtain risk-adjusted returns, we further run times series regressions of the coefficients averaged over j=1,…,12 (one for each average) on the contemporaneous Fama-French factor realizations to hedge out the factor exposure. The numbers reported for risk adjusted returns are intercepts from these time-series regressions. They are in percent per month and their t-statistics are in parentheses. Nobs is the time-series average number of cross-sectional observations in each monthly regression.

	Raw Monthly Returns		Risk-Adjusted Monthly Returns	
	(1)	(2)	(3)	(4)
Intercept	1.23 (4.33)	1.28 (4.38)	-0.08 (-1.13)	-0.02 (-0.35)
$R_{i,t-1}$	-4.64 (-10.14)	-4.73 (-10.49)	-3.99 (-9.05)	-4.09 (-9.43)
Book-to-market	0.28 (4.15)	0.27 (3.99)	0.22 (5.51)	0.21 (5.28)
Size	-0.02 (-0.44)	-0.02 (-0.44)	-0.01 (-0.28)	-0.01 (-0.25)
52 Wk High Loser	-0.53 (-3.65)	-0.55 (-4.10)	-0.62 (-4.72)	-0.65 (-5.21)
52 Wk High Winner	0.31 (4.98)	0.31 (5.25)	0.43 (7.33)	0.44 (7.77)
Low Leverage		0.04 (0.36)		0.07 (0.86)
High Leverage		-0.16 (-2.42)		-0.19 (-3.60)
Low Default Probability	-0.01 (-0.08)	-0.04 (-0.50)	0.12 (2.61)	0.07 (1.46)
High Default Probability	-0.19 (-2.39)	-0.14 (-1.56)	-0.30 (-4.05)	-0.24 (-3.12)
Nobs	1937	1923	1937	1923

High – Low Leverage		-0.20 (-1.30)		-0.26 (-2.47)
High – Low Default Probability	-0.18 (-1.57)	-0.10 (-0.66)	-0.42 (-4.80)	-0.31 (-3.24)

Table 5
Leverage and Tax Benefits

Each month between January 1971 and December 2003, 12 (j=1,…,12) cross-sectional regressions of the following form are estimated:

$$R_{it} = b_{0jt} + b_{1jt} R_{i,t-1} + b_{2jt} (book_{i,t-1}/mkt_{i,t-1}) + b_{3jt}\, size_{i,t-1} + b_{4jt}\, 52wkW_{i,t-j} + b_{5jt}\, 52wkL_{i,t-j} + b_{6jt}\, LevL_{i,t-j} + b_{7jt}\, LevL_{i,t-j}{*}TaxL_{i,t-j}$$
$$+ b_{8jt}\, LevL_{i,t-j}{*}TaxH_{i,t-j} + b_{9jt}\, LevH_{i,t-j} + b_{10,jt}\, LevH_{i,t-j}{*}TaxL_{i,t-j} + b_{11,jt}\, LevH_{i,t-j}{*}TaxH_{i,t-j} + e_{ijt}$$

where $R_{i,t}$ and $size_{i,t}$ are the return and the market capitalization of stock i in month t; $52wkW_{i,t-j}$ ($52wkL_{i,t-j}$) is the 52-week high winner (loser) dummy that takes the value of 1 if the 52-week high measure for stock i is ranked in the top (bottom) 20% in month t-j, and zero otherwise. The 52-week high measure in month t-j is the ratio of price level in month t-j to the maximum price achieved in months t-j-12 to t-j. The $(book_{i,t-1}/mkt_{i,t-1})$ variable is computed from the book value of equity in the most recent annual financial statements whose closing date is at least six-months prior to month t, and market value of equity at the end of month t-1. The leverage and unlevered tax rate dummies are constructed based on highest and lowest 20% rankings by book leverage and the unlevered tax rate as computed in Graham (2000). The accounting variables used to compute book leverage are drawn from the most recent annual financial statements whose closing date is at least six-months prior to month t. The coefficient estimates of a given independent variable are averaged over j=1,…,12. The numbers reported in the Raw Returns columns are the time-series averages of these averages. They are in percent per month. The accompanying t-statistics are calculated from the time series. To obtain risk-adjusted returns, we further run times series regressions of the coefficients averaged over j=1,…,12 (one for each average) on the contemporaneous Fama-French factor realizations to hedge out the factor exposure. The numbers reported for risk adjusted returns are intercepts from these time-series regressions. They are in percent per month and their t-statistics are in parentheses. Nobs is the time-series average number of cross-sectional observations in each monthly regression.

