Default Risk, Shareholder Advantage, and Stock Returns[*]

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Abstract

In this paper, we analyze the relationship between default probability and stock returns. Using the market-based measure of *Expected Default Frequency*™ (EDF™) constructed by *Moody's KMV*, we first demonstrate that higher default probabilities *are not necessarily* associated with higher expected stock returns, a finding that complements the existing evidence based on alternative measures of default probability. We then show that the puzzling and complex relationship between stock returns and default probability is consistent with the implications of existing structural models of default that explicitly account for the renegotiation between equity-holders and debt-holders, and hence for the deviation from the absolute priority rule upon default. We derive an analytical relationship between expected returns and default probability based on one such model (Fan and Sundaresan (2000)). Our analysis implies that distressed firms in which shareholders have a stronger advantage in renegotiation should exhibit lower expected returns, and default risk to equity is not properly represented by default probability alone. We test this implication using several proxies for shareholder advantage and find strong support in the data. The data do not seem to support, conversely, the hypothesis that this relationship is caused by market mispricing of financially distressed firms. Our study highlights the effect of strategic interactions between firm's claimants on stock returns, and provides a novel understanding of the link between default risk and stock returns.

Keywords: Default Risk, Stock Returns, Bankruptcy, Liquidation.
JEL Classification: G12, G14.

1 Introduction

Default is a key aspect of every company's life. Default risk is usually defined as the possibility that a company will not be able to meet its financial obligations in the future. Given the customary assumption that equity-holders receive nothing upon default, economic intuition would suggest that the equity of a company with a higher level of default risk should demand a higher expected return. However, earlier studies (e.g., Dichev (1998) and Griffin and Lemmon (2002)) have documented an empirical relationship that is the *opposite* of this intuition: companies with a higher probability of default usually earn *lower* stock returns.[1] The studies argue that this pattern may be attributable to market mispricing of these stocks. Since default risk is often used as an explanation for a variety of asset pricing anomalies,[2] it is essential to have a solid understanding of the underlying economic mechanism driving the observed relationship between default risk and stock returns.

In this paper we provide a simple explanation of the connection between default risk and equity returns that does not appeal to market mispricing and is in fact consistent with the risk-return trade-off. We achieve this objective in three steps. First, we revisit the empirical relationship between default risk and stock returns by directly employing a database of *Expected Default Frequencies*™ (EDF™) generated by *Moody's KMV* (MKMV), which is widely used by financial institutions as a predictor of default probability. Using the EDF measure, we find that higher default probabilities do not consistently lead to higher expected stock returns. This finding complements the existing evidence from alternative measures of default risk and is suggestive of cross-sectional variations in the relationship.

Second, we illustrate the point that, in order to understand the empirically observed pattern, it is essential to recognize that assessing the risk to equity associated with default should also take into account the potential recovery for *shareholders*, which can be an outcome of the renegotiation between debt-holders and shareholders in the event of financial distress. The importance of considering explicitly the strategic interaction between claimants is underscored by the fact that firms in financial distress often try to reorganize their debt obligations either through private workouts or under the protection of Chapter 11 bankruptcy filings. A number of theoretical models have explicitly considered this strategic interaction and investigated its

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[1] This pattern has been recently confirmed by Campbell, Hilscher, and Szilagyi (2005).

[2] See, for example, Fama and French (1996) and Chan and Chen (1991).

implications for optimal capital structure and credit spreads on corporate bonds.[3] Our innovation in this paper is to show that this consideration is also important for explaining the puzzling behavior of stock returns. For this purpose, we adopt the model of Fan and Sundaresan (2000), whose parsimonious setup captures the essence of the bargaining game between debt-holders and shareholders and allows us to derive explicitly the link between default probability and expected stock returns.

Our analysis highlights the crucial role of *shareholder advantage*—defined as the combination of shareholders' bargaining power and the efficiency gained through bargaining (i.e., avoided liquidation costs)—in the determination of equity returns. We show that the ability of shareholders with a stronger advantage to extract value from debt-holders leads to lower risk for equity and hence lower expected returns. On the other hand, for stocks whose shareholders have a weaker advantage, we show that there exists a positive relationship between default probability and expected equity returns, consistent with the original intuition associated with treating default as *liquidation* without recovery. Therefore, our analysis indicates that, in the presence of shareholder advantage, default probability does not adequately represent the risk of default to equity, since higher default probability is associated with a potential reduction in debt burden and hence in equity risk. In fact, the trade-off between default risk and the likelihood of bargaining gains in renegotiation results in a hump-shaped relationship between expected return and default probability. For low levels of default probability, when strategic issues in debt renegotiations are less likely to emerge, the relationship is positive. For high levels of default probability, this relationship turns negative, reflecting the higher likelihood of shareholders' strategic gains from renegotiation.

Third, through the "lenses" of the model, we are able to refine our empirical analysis by taking a fresher look at the data. We hypothesize that the negative relationship between default risk and expected return is more pronounced for firms with (i) a large asset base, which can make their shareholders more powerful in renegotiations; (ii) low R&D expenditures, which, *ceteris paribus*, reduce the likelihood of a liquidity shortage and hence strengthen shareholders' bargaining position; (iii) high liquidation costs—proxied by asset specificity—which give debt-holders a stronger incentive for a negotiated settlement; and (iv) a low book-to-market ratio, which, similarly, would make all claimholders of such firms more keen to renegotiate in order

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[3] See, for example, Anderson and Sundaresan (1996), Mella-Barral and Perraudin (1997), Fan and Sundaresan (2000), Acharya, Huang, Subrahmanyam, and Sundaram (2004), and François and Morellec (2004).

to avoid liquidation and the ensuing destruction of valuable growth options. All else being equal, shareholder advantage will be stronger either because their bargaining position in debt renegotiation is stronger or because benefits from renegotiation to avoid liquidation are greater.

Using the above variables as proxies for shareholder advantage, we study the relationship between stock return and EDF through both a sub-portfolio analysis and a multivariate regression analysis. To isolate the effect of shareholder advantage on stock returns from other characteristics that might be correlated with our variables, we follow Daniel, Grinblatt, Titman, and Wermers (1997) and examine excess returns relative to corresponding benchmark portfolios matched in size, book-to-market ratio, and past momentum.

Our empirical findings are strongly supportive of the conjecture that shareholder advantage plays a key role in the link between default probability and stock returns. In particular, returns decrease in EDF for firms with large asset size and low R&D expenditure (proxies for bargaining power) and for firms with high asset specificity and low book-to-market ratio (proxies for bargaining benefits). Moreover, we find that the cross-sectional divergence in the relationship is both statistically significant and economically meaningful.

One possible alternative explanation for the documented relationship between default probability and equity returns is the market mispricing argument advanced by Dichev (1998) and Griffin and Lemmon (2002). If the observed phenomenon is due to investors committing cognitive errors in evaluating financially distressed firms, it is reasonable to believe that this is more likely to happen among firms that have a higher level of information asymmetry, are illiquid, or have fewer institutional holdings. Contrary to the mispricing argument, however, we find no discernible difference in the relationship between default probability and equity returns when we compare (i) portfolios of stocks with high and low degrees of dispersion in analyst forecasts (a proxy for asymmetric information), (ii) portfolios of stocks with high and low turnover (a proxy for liquidity), and (iii) portfolios of stocks with high and low institutional holdings. This implies that market mispricing is not likely to be the main cause for the observed complex relationship between default probability and stock returns.

Compared to the large body of work devoted to modelling default risk for the purpose of valuating corporate debt,[4] the literature has so far paid relatively less attention to the relationship between stock returns and default probability, except for the few papers cited above that

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[4] See the book by Duffie and Singleton (2003) for a comprehensive overview of the literature on credit risk and the pricing of corporate debt.

have documented an inverse relationship. Vassalou and Xing (2004), using an own-constructed default measure that mimics MKMV EDF, argue for a *positive* relationship between stock returns and default probability, which seems at odds with the evidence cited earlier. We show, however, that a deeper analysis of the underlying economic mechanisms emerging for firms in financial distress is necessary to understand the subtleties of the relationship between default risk and equity returns.

As mentioned before, the mechanism we use to explain the link between stock returns and default risk—shareholder advantage in strategic debt service—has been initially proposed in the literature of optimal capital structure and bond pricing. Several recent theoretical papers also examine specific features of bankruptcy codes and their effects on the valuation of corporate debt.[5] None of these papers, however, focus on the relationship between stock returns and default probability examined in this paper. On the empirical side, Davydenko and Strebulaev (2004) investigate the significance of shareholders' strategic actions for credit spreads and find that while the effect is statistically significant, its economic impact on debt-holders is minimal.

In this paper we show that, conversely, the economic impact of shareholders' strategic actions can be very significant to *shareholders*, who would have received nothing in liquidation. Our study demonstrates that this economic mechanism can help explain the complex effect of default risk on stock returns and highlight the importance of strategic interactions in a setting where it matters the most, to the residual claimants. Our analysis clarifies the characterization of default risk and illustrates that the observed patterns are in fact consistent with the risk-return tradeoff. Our findings of cross-sectional variations in the relationship between stock returns and default probability are robust to a host of different econometric specifications and help to reconcile the conflicting evidence reported in the literature.

The rest of the paper proceeds as follows. In Section 2 we review the existing empirical evidence on the relationship between default probability and stock returns and present our own empirical results. In Section 3 we derive the relationship in the context of the Fan and Sundaresan (2000) model, and in Section 4 we test its empirical implications in the cross section. In Section 5 we investigate whether the observed relationship between equity returns and default probability is attributable to mispricing. We conclude in section 6. We provide technical details in Appendix A, and tables and figures in Appendix B.

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[5] See for example, Broadie, Chernov, and Sundaresan (2004), Galai, Raviv, and Wiener (2003), François and Morellec (2004), and Paseka (2003).

2 Should expected stock returns increase with default risk?

To help place the empirical evidence in a proper context, consider the textbook case of a firm whose capital structure is composed of equity (E) and a single zero-coupon debt issue with face value D and maturing at time T. This is what underlies the Merton (1974) model for debt valuation. Assuming that the conditions of the Black and Scholes (1973) model are satisfied, we can evaluate the equity as a European call option on the value of the assets (V), i.e.,

$$E = V\,\mathcal{N}(d_1) - D\,e^{-rT}\mathcal{N}(d_2) \tag{1}$$

where $\mathcal{N}(\cdot)$ is the cumulative standard Normal distribution and

$$d_1 = \frac{\log\left(\frac{V}{D}\right) + (r + \frac{\sigma^2}{2})T}{\sigma\sqrt{T}}, \quad d_2 = d_1 - \sigma\sqrt{T}, \tag{2}$$

with r denoting the risk-free rate for lending and borrowing and σ representing the volatility of asset values. In the context of this simple Black-Scholes' world, it is well-known that the expected instantaneous return r_E on equity is

$$r_E = r + (\mu - r) \times \mathcal{N}(d_1)\frac{V}{E} \tag{3}$$

where μ is the growth rate of the asset value and $\mathcal{N}(d_1)$ is the "delta" of equity. In this setting, the default threshold is simply the face value of the debt D and the default probability, evaluated at time zero under the true probability measure governing the underlying process V, is

$$\text{Prob}(V_T < D) = \mathcal{N}(h), \qquad h = \frac{\log\left(\frac{D}{V}\right) - \left(\mu - \frac{\sigma^2}{2}\right)T}{\sigma\sqrt{T}}, \tag{4}$$

where V_T is the asset value at time T. In this simple setup, we can show that the expected equity return (3) is increasing in default probability (4), as stated in the following proposition.

Proposition 1 *Suppose that the assumptions of the Black and Scholes (1973) model are satisfied and that assets demand a positive risk premium, $\mu - r > 0$. If default triggers liquidation and equity-holders receive nothing upon default, then expected return on equity is monotonically increasing in default probability.*

Proof: See Appendix A.

The intuition for this result is simple. Consider for example an increase in the asset value V. This lowers the value of h and hence the default probability. In Appendix A we show that the derivative of r_E with respect to the leverage ratio D/V is always positive. Hence an increase in the leverage ratio simultaneously raises the probability of default and the expected return on equity. It follows that, if default triggers liquidation, there always exists a positive relationship between probability of default and expected returns.

