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### IN SEARCH OF DISTRESS RISK

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### **ABSTRACT**

This paper explores the determinants of corporate failure and the pricing of financially distressed stocks using US data over the period 1963 to 2003. Firms with higher leverage, lower profitability, lower market capitalization, lower past stock returns, more volatile past stock returns, lower cash holdings, higher market-book ratios, and lower prices per share are more likely to file for bankruptcy, be delisted, or receive a D rating. When predicting failure at longer horizons, the most persistent firm characteristics, market capitalization, the market-book ratio, and equity volatility become relatively more significant. Our model captures much of the time variation in the aggregate failure rate. Since 1981, financially distressed stocks have delivered anomalously low returns. They have lower returns but much higher standard deviations, market betas, and loadings on value and small-cap risk factors than stocks with a low risk of failure. These patterns hold in all size quintiles but are particularly strong in smaller stocks. They are inconsistent with the conjecture that the value and size effects are compensation for the risk of financial distress.

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# 1 Introduction

The concept of financial distress has been invoked in the asset pricing literature to explain otherwise anomalous patterns in the cross-section of stock returns (Chan and Chen 1991, Fama and French 1996). The idea is that certain companies have an elevated probability that they will fail to meet their financial obligations; the stocks of these financially distressed companies tend to move together, so their risk cannot be diversified away; and investors charge a premium for bearing such risk.<sup>2</sup> The premium for distress risk may not be captured by the standard Capital Asset Pricing Model (CAPM) if corporate failures are correlated with deteriorating investment opportunities (Merton 1973) or declines in unmeasured components of wealth such as human capital (Fama and French 1996) or debt securities (Ferguson and Shockley 2003).<sup>3</sup> In this case distress risk may help to explain patterns such as the size and value effects that are anomalies in the standard CAPM.

While this idea has a certain plausibility, it leaves some basic empirical questions unanswered. How should we measure the failure to meet financial obligations and the probability that a firm will fail in the future? Given an empirical measure of financial distress, do the stock prices of financially distressed companies move together, and what returns have they generated historically? Is there any evidence that financial distress risk carries a premium?

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<sup>2</sup>Chan and Chen (1991), for example, attribute the size premium to the prevalence of “marginal firms” in small-stock portfolios, and describe marginal firms as follows: “They have lost market value because of poor performance, they are inefficient producers, and they are likely to have high financial leverage and cash flow problems. They are marginal in the sense that their prices tend to be more sensitive to changes in the economy, and they are less likely to survive adverse economic conditions.” Fama and French (1996) use the term “relative distress” in a similar fashion.

<sup>3</sup>Fama and French (1996) explain the point as follows: “Why is relative distress a state variable of special hedging concern to investors? One possible explanation is linked to human capital, an important asset for most investors. Consider an investor with specialized human capital tied to a growth firm (or industry or technology). A negative shock to the firm’s prospects probably does not reduce the value of the investor’s human capital; it may just mean that employment in the firm will grow less rapidly. In contrast, a negative shock to a distressed firm more likely implies a negative shock to the value of human capital since employment in the firm is more likely to contract. Thus, workers with specialized human capital in distressed firms have an incentive to avoid holding their firms’ stocks. If variation in distress is correlated across firms, workers in distressed firms have an incentive to avoid the stocks of all distressed firms. The result can be a state-variable risk premium in the expected returns of distressed stocks.” (p.77).

We address these questions in two steps. In the first step we construct an empirical measure of financial distress, and in the second step we calculate the average returns on distressed stocks. We start by considering two alternative ways in which a firm may fail to meet its financial obligations. First, we look at bankruptcy filings under either Chapter 7 or Chapter 11 of the bankruptcy code. Second, we look at failures, defined more broadly to include bankruptcies, delistings, or D (“default”) ratings issued by a leading credit rating agency. The broader definition of failure allows us to capture at least some cases where firms avoid bankruptcy by negotiating with creditors out of court (Gilson, John, and Lang 1990, Gilson 1997). It also captures firms that perform so poorly that their stocks are delisted from the exchange, an event which sometimes precedes bankruptcy or formal default.

To measure the probability that a firm enters either bankruptcy or failure, we adopt a relatively atheoretical econometric approach. We estimate a dynamic panel model using a logit specification, following Shumway (2001), Chava and Jarrow (2004), and others. We extend the previous literature by considering a wide range of explanatory variables, including both accounting and equity-market variables, and by explicitly considering how the optimal specification varies with the horizon of the forecast. Some papers on bankruptcy concentrate on predicting the event that a bankruptcy will occur during the next month. Over such a short horizon, it should not be surprising that the recent return on a firm’s equity is a powerful predictor, but this may not be very useful information if it is relevant only in the extremely short run, just as it would not be useful to predict a heart attack by observing a person dropping to the floor clutching his chest. We also explore time-series variation in the number of bankruptcies, and ask how much of this variation is explained by changes over time in the variables that predict bankruptcy at the firm level.

Our empirical work begins with monthly bankruptcy and failure indicators provided by Kamakura Risk Information Services (KRIS). The bankruptcy indicator was used by Chava and Jarrow (2004), and covers the period from January 1963 through December 1998. The failure indicator runs from January 1963 through December 2003. We merge these datasets with firm level accounting data from COMPUSTAT as well as monthly and daily equity price data from CRSP. This gives us about 800 bankruptcies, 1600 failures, and predictor variables for 1.7 million firm months.