	Raw Monthly Return	Risk-Adjusted Monthly Return
Intercept	1.32	-0.07
	(4.36)	(-0.82)
$R_{i,t-1}$	-3.66	-3.03
	(-7.10)	(-5.98)
Book to Market	0.20	0.16
	(2.85)	(3.77)
Size	0.01	-0.01
	(0.20)	(-0.49)
52 WK high Loser	-0.42	-0.69
	(-1.99)	(-3.81)
52 WK high Winner	0.35	0.46
	(4.87)	(6.61)
Low Leverage	0.07	0.21
	(0.66)	(2.22)
Low Leverage* Low Tax Benefits	-0.17	-0.22
	(-0.81)	(-1.20)
Low Leverage* High Tax Benefits	0.08	0.04
	(0.84)	(0.38)
High Leverage	-0.16	-0.24
	(-1.65)	(-2.51)
High Leverage* Low Tax Benefits	-0.48	-0.45
	(-2.60)	(-2.48)
High Leverage* High Tax Benefits	0.05	0.02
	(0.55)	(-0.24)
Nobs	2413	2413

Table 6
Leverage and Analyst Coverage

Each month between January 1982 and December 2003, 12 (j=1,…,12) cross-sectional regressions of the following form are estimated:

$$R_{it} = b_{0jt} + b_{1jt} R_{i,t-1} + b_{2jt} (book_{i,t-1}/mkt_{i,t-1}) + b_{3jt}\, size_{i,t-1} + b_{4jt}\, 52wkW_{i,t-j} + b_{5jt}\, 52wkL_{i,t-j} + b_{6jt}\, LevL_{i,t-j} + b_{7jt}\, LevL_{i,t-j}{*}LowCov_{i,t-1} + b_{8jt}\, LevH_{i,t-j} + b_{9jt}\, LevH_{i,t-j}{*}LowCov_{i,t-1} + e_{ijt}$$

where $R_{i,t}$ and $size_{i,t}$ are the return and the market capitalization of stock i in month t; $52wkW_{i,t-j}$ ($52wkL_{i,t-j}$) is the 52-week high winner (loser) dummy that takes the value of 1 if the 52-week high measure for stock i is ranked in the top (bottom) 20% in month t-j, and zero otherwise. The 52-week high measure in month t-j is the ratio of price level in month t-j to the maximum price achieved in months t-j-12 to t-j. The $(book_{i,t-1}/mkt_{i,t-1})$ variable is computed from the book value of equity in the most recent annual financial statements whose closing date is at least six-months prior to month t, and market value of equity at the end of month t-1. The leverage dummies are constructed based on highest and lowest 20% rankings by book leverage. The accounting variables used to compute book leverage are drawn from the most recent annual financial statements whose closing date is at least six-months prior to month t. The low analyst coverage dummy is defined to be one if the firm has less than two analysts covering the stock in month t-1 according to IBES. The coefficient estimates of a given independent variable are averaged over j=1,…,12. The numbers reported in the Raw Returns columns are the time-series averages of these averages. They are in percent per month. The accompanying t-statistics are calculated from the time series. To obtain risk-adjusted returns, we further run times series regressions of the coefficients averaged over j=1,…,12 (one for each average) on the contemporaneous Fama-French factor realizations to hedge out the factor exposure. The numbers reported for risk adjusted returns are intercepts from these time-series regressions. They are in percent per month and their t-statistics are in parentheses. Nobs is the time-series average number of cross-sectional observations in each monthly regression.