2.1 Previous empirical evidence

Despite its intuitive nature, the implication of the above analysis is not supported by the existing empirical evidence. Dichev (1998), using Ohlson (1980) O-score and Altman (1968) Z-score as proxies for the likelihood of default, finds an inverse relationship between stock returns and default probability.[6] This result is confirmed by Griffin and Lemmon (2002) who argue that the phenomenon is driven by the poor performance of the firms with low book-to-market ratio and high distress risk, and attribute it to market mispricing of these distressed stocks.

Recognizing that both O-score and Z-score are accounting-based measures that may have limited forecasting power, Vassalou and Xing (2004) construct a metric for default probability in the same spirit of the Merton (1974) model of the previous section. They find that high-default-risk firms with a small market capitalization and a high book-to-market ratio earn higher returns than their low-default-risk counterparts and conclude that default risk is systematic and positively priced in stock returns. However, this result has been questioned by Da and Gao (2005) who show that some of the very high returns earned by small stocks with high default risk and a high book-to-market ratio are attributable to the illiquidity of these stocks.

Campbell, Hilscher, and Szilagyi (2005) study the determinants of corporate bankruptcy using a hazard model approach, similar to Shumway (2001) and Chava and Jarrow (2002), and find that firms with a high probability of bankruptcy do not have high average returns. They suggest that this evidence is indicative of the fact that equity markets do not properly price distress risk.

In the following subsection, we present our own evidence on the relationship between stock returns and distress risk using the EDF measure from MKMV. This measure has not been used

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[6] There is, however, a discernable hump in the relationship documented by Dichev (1998).

in this context before in the literature, so our investigation adds to the body of evidence and helps clarify the empirical regularity on this issue.

2.2 Our empirical findings

2.2.1 Data and summary statistics

Our measure of default risk is the *Expected Defalut Frequency* (EDF) obtained directly from MKMV. This measure is constructed from the Vasicek-Kealhofer model (Kealhofer (2003a) and Kealhofer (2003b)) which adapts the Black and Scholes (1973) and Merton (1974) framework to make it suitable for practical analysis.[7]

To be included in our analysis a stock should be present simultaneously in the CRSP, COMPUSTAT and MKMV databases. Specifically, for a given month, we require a firm to have an EDF measure and an implied asset value in the MKMV dataset, price, shares outstanding and returns data from CRSP, and accounting numbers from COMPUSTAT. We limit our sample to non-financial US firms.[8] We drop from our sample stocks with a negative book-to-market ratio. Our baseline sample contains 1,430,713 firm-month observations and spans from January 1969 to December 2003.[9]

Figure 1 reports the time series of monthly cross-sectional average of EDF over our sample period with shaded areas representing NBER recession periods. The picture clearly shows that average default rates usually peak in recessions, suggesting the presence of a systematic macroeconomic influence in the default measure. Summary statistics for the EDF measure are reported in Table 1. The average EDF measure in our sample is 3.44% with a median of 1.19%. Figure 2 provides snapshots of the cross-sectional distribution of the EDF measure at four instants in our sample: March of 1972, 1982, 1992 and 2002. During the economic downcycles the distribution of the EDF measure appears to widen. The spikes observed at the EDF measure of 20% in Figure 2 are due to the fact that MKMV assigns a EDF score of 20% to all firms with an EDF measure larger than 20%. The table and figures show that while there are

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[7] See Crosbie and Bohn (2003) for details on how MKMV implements the Vasicek-Kealhofer model to construct the EDF measure. In addition, as indicated by Jeff Bohn of Moody's KMV, the EDF measure is constructed based on extensive data filtering to avoid the influence of outliers due to data errors, a sophisticated iterative search routine to determine asset volatility and access to a comprehensive database of default experiences for an empirical distribution of distance-to-default.

[8] Financial firms are identified as firms whose industrial code (SIC) are between 6000 and 6999.

[9] We follow Shumway (1997) to deal with the problem of delisted firms. Specifically, whenever available, we use the delisted return reported in the CRSP datafile for stocks that are delisted in a particular month. If the delisting return is missing but the CRSP datafile reports a performance-related delisting code (500, 520-584), then we impute a delisted return of -30% in the delisting month.

time-series variations in the average EDF measure and in the distribution of the EDF measure, the majority of the firms in our dataset have an EDF score below 4%.

2.2.2 Equity returns and default probability

In our empirical analysis, we measure default probability by using an exponentially smoothed EDF measure based on a time-weighted average in order to mitigate the effect of stock volatility on the estimation of the original EDF measure. Specifically, for default probability in month t, we use

$$\overline{EDF_t} = \frac{\sum_{s=0}^{5} e^{-s\nu} EDF_{t-s}}{\sum_{s=0}^{5} e^{-s\nu}}, \tag{5}$$

where ν is chosen to satisfy $e^{-5\nu} = 1/2$, such that the five-month lagged EDF measure receives half the weight of the current EDF measure. The empirical results are reported based on $\overline{EDF_t}$, which we will still refer to as EDF for notational convenience. Our results, however, are robust to the use of the original EDF measure.

We start our analysis by forming portfolios of stocks according to their EDF ranking, namely, we form portfolios based on the weighted EDF measure in month t. Our analysis is performed on the returns of these portfolios in month $t + 2$, so that we skip a month between portfolio formation and return recording in order to control for microstructure and liquidity issues.[10] The results are presented in Table 2, where we report the time-series averages and t-statistics of the returns in each EDF quintile.

Panel A of Table 2 demonstrates a puzzling pattern in the relationship between stock returns and EDF measures. While equally-weighted portfolio returns show a positive relationship to default probability, for value-weighted portfolio returns, this relationship is almost flat and slightly humped. Although this pattern is similar to that in Vassalou and Xing (2004),[11] it seems to be in contrast to the results reported by Dichev (1998), Griffin and Lemmon (2002) and Campbell, Hilscher, and Szilagyi (2005). To see the effect of extremely low-priced stocks on this return pattern, in Panel B we report the result obtained by excluding stocks with price per share less than \$2. The absence of low-priced stocks takes away the positive relationship between equally-weighted returns and EDFs while keeping the result for value-weighted returns virtually

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[10] We have also examined one- and three-month returns and obtained similar results.

[11] While these authors construct their own market-based default probability measure using the Merton (1974) model, we use the EDF measure directly obtained from MKMV. Because sometimes results can be heavily impacted by outliers in these measures due to data errors, by using MKMV's EDF measure directly we benefit from the extensive data cleaning and the rich empirical default database reflected in MKMV's EDF measure.

intact. Hence the positive relationship for equally-weighted return in Panel A is attributable to low-priced stocks.

To isolate the effect of the EDF measure on stock returns from other characteristics, we follow the methodology suggested by Daniel, Grinblatt, Titman, and Wermers (1997) (DGTW henceforth) and adjust the return of each stock by subtracting the return of a benchmark portfolio that matches the stock's size, book-to-market ratio and momentum (see also Wermers (2004)).[12] The sample period of DGTW-adjusted returns spans from June 1975 to June 2003 due to the availability of the benchmark portfolio returns. The relationship is presented in Panel C of Table 2 for the full sample and Panel D for the subsample without stocks priced less than $2 per share. The results show that for the full sample the positive relationship between equally-weighted DGTW-adjusted returns and EDFs is now stronger and statistically significant, while the relationship for value-weighted returns remain mostly flat and slightly humped. This again suggests different behaviors of small and large stocks. Without the low-priced stocks, however, both equally- and value-weighted DGTW-adjusted returns are declining with the EDF measure, after an initial hump. As shown in Panel D, the return difference between low-EDF and high-EDF value-weighted portfolios is economically significant at 0.34% per month, and also statistically significant at 10% level with a t-statistic of -1.72.

Compared to Dichev (1998), Griffin and Lemmon (2002) and Campbell, Hilscher, and Szilagyi (2005), our results convey a similar observation, namely, high default probability is not associated with high future stock returns. Our empirical design, however, is different from theirs, as these other studies examine returns over longer holding periods (1-4 years) while our study focuses on returns over shorter horizons (1-3 months). Because we are interested in the relation between expected equity returns and the *level* of default probability, shorter horizons mitigate a potential problem of credit migration and its effect on stock returns that may interfere with the inference using long-horizon returns (see, e.g., Avramov, Chordia, Jostova, and Philipov (2005)). While the relation between expected equity returns and the *change* in default probability is an interesting and important subject to study, it is beyond the scope of this paper.

Our findings in this section seem to defy a simple explanation. On the one hand, they are not consistent with the simple intuition we discussed earlier that calls for a positive relationship between stock return and default probability. On the other hand, the different behavior of equal- and value-weighted returns suggests cross-sectional variations in this relationship. In the

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[12] We thank Kent Daniel and Russ Wermers for providing data on characteristics benchmark portfolio returns.

following sections, we propose a mechanism based on strategic interactions between claimholders in distressed firms that generate implications consistent with the observed empirical evidence without violating the risk-return trade-off.

3 Understanding the effect of default risk on stock returns

The empirical evidence presented in the previous section seems at odds with simple intuition, which is based on the premise that upon default, a firm will liquidate its assets and pay off creditors. In practice, though, liquidation is only one of the possibilities open to a firm in financial distress and it is usually a last-resort option. Frequently, firms choose to renegotiate outstanding debt either in a private workout or under the protection of the U.S. Bankruptcy Code (Chapter 11). In principle, the decision to renegotiate is a choice of the manager and, if accepted by the debt-holders, entails a bargaining game between the parties involved. There is substantial evidence in the literature (e.g, Franks and Torous (1989), Weiss (1991), Eberhart, Moore, and Roenfeldt (1990), and Betker (1995)) on direct and indirect costs of bankruptcy as well as on the fact that bankruptcy procedures frequently allow for opportunistic behavior of claimholders and subsequent violation of the absolute priority rule.

Anderson and Sundaresan (1996), Mella-Barral and Perraudin (1997), Fan and Sundaresan (2000), Acharya, Huang, Subrahmanyam, and Sundaram (2004) explicitly evaluate corporate claims within a model that allows for the possibility of out-of-court renegotiation while François and Morellec (2004) develop a model designed to capture the unique features of Chapter 11 renegotiation (automatic stay and exclusivity period).[13]

In this section we show how the strategic framework proposed by these theoretical models can be used to reconcile the puzzling empirical relationship between default ptobability and stock returns documented earlier. The main intuition is that in a renegotiation game there is room for strategic default such that shareholders can extract rents from bondholders in the form of lower payments on their debt contract obligations. This "shareholder advantage" is a function of their bargaining power and has to ultimately affect the riskiness of equity in equilibrium. The stronger the bargaining power in the renegotiation game, the higher the rent extraction ability of shareholders, the lower the risk and expected returns of equity.

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[13] Other papers analyzing the effect of the bankruptcy codes on debt valuation include Broadie, Chernov, and Sundaresan (2004), Galai, Raviv, and Wiener (2003), and Paseka (2003).

For the purpose of our argument, we adopt the model of Fan and Sundaresan (2000) which, we believe, is the most parsimonious setup in which we can fully highlight "the implication of the *relative bargaining power of claimants* on optimal reorganization and debt valuation." (p. 1050, their emphasis). As it will become clear, the implication of our analysis can be easily obtained in the context of all the other models that allow for a bargaining game in renegotiation.