We start by estimating a basic specification used by Shumway (2001) and similar to that of Chava and Jarrow (2004). The model includes both equity market and accounting data. From the equity market, we measure the excess stock return of each

company over the past month, the volatility of daily stock returns over the past three months, and the market capitalization of each company. From accounting data, we measure net income as a ratio to assets, and total leverage as a ratio to assets. We obtain similar coefficient estimates whether we are predicting bankruptcies through 1998, failures through 1998, or failures through 2003.

From this starting point, we make a number of contributions to the prediction of corporate bankruptcies and failures. First, we explore some sensible modifications to the variables listed above. Specifically, we show that scaling net income and leverage by the market value of assets rather than the book value, and adding further lags of stock returns and net income, can improve the explanatory power of the benchmark regression.

Second, we explore some additional variables and find that corporate cash holdings, the market-book ratio, and a firm's price per share contribute explanatory power. In a related exercise we construct a measure of distance to default, based on the practitioner model of Moody's KMV (Crosbie and Bohn 2001) and ultimately on the structural default model of Merton (1974). We find that this measure adds relatively little explanatory power to the reduced-form variables already included in our model.<sup>4</sup>

Third, we examine what happens to our specification as we increase the horizon at which we are trying to predict failure. Consistent with our expectations, we find that our most persistent forecasting variable, market capitalization, becomes relatively more important as we predict further into the future. Volatility and the market-book ratio also become more important at long horizons relative to net income, leverage, and recent equity returns.

Fourth, we study time-variation in the number of failures. We compare the realized frequency of failure to the predicted frequency over time. Although the model underpredicts the frequency of failure in the 1980s and overpredicts it in the 1990s, the model fits the general time pattern quite well.

In the second part of this paper, we use our fitted probability of failure as a measure of financial distress and calculate the risks and average returns on portfolios of stocks sorted by this fitted probability. We find that financially distressed firms have high market betas and high loadings on the HML and SMB factors proposed

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<sup>4</sup>This finding is consistent with recent results of Bharath and Shumway (2004), circulated after the first version of this paper.

by Fama and French (1993, 1996) to capture the value and size effects. However they have low, not high, average returns, suggesting that the equity market has not properly priced distress risk.

We show that the low returns to distressed stocks are not concentrated around earnings announcements, suggesting that the anomaly does not result from overoptimistic investor expectations about future earnings. We also show that almost all the variables in our failure prediction model contribute to these low returns, so that the anomaly does not reflect simply momentum in small loser stocks (Hong, Lim, and Stein 2000), low returns to volatile stocks (Ang, Hodrick, Xing, and Zhang 2006), or other phenomena already documented in the asset pricing literature.

We report some suggestive time-series correlations between the returns to distressed stocks and aggregate developments in financial markets. We show that returns to distressed stocks are particularly low when the implied volatility of the S&P 500 index, measured by the VIX, increases. This implies that distressed stocks are vulnerable to increases in marketwide risk or risk aversion, but it does not help explain the low returns to these stocks as increases in the VIX are normally taken to be negative events, and stocks that do poorly at such times typically have high average returns (Ang, Hodrick, Xing, and Zhang 2006). Finally, we show that the low returns to distressed stocks are correlated with increases in the share of corporate equities owned by institutions that make 13-F filings to the SEC. This suggests that institutional aversion to distressed stocks may have depressed the prices of these stocks during our sample period.

A large related literature studies the prediction of corporate bankruptcy. The literature varies in the choice of variables to predict bankruptcy and the methodology used to estimate the likelihood of bankruptcy. Beaver (1966), Altman (1968), Ohlson (1980), and Zmijewski (1984) use accounting variables to estimate the probability of bankruptcy in a static model. Altman's Z-score and Ohlson's O-score have become popular and widely accepted measures of financial distress. They are used, for example, by Dichev (1998), Griffin and Lemmon (2002), and Ferguson and Shockley (2003) to explore the risks and average returns for distressed firms. A parallel literature uses accounting variables to predict credit ratings, which can be interpreted as subjective default probabilities provided by credit rating agencies (Kaplan and Urwitz 1979, Blume, Lim, and MacKinlay 1998, Molina 2005).

Shumway (2001) estimates a hazard model at annual frequency and adds equity market variables to the set of scaled accounting measures used in the earlier literature.

He points out that estimating the probability of bankruptcy in a static setting introduces biases and overestimates the impact of the predictor variables. This is because the static model does not take into account that a firm could have had unfavorable indicators several periods before going into bankruptcy. Other recent papers using the hazard approach include Chava and Jarrow (2004), who work with monthly data and explore industry effects, and Beaver, McNichols, and Rhie (2005), who explore the stability of the coefficients over time.

Duffie, Saita, and Wang (2006) emphasize that the probability of failure depends on the horizon one is considering. They estimate mean-reverting time series processes for macroeconomic and firm-specific predictors of failure and combine these with a short-horizon failure model to find the marginal probabilities of failure at different horizons. We conduct a similar exercise using a reduced-form econometric approach; we do not model the time-series evolution of the predictor variables but instead directly estimate longer-term failure probabilities.

The remainder of the paper is organized as follows. Section 2 describes the construction of the data set, outlier analysis and summary statistics. Section 3 discusses our basic monthly panel model, extensions to it, and the effects of estimating the model at longer horizons. This section also considers the ability of the model to fit the aggregate time series of failures. Section 4 studies the return properties of equity portfolios formed on the fitted value from our bankruptcy prediction model. We ask whether stocks with high bankruptcy probability have unusually high or low returns relative to the predictions of standard cross-sectional asset pricing models such as the CAPM or the three-factor Fama-French model. Section 5 concludes.