	Raw Monthly Return	Risk-Adjusted Monthly Return
Intercept	1.23	-0.10
	(4.21)	(-1.12)
$R_{i,t-1}$	-3.35	-2.82
	(-6.32)	(-5.40)
Book to Market	0.23	0.20
	(3.51)	(4.76)
Size	0.01	0.00
	(0.34)	(-0.04)
52 WK high Loser	-0.66	-0.87
	(-3.07)	(-4.77)
52 WK high Winner	0.39	0.51
	(5.28)	(7.16)
Low Leverage	0.24	0.31
	(1.62)	(3.15)
Low Leverage*	-0.23	-0.14
Low Analyst Coverage	(-1.65)	(-1.37)
High Leverage	-0.25	-0.39
	(-3.35)	(-5.51)
High Leverage*	0.03	0.19
Low Analyst Coverage	(0.37)	(2.20)
Nobs	3279	3279

Table 7
Earnings Announcement Abnormal Returns

Every June from 1966 to 2002, we sort firms independently into five groups by O-score and three groups by debt/asset ratio (top 30%, middle 40% and bottom 30%), and form portfolios based on these groupings. For each firm, we then compute the average abnormal return over the four quarterly announcement returns following portfolio formation and annualize this number by multiplying by four. Following La Porta et al (1997), we benchmark each earnings announcement return by the firm with median book-to-market in the same size decile as the announcer. The numbers in the table are the equally weighted average annualized earning announcement abnormal (net of benchmark) returns. The column labeled H-L is the difference between the returns to high and low leverage groups, and p-values relate to a test of the null hypothesis that the difference between the mean abnormal returns of high and low leverage groups is zero.

	Cumulative Abnormal Returns						**Number of stocks**		
	Debt/Assets						Debt/Assets		
O-Score	L	M	H	H-L	p-value	O-Score	L	M	H
L	-0.37	0.04	0.05	0.42	0.751	L	355	69	2
2	0.07	0.02	-0.10	-0.17	0.756	2	180	219	33
3	0.01	0.60	0.31	0.30	0.454	3	80	216	131
4	0.61	0.45	-0.01	-0.62	0.286	4	48	141	232
H	-0.89	-0.21	0.11	1.00	0.131	H	34	74	281

Table 8
Company Performance
Sorted by Oscore

Using annual Compustat data from 1966 to 2002, firms are independently ranked into three categories based on book value of leverage (debt/assets), and five groups by the VX Index. Return on Assets is computed from annual Compustat data, and standard deviations of return on assets are computed from quarterly Compustat data over 36 future quarters (with a minimum of 10) relative to the ranking period. The panels report time-series averages of annual size-adjusted medians computed within each leverage-O-Score category. Figures at the far right of the H-L rows are p-values for a test of equality of H-L between high and low leverage columns. Firms are included in a given year only if there is non-missing data for all attributes listed below.

	Debt/Assets				Debt/Assets			
	L	**M**	**H**		**L**	**M**	**H**	
	Return on Assets Year 0 (percent)				Return on Assets Year 1 (percent)			
Oscore								
L	10.64	8.49	5.87		9.62	7.64	5.47	
2	8.01	7.32	6.54		7.82	6.79	5.53	
3	6.04	6.31	5.31		6.73	6.21	5.03	
4	4.04	5.03	4.41		5.82	5.28	4.38	
H	-5.34	1.60	2.53		3.23	4.24	3.41	
H-L	-15.98	-6.89	-3.56	0.00	-6.39	-3.40	-2.16	0.00
p-value	0.00	0.00	0.00		0.00	0.00	0.02	