3.1 Equity returns in the Fan and Sundaresan (2000) model

We briefly review the basic elements of the renegotiation model of Fan and Sundaresan (2000) (FS hereafter) and rely on their valuation results to derive an expressions for expected returns on equity and default probabilities. The model is set in continuous time and makes the following assumptions:

Assumption 1 *A firm has equity and a single issue of perpetual debt outstanding with a promised coupon rate* c *per unit time.*

Assumption 2 *The default-free term structure is flat with instantaneous riskless rate,* r*, per unit time.*

Assumption 3 *The payment of the contractual coupon* c *entails the firm to a tax benefit* τc *(*$0 \leq \tau \leq 1$*). Such benefits are lost during the default period.*

Assumption 4 *Firms cannot sell assets to pay dividends.*

Assumption 5 *There are dissipative liquidation costs* α $(0 \leq \alpha \leq 1)$*, proportional to the value of the asset upon liquidation. The absolutely priority rule is strictly followed upon liquidation, that is, if liquidation occurs when the values of the assets is* V_B*, equityholders get nothing and debt-holders get* $(1-\alpha)V_B$*.*

Assumption 6 *The asset value of the firm,* $V(t)$*, follows the geometric Brownian motion*

$$\frac{dV(t)}{V(t)} = (\mu - \delta)\, dt + \sigma\, dB(t) \tag{6}$$

where μ *is the instantaneous rate of return on assets,* δ *is the payout rate,* σ *is the instantaneous volatility and* $B(t)$ *is a standard Brownian motion. With the tax-shield the value of the firm,* $v(V)$*, is larger than the value of the assets,* V*.*

Although FS consider also extensions to allow for fixed liquidation costs and finite-maturity debt, to keep our analysis more tractable without affecting economic intuition, we maintain the assumptions outlined above.

FS analyze two types of exchange offers happening during debt workouts: (i) *debt-equity swaps*, in which shareholders offer debt-holders a fraction of the firm's equity in replacement of their original debt obligations, leaving the control of the firm in the hands of debt-holders, and (ii) *strategic debt service*, in which shareholders stop making the agreed-upon payments to bondholders when the asset value falls below a threshold but keep control of the firm, servicing the debt "strategically" until the asset value returns above such threshold. In the absence of taxes the two types of exchange offers are identical. In the presence of taxes, however, the strategic default service is the dominating alternative since under this arrangement shareholders can capture the future tax benefits which are foregone in the debt-equity swap. We will henceforth limit our analysis to the case of strategic debt service.

3.1.1 The bargaining game

Upon entering the default state, a bargaining game between firm's claimants ensues. The parties will bargain over the total value of the firm $v(V)$ and the sharing rule is determined as an equilibrium of a Nash bargaining game between shareholders and debt-holders. More specifically, if $\widetilde{V}_S$ denotes the trigger point in asset value for which strategic debt service is initiated, for any $V \leq \widetilde{V}_S$ the firm value $v(V)$ is split between equityholders and debt-holders as follows

$$\widetilde{E}(V) = \tilde{\theta} v(V), \quad \widetilde{D}(V) = (1-\tilde{\theta}) v(V), \tag{7}$$

where $\widetilde{E}(\cdot)$ and $\widetilde{D}(\cdot)$ are the values of equity and debt, respectively, and $\tilde{\theta}$ is the sharing rule.

To determine the equilibrium sharing rule, FS consider a Nash bargaining game in which η represents the bargaining power of shareholders and $1-\eta$ is the bargaining power of bondholders. The incremental value for shareholders by bargaining is $\tilde{\theta} v(V) - 0$, since the alternative to bargaining is being liquidated and receiving zero. The incremental value to debt-holder is $(1-\tilde{\theta})v(V) - (1-\alpha)V$, since the alternative again is liquidation, which entails a dissipative cost α (Assumption 5). The Nash solution is hence

$$\begin{aligned}\tilde{\theta}^* &= \arg\max \left[\tilde{\theta} v(V) - 0\right]^{\eta} \left[(1-\tilde{\theta})v(V) - (1-\alpha)V\right]^{1-\eta} \\ &= \eta \left(1 - \frac{(1-\alpha)V}{v(V)}\right), \end{aligned} \tag{8}$$

showing that shareholders get more of the renegotiation surplus, the higher is their bargaining power η and the larger is the liquidation cost α. The effect of bargaining power on the sharing rule is obvious. The role of the liquidation costs is more subtle and derives from the fact that higher liquidation costs generate a stronger incentive for debt-holders to participate in the bargaining game, and thus indirectly increasing shareholders' bargaining power.

3.1.2 Valuation

The valuation of claims follows standard techniques of contingent claim analysis (see, for example, Dixit and Pindyck (1994)). Proposition 3 in FS gives the trigger point for the strategic debt service as

$$\widetilde{V}_S = \frac{c(1-\tau+\eta\tau)}{r}\frac{-\lambda_1}{1-\lambda_1}\frac{1}{1-\eta\alpha}, \tag{9}$$

where

$$\lambda_1 = \left(\frac{1}{2} - \frac{r-\delta}{\sigma^2}\right) - \sqrt{\left(\frac{1}{2} - \frac{r-\delta}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} < 0. \tag{10}$$

The corresponding equity value is given by

$$\widetilde{E}(V) = \begin{cases} V - \frac{c(1-\tau)}{r} + \left[\frac{c(1-\tau)}{(1-\lambda_1)r} - \frac{\lambda_1(1-\lambda_2)\eta}{(\lambda_2-\lambda_1)(1-\lambda_1)}\frac{\tau c}{r}\right]\left(\frac{V}{\widetilde{V}_S}\right)^{\lambda_1} & \text{if } V > \widetilde{V}_S, \\ \eta\alpha V - \eta\frac{\lambda_1}{\lambda_2-\lambda_1}\frac{\tau c}{r}\left(\frac{V}{\widetilde{V}_S}\right)^{\lambda_2} & \text{if } V \leq \widetilde{V}_S, \end{cases} \tag{11}$$

where

$$\lambda_2 = \left(\frac{1}{2} - \frac{r-\delta}{\sigma^2}\right) + \sqrt{\left(\frac{1}{2} - \frac{r-\delta}{\sigma^2}\right)^2 + \frac{2r}{\sigma^2}} > 1. \tag{12}$$

3.2 Equity returns and default probabilities

For its empirical relevance, the relationship we are most interested in is the connection between equity returns and default probabilities. In order to analyze this relationship we need to derive both the expected return on equity and the cumulative default probability implied by the above model.

The closed-form expression for equity in (11) is our starting point for deriving implications of the bargaining game for expected returns. The theoretical equivalent of the MKMV EDF measure in the FS model is the probability of hitting the renegotiation boundary $\widetilde{V}_S$ in (9) under the *true* probability measure governing the underlying process V. The following proposition formally derives expected returns and default probabilities in the FS model.

Proposition 2 *Let the assumptions of the FS model be satisfied. The t-period continuously compounded expected return on equity is*

$$r^E_{(0,t]}(V_0) = \frac{1}{t}\log\left(\frac{\mathbb{E}(\widetilde{E}(V_t))}{\widetilde{E}(V_0)}\right), \tag{13}$$

where $\mathbb{E}(\cdot)$ *denotes expectation taken with respect to the true probability measure governing the asset value process in (6) and, given (11),*

$$\begin{aligned} \mathbb{E}(\widetilde{E}(V_t)) \;=\; & \eta\alpha V_0 e^{(\mu-\delta)t}\mathcal{N}\left(h(t)-\sigma\sqrt{t}\right) - \eta\frac{\lambda_1}{\lambda_2-\lambda_1}\frac{\tau c}{r}\left(\frac{V_0}{\widetilde{V}_S}\right)^{\lambda_2} e^{\lambda_2(\gamma-\lambda_2)t}\mathcal{N}\left(h(t)-\lambda_2\sigma\sqrt{t}\right) \\ & + V_0 e^{(\mu-\delta)t}\mathcal{N}\left(-h(t)+\sigma\sqrt{t}\right) - \frac{c(1-\tau)}{r}\mathcal{N}\left(-h(t)\right) \\ & + \left[\frac{c(1-\tau)}{(1-\lambda_1)r} - \frac{\lambda_1(1-\lambda_2)\eta}{(\lambda_2-\lambda_1)(1-\lambda_1)}\frac{\tau c}{r}\right]\left(\frac{V}{\widetilde{V}_S}\right)^{\lambda_1} e^{\lambda_1(\gamma-\lambda_1)t}\mathcal{N}\left(-h(t)+\lambda_1\sigma\sqrt{t}\right), \end{aligned} \tag{14}$$

with $\gamma = \mu - \delta - \frac{1}{2}\sigma^2$, $h(t) = \frac{\log\left(\widetilde{V}_S/V_0\right)-\gamma t}{\sigma\sqrt{t}}$ *and* $\mathcal{N}(\cdot)$ *the cumulative standard normal function.*

The cumulative real default probability $\mathrm{Pr}_{(0,T]}$ *over the time period* $(0,T]$ *calculated with information available at time 0, is given by*

$$\mathrm{Pr}_{(0,T]}(V_0) = \mathcal{N}\left(h(T)\right) + \left(\frac{V_0}{\widetilde{V}_S}\right)^{-\frac{2\gamma}{\sigma^2}}\mathcal{N}\left(h(T)+\frac{2\gamma T}{\sigma\sqrt{T}}\right). \tag{15}$$

Proof: See Appendix A.

The empirical analysis in Section 2 highlighted a complex relationship between default probabilities and equity returns. Given that we are able to obtain these two quantities explicitly within a plausible model of the default process, we can now analyze the implications of the model and then compare them with the empirical evidence.

We investigate the relationship between expected returns (13) and default probabilities (15) with the help of a calibrated numerical example of the FS model. Our main objective is to highlight the role of the bargaining power coefficient η and of the liquidation cost coefficient α in determining how default probability and expected returns are related to each other.

3.3 Empirical implications

In Figure 3 we plot the relationship between expected returns and the default probability derived in Proposition 2.[14] The horizontal axis reports the probability of default, computed according to (15), while the vertical axis reports the continuously compounded expected return on equity, computed according to (13). The graph displays the pairs $(\Pr_{(0,T]}, r^E_{(0,t]})$ of default probabilities and annualized continuously compounded returns obtained by varying the underlying current asset value $V_0 \geq \widetilde{V}_S$. To match our empirical results, in the figure we take the horizon t for returns to be equal to one month and the horizon T for the default probability to be equal to 1 year. Panel A analyzes the effect of the bargaining power coefficient η on the relationship of interest while keeping the liquidation cost at a constant level of 30% ($\alpha = 0.3$). Panel B, on the other hand, considers the effect of a changing level of liquidation cost α while assuming equal bargaining power ($\eta = 0.5$) between claimants.

The left graph in Panel A shows the relationship between expected return and default probability when shareholders have no bargaining power ($\eta = 0$). In this case the relationship is monotonically increasing and “explodes” when default is certain. The intuition for this result is the same as the one presented in Proposition 1. The case of no-bargaining power corresponds to the situation in which default triggers immediate liquidation. Shareholders are getting nothing in the event of default and therefore a higher probability of default is associated with higher risk. Note also that in this case the liquidation cost does not play any role. This is plausible because if shareholders has no bargaining power, they will not be able to initiate a renegotiation and default will automatically lead to liquidation. In this case, default boundary and default probability are all independent of α.

The situation is dramatically different in the right graph of Panel A. The three lines shown refer to situations when shareholders have (i) relatively low bargaining power ($\eta = 0.2$, dash-dotted line); (ii) the same bargaining power as the debt-holders' ($\eta = 0.5$, dashed line); and (iii) all the bargaining power ($\eta = 1$, solid line). Two patterns clearly emerge from this figure. First, the relationship between expected return and default probability is hump-shaped. Second, keeping everything else constant, a high bargaining power is associated with low expected returns.

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[14] We use the following parameter values: $r = .075$, $\sigma = .1$, $c = .1$, $\tau = .35$, $\delta = .05$, $\mu = .1$. Quantities are intended on a per annum basis.

The hump-shaped relationship results from the fact that now default is not synonymous of liquidation and shareholders are receiving a fraction of the assets as an outcome of the renegotiation process. The riskiness of equity therefore should correctly account for that. For low value of the probability of default, the likelihood of strategic renegotiation is low since the probability of the firm entering default is low. In such cases, the link between default probability and expected return follows the intuitive channel, as a higher default probability means higher risk and hence higher required return. In the opposite case in which default is highly likely, the risk of equity is similar to the risk of the underlying unlevered assets, a fraction of which is received by shareholders as a prize from the renegotiation game. Therefore, conditional on shareholders having a strong advantage, a high probability of default means a good chance of debt relief. Since equity is a levered position on the asset, debt relief reduces leverage and hence risk. Default probability in this case does not at all measure the risk of default to equity. This intuition also helps explain the second interesting pattern emerging from the figure, that is, the higher is the bargaining power, the lower is the expected return. A higher bargaining power translates into a higher equilibrium sharing rule $\tilde{\theta}$ in the Nash bargaining game (see equation (8)), hence into a higher fraction of the asset value to the advantage of shareholders upon default. This leads to lower risk of default to equity and reduces the expected return.