## 2 Data description

In order to estimate a dynamic logit model we need an indicator of financial distress and a set of explanatory variables. The bankruptcy indicator we use is taken from Chava and Jarrow (2004); it includes all bankruptcy filings in the Wall Street Journal Index, the SDC database, SEC filings and the CCH Capital Changes Reporter. The indicator equals one in a month in which a firm filed for bankruptcy under Chapter 7 or Chapter 11, and zero otherwise; in particular, the indicator is zero if the firm disappears from the dataset for some reason other than bankruptcy such as acquisition or delisting. The data span the months from January 1963 through December

1998. We also consider a broader failure indicator, which equals one if a firm files for bankruptcy, delists, or receives a D rating, over the period January 1963 through December 2003.

Table 1 summarizes the properties of our bankruptcy and failure indicators. The first column shows the number of active firms in the CRSP database in each year. The second column shows the number of bankruptcies, and the third column the corresponding percentage of active firms that went bankrupt in each year. The fourth and fifth columns repeat this information for our failure series.

It is immediately apparent that bankruptcies were extremely rare until the late 1960's. In fact, in the three years 1967–1969 there were no bankruptcies at all in our dataset. The bankruptcy rate increased in the early 1970's, and then rose dramatically during the 1980's to a peak of 1.5% in 1986. It remained high through the economic slowdown of the early 1990's, but fell in the late 1990's to levels only slightly above those that prevailed in the 1970's.

Some of these changes through time are probably the result of changes in the law governing corporate bankruptcy in the 1970's, and related financial innovations such as the development of below-investment-grade public debt (junk bonds) in the 1980's and the advent of prepackaged bankruptcy filings in the early 1990's (Tashjian, Lease, and McConnell 1996). Changes in corporate capital structure (Bernanke and Campbell 1988) and the riskiness of corporate activities (Campbell, Lettau, Malkiel, and Xu 2001) are also likely to have played a role, and one purpose of our investigation is to quantify the time-series effects of these changes.

The broader failure indicator tracks the bankruptcy indicator closely until the early 1980's, but towards the end of the sample it begins to diverge significantly. The number of failures increases dramatically after 1998, reflecting the financial distress of many young firms that were newly listed during the boom of the late 1990's.

In order to construct explanatory variables at the individual firm level, we combine quarterly accounting data from COMPUSTAT with monthly and daily equity market data from CRSP. From COMPUSTAT we construct a standard measure of profitability: net income relative to total assets. Previous authors have measured total assets at book value, but we measure the equity component of total assets at market value by adding the book value of liabilities to the market value of equities. We call the resulting profitability ratio NIMTA (Net Income to Market-valued Total Assets) and the traditional series NITA (Net Income to Total Assets). We find that



NIMTA has stronger explanatory power, perhaps because market prices more rapidly incorporate new information about the firm's prospects or more accurately reflect intangible assets of the firm. We also use COMPUSTAT to construct a measure of leverage: total liabilities relative to total assets. We again find that a market-valued version of this series, defined as total liabilities divided by the sum of market equity and book liabilities, performs better than the traditional book-valued series. We call the two series TLMTA and TLTA, respectively. To these standard measures of profitability and leverage, we add a measure of liquidity, the ratio of a company's cash and short-term assets to the market value of its assets (CASHMTA). We also calculate each firm's market-to-book ratio (MB).

In constructing these series we adjust the book value of assets to eliminate outliers, following the procedure suggested by Cohen, Polk, and Vuolteenaho (2003). That is, we add 10% of the difference between market and book equity to the book value of total assets, thereby increasing book values that are extremely small, probably mismeasured, and create outliers when used as the denominators of financial ratios. A few firms still have negative values for book equity even after this adjustment, and we replace these negative values with small positive values. We also winsorize all variables at the 5th and 95th percentiles of their cross-sectional distributions. That is, we replace any observation below the 5th percentile with the 5th percentile, and any observation above the 95th percentile with the 95th percentile. We align each company's fiscal year appropriately with the calendar year, converting Compustat fiscal-year data to a calendar basis, and then lag accounting data by two months. This adjustment ensures that the accounting data are available at the beginning of the month over which bankruptcy is measured. The Appendix to this paper describes the construction of these variables in greater detail.

We add several market-based variables to these two accounting variables. We calculate the monthly log excess return on each firm's equity relative to the S&P 500 index (EXRET), the standard deviation of each firm's daily stock return over the past three months (SIGMA), and the relative size of each firm measured as the log ratio of its market capitalization to that of the S&P 500 index (RSIZE). Finally, we calculate each firm's log price per share, truncated above at \$15 (PRICE). This captures a tendency for distressed firms to trade at low prices per share, without reverse-splitting to bring price per share back into a more normal range.

## 2.1 Summary statistics

Table 2 summarizes the properties of our ten main explanatory variables. The first panel in Table 2 describes the distributions of the variables in almost 1.7 million firm-months with complete data availability, the second panel describes a much smaller sample of almost 800 bankruptcy months, and the third panel describes just over 1600 failure months.<sup>5</sup>

In interpreting these distributions, it is important to keep in mind that we weight every firm-month equally. This has two important consequences. First, the distributions are dominated by the behavior of relatively small companies; value-weighted distributions look quite different. Second, the distributions reflect the influence of both cross-sectional and time-series variation. The cross-sectional averages of several variables, in particular NIMTA, TLMTA, and SIGMA, have experienced significant trends since 1963: SIGMA and TLMTA have trended up, while NIMTA has trended down. The downward trend in NIMTA is not just a consequence of the buoyant stock market of the 1990's, because book-based net income, NITA, displays a similar trend. These trends reflect increasingly conservative accounting (Basu 1997) and the tendency for companies to go public earlier in their lifecycle when they are still unprofitable.<sup>6</sup>