	Return on Assets Year 2 (percent				STD of Return on Assets (percent)			
Oscore								
L	9.08	7.14	3.46		2.98	2.46	7.86	
2	7.69	6.63	5.05		2.85	2.38	3.91	
3	6.45	6.08	4.94		3.69	5.72	2.82	
4	5.75	5.27	4.52		5.71	2.96	2.94	
H	3.38	4.64	3.85		7.73	5.90	4.90	
H-L	-5.70	-2.50	0.27	0.00	5.18	3.44	-2.65	0.03
p-value	0.00	0.00	0.68		0.00	0.00	0.46	

Oscore	Oscore Index			Number of Observations		
L	-3.57	-3.09	-2.81	225	62	1
2	-2.40	-2.26	-2.13	109	164	18
3	-1.59	-1.55	-1.55	51	170	64
4	-0.79	-0.83	-0.72	29	118	141
H	0.39	0.18	0.40	21	62	205
all	-2.85	-1.65	-0.50	429	571	406

Table 9
Company Performance
Sorted by VX Index

Using annual Compustat data from 1966 to 2002, firms are independently ranked into three categories based on book value of leverage (debt/assets), and five groups by the VX Index. Return on Assets is computed from annual Compustat data, and standard deviations of return on assets are computed from quarterly Compustat data over 36 future quarters (with a minimum of 10) relative to the ranking period. The panels report time-series averages of annual size-adjusted medians computed within each VX-Index category. Figures at the far right of the H-L rows are p-values for a test of equality of H-L between high and low leverage columns. Firms are included in a given year only if there is non-missing data for all attributes listed below.

VX Index	Debt/Assets L	Debt/Assets M	Debt/Assets H		Debt/Assets L	Debt/Assets M	Debt/Assets H	
	Return on Assets Year 0 (percent)				Return on Assets Year 1 (percent)			
L	9.38	7.26	5.37		8.90	7.05	5.34	
2	8.24	6.39	5.17		7.79	6.29	5.56	
3	7.66	5.90	5.21		6.79	5.77	5.51	
4	6.54	5.55	4.01		5.83	5.49	4.20	
H	6.39	4.48	2.83		3.51	3.69	3.00	
H-L	-2.99	-2.69	-2.54	0.49	-5.40	-3.39	-2.33	0.03
p-value	0.00	0.00	0.00		0.00	0.00	0.00	
	Return on Assets Year 2 (percent)				STD of Return on Assets (percent)			
L	8.31	6.89	5.66		0.96	0.90	0.83	
2	7.07	6.32	5.33		1.38	0.90	1.04	
3	6.26	5.69	5.50		1.52	1.03	0.89	
4	5.58	5.33	4.27		1.85	1.20	1.09	
H	4.72	4.39	3.45		2.22	1.61	1.29	
H-L	-3.45	-2.64	-2.16	0.01	1.26	0.70	0.44	0.00
p-value	0.00	0.00	0.00		0.08	0.07	0.06	
	VX default Probability (percent				Number of Observations			
L	0.00	0.00	0.00		141	93	22	
2	0.00	0.00	0.00		48	59	20	
3	0.00	0.00	0.00		49	84	46	
4	0.10	0.06	0.06		32	80	75	
H	1.22	1.45	2.58		15	56	114	
all	0.00	0.03	0.18		271	359	251	

Table 10
Leverage and VX Index of Distress Risk with Interactions

Each month between January 1971 and December 2003, 12 (j=1,…,12) cross-sectional regressions of the following form are estimated:

$$R_{it} = b_{0jt} + b_{1jt} R_{i,t-1} + b_{2jt} (book_{i,t-1}/mkt_{i,t-1}) + b_{3jt}\, size_{i,t-1} + b_{4jt}\, 52wkW_{i,t-j} + b_{5jt}\, 52wkL_{i,t-j} + b_{6jt}\, LevL_{i,t-j} + b_{7jt}\, LevH_{i,t-j} + b_{8jt}\, VXIndexL_{i,t-j}$$