Panel B of Figure 3 demonstrates the relationship between default probability and expected returns as the level of liquidation costs changes while the bargaining power of claimholders is fixed at a common level $\eta = 0.5$. The three lines represent the cases of (i) zero liquidation costs (dash-dotted line); (ii) moderate liquidation costs ($\alpha = 0.2$, dashed line) and (iii) high liquidation costs ($\alpha = 0.9$, solid line). The patterns emerging from this figure are similar to the ones discussed earlier, and similar also are the forces driving the shape of the relationship. We note that the liquidation cost enters with the same sign in the solution of the optimal sharing rule in the Nash bargaining game. Since the liquidation cost is a dissipative cost that affects the bargaining surplus to be divided between shareholders and debt-holders, a larger liquidation cost can be thought of as "similar" to a larger shareholders' bargaining power. The similarity is, however, not complete and there is a meaningful role for liquidation costs that is not subsumed by the bargaining power. For example, a zero liquidation costs does not correspond to a zero sharing rule, $\tilde{\theta}$, in the presence of taxes, as (8) clearly shows. Equity-holders are always getting something in default as long as they have *some* bargaining power. As long as this happens, we should expect a humped-shaped relationship between expected return and default probability. Moreover, keeping everything else constant, high liquidating costs are associated with low expected returns.

The discussion above suggests the following testable implications:

Hypothesis 1 *The relationship between default probability and expected return should be (i) upward-sloping for firms with minimal shareholder advantage and (ii) downward sloping or hump-shaped for firms with substantial shareholder advantage.*

Hypothesis 2 *For a given default probability the expected return should be lower for firms in which (i) shareholders have stronger bargaining power and/or (ii) the economic gains from renegotiation are larger.*

In the next section we set out to perform empirical tests of these two hypotheses.

4 Empirical analysis

The above theoretical argument shows that both bargaining power and liquidation costs contribute to shareholder advantage when a firm is in financial distress. The model predicts that for firms where shareholders are capable of obtaining large advantage, expected returns are declining or hump-shaped in default probability, while for firms where shareholders are disadvantaged, a higher probability of default is associated with a higher probability of liquidation and hence a higher expected return. In order to assess the validity of these theoretical predictions, in this section we conduct an empirical analysis of the effect of shareholder advantage on expected returns of leveraged stocks.

4.1 Data construction

We first construct variables that proxy for the advantage of shareholders in financially distressed firms.

Shareholders' bargaining power

An important determinant of the advantage of shareholders in a financially distressed firm is shareholders' bargaining power. Small firms, due to associated information asymmetry, usually have a concentrated group of debt-holders, mostly banks, which may have an advantage at monitoring the firm (see, e.g., Diamond (1991) and Sufi (2005)). This concentration of, and close monitoring by, creditors severely weakens shareholders' bargaining power in the event of financial distress. Consistent with this notion, Franks and Torous (1994) find that firm size is a persistent determinant of deviation from the absolute priority rule for a sample of workouts and bankruptcies. This finding is confirmed by Betker (1995).

We measure firm size by the market value of assets instead of the market value of equity in our test for two reasons. First, this corresponds closely to the theoretical formulation as the bargaining is over the remaining assets. Second, this can mitigate the potential bias caused by small equity values of firms close to bankruptcy even though they have a substantial asset base and a diffuse group of debt-holders. The market value of assets is obtained from Moody's KMV. This variable is available on a monthly basis and calculated, together with the EDF measure, as a function of the market value of equity, outstanding liability and historical default data. Alternatively, we have also used the book value of assets from COMPUSTAT and obtained qualitatively similar results, which are omitted here for brevity.

Another measure we use to proxy for shareholders' bargaining power is the ratio of R&D expenditure to assets. Firms with high costs of research and development are particularly vulnerable to liquidity shortage in financial distress. Opler and Titman (1994) find that, in terms of corporate performance, highly leveraged firms that engage in research and development suffer the most in economically distressed periods. This implies that these firms are more likely to encounter cash-flow problems that can put them in an disadvantaged position in renegotiation with creditors. In our test, the variable is calculated as a ratio of a firm's R&D expense to the book value of assets. To allow time for accounting information to be incorporated into prices we attribute the R&D ratio computed at the end of fiscal year t to the one-year period starting from July of year $t + 1$.

Liquidation costs

In the renegotiation between debt-holders and equity-holders, the cost of liquidation figures prominently in the bargaining surplus. Existing literature suggests that the specificity of a firm's assets is important in determining a firm's liquidation value in bankruptcy (e.g., Acharya, Sundaram, and John (2005)). The argument is that if a firm's assets are highly specific, or unique, then they are likely to suffer from "fire-sale" discounts in liquidation auctions. As pointed out in Shleifer and Vishny (1992), asset specificity is related to industry competitiveness. This leads us to use the Herfindahl index as a proxy for asset specificity and in turn for liquidation costs.

To calculate the Herfindahl index on sales, at the end of fiscal year t, we first categorize firms according to the ten industry classifications on Kenneth French's website and obtain their sales data from COMPUSTAT. We exclude all the firms whose industry codes fall into the category of either "unavailable" or "other". The Herfindahl index for an industry is simply the sum of the squared sales proportions of each firm in the industry. We apply the calculated Herfindahl index to the one-year period starting from July of year $t + 1$.[15]

Shareholder's advantage in renegotiation are stronger the stronger are the gain from bargaining. Given a certain default probability, such gains are likely to be higher for firms with low book-to-market equity ratio. The reason is that for both shareholders and debt-holders of these firms, renegotiating the debt is particularly attractive since it can prevent the loss of potentially valuable growth options in liquidation. As reported by Gilson, John, and Lang (1990), firms with high Tobin's Q ratio, which is similar in construction and highly correlated with the book-to-market equity ratio, tend to restructure their claims out of court. The high liquidation costs faced by this type of firms and the potential power shareholders could wield in the renegotiation process imply a strong shareholder advantage in these firms. We have used both the Q ratio and the book-to-market equity ratio in our empirical analysis and obtained similar results. We will therefore report only the results based on the book-to-market equity ratio.

We follow Fama and French (1992) in calculating the book-to-market ratio. Specifically, we first sum up a firm's book value of common equity and deferred taxes at the end of fiscal year t, and then divide it by the firm's market capitalization of equity at the end of December of year t to obtain its book-to-market ratio. We apply the calculated book-to-market ratio to the one-year period starting from July of year $t + 1$.

4.2 Sub-portfolio analysis

We first carry out a sub-portfolio analysis by examining the relationship between returns and default probability (EDF) for subsets of stocks grouped by one of their characteristics described above. Specifically, each month we sort stocks into quintiles according to their exponentially-weighted EDF measures over the preceding six-month period and, independently, into triplets

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[15] We have also used the Herfindahl index on asset values, which is constructed similarly, and obtained similar results, which are omitted for brevity.

according to one of the characteristics: asset size, R&D expense ratio, Herfindahl index of sales and book-to-market equity ratio, all calculated based on the respective accounting numbers at the end of the prior fiscal year. We then calculate the monthly return in the second month after the portfolio formation, i.e., we skip a month before accumulating returns, to avoid potential liquidity issues. In addition to raw monthly returns, we also calculate the DGTW-adjusted returns that control for the known effects of size, book-to-market ratio and momentum. The results with proxies for shareholders' bargaining power are reported in Table 3 and those with proxies for liquidation costs in Table 4.

Panel A of Table 3 presents the results based on firm size. Raw portfolio returns exhibit no discernible patterns in the relationship between returns and EDFs except for slight humps for medium and large firms. Although small firms seems to exhibit higher returns than large firms, the pattern is not statistically significant except for the highest-EDF group (at 10% level). The reason for this finding is that there are two offsetting forces at work. While shareholders' bargaining power implies a positive relationship for small firms and a negative (and hump-shaped) relationship for large firms, return momentum may act as an opposing force. For small firms, the slow transmission of bad news has been shown to contribute to negative momentum in stock returns (Hong, Lim, and Stein (2000)). It has also been reported that momentum and credit quality are closely related (Avramov, Chordia, Jostova, and Philipov (2005)), and many small firms are in fact "fallen angels" going through a series of credit deterioration. This confounding influence of negative momentum offsets the conjectured effect of bargaining power on returns.

To mitigate the confounding effects of momentum and control for other known effects of the characteristics such as size and book-to-market ratio, we report the result with the DGTW-adjusted returns in Panel A. The adjustment unveils a positive association between DGTW-adjusted returns and EDFs for small firms and a negative relationship for large firms, and this divergence in the relationship—difference in slopes—is statistically significant with a t-statistic of 1.99. Moreover, for firms with high EDFs, small firms outperform large firms by statistically significant amounts (0.42% and 0.76% per month, respectively for fourth and fifth quintiles of EDF measures) even after the size and momentum effects are controlled for. These results are supportive of the hypotheses in the last section as we regard shareholders of larger distressed firms as having a stronger bargaining power, hence facing lower risk for equity.

Panel B of Table 3 presents the result related to R&D expenses. Firms with low levels of R&D expense ratio exhibit a negative relationship between EDF measures and future returns, and firms with high levels of R&D expense ratio show a positive relationship. This difference in the slope of the relationship is statistically significant with a t-statistic of 3.40, consistent with Hypothesis 1. In particular, for firms in the highest EDF quintile, those with high R&D expense ratios earn monthly returns 1.14% higher than those with low R&D expense ratios, consistent with Hypothesis 2 when we regard shareholders in high R&D firms as being disadvantaged in renegotiation with creditors. Using the DGTW-adjusted returns to control for the effects of other characteristics, we observe that the divergence in the relationship between returns and EDFs between top and bottom groups is robust in both magnitude and statistical significance. Moreover, the difference in DGTW-adjusted returns between high R&D firms and low R&D firms is statistically significant across multiple credit grades except for the highest quality ones (low EDF).

Panel A of Table 4 examines the effect of industry concentration, as a proxy for liquidation costs, on the relationship between EDF measures and stock returns. As we described before, industry concentration is measured by the Herfindahl index based on total sales. The results show that the relationship is upward sloping for firms in less concentrated, and potentially more competitive, industries. For firms in highly concentrated industries where the problem of asset specificity can be serious, the relationship is downward sloping. The difference in this relationship between firms with high and low Herfindahl indices is statistically significant, consistent with our hypothesis. Moreover, among firms with high default probability (in the fifth EDF quintile), stocks with low Herfindahl indices earn significantly larger returns than stocks with high Herfindahl indices, with the difference of 0.84% per month that is statistically significant with a t-statistic of 2.66. The panel shows that these results hold with DGTW-adjusted returns as well, proving that the observed patterns are indeed separate from the effects of other firm characteristics on returns.

The results based on the book-to-market equity ratio are reported in Panel B of Table 4. They show that, for firms with a low book-to-market ratio, higher probabilities of default, measured by EDF scores, leads to lower stock returns. This trend appears monotonic and the difference in monthly returns between the top and bottom quintiles of the EDF measure is economically and statistically significant at 1.05%. This is consistent with the finding reported in Griffin and Lemmon (2002) who use O-score and Z-score to measure default probability. For firms with a medium level of the book-to-market equity ratio, we observe a hump-shaped relationship between return and EDF, and for firms with a high book-to-market ratio, stock returns are positively related to EDF measures. This statistically significant divergence in the slope of the return-EDF relationship for firms with high or low book-to-market ratios, with a t-statistic of 4.53, is consistent with Hypothesis 1. Moreover, for a given EDF group (except for the one with lowest EDFs), stocks with higher book-to-market ratios consistently earn higher returns than those with lower book-to-market ratios, as predicted by Hypothesis 2.