These facts help to explain several features of Table 2. The mean level of NIMTA, for example, is almost exactly zero (in fact, very slightly negative). This is lower than the median level of NIMTA, which is positive at 0.6% per quarter or 2.4% at an annual rate, because the distribution of profitability is negatively skewed. The gap between mean and median is even larger for NITA. All these measures of profitability are strikingly low, reflecting the prevalence of small, unprofitable listed companies in recent years. Value-weighted mean profitability is considerably higher.<sup>7</sup>

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<sup>5</sup>For a firm-month to be included in Table 2, we must observe leverage, profitability, excess return, and market capitalization. We do not require a valid measure of volatility, and replace SIGMA with its cross-sectional mean when this variable is missing.

<sup>6</sup>The influence of these trends is magnified by the growth in the number of companies and the availability of quarterly accounting data over time, which means that recent years have greater influence on the distribution than earlier years. In particular, there is a scarcity of quarterly Compustat data before the early 1970's so years before 1973 have very little influence on our empirical results.

<sup>7</sup>In addition, the distributions of NIMTA and NITA have large spikes just above zero, a phenomenon noted by Hayn (1995). There is a debate in the accounting literature about this spike. Burgstahler and Dichev (1997) argue that it reflects earnings management to avoid losses, but De-

The average value of EXRET is -0.011 or -1.1% per month. This extremely low number reflects both the underperformance of small stocks during the later part of our sample period (the value-weighted mean is almost exactly zero), and the fact that we are reporting a geometric average excess return rather than an arithmetic average. The difference is substantial because individual stock returns are extremely volatile. The average value of the annualized firm-level volatility SIGMA is 56%, again reflecting the strong influence of small firms and recent years in which idiosyncratic volatility has been high (Campbell, Lettau, Malkiel, and Xu 2001).

A comparison of the top and the second panel of Table 2 reveals that bankrupt firms have intuitive differences from the rest of the sample. In months immediately preceding a bankruptcy filing, firms typically make losses (the mean loss is 4.0% quarterly or 16% of market value of assets at an annual rate, and the median loss is 4.7% quarterly or almost 19% at an annual rate); the value of their debts is extremely high relative to their assets (average leverage is almost 80%, and median leverage exceeds 87%); they have experienced extremely negative returns over the past month (the mean is -11.5% over a month, while the median is -17% over a month); and their volatility is extraordinarily high (the mean annualized volatility is 106% and the median is 126%). Bankrupt firms also tend to be relatively small (about 7 times smaller than other firms on average, and 10 times smaller at the median), and they have only about half as much cash and short-term investments, in relation to the market value of assets, as non-bankrupt firms.

The market-book ratio of bankrupt firms has a slightly higher mean and a much higher standard deviation than the market-book ratio of other firms. It appears that some firms go bankrupt after realized losses have driven down their book values relative to market values, while others go bankrupt after bad news about future prospects has driven down their market values relative to book values. Thus bankruptcy is associated with a wide spread in the market-book ratio.

Finally, firms that go bankrupt typically have low prices per share. The mean price per share is just over \$1.50 for a bankrupt firm, while the median price per share is slightly below \$1.

The third panel of Table 2 reports the summary statistics for our failure sample through December 2003. The patterns are similar to those in the second panel, but some effects are stronger for failures than for bankruptcies (losses are more extreme,

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chow, Richardson, and Tuna (2003) and Durtschi and Easton (2004) challenge this interpretation.

volatility is higher, price per share is lower, and market capitalization is considerably smaller), while other effects are weaker (leverage is less extreme and cash holdings are higher).

### 3 A logit model of bankruptcy and failure

The summary statistics in Table 2 show that bankrupt and failed firms have a number of unusual characteristics. However the number of bankruptcies and failures is tiny compared to the number of firm-months in our dataset, so it is not at all clear how useful these variables are in predicting bankruptcy. Also, these characteristics are correlated with one another and we would like to know how to weight them optimally. Following Shumway (2001) and Chava and Jarrow (2004), we now estimate the probabilities of bankruptcy and failure over the next period using a logit model.

We assume that the marginal probability of bankruptcy or failure over the next period follows a logistic distribution and is given by

$$P_{t-1}(Y_{it} = 1) = \frac{1}{1 + \exp(-\alpha - \beta x_{i,t-1})} \quad (1)$$

where  $Y_{it}$  is an indicator that equals one if the firm goes bankrupt or fails in month  $t$ , and  $x_{i,t-1}$  is a vector of explanatory variables known at the end of the previous month. A higher level of  $\alpha + \beta x_{i,t-1}$  implies a higher probability of bankruptcy or failure.

Table 3 reports logit regression results for various alternative specifications. In the first three columns we follow Shumway (2001) and Chava and Jarrow (2004), and estimate a model with five standard variables: NITA, TLTA, EXRET, SIGMA, and RSIZE. This model measures assets in the conventional way, using annual book values from COMPUSTAT. It excludes firm age, a variable which Shumway (2001) considered but found to be insignificant in predicting bankruptcy. Column 1 estimates the model for bankruptcy over the period 1963-1998, column 2 estimates it for failure over the same period, and column 3 looks at failure over the entire 1963-2003 period.

All five of the included variables in the Shumway (2001) bankruptcy model enter significantly and with the expected sign. As we broaden the definition of financial

distress to failure, and as we include more recent data, the effects of market capitalization and volatility become stronger, while the effects of losses, leverage, and recent past returns become slightly weaker.