$$+ b_{9jt}\, VXIndexH_{i,t-j} + b_{10,jt}\, LevL_{i,t-j}{*}VXIndexL_{i,t-j} + b_{11,jt}\, LevL_{i,t-j}{*}VXIndexH_{i,t-} + b_{12,jt}\, LevH_{i,t-j}{*}VXIndexL_{i,t-j} + b_{13,jt}\, LevL_{i,t-j}{*}VXIndexH_{i,t-j} + e_{ijt}$$

where $R_{i,t}$ and $size_{i,t}$ are the return and the market capitalization of stock i in month t; $52wkW_{i,t-j}$ ($52wkL_{i,t-j}$) is the 52-week high winner (loser) dummy that takes the value of 1 if the 52-week high measure for stock i is ranked in the top (bottom) 20% in month $t-j$, and zero otherwise. The 52-week high measure in month $t-j$ is the ratio of price level in month $t-j$ to the maximum price achieved in months $t-j$-12 to $t-j$. The $(book_{i,t-1}/mkt_{i,t-1})$ variable is computed from the book value of equity in the most recent annual financial statements whose closing date is at least six-months prior to month t, and market value of equity at the end of month $t-1$. The leverage and VX Index dummies are constructed based on highest and lowest 20% rankings by book leverage and the default probability measure of Vassalou and Xing (2004). The accounting variables used to compute book leverage are drawn from the most recent annual financial statements whose closing date is at least six-months prior to month t. The coefficient estimates of a given independent variable are averaged over j=1,…,12. The numbers reported in the raw returns column are the time-series averages of these averages. They are in percent per month. The accompanying t-statistics are calculated from the time series. To obtain risk-adjusted returns, we further run times series regressions of the coefficients averaged over j=1,…,12 (one for each average) on the contemporaneous Fama-French factor realizations to hedge out the factor exposure. The numbers reported for risk adjusted returns are intercepts from these time-series regressions. They are in percent per month and their t-statistics are in parentheses. Nobs is the time-series average number of cross-sectional observations in each monthly regression.

	Raw Monthly Return	Risk-Adjusted Monthly Return
Intercept	1.35 (4.63)	-0.04 (-0.63)
$R_{i,t-1}$	-4.78 (-10.43)	-4.02 (-9.11)
Book-to-market	0.28 (4.05)	0.22 (5.41)
Size	-0.01 (-0.29)	0.00 (-0.05)
52 Wk High Loser	-0.47 (-3.31)	-0.58 (-4.35)
52 Wk High Winner	0.33 (5.30)	0.46 (7.86)
Low Leverage	-0.06 (-0.49)	0.07 (1.17)
High Leverage	-0.18 (-2.51)	-0.23 (-2.74)
Low Default Probability	-0.05 (-0.55)	-0.01 (-0.06)
High Default Probability	-0.19 (-2.16)	-0.20 (-3.35)
Low Def. Prob* Low Leverage	0.17 (1.56)	0.13 (1.18)
Low Def. Prob* High Leverage	-0.09 (-0.87)	0.06 (0.66)
High Def. Prob* Low Leverage	0.92 (2.30)	1.27 (3.08)
High Def. Prob* High Leverage	0.16 (1.54)	0.02 (0.19)
Nobs	1881	1881

Table 11
Company Performance
by Subperiod

Using annual Compustat data from June 1966 to June 1980, then again from June 1980 to June 2001, firms are independently ranked into three categories based on book value of leverage (debt/assets), and five groups by O-Score. Each panel reports the time-series average of annual size-adjusted medians computed within each leverage-O-Score category. In this table, firms are included in a given year only if there is non-missing data for all attributes listed below. Figures at the far right of the H-L rows are p-values for a test of equality of H-L between high and low leverage columns. The panel labeled Number of Firms per year reports the time-series average of the number of firms included in the annual median computations.