Similar to firm size, when we use a firm characteristic like the book-to-market ratio to proxy for shareholder advantage, one has to make sure that the result is not driven or contaminated by its own known effect on stock returns. This concern is mitigated by examining the return pattern using DGTW-adjusted returns, which is also presented in Panel B. The result shows that the return pattern with respect to EDF measures for different book-to-market ratio firms is robust with similar economic and statistical significance. This also implies that the observed return pattern is independent of the book-to-market ratio effect on stock returns, but consistent with our interpretation of large shareholder advantage in low book-to-market-ratio firms.

4.3 Multivariate regression analysis

To further examine the evidence we have presented thus far, we perform a regression analysis. While the sub-portfolio analysis presents a non-parametric examination of the cross-sectional difference in the relationship between default probability and stock returns, a regression analysis provides a structural and multivariate view of this cross-sectional difference and further illuminate the role of shareholder advantage. We carry out our analysis using the methodology of Fama and MacBeth (1973) methodology: First, in each month, we regress monthly returns on a set of firm characteristics, and then we average the time-series of regression coefficients and calculate corresponding t-statistics, which are adjusted for auto-correlation and heteroschedasticity (Newey and West (1987)).

For explanatory variables, we include the ranking of a firm's EDF (EDFAdjRank), which is normalized to be between 0 and 1. We use ranking instead of the EDF measure itself to mitigate the problem due to its skewed distribution. Similarly, for the characteristics that proxy for shareholder advantage, we use firm's rank (between 1 and 10) for Herfindahl index (HFdlRank) and for R&D expense ratio (R&DRank). The asset value and the book-to-market ratio are represented by their respective natural logarithmic values. The set of independent variables also contains characteristics, such as beta, book-to-market ratio, momentum measured by past six-month returns, that are known to affect returns. We do not include the equity market capitalization, because it is highly correlated with the asset size. In addition, we include interaction terms between the EDF rank with asset size, book-to-market equity ratio, rank for for Herfindahl index and rank for R&D expense ratio.

Table 5 presents pairwise Pearson correlation coefficients between these explanatory variables. There is a very significantly negative correlation between the asset size and the EDF rank variable. The EDF rank variable is also substantially correlated with the book-to-market ratio and with momentum measured by past six-month returns. The Herfindahl index rank is not substantially correlated with other variables except for the R&D rank variable, while the R&D rank variable is also significantly correlated with the book-to-market ratio. These correlations suggest that it is important to examine the respective roles of these proxies in a multivariate regression. We report the results from both univariate and multivariate regressions in Table 6.

Model 1 in Table 6 is the basic benchmark known in the literature, although we replace the equity size with the asset size, without affecting the qualitative results, to facilitate comparisons with other models presented in the table. The result is consistent with those established in the literature. Model 2 shows that the likelihood of default also matters, but it has a negative relation with stock returns, consistent with our empirical evidence presented earlier. The inclusion of default probability does not qualitatively impact the effects of other characteristics except for strengthening the size effect. Model 3 through Model 6 present evidence on the four individual proxies for shareholder advantage used in the sub-portfolio analysis. The interaction terms in these models are all statistically significant. Combined with the coefficient for the EDF rank variable, these results represent a conditional dependence of stock returns on default probability. For instance, Model 3 implies that for firms with an asset size less than $\exp(0.1026/0.0058) = \$48$ million, its stock return will generally have a positive relationship with its EDF rank. For firms with a larger asset base, this relation will turn negative. Individually, these results are all consistent with those presented in Tables 3 and 4.

Finally, Model 7 provides a multivariate examination of these individual variables we have used separately so far. The result shows that these variables capture different aspects of shareholder advantage in financial distress, as each variable maintains its statistical significance in the multivariate context. The only exception is the effect of the Herfindahl index which diminishes by more than one half while still retaining statistical significance at the 10% level. Nevertheless, this multivariate regression analysis demonstrates the multi-facet nature of the effect of shareholder advantage on stock returns.

4.4 Robustness tests

We carry out additional tests along two dimensions to check the robustness of our results. First, we verify that the results we presented above are not sensitive to the holding period over which returns are measured. This is an important concern because many stocks with high default risk are not very liquid, therefore illiquidty may bias their returns. Because of this concern, the reported results so far are based on the returns in the second month after the formation of portfolios, i.e., we skip a month before we measure the return. However, we verify that our reported results hold qualitatively even if we use the return in the month immediately after portfolio formation. This is also true if we form portfolios every quarter, instead of every month, and measure returns over the following quarter.

The second dimension along which we check the robustness of our results is to examine additional proxies related to the strategic interaction between shareholders and creditors that have been used in the literature. Several variables are related to those we have used. These include book-to-market asset ratio, as opposed to book-to-market equity ratio; Tobin's Q; book value of assets, as opposed to (implied) market value of assets, and the ratio of R&D expenditure to total capital expenditure, as opposed to the ratio of R&D expenditure to total assets. We have verified that all of these variables produce qualitatively similar results as those by their counterparts discussed before.

One variable that may proxy for shareholders' bargaining power is managerial holdings in company's shares, which is used by Davydenko and Strebulaev (2004). The argument is that the more shares managers hold in the company, the more effort they will exert in extracting rents from creditors in the case of financial distress, hence reduce the risk of the equity. However, there is another offsetting force that may be at work as well. As documented by Core and Larcker (2002), an increase in executive stock holdings is associated with an improvement in firm's financial performance, and hence a higher future stock return. This *cash-flow effect* offsets the *discount rate effect* of shareholder advantage, thus leaving the net effect ambiguous. That is what we find when we group stocks according to the relative stock holdings by top five executives.[16] As shown in Panel A of Table 7, while, as expected, low levels of executive holdings are associated with a positive relation between stock returns and default probability , for firms with high levels of executive stock holdings, the relationship is essentially flat, consistent with the argument above about the opposing effects.

For bankruptcy costs, Davydenko and Strebulaev (2004) use non-fixed assets as a proxy, based on the empirical evidence that fixed assets are a good proxy for the lack of costs of liquidation Alderson and Betker (1995)). This argument, however, may be problematic if non-fixed assets include liquid assets, such as short-term securities, that can be easily liquidated. In fact, in our test using this proxy, we fail to find any discernible change in the relation between stock return and default probability across firms, as demonstrated in Panel B of Table 7.

5 Is mispricing an alternative explanation?

Another natural explanation for the observed evidence is market mispricing, namely, investors commit cognitive errors in evaluating financial distressed firms and cause their stock prices to deviate significantly from their fundamentals. If this argument is valid, then it should be more plausible for firms that have a higher level of information asymmetry, are illiquid, or have little presence of institutional investors. In the following, we examine if and how the relationship between default probability and stock returns varies across these characteristics.

We start by investigating if the observed relationship between default probability and stock returns is different for firms with a more transparent information environment than for firms without. A variable often used to capture information asymmetry or differences of opinion leading to mispricing is the dispersion of analysts' forecast (see, e.g., Diether, Malloy, and Scherbina (2002)). Firms with high forecast dispersion are more prone to mispricing. If the negative relationship between default probability and expected returns is due to mispricing, then it should manifest more strongly for these firms. For each firm-month, we obtain one-year earning forecast from I/B/E/S and calculate analyst dispersion as the standard deviation of the forecast divided by the mean forecast. The result in Panel A of Table 8 demonstrates no significant difference across firms with different forecast dispersions. This conclusion holds true for DGTW-adjusted returns as well. Therefore, the relationship is not likely to be due to mispricing attributable to the difference in a firm's information environment.

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[16] We obtain managerial holdings from CompuStat Executive Compensation database.

Panel B of Table 8 examines whether the observed relationship may be caused by mispricing due to illiquidity. We use monthly turnover ratio, i.e., the ratio of trading volume over total number of shares outstanding, to proxy for liquidity.[17] Because the turnover of Nasdaq stocks is inflated relative to that of NYSE/AMEX stocks, we only include NYSE/AMEX stocks for this test. The result again shows no discernible difference across stocks with different levels of turnover ratio.

Finally, because recent studies have found that institutional ownership of a stock can affect its market price efficiency (see, e.g., Gompers and Metrick (2001)), we examine the effect of institutional holdings in a stock on the relationship between default risk and stock returns. We obtain institutional holdings data from Thomson Financial's 13f database. Since institutional holding data are reported on a quarterly basis, we form portfolios every quarter, and examine the average monthly returns during the next three-month period. Panel C of Table 8 shows little difference in the relationship for firms with low institutional holdings and for firms with high institutional holdings.[18] While there is some debate about the role of institutional investors in mitigating or causing market mispricing, the lack of difference across stocks with different levels of institutional ownership implies that mispricing due to institutional ownership (or the lack thereof) is not likely to be the main cause for the observed relationship between default risk and stock returns.

In summary, the above analysis does not seem to support the view that mispricing is the prevalent cause for the inverse relationship between default probability and expected returns and provide further credibility to the more fundamental economic mechanism described in Section 3.

6 Conclusion

Using the market-based EDF measure of *Moody's KMV* as an indicator of default probability we document that, in general, expected return are not positively related to default probability. These findings complement the existing evidence in the literature on the relation of stock returns to alternative measures of default probability. Through a simple strategic bargaining model built on Fan and Sundaresan (2000), we argue that the opportunity for equity-holders of distressed

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[17] We have also used the residual turnover ratio controlling for the size. The result is qualitatively similar and omitted here for brevity. While we do not explicitly examine other measures of liquidity, the lack of difference across stocks of different levels of turnover leads us to believe that they will not make a qualitative difference.

[18] A similar result, omitted here for brevity, holds if instead of institutional holdings we use the number of institutional holders.

firms to renegotiate and extract benefits, in violation of the absolute priority rule, is essential for explaining the counter-intuitive empirical regularity in a rational context with proper risk-return trade-off. Our empirical investigation, using a variety of proxies for shareholder advantage, has provided consistent support for our conjectures and demonstrated that market mispricing is not likely to be the primary reason for the observed relationship between default risk and stock returns.

Our study is among the first systematic examinations of the effect of strategic interaction between equityholders and debt-holders on equity returns and illustrates an important role for considering such features in determining expected returns. This is along the line of recent academic inquiries that uncover the effects of legal systems and corporate governance on asset returns and further extend the frontier of asset pricing literature.

A Appendix: Proofs

Proof of Proposition 1

From (4) it is immediate to see that default probability decreases in V/D. Let $y \equiv V/(De^{-rT})$ and, using (1), re-write (3) as follows

$$r_E = r + (\mu - r)\frac{1}{1 - \frac{N(d_2)}{yN(d_2)}} \tag{A1}$$

where $d_1 = \frac{\log(y)+1/2\sigma^2 T}{\sigma\sqrt{T}}$ and $d_2 = d_1(y) - \sigma\sqrt{T}$. Differentiating $\frac{N(d_2)}{yN(d_2)}$ with respect to y, we obtain

$$-\frac{N(d_1)N(d_2) + \frac{1}{\sigma\sqrt{T}}(n(d_1)N(d_2) - N(d_1)n(d_2))}{(yN(d1))^2}, \tag{A2}$$

where where $n(\cdot)$ denotes the density of the normal distribution. If the above expression is (weakly) negative then, given $\mu - r > 0$ and (A1), expected returns are decreasing in y and, consequently, positively related to default probabilities.