In columns 4, 5, and 6 we report results for an alternative model that modifies the Shumway specification in several ways. First, we replace the traditional accounting ratios NITA and TLTA that use the book value of assets, with our ratios NIMTA and TLMTA that use the market value of assets. These measures are more sensitive to new information about firm prospects since equity values are measured using monthly market data rather than quarterly accounting data.

Second, we add lagged information about profitability and excess stock returns. One might expect that a long history of losses or a sustained decline in stock market value would be a better predictor of bankruptcy than one large quarterly loss or a sudden stock price decline in a single month. Exploratory regressions with lagged values confirm that lags of NIMTA and EXRET enter significantly, while lags of the other variables do not. As a reasonable summary, we impose geometrically declining weights on these lags. We construct

$$NIMTAAVG_{t-1,t-12} = \frac{1 - \phi^3}{1 - \phi^{12}} (NIMTA_{t-1,t-3} + \dots + \phi^9 NIMTA_{t-9,t-12}), \quad (2)$$

$$EXRETAVG_{t-1,t-12} = \frac{1 - \phi}{1 - \phi^{12}} (EXRET_{t-1} + \dots + \phi^{11} EXRET_{t-12}), \quad (3)$$

where the coefficient  $\phi = 2^{-\frac{1}{3}}$ , implying that the weight is halved each quarter. When lagged excess returns or profitability are missing, we replace them with their cross-sectional means in order to avoid losing observations. The data suggest that this parsimonious specification captures almost all the predictability obtainable from lagged profitability and stock returns.

Third, we add the ratio of cash and short-term investments to the market value of total assets, CASHMTA, in order to capture the liquidity position of the firm. A firm with a high CASHMTA ratio has liquid assets available to make interest payments, and thus may be able to postpone bankruptcy with the possibility of avoiding it altogether if circumstances improve.<sup>8</sup>

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<sup>8</sup>We also considered more traditional measures of working capital, the current ratio of current

Fourth, the market-book ratio, MB, captures the relative value placed on the firm's equity by stockholders and by accountants. Our profitability and leverage ratios use market value; if book value is also relevant, then MB may enter the regression as a correction factor, increasing the probability of bankruptcy when market value is unusually high relative to book value. Recall from Table 2 that the average market-book ratio is slightly higher for bankrupt firms, so there may also be a modest direct effect of overvaluation on failure probability.<sup>9</sup>

Finally, we add the log price per share of the firm, PRICE. We expect this variable to be relevant for low prices per share, particularly since both the NYSE and the Nasdaq have a minimum price per share of \$1 and commonly delist stocks that fail to meet this minimum (Macey, O'Hara, and Pompilio 2004). Reverse stock splits are sometimes used to keep stock prices away from the \$1 minimum level, but these often have negative effects on returns and therefore on market capitalization, suggesting that investors interpret reverse stock splits as a negative signal about company prospects (Woolridge and Chambers 1983, Hwang 1995). Exploratory analysis suggested that price per share is relevant below \$15, and so we truncate price per share at this level before taking the log.

All the new variables in our model enter the logit regression with the expected sign and are highly statistically significant. After accounting for differences in the scaling of the variables, there is little effect on the coefficients of the variables already included in the Shumway model, with the important exception of market capitalization. This variable is strongly correlated with log price per share; once price per share is included, market capitalization enters with a weak positive coefficient, probably as an ad hoc correction to the negative effect of price per share.

To get some idea of the relative impact of changes in the different variables, we compute the proportional impact on the failure probability of a one-standard-deviation increase in each predictor variable for a firm that initially has sample mean values of the predictor variables. Such an increase in profitability reduces the probability of failure by 44% of its initial value; the corresponding effects are a 156% increase for leverage, a 28% reduction for past excess return, a 64% increase for volatility, a 17% increase for market capitalization, a 21% reduction for cash holdings, a 9%

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assets to current liabilities, and the acid test ratio of cash, short-term investments, and receivables to current liabilities. These variables are slightly less effective predictors than CASHMTA, perhaps because our ratio uses the market value of assets in the denominator.

<sup>9</sup>Chacko, Hecht, and Hilscher (2004) discuss the measurement of credit risk when the market-to-book ratio is influenced both by cash flow expectations and discount rates.

increase for the market-book ratio, and a 56% reduction for price per share. Thus variations in leverage, volatility, price per share, and profitability are more important for failure risk than movements in market capitalization, cash, or the market-book ratio. These magnitudes roughly line up with the  $t$  statistics reported in Table 3.

Our proposed model delivers a noticeable improvement in explanatory power over the Shumway model. We report McFadden’s pseudo  $R^2$  coefficient for each specification, calculated as  $1 - L_1/L_0$ , where  $L_1$  is the log likelihood of the estimated model and  $L_0$  is the log likelihood of a null model that includes only a constant term. The pseudo  $R^2$  coefficient increases from 0.26 to 0.30 in predicting bankruptcies or failures over 1963–1998, and from 0.27 to 0.31 in predicting failures over 1963–2003.