Panel A: 1966 – 1979

	Debt/Assets				Debt/Assets			
	L	**M**	**H**		**L**	**M**	**H**	
	Return on Assets Year 0 (percent)				Return on Assets Year 1 (percent)			
OScore								
L	11.02	7.95	6.80		10.38	7.79	4.97	
2	9.20	7.09	6.48		8.72	6.80	5.69	
3	7.97	6.50	5.21		7.66	6.45	5.15	
4	7.09	5.86	4.78		6.62	5.79	4.67	
H	4.66	5.20	3.64		5.51	5.66	3.97	
H-L	-6.37	-2.74	-3.31	0.03	-4.87	-2.13	-1.33	0.10
p-value	0.00	0.00	0.06		0.00	0.00	0.32	

	Return on Assets Year 2 (percent)				STD of Return on Assets (percent)			
OScore								
L	10.02	7.46	5.92		0.92	0.78	1.06	
2	8.32	6.68	5.48		0.94	0.71	1.35	
3	6.95	6.25	5.21		0.87	1.89	0.71	
4	6.15	5.77	4.77		0.94	0.75	0.81	
H	5.75	5.71	4.34		1.15	0.98	0.94	
H-L	-4.27	-1.74	-1.88	0.25	0.27	0.21	-0.22	0.26
p-value	0.00	0.00	0.14		0.47	0.18	0.61	

OScore	Oscore Index			Number of Observations		
L	-3.41	-2.92	-2.52	140	35	1
2	-2.28	-2.18	-2.03	68	100	13
3	-1.51	-1.52	-1.78	30	105	35
4	-0.89	-0.90	-0.79	20	72	83
H	0.25	-0.03	0.29	12	40	126
all	-2.73	-1.62	-0.86	259	345	216

Panel B: 1980 – 2001

	Debt/Assets				Debt/Assets			
	L	M	H		L	M	H	
	Return on Asserts				Return on Asserts			
OScore	Year 0 (percent)				Year 1 (percent)			
L	10.24	8.71	5.95		8.89	7.31	5.33	
2	7.10	7.36	6.44		7.11	6.67	5.20	
3	4.63	6.11	5.27		6.06	5.99	4.78	
4	1.94	4.42	4.08		5.31	4.88	4.10	
H	-12.73	-0.82	1.77		1.54	3.42	3.05	
H-L	-22.97	-9.53	-4.22	0.00	-7.35	-3.89	-2.24	0.00
p-value	0.00	0.00	0.00		0.00	0.00	0.03	

	Return on Asserts				STD of Return on Assets			
OScore	Year 2 (percent)				(percent)			
L	8.18	6.72	2.24		2.27	1.93	3.72	
2	7.23	6.53	4.54		2.17	1.63	2.01	
3	6.01	5.90	4.72		2.61	1.50	1.57	
4	5.54	4.95	4.21		3.08	1.58	1.35	
H	1.82	4.00	3.55		4.27	2.49	1.68	
H-L	-6.35	-2.72	1.32	0.00	2.01	0.56	-2.04	0.00
p-value	0.00	0.00	0.13		0.00	0.00	0.34	

OScore	Oscore Index			Number of Observations		
L	-3.60	-3.16	-2.93	259	75	2
2	-2.45	-2.30	-2.14	127	190	19
3	-1.63	-1.57	-1.45	60	198	78
4	-0.78	-0.83	-0.70	34	137	166
H	0.52	0.23	0.38	25	71	240
all	-2.92	-1.63	-0.37	505	671	505

Table 12
Leverage and O-Score by Subperiod

Each month between June 1965 and December 2003, 12 (j=1,…,12) cross-sectional regressions of the following form are estimated:

$$R_{it} = b_{0jt} + b_{1jt} R_{i,t-1} + b_{2jt} (book_{i,t-1}/mkt_{i,t-1}) + b_{3jt}\, size_{i,t-1} + b_{4jt}\, 52wkW_{i,t-j} + b_{5jt}\, 52wkL_{i,t-j} + b_{6jt}\, LevH_{i,t-j} + b_{7jt}\, LevL_{i,t-j} + b_{8jt}\, OscH_{i,t-j} + b_{9jt}\, OscL_{i,t-j} + e_{ijt}$$