To simplify the notation, let us set $a = \sigma\sqrt{T}$, $d_1 = x+a$, and, consequently $d_2 = x$. Expected returns (A1) are decreasing in y if (A2) is (weakly) negative. Expression (A2) is negative if the following quantity is positive

$$F(x) = a\mathcal{N}(x+a)\mathcal{N}(x) + n(x+a)\mathcal{N}(x) - \mathcal{N}(x+a)n(x) \tag{A3}$$

Since $\lim_{x\to-\infty} F(x) = 0$ and $\lim_{x\to+\infty} F(x) = a > 0$, $F(x) \geq 0$ if and only if its derivative $F'(x)$ is always positive. Differentiating with respect to x and using (A5) we obtain

$$F'(x) = -x\mathcal{N}(x)n(x+a) + (a+x)\mathcal{N}(x+a)n(x) \tag{A4}$$

Notice that

$$\begin{aligned} n'(x) &= -xn(x) && \text{(A5)} \\ n(x) &= -x\mathcal{N}(x) + \int_{-\infty}^{x} \mathcal{N}(t)dt && \text{(A6)} \end{aligned}$$

Using property (A6) and simplifying we arrive at the following expression

$$F'(x) = \int_{-\infty}^{x} \left[n(x)\mathcal{N}(t+a) - n(x+a)\mathcal{N}(t)\right] dt \tag{A7}$$

We are left to show that $G(t;x) \equiv n(x)\mathcal{N}(t+a) - n(x+a)\mathcal{N}(t) \geq 0$ for all $t \leq x$. Note that $G(-\infty;x) = 0$. So we need to show that $\frac{\partial G}{\partial t} \geq 0$. Differentiating with respect to t and using the definition of density of a normal distribution we have

$$\begin{aligned} \frac{\partial G}{\partial t} &= n(x)n(t+a) - n(x+a)n(t) && \text{(A8)} \\ &= n(x)n(t)e^{-a^2/2}\left[e^{-at} - e^{-ax}\right] && \text{(A9)} \end{aligned}$$

Since $t \leq x$, $e^{-at} - e^{-ax} \geq 0$. Hence $G(t;x) \geq 0$, $F'(x) \geq 0$, $F(x) \geq 0$, and finally (A2) is (weakly) negative. ∎

Proof of Proposition 2

Let $\mathbb{P}$ be the probability measure governing the dynamics of asset values in (6). Straightforward application of Itô's lemma yields

$$V_t = V_0 e^{\left(\mu-\delta-\frac{1}{2}\sigma^2\right)t+\sigma\sqrt{t}B_t}, \tag{A10}$$

where B_t is a standard Brownian motion under $\mathbb{P}$. Hence, V_t is log-normally distributed with mean $V_0e^{(\mu-\delta)t}$ and variance $V_0^2e^{2(\mu-\delta)t}\left(e^{\sigma^2 t}-1\right)$. The expected value of $\mathbb{E}(\widetilde{E}(V_t))$, is given by

$$\mathbb{E}(\widetilde{E}(V_t)) = \int_0^\infty \mathbb{E}(V_t)f(V_t)dV_t, \tag{A11}$$

where $f(V_t)$ is the log-normal density of V_t. From the expression (11) for the value of equity, using a suitable change of variable to deal with integrals involving lognormal distributions we arrive at expression (14).

The cumulative default probability over $(0,T]$ is defined as follows

$$\Pr_{(0,T]} = 1 - \Pr\left\{\inf_{0<t\leq T} V_t \geq \widetilde{V}_S \,\middle|\, V_0 > \widetilde{V}_S\right\} \tag{A12}$$

Let $X_t = \log(V_t)$. By (A10), X_t follows the following arithmetic Brownian motion

$$dX_t = \gamma dt + \sigma dB_t, \quad X_0 = \log(V_0), \tag{A13}$$

where $\gamma = \mu - \delta - \frac{1}{2}\sigma^2$. The probability in (A12) is equivalent to the following

$$\Pr_{(0,T]} = 1 - \Pr\left\{\inf_{0<t\leq T} X_t \geq \log(\widetilde{V}_S) \,\middle|\, X_0 > \log(\widetilde{V}_S)\right\}. \tag{A14}$$

Let $y = \log(\widetilde{V}_S)$. After some simple manipulation we can write

$$\Pr_{(0,T]} = 1 - \Pr\left\{ \sup_{0<t\leq T} -(X_t - X_0) \leq X_0 - y \mid X_0 > y \right\}. \tag{A15}$$

This probability can be computed from the hitting time distribution of the Brownian motion (Harrison, 1985, equation (11), p.14) and is equal to

$$\Pr_{(0,T]} = \mathcal{N}\left(\frac{y - X_0 - \gamma T}{\sigma\sqrt{T}}\right) + e^{\frac{2\gamma(y-X_0)}{\sigma^2}} \mathcal{N}\left(\frac{y - X_0 + \gamma T}{\sigma\sqrt{T}}\right). \tag{A16}$$

Replacing $y = \log(\widetilde{V}_S)$ and $X_0 = \log(V_0)$, we arrive at equation (15). ∎

B Appendix: Tables and Figures

Table 1: Summary statistics of the EDF measure

Our sample period spans from January 1969 to December 2003. At the beginning of every three-year interval in our sample (starting from January 1970), the table reports the number of firms in our sample, the mean, standard deviation, median, first and third quartile of the EDF distribution. EDF quantities are expressed in percent units.

Month	# Firm	Mean	Std.	Median	Quart 1	Quart 3
Jan-70	1,455	1.19	1.76	0.56	0.17	1.50
Jan-73	1,894	2.00	3.20	0.83	0.23	2.25
Jan-76	2,945	3.87	4.77	2.06	0.88	4.58
Jan-79	3,149	2.57	4.21	0.97	0.31	2.56
Jan-82	3,116	3.19	4.60	1.42	0.59	3.40
Jan-85	3,566	3.21	5.17	0.98	0.34	3.18
Jan-88	3,745	4.25	5.83	1.68	0.48	5.02
Jan-91	3,627	5.48	7.11	1.80	0.37	8.08
Jan-94	3,916	2.73	4.56	0.85	0.22	2.82
Jan-97	4,541	2.72	4.61	0.78	0.18	2.82
Jan-00	4,246	3.68	5.11	1.53	0.52	4.26
Jan-03	3,572	5.23	6.52	2.03	0.59	7.39
Full Sample	1,430,713	3.44	5.22	1.19	0.35	3.75

Table 2: Portfolio returns sorted on the basis of EDF quintiles

At the end of each month t from June 1969 to October 2003, we sort stocks into quintiles based on their weighted EDF measures and then record the returns of these portfolios in the month $t+2$, i.e., one month after the portfolio formation. We report the time series averages of returns and EDFs of these portfolios in this table. Both equally-weighted and value-weighted quantities are reported. The High-Low is the difference between a quantity of the high EDF quintile and that of the low EDF quintile, and the t-value is the t-statistic of this difference. Panels A and B contain the results with raw returns for the full sample and for the sub-sample containing stocks with price larger than $2, respectively. Panels C and D contain the results for DGTW-adjusted returns for the full sample and for the sub-sample containing stocks with price larger than $2, respectively. The sample period of DGTW-adjusted results spans from June 1975 to June 2003 due to the availability of the DGTW benchmark portfolio returns.

	Low EDF 1	2	3	4	High EDF 5	High-Low	t-value
			Panel A: Raw returns. Full sample.				
EW	1.14	1.23	1.26	1.25	1.65	0.51	**1.50**
EDF	0.16	0.56	1.34	3.24	11.10	10.94	
VW	0.96	1.11	1.08	0.95	0.82	-0.14	**-0.38**
EDF	0.10	0.51	1.26	2.97	9.17	9.06	
			Panel B: Raw returns. Stocks with price $\geq \$2$.				
EW	1.14	1.22	1.23	1.19	1.05	-0.09	**-0.38**
EDF	0.14	0.46	1.03	2.19	7.08	6.94	
VW	0.97	1.05	1.11	0.95	0.82	-0.15	**-0.48**
EDF	0.09	0.43	0.98	2.06	5.97	5.88	
			Panel C: DGTW-adjusted returns. Full sample.				
EW	0.03	0.08	0.08	0.09	0.74	0.72	**2.95**
EDF	0.15	0.53	1.28	3.17	11.43	11.28	
VW	-0.01	0.07	-0.02	-0.18	-0.23	-0.22	**-0.84**
EDF	0.10	0.49	1.20	2.88	9.26	9.15	
			Panel D: DGTW-adjusted returns. Stocks with price $\geq \$2$.				
EW	0.04	0.06	0.04	0.03	-0.11	-0.15	**-1.07**
EDF	0.14	0.44	0.98	2.09	7.07	6.93	
VW	0.01	0.03	-0.02	-0.12	-0.33	-0.34	**-1.72**
EDF	0.10	0.41	0.93	1.97	5.86	5.77	

Table 3: EDF and stock returns in the cross-section: Asset size and R&D expenses

At the end of each month t from June 1969 to October 2003 (June 1975 to June 2003 for calculating the DTGW-adjusted returns), we sort stocks independently into five groups of equal size according to their weighted EDF measures and three groups of equal size according to their asset size (Panel A) and R&D expense ratio (Panel B). The returns are recorded in month $t+2$, i.e., one month after the portfolio formation. We present the time series averages of the value-weighted portfolio returns (both raw and DTGW-adjusted). The column "High-Low" reports the difference in returns between the high EDF quintile and low EDF quintile and the corresponding t-statistics. The rows "Large-Small" and "High-Low" report the difference in returns between top and bottom groups in asset size or R&D expense ratio as well as the corresponding t-statistics. In addition, we also report in the "High-Low" column the difference of the top and bottom differences and its t-statistic.

	Low EDF				High EDF		
	1	2	3	4	5	High-Low	t-value
			Panel A: Size				
Raw Returns							
Small	1.31	1.18	1.31	1.25	1.31	-0.01	**-0.03**
Medium	1.21	1.23	1.17	1.08	0.73	-0.49	**-1.51**
Large	0.96	1.10	1.07	0.93	0.68	-0.28	**-0.65**
Large - Small	-0.35	-0.09	-0.24	-0.32	-0.63	-0.28	
t-value	**-1.52**	**-0.44**	**-1.08**	**-1.35**	**-1.85**	**-0.77**	
DGTW Returns							
Small	-0.01	0.14	0.19	0.16	0.29	0.30	**1.05**
Medium	0.11	0.06	0.07	-0.07	-0.26	-0.37	**-1.32**
Large	0.00	0.08	-0.01	-0.26	-0.47	-0.47	**-1.20**
Large - Small	0.01	-0.07	-0.20	-0.42	-0.76	-0.77	
t-value	**0.04**	**-0.41**	**-1.23**	**-2.13**	**-2.14**	**-1.99**	
			Panel B: R&D				
Raw Returns							
Low	1.12	1.09	0.96	0.84	0.55	-0.57	**-1.44**
Medium	0.97	1.35	1.21	1.23	1.16	0.19	**0.39**
High	1.02	1.39	1.27	1.36	1.69	0.67	**1.30**
High - Low	-0.10	0.30	0.31	0.52	1.14	1.24	
t-value	**-0.47**	**0.90**	**1.05**	**1.64**	**3.03**	**3.40**	
DGTW Returns							
Low	-0.02	-0.02	-0.24	-0.58	-0.44	-0.42	**-1.38**
Medium	0.05	0.19	0.28	0.06	-0.03	-0.08	**-0.20**
High	0.11	0.42	0.46	0.19	0.89	0.78	**1.74**
High - Low	0.13	0.44	0.70	0.77	1.32	1.19	
t-value	**0.99**	**1.56**	**2.37**	**2.45**	**3.13**	**2.83**	

Table 4: EDF stock returns in the cross-section: Herfindahl index and B/M ratio

At the end of each month t from June 1969 to October 2003 (June 1975 to June 2003 for calculating the DTGW-adjusted returns), we sort stocks independently into five groups of equal size according to their weighted EDF measures and three groups of equal size according to their Herfindahl index (Panel A) and book-to-market ratio (Panel B). The returns are recorded in month $t+2$, i.e., one month after the portfolio formation. We present the time series averages of the value-weighted portfolio returns (both raw and DTGW-adjusted). The column "High-Low" reports the difference in returns between the high EDF quintile and low EDF quintile and the corresponding t-statistics. The row "High-Low" reports the difference in returns between top and bottom groups in Herfindahl index or book-to-market as well as the corresponding t-statistics. In addition, we also report in the "High-Low" column the difference of the top and bottom differences and its t-statistic.