### 3.1 Forecasting at long horizons

At the one month horizon our best specification captures about 30% of the variation in bankruptcy risk. We now ask what happens as we try to predict bankruptcies further into the future. In Table 4 we estimate the conditional probability of bankruptcy in six months, one, two and three years. We again assume a logit specification but allow the coefficients on the variables to vary with the horizon of the prediction. In particular we assume that the probability of bankruptcy in  $j$  months, conditional on survival in the dataset for  $j - 1$  months, is given by

$$P_{t-1}(Y_{i,t-1+j} = 1 \mid Y_{i,t-2+j} = 0) = \frac{1}{1 + \exp(-\alpha_j - \beta_j x_{i,t-1})}. \quad (4)$$

Note that this assumption does not imply a cumulative probability of bankruptcy that is logit. If the probability of bankruptcy in  $j$  months did not change with the horizon  $j$ , that is if  $\alpha_j = \alpha$  and  $\beta_j = \beta$ , and if firms exited the dataset only through bankruptcy, then the cumulative probability of bankruptcy over the next  $j$  periods would be given by  $1 - (\exp(-\alpha - \beta x_i) / (1 + \exp(-\alpha - \beta x_i)))^j$ , which no longer has the logit form. Variation in the parameters with the horizon  $j$ , and exit from the dataset through mergers and acquisitions, only make this problem worse. In principle we could compute the cumulative probability of bankruptcy by estimating models for each horizon  $j$  and integrating appropriately; or by using our one-period model and making auxiliary assumptions about the time-series evolution of the predictor variables in the manner of Duffie, Saita, and Wang (2006). We do not pursue these

possibilities here, concentrating instead on the conditional probabilities of default at particular dates in the future.

As the horizon increases in Table 4, the coefficients, significance levels, and overall fit of the logit regression decline as one would expect. Even at three years, however, almost all the variables remain statistically significant.

Three predictor variables are particularly important at long horizons. The coefficient and  $t$  statistic on volatility SIGMA are almost unchanged as the horizon increases; the coefficient and  $t$  statistic on the market-to-book ratio MB increase with the horizon; and the coefficient on relative market capitalization RSIZE switches sign, becoming increasingly significant with the expected negative sign as the horizon increases. These variables, market capitalization, market-to-book ratio, and volatility, are persistent attributes of a firm that become increasingly important measures of financial distress at long horizons. Log price per share also switches sign, presumably as a result of the previously noted correlation between this variable and market capitalization.

Leverage and past excess stock returns have coefficients that decay particularly rapidly with the horizon, suggesting that these are primarily short-term signals of financial distress. Profitability and cash holdings are intermediate, with effects that decay more slowly. Overall, market-based variables become more important relative to accounting variables as we increase the forecast horizon. This pattern is not just due to our use of quarterly accounting data, as we find very similar results if we estimate our model using annual accounting data.

In Table 4 the number of observations and number of failures vary with the horizon, because increasing the horizon forces us to drop observations at both the beginning and end of the dataset. Failures that occur within the first  $j$  months of the sample cannot be related to the condition of the firm  $j$  months previously, and the last  $j$  months of the sample cannot be used to predict failures that may occur after the end of the sample. Also, many firms exit the dataset for other reasons between dates  $t-1$  and  $t-1+j$ . On the other hand, as we lengthen the horizon we can include failures that are immediately preceded by missing data. We have run the same regressions for a subset of firms for which data are available at all the different horizons. This allows us to compare  $R^2$  statistics directly across horizons. We obtain very similar results to those reported in Table 4, telling us that variation in the available data is not responsible for our findings.



## 3.2 Comparison with distance to default

A leading alternative to the reduced-form econometric approach we have implemented in this paper is the structural approach of Moody’s KMV (Crosbie and Bohn 2001), based on the structural default model of Merton (1974). This approach uses the Merton model to construct “distance to default”, DD, a measure of the difference between the asset value of the firm and the face value of its debt, scaled by the standard deviation of the firm’s asset value. Taken literally, the Merton model implies a deterministic relationship between DD and the probability of default, but in practice this relationship is estimated by a nonparametric regression of a bankruptcy or failure indicator on DD. That is, the historical frequency of bankruptcy is calculated for firms with different levels of DD, and this historical frequency is used as an estimate of the probability of bankruptcy going forward.

To implement the structural approach, we calculate DD in the manner of Hilgeist, Keating, Cram, and Lunstedt (2004) by solving a system of two nonlinear equations. The details of the calculation are described in the Appendix. Table 5 compares the predictive power of the structural model with that of our best reduced-form model. The top panel reports the coefficients on DD in a simple regression of our failure indicator on DD, and in a multiple regression on DD and the variables included in our reduced-form model. DD enters with the expected negative sign and is highly significant in the simple regression. In the multiple regression, however, it enters with a *positive* sign at a short horizon, presumably because the reduced-form model already includes volatility and leverage, which are the two main inputs to the calculation of DD. The coefficient on DD only becomes negative and significant when the horizon is extended to one or three years.

The bottom panel of Table 5 reports the pseudo  $R^2$  statistics for these regressions. While the structural model achieves a respectable  $R^2$  of 16% for short-term failure prediction, our reduced-form model almost doubles this number. Adding DD to the reduced-form model has very little effect on the  $R^2$ , which is to be expected given the presence of volatility and leverage in the reduced-form model. These results hold both when we calculate  $R^2$  in-sample, using coefficients estimated over the entire period 1963-2003, and when we calculate it out-of-sample, using coefficients each year from 1981 onwards that were estimated over the period up to but not including that year. The two sets of  $R^2$  are very similar because most failures occur towards the end of the dataset, when the full-sample model and the rolling model have very similar coefficients.

The structural approach is designed to forecast default at a horizon of one year. This suggests that it might perform relatively better as we forecast failure further into the future. It is true that DD enters our model significantly with the correct sign at longer horizons, but Table 5 shows that the relative performance of DD and our econometric model is relatively constant across forecast horizons.