where $R_{i,t}$ and $size_{i,t}$ are the return and the market capitalization of stock i in month t; $52wkW_{i,t-j}$ ($52wkL_{i,t-j}$) is the 52-week high winner (loser) dummy that takes the value of 1 if the 52-week high measure for stock i is ranked in the top (bottom) 20% in month $t-j$, and zero otherwise. The 52-week high measure in month $t-j$ is the ratio of price level in month $t-j$ to the maximum price achieved in months $t-j$-12 to $t-j$. The $(book_{i,t-1}/mkt_{i,t-1})$ variable is computed from the book value of equity in the most recent annual financial statements whose closing date is at least six-months prior to month t, and market value of equity at the end of month $t-1$. The leverage and O-Score dummies are constructed based on highest and lowest 20% rankings by book leverage and O-Score. The accounting variables used to compute book leverage and O-Score are drawn from the most recent annual financial statements whose closing date is at least six-months prior to month t. The coefficient estimates of a given independent variable are averaged over j=1,…,12. For Raw Returns, the numbers reported in the table are the time-series averages of these averages, in percent per month. The accompanying t-statistics are calculated from the time series. For Risk Adjusted Returns, we further run times series regressions of these 12-month averages (one for each average) on the contemporaneous Fama-French factor realizations to hedge out the factor exposure. The numbers reported are intercepts from these time-series regressions. They are in percent per month and their t-statistics are in parentheses. Nobs is the time-series average number of cross-sectional observations in each monthly regression. Results for the entire sample period are repeated from Table 3 for ease of comparison.

	Raw Monthly Returns			Risk Adjusted Monthly Returns		
	Jun 1965 to Dec 1979	**Jan 1980 to Dec 2003**	**Entire Sample**	**Jun 1965 to Dec 1979**	**Jan 1980 to Dec 2003**	**Entire Sample**
	(1)	(2)	(3)	(4)	(5)	(6)
Intercept	1.10	1.20	1.19	0.01	-0.09	-0.06
	(2.13)	(4.08)	(4.47)	(0.19)	(-0.94)	(-1.02)
$R_{i,t-1}$	-7.39	-2.84	-4.95	-6.74	-2.49	-4.45
	(-9.97)	(-5.02)	(11.39)	(-9.91)	(-4.46)	(-10.49)
Book-to-market	0.26	0.24	0.22	0.14	0.20	0.16
	(2.26)	(3.52)	(3.60)	(2.56)	(4.29)	(4.41)
Size	-0.13	0.00	-0.05	-0.01	0.01	0.00
	(-1.67)	(0.11)	(1.38)	(-0.33)	(0.36)	(-0.18)
52 Wk High Loser	-0.42	-0.54	-0.50	-0.61	-0.71	-0.64
	(-2.63)	(-2.79)	(3.78)	(-4.95)	(-4.12)	(-5.58)
52 Wk High Winner	0.18	0.40	0.33	0.30	0.52	0.43
	(1.86)	(5.41)	(5.79)	(3.52)	(7.40)	(8.08)
Low Leverage	0.05	0.16	0.12	0.10	0.27	0.21
	(0.67)	(1.88)	(2.02)	(1.33)	(3.59)	(3.70)
High Leverage	-0.12	-0.20	-0.18	-0.10	-0.30	-0.19
	(-0.85)	(-2.99)	(2.71)	(-0.76)	(-5.06)	(-3.28)
Low O-Score	0.06	-0.02	0.01	0.07	0.05	0.08
	(0.72)	(-0.25)	(0.24)	(0.97)	(0.85)	(1.71)
High O-Score	0.10	-0.11	-0.04	0.09	-0.10	-0.05
	(1.04)	(-1.36)	(0.62)	(0.93)	(-1.11)	(-0.72)
Nobs	1394	2544	2065	1394	2544	2065