	Low EDF				High EDF		
	1	2	3	4	5	High-Low	t-value
			Panel A: Herfindahl Index				
Raw Returns							
Low	0.87	1.06	1.12	1.06	1.34	0.47	**1.15**
Medium	1.00	1.18	1.11	0.93	0.83	-0.18	**-0.46**
High	1.03	1.12	1.15	0.76	0.50	-0.53	**-1.22**
High - Low	0.16	0.06	0.03	-0.30	-0.84	-0.99	
t-value	**0.83**	**0.34**	**0.12**	**-1.16**	**-2.66**	**-3.01**	
DGTW Returns							
Low	0.01	0.14	0.04	-0.01	0.23	0.22	**0.70**
Medium	0.06	0.05	0.16	-0.15	-0.13	-0.19	**-0.62**
High	-0.01	0.11	-0.04	-0.38	-0.71	-0.70	**-1.95**
High - Low	-0.02	-0.02	-0.08	-0.37	-0.94	-0.92	
t-value	**-0.16**	**-0.13**	**-0.31**	**-1.26**	**-2.56**	**-2.57**	
			Panel B: Book-to-Market				
Raw Returns							
Low	0.97	0.69	0.63	0.00	-0.09	-1.05	**-2.31**
Medium	1.05	1.19	1.17	1.17	0.71	-0.34	**-0.81**
High	1.06	1.35	1.31	1.58	1.51	0.46	**1.20**
High - Low	0.09	0.66	0.68	1.58	1.60	1.51	
t-value	**0.49**	**2.76**	**2.80**	**5.65**	**4.79**	**4.53**	
DGTW Returns							
Low	0.04	-0.04	-0.22	-0.59	-0.87	-0.91	**-2.37**
Medium	-0.04	0.12	0.15	0.04	-0.22	-0.18	**-0.55**
High	-0.09	0.06	0.09	0.06	0.24	0.34	**1.17**
High - Low	-0.13	0.10	0.31	0.65	1.11	1.24	
t-value	**-1.16**	**0.52**	**1.53**	**2.42**	**3.16**	**3.47**	

Table 5: Correlations among independent variables used in regressions

In this table, we report the time-series average of the cross-sectional correlation coefficients between independent variables used in the regression analysis. *Beta* is calculated at the end of the previous year and obtained from CRSP; *Ln(AVL)* is the natural log of a firm's implied market value of assets at the end of month t, provided by Moody's KMV; *Ln(BM)* is the natural log of a firm's book-to-market ratio; *Ret* $(-6,-1)$ is the six-month average monthly returns from month $t-5$ to month t; *EDFAdjRank*, is a normalized EDF rank variable between 0 and 1 obtained in month t; *R&Drank* is the rank of R&D expense ratio of a firm measured at the previous fiscal year end ranging from 1 to 10; *Hfdlrank* is the rank of Herfindahl index of a firm measured at the previous fiscal year end ranging from 1 to 10.

	Beta	Ln(AVL)	Ln(BM)	Ret(-6,-1)	EDFAdjRank	R&Drank	Hfdlrank
Beta	1.0000						
Ln(AVL)	0.2014	1.0000					
Ln(BM)	-0.2271	-0.1095	1.0000				
Ret(-6,-1)	-0.0455	0.0634	0.0678	1.0000			
EDFAdjRank	-0.0735	-0.4661	0.2111	-0.1126	1.0000		
R&Drank	0.1937	-0.0716	-0.3024	0.0274	-0.0619	1.0000	
Hfdlrank	-0.0874	0.1043	-0.0149	0.0024	-0.0322	-0.2278	1.0000

Table 6: EDF and stock returns: Regression analysis

This table presents the results from the Fama-MacBeth regression analysis of the cross-sectional variation of the relationship between EDF measures and stock returns. For each model, we first run a cross-sectional regression every month from June 1969 to October 2003. Next, we calculate and report the time series averages and Newey-West adjusted t-statistics of regression coefficients. We also report the time-series average of adjusted R-square for each model. For cross-sectional regressions, the dependent variables are monthly returns measured in month $t+2$, and the independent variables are as follows: *Beta*, calculated at the end of the previous year and obtained from CRSP; *Ln(AVL)*, the natural log of a firm's implied market value of assets at the end of month t, provided by Moody's KMV; *Ln(BM)*, the natural log of a firm's book-to-market ratio; *Ret* $(-6,-1)$, the six-month average monthly returns from month $t-5$ to month t; *EDFAdjRank*, a normalized EDF rank variable between 0 and 1 obtained in month t; *R&Drank*, the rank of R&D expense ratio of a firm measured at the previous fiscal year end ranging from 1 to 10; *Hfdlrank*, the rank of Herfindahl index of a firm measured at the previous fiscal year end ranging from 1 to 10; the interaction terms of *Ln(AVL)*, *R&Drank*, *Hfdlrank*, and *Ln(BM)* with *EDFAdjRank*, respectively.

Models	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7
Beta	-0.0009	-0.0007	0.0001	-0.0024	-0.0007	-0.0008	-0.0016
t-stat	**-0.58**	**-0.55**	**0.08**	**-1.86**	**-0.50**	**-0.62**	**-1.30**
Ln(AVL)	-0.0014	-0.0019	0.0005	-0.0012	-0.0017	-0.0019	0.0009
t-stat	**-2.32**	**-4.36**	**1.25**	**-3.02**	**-4.18**	**-4.33**	**1.83**
Ln(BM)	0.0041	0.0045	0.0047	0.0053	0.0044	0.0023	0.0039
t-stat	**5.41**	**5.68**	**5.94**	**7.42**	**5.37**	**2.12**	**3.75**
Ret(-6,-1)	0.0207	0.0179	0.0208	0.0194	0.0175	0.0174	0.0206
t-stat	**1.67**	**1.59**	**1.86**	**1.75**	**1.54**	**1.48**	**1.87**
EDFAdjRank		-0.0051	0.1026	-0.0107	0.0040	-0.0025	0.0884
t-stat		**-1.60**	**5.62**	**-3.12**	**0.97**	**-0.79**	**4.42**
R&Drank				0.0001			0.0001
t-stat				**0.32**			**0.25**
HfdlRank					0.0007		0.0005
t-stat					**4.74**		**2.53**
Ln(AVL)*EDFAdjRank			-0.0058				-0.0051
t-stat			**-6.14**				**-5.00**
R&DRank*EDFAdjRank				0.0019			0.0021
t-stat				**4.44**			**4.55**
HfdlRank*EDFAdjRank					-0.0016		-0.0007
t-stat					**-5.28**		**-1.82**
Ln(BM)*EDFAdjRank						0.0039	0.0033
t-stat						**3.06**	**2.17**
Average Adj. R-square	0.0388	0.0430	0.0461	0.0548	0.0492	0.0441	0.0563

Table 7: EDF and stock returns: Managerial holdings and non-fixed assets

At the end of each month t from December 1992 to October 2003 (from June 1969 to October 2003), we sort stocks independently into five groups of equal size according to their weighted EDF measures and three groups of equal size according to their top-five managerial stock holdings in Panel A (their ratios of non-fixed assets in Panel B). The returns are recorded in month $t + 2$, i.e., one month after the portfolio formation. We present the time series averages of the value-weighted portfolio returns (both raw and DTGW-adjusted). The column "High-Low" reports the difference in returns between the high EDF quintile and low EDF quintile and the corresponding t-statistics. The row "High-Low" reports the difference in returns between top and bottom groups in managerial holdings or non-fixed asset ratios as well as the corresponding t-statistics. In addition, we also report in the "High-Low" column the difference of the top and bottom differences and its t-statistic.

	Low EDF 1	2	3	4	High EDF 5	High-Low	t-value
			Panel A: Managerial Holdings				
Raw Returns							
Low	0.84	1.21	1.26	1.26	2.23	1.39	**1.88**
Medium	0.95	1.28	1.06	1.12	1.32	0.36	**0.56**
High	0.88	1.55	0.85	1.36	1.58	0.70	**0.92**
High - Low	0.04	0.34	-0.41	0.10	-0.65	-0.69	
t-value	**0.11**	**0.63**	**-0.89**	**0.23**	**-1.17**	**-1.26**	
DGTW Returns							
Low	-0.13	0.19	0.08	0.43	0.83	0.96	**1.55**
Medium	0.13	0.22	0.02	0.03	0.00	-0.13	**-0.26**
High	0.03	0.54	0.12	0.13	0.40	0.37	**0.55**
High - Low	0.16	0.35	0.04	-0.30	-0.43	-0.59	
t-value	**0.58**	**0.94**	**0.12**	**-0.91**	**-0.84**	**-1.12**	
			Panel B: Non-Fixed Asset				
Raw Returns							
Low	0.98	1.12	1.16	0.92	0.71	-0.27	**-0.69**
Medium	1.01	1.04	1.10	1.10	1.17	0.15	**0.35**
High	0.97	1.09	0.96	0.84	0.83	-0.14	**-0.35**
High - Low	-0.01	-0.03	-0.20	-0.08	0.12	0.13	
t-value	**-0.06**	**-0.14**	**-1.05**	**-0.32**	**0.47**	**0.45**	
DGTW Returns							
Low	-0.04	0.02	-0.08	-0.35	-0.49	-0.46	**-1.43**
Medium	0.04	0.10	0.09	0.04	0.09	0.05	**0.16**
High	0.08	0.08	0.01	-0.25	-0.08	-0.16	**-0.52**
High - Low	0.12	0.05	0.08	0.10	0.42	0.30	
t-value	**0.97**	**0.28**	**0.43**	**0.39**	**1.43**	**0.98**	

Table 8: EDF, stock returns and mispricing

At the end of each month t from June 1969 to October 2003 (June 1975 to June 2003 for calculating the DTGW-adjusted returns), we sort stocks independently into five groups of equal size according to their weighted EDF measures and three groups of equal size according to their dispersion of analyst forecasts (Panel A), monthly turnover (Panel B) and institutional holdings (Panel C). The returns are recorded in month $t+2$, i.e., one month after the portfolio formation. We present the time series averages of the value-weighted portfolio returns (both raw and DTGW-adjusted). The column "High-Low" reports the difference in returns between the high EDF quintile and low EDF quintile and the corresponding t-statistics. The row "High-Low" reports the difference in returns between top and bottom groups in analyst dispersion, turnover and institutional holdings as well as the corresponding t-statistics. In addition, we also report in the "High-Low" column the difference of the top and bottom differences and its t-statistic.

	Low EDF				High EDF		
	1	2	3	4	5	High-Low	t-value
			Panel A: Analyst Dispersion				
Raw Returns							
Low	1.30	1.32	1.38	1.61	1.06	-0.25	**-0.58**
Medium	0.95	1.06	1.19	1.11	0.63	-0.32	**-0.74**
High	0.91	0.83	1.53	1.03	0.76	-0.15	**-0.35**
High - Low	-0.39	-0.49	0.15	-0.57	-0.30	0.10	
t-value	**-1.21**	**-1.67**	**0.49**	**-1.96**	**-0.80**	**0.22**	
DGTW Returns							
Low	0.11	-0.03	0.27	0.30	0.00	-0.10	**-0.29**
Medium	-0.11	-0.03	0.11	-0.13	-0.60	-0.49	**-1.53**
High	0.01	-0.15	0.32	0.10	-0.33	-0.34	**-0.89**
High - Low	-0.09	-0.12	0.05	-0.21	-0.33	-0.23	
t-value	**-0.38**	**-0.54**	**0.21**	**-0.78**	**-0.84**	**-0.54**	
			Panel B: Turnover				
Raw Returns							
Low	0.97	1.04	1.14	1.28	1.04	0.07	**0.22**
Medium	0.94	1.08	1.48	1.37	1.41	0.47	**1.30**
High	0.90	0.97	1.15	0.99	1.08	0.18	**0.52**
High - Low	-0.07	-0.06	0.01	-0.28	0.03	0.11	
t-value	**-0.43**	**-0.33**	**0.04**	**-1.42**	**0.11**	**0.37**	
DGTW Returns							
Low	-0.03	-0.14	-0.09	0.00	-0.16	-0.13	**-0.65**
Medium	-0.01	-0.02	0.34	0.01	0.28	0.29	**1.14**
High	-0.08	0.02	0.07	-0.05	-0.07	0.00	**0.02**
High - Low	-0.05	0.16	0.16	-0.05	0.08	0.14	
t-value	**-0.39**	**0.94**	**0.84**	**-0.27**	**0.27**	**0.45**	
			Panel C: Institutional Holdings				
Raw Returns							
Low	0.72	0.55	0.76	0.50	0.87	0.16	**0.29**
Medium	1.09	1.19	1.28	1.01	0.85	-0.24	**-0.42**
High	1.18	1.24	1.12	1.12	0.91	-0.28	**-0.50**
High - Low	0.47	0.69	0.37	0.63	0.03	-0.43	
t-value	**1.76**	**2.73**	**1.22**	**1.69**	**0.07**	**-0.95**	
DGTW Returns							
Low	-0.29	-0.47	-0.36	-0.63	-0.10	0.19	**0.46**
Medium	-0.08	-0.06	0.09	-0.15	-0.37	-0.28	**-0.73**
High	0.03	0.02	-0.03	-0.20	0.15	0.12	**0.30**
High - Low	0.33	0.49	0.33	0.42	0.25	-0.07	
t-value	**1.67**	**2.56**	**1.55**	**1.41**	**0.66**	**-0.17**	

Figure 1: Average EDF measure over time

The figure shows the average EDF measure at each point in time over the sample period from January 1969 to December 2003. Values are expressed in percentage units along the vertical axis. The shaded areas correspond to recession periods dated by NBER.