We conclude that the structural approach captures important aspects of the process determining corporate failure. The predictive power of DD is quite impressive given the tight restrictions on functional form imposed by the Merton model. If one's goal is to predict failures, however, it is clearly better to use a reduced-form econometric approach that allows volatility and leverage to enter with free coefficients and that includes other relevant variables. Bharath and Shumway (2004), in independent recent work, reach a similar conclusion.

### 3.3 Other time-series and cross-sectional effects

As we noted in our discussion of Table 1, there is considerable variation in the failure rate over time. We now ask how well our model fits this pattern. We first calculate the fitted probability of failure for each company in our dataset using the coefficients from our best reduced-form model. We then average over all the predicted probabilities to obtain a prediction of the aggregate failure rate among companies with data available for failure prediction.

Figure 1 shows annual averages of predicted and realized failures, expressed as a fraction of the companies with available data.<sup>10</sup> Our model captures much of the broad variation in corporate failures over time, including the strong and long-lasting increase in the 1980's and cyclical spikes in the early 1990's and early 2000's. However it somewhat overpredicts failures in 1974-5, underpredicts for much of the 1980's, and then overpredicts in the early 1990's.

Deviations of the aggregate failure rate from the predictions of a model like ours can be caused by shocks that are correlated across firms, and possibly over time. The effect of correlated shocks is sometimes referred to as frailty (Das, Duffie, Kapadia, and Saita 2005, Duffie, Eckner, Horel, and Saita 2006). Correlated shocks could

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<sup>10</sup>The realized failure rate among these companies is slightly different from the failure rate reported in Table 1, which includes all failures and all active companies, not just those with data available for failure prediction.

result from structural changes in corporate finance such as the creation of the junk bond market, from macroeconomic events such as recessions whose influence is not fully captured by the explanatory variables in our model, or from direct effects of one corporate failure on other distressed corporations. To examine the importance of such shocks, we have considered year dummies that shift the baseline probability of bankruptcy from one year to the next. We have run bankruptcy prediction regressions on a set of year dummies only, and on both year dummies and our explanatory variables. We can reject the hypothesis that time effects can be omitted from our model, but find that the model captures a large share of the time-variation in bankruptcies.<sup>11</sup> Given our focus on differences in distress risk across firms and the pricing of distressed stocks, we do not pursue this issue further here.

We have also explored the possibility that there are industry effects on bankruptcy and failure risk. The Shumway (2001) and Chava-Jarrow (2004) specification appears to behave somewhat differently in the finance, insurance, and real estate (FIRE) sector. That sector has a lower intercept and a more negative coefficient on profitability. However there is no strong evidence of sector effects in our best model, which relies more heavily on equity market data.

We have also used market capitalization and leverage as interaction variables, to test the hypotheses that other firm-specific explanatory variables enter differently for small or highly indebted firms than for other firms. We have found no clear evidence that such interactions are important.

## 4 Risks and average returns on distressed stocks

We now turn our attention to the asset pricing implications of our failure model. Recent work on the distress premium has tended to use either traditional risk indices such as the Altman Z-score or Ohlson O-score (Dichev 1998, Griffin and Lemmon 2002, Ferguson and Shockley 2003) or the distance to default measure of KMV (Vasalou and Xing 2004, Da and Gao 2004). To the extent that our reduced-form model more accurately measures the risk of failure at short and long horizons, we can more

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<sup>11</sup>We have also considered interacting macroeconomic variables with firm-specific variables. We find that the AAA-BAA credit spread and the Treasury term spread interact with firms' size and leverage to predict bankruptcy. A more complex model including such terms further reduces the importance of time effects.

accurately measure the premium that investors receive for holding distressed stocks.

We measure the premium for financial distress by sorting stocks according to their failure probabilities, estimated using the 12-month-ahead model of Table 4. Each January from 1981 through 2003, the model is reestimated using only historically available data to eliminate look-ahead bias. We then form ten value-weighted portfolios of stocks that fall in different regions of the failure risk distribution. We minimize turnover costs and the effects of bid-ask bounce by eliminating stocks with prices less than \$1 at the portfolio construction date, and by holding the portfolios for a year, allowing the weights to drift with returns within the year rather than rebalancing monthly in response to updated failure probabilities.<sup>12</sup> Our portfolios contain stocks in percentiles 0–5, 5–10, 10–20, 20–40, 40–60, 60–80, 80–90, 90–95, 95–99, and 99–100 of the failure risk distribution. This portfolio construction procedure pays greater attention to the tails of the distribution, where the distress premium is likely to be more relevant, and particularly to the most distressed firms. We also construct long-short portfolios that go long the 10% or 20% of stocks with the lowest failure risk, and short the 10% or 20% of stocks with the highest failure risk.

Because we are studying the returns to distressed stocks, it is important to handle carefully the returns to stocks that are delisted and thus disappear from the CRSP database. In many cases CRSP reports a delisting return for the final month of the firm’s life; we have 6,481 such delisting returns in our sample and we use them where they are available. Otherwise, we use the last available full-month return in CRSP. In some cases this effectively assumes that our portfolios sell distressed stocks at the end of the month before delisting, which imparts an upward bias to the returns on distressed-stock portfolios (Shumway 1997, Shumway and Warther 1999).<sup>13</sup> We assume that the proceeds from sales of delisted stocks are reinvested in each portfolio in proportion to the weights of the remaining stocks in the portfolio. In a few cases, stocks are delisted and then re-enter the database, but we do not include these stocks in the sample after the first delisting. We treat firms that fail as equivalent to delisted firms, even if CRSP continues to report returns for these firms. That is, our portfolios sell stocks of companies that fail and we use the latest available CRSP data to calculate a final return on such stocks.