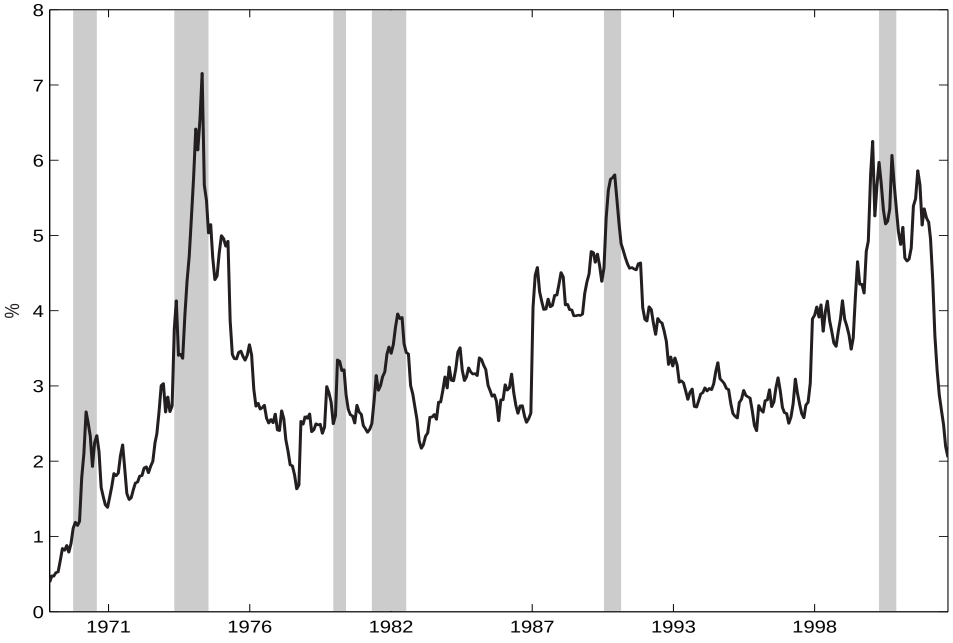
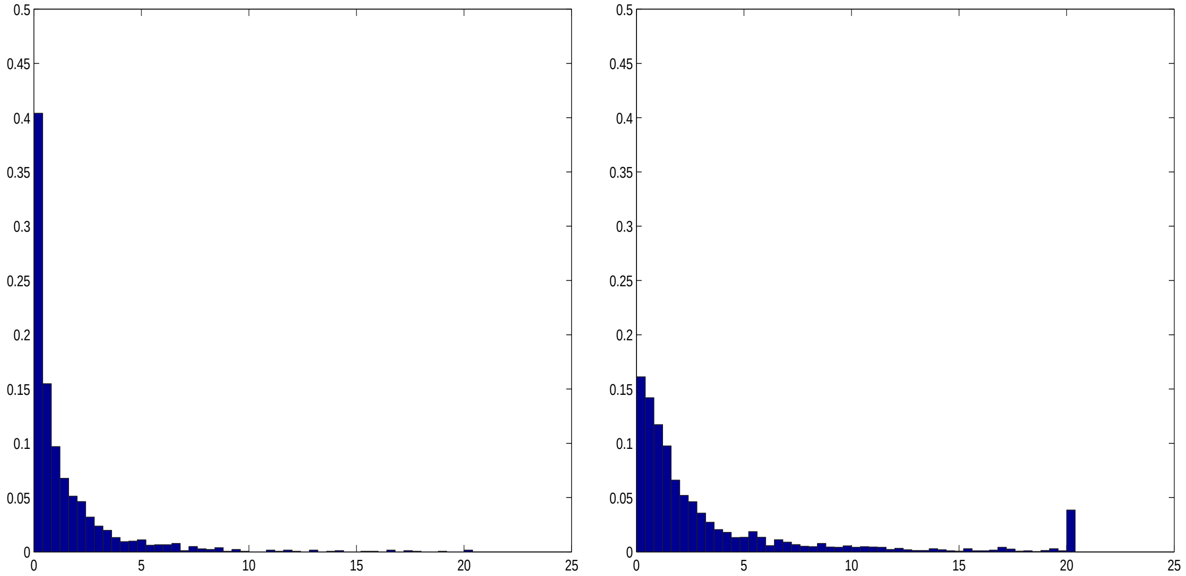
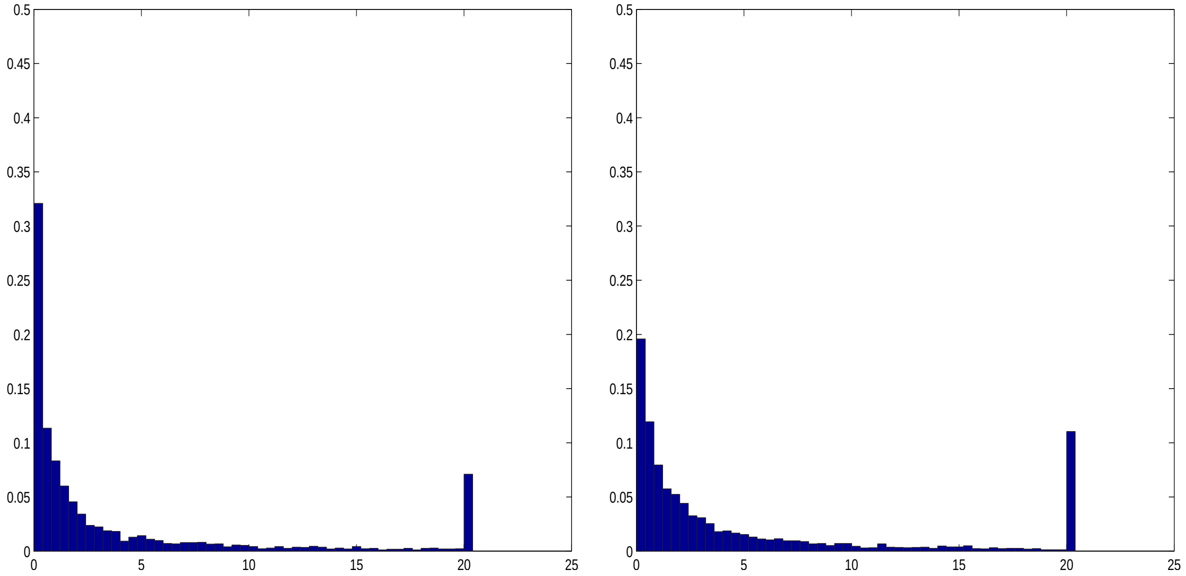


Figure 2: Distribution of EDF measures

The four panels in the figure shows the distribution of EDF measures in the month of March of the following four years: 1972, 1982, 1992 and 2002. The horizontal axis reports the value of the EDF measure in percentage points.


Panel A: March 1972

Panel B: March 1982

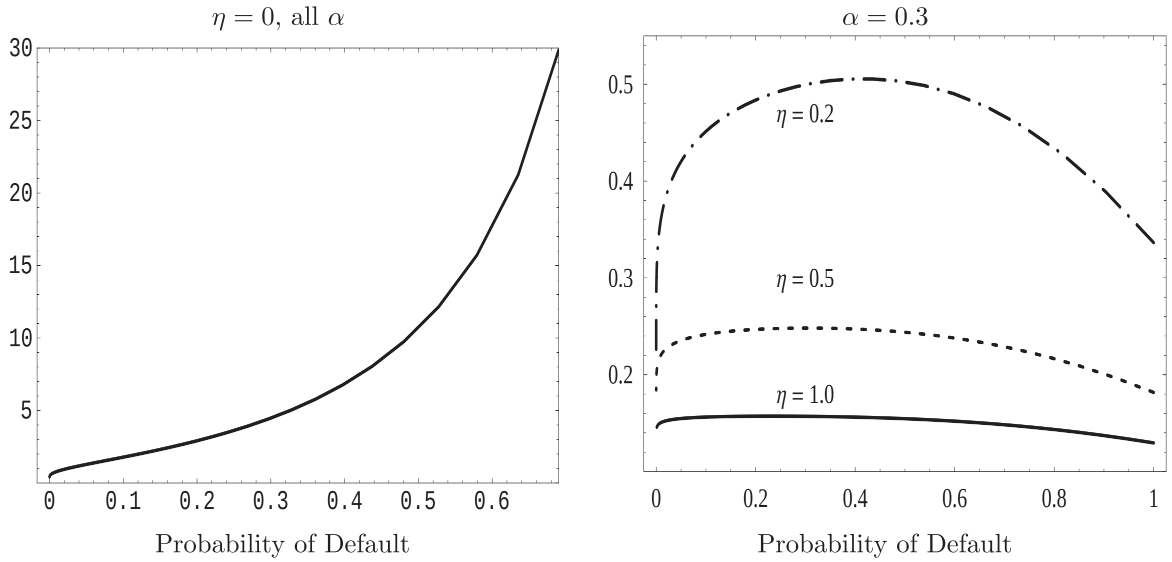

Panel C: March 1992

Panel D: March 2002

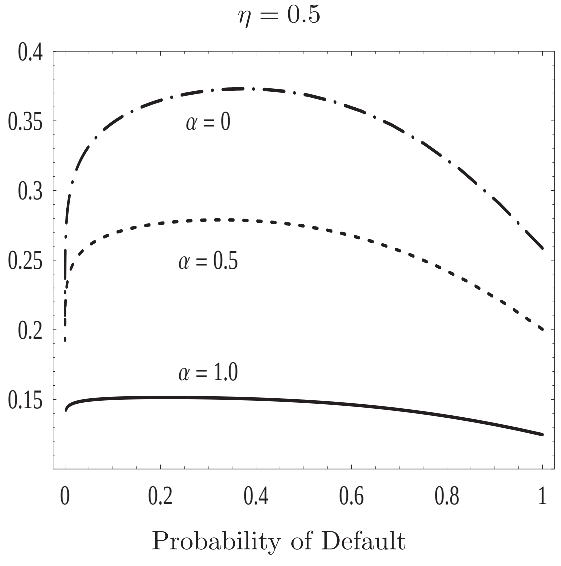
Figure 3: Default probability and expected returns

In each graph, the horizontal axis reports the probability of default $\Pr_{(0,T]}$, computed according to (15) and the vertical axis reports the annualized continuously compounded expected returns, $r^E_{(0,t]}$, computed according to equation (13). The plots are obtained by using the following parameter values: $r = .075$, $\sigma = .1$, $c = .1$, $\tau = .35$, $\delta = .05$, $\mu = .1$, $t = 1/12$, $T = 1$. The left figure in Panel A is obtained by assuming no bargaining power for shareholders while the right figure in the same panel analyzes three three different levels of bargaining power ($\eta = 0.2$, dash-dotted, $\eta = 0.5$, dashed and $\eta = 1$, solid) while fixing the liquidation cost at the level $\alpha = 0.3$. Panel B reports the case of three different level of liquidation costs ($\alpha = 0$, dash-dotted, $\alpha = 0.2$, dashed and $\alpha = 0.9$, solid) while fixing the bargaining power at $\eta = 0.5$.

Panel A: Effect of bargaining power η



Panel B: Effect of liquidation cost α



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