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<sup>12</sup>In the first version of this paper we calculated returns on portfolios rebalanced monthly, and obtained similar results to those reported here.

<sup>13</sup>In the first version of this paper we did not use CRSP delisting returns. The portfolio results were similar to those reported here.

Table 6 reports the results. Each portfolio corresponds to one column of the table. Panel A reports average simple returns in excess of the market, in annualized percentage points, with  $t$  statistics below in parentheses, and then alphas with respect to the CAPM, the three-factor model of Fama and French (1993), and a four-factor model proposed by Carhart (1997) that also includes a momentum factor. Panel B reports estimated factor loadings for excess returns on the three Fama-French factors, again with  $t$  statistics. Panel C reports some relevant characteristics for the portfolios: the annualized standard deviation and skewness of each portfolio's excess return, the value-weighted mean standard deviation and skewness of the individual stock returns in each portfolio, and value-weighted means of RSIZE, market-book, and estimated failure probability for each portfolio. Figures 2 and 3 graphically summarize the behavior of factor loadings and alphas.

The average excess returns reported in the first row of Table 6 are strongly and almost monotonically declining in failure risk. The average excess returns for the lowest-risk 5% of stocks are positive at 3.4% per year, and the average excess returns for the highest-risk 1% of stocks are significantly negative at -17.0% per year. A long-short portfolio holding the safest decile of stocks and shorting the most distressed decile has an average return of 10.0% per year and a standard deviation of 26%, so its Sharpe ratio is comparable to that of the aggregate stock market.

There is striking variation in factor loadings across the portfolios in Table 6. The low-failure-risk portfolios have negative market betas for their excess returns (that is, betas less than one for their raw returns), negative loadings on the value factor HML, and negative loadings on the small firm factor SMB. The high-failure-risk portfolios have positive market betas for their excess returns, positive loadings on HML, and extremely high loadings on SMB, reflecting the prevalence of small firms among distressed stocks.

These factor loadings imply that when we correct for risk using either the CAPM or the Fama-French three-factor model, we worsen the anomalous poor performance of distressed stocks rather than correcting it. A long-short portfolio that holds the safest decile of stocks and shorts the decile with the highest failure risk has an average excess return of 10.0% with a  $t$  statistic of 1.9; it has a CAPM alpha of 12.4% with a  $t$  statistic of 2.3; and it has a Fama-French three-factor alpha of 22.7% with a  $t$  statistic of 6.1. When we use the Fama-French model to correct for risk, all portfolios beyond the 60th percentile of the failure risk distribution have statistically significant negative alphas.

One of the variables that predicts failure in our model is recent past return. This suggests that distressed stocks have negative momentum, which might explain their low average returns. To control for this, Table 6 also reports alphas from the Carhart (1997) four-factor model including a momentum factor. This adjustment cuts the alpha for the long-short decile portfolio roughly in half, from 22.7% to 12.0%, but it remains strongly statistically significant.

Figure 4 illustrates the performance over time of the long-short portfolios that hold the safest decile (quintile) of stocks and short the most distressed decile (quintile). Performance is measured both by cumulative return, and by cumulative alpha or risk-adjusted return from the Fama-French three-factor model. For comparison, we also plot the cumulative return on the market portfolio. Raw returns to these portfolios are concentrated in the late 1980's and late 1990's, with negative returns in the last few years; however the alphas for these portfolios are much more consistent over time.

The bottom panel of Table 6 reports characteristics of these portfolios. There is a wide spread in failure risk across the portfolios. Stocks in the safest 5% have an average failure probability of about 1 basis point, while stocks in the riskiest 5% have a failure probability of 34 basis points and the 1% of riskiest stocks have a failure probability of 80 basis points.

Stocks with a high risk of failure are highly volatile, with average standard deviations of almost 80% in the 5% most distressed stocks and 95% in the 1% most distressed stocks. This volatility does not fully diversify at the portfolio level.<sup>14</sup> The excess return on the portfolio containing the 5% of stocks with the lowest failure risk has an annual standard deviation of 11%, while the excess return for the portfolio containing the 5% of stocks with the highest failure risk has a standard deviation of 26%, and the concentrated portfolio containing the 1% most distressed stocks has a standard deviation of almost 40%. The returns on distressed stocks are also positively skewed, both at the portfolio level and particularly at the individual stock level.

Distressed stocks are much smaller than safe stocks. The value-weighted average size of the 5% safest stocks, reported in the table, is over 16 times larger than the

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<sup>14</sup>On average there are slightly under 500 stocks for each 10% of the failure risk distribution, so purely idiosyncratic firm-level risk should diversify well, leaving portfolio risk to be determined primarily by common variation in distressed stock returns.

value-weighted average size of the 5% most distressed stocks, and the equal-weighted size is about 9 times larger. Market-book ratios are high at both extremes of the failure risk distribution, and lower in the middle. This implies that distressed stocks have the market-book ratios of growth stocks, but the factor loadings of value stocks, since they load positively on the Fama-French value factor.

The wide spread in firm characteristics across the failure risk distribution suggests the possibility that the apparent underperformance of distressed stocks results from their characteristics rather than from financial distress per se. For example, it could be the case that extremely small stocks underperform in a manner that is not captured by the Fama-French three-factor model. To explore this possibility, in Table 7 we double-sort stocks, first on size using NYSE quintile breakpoints, and then on failure risk. In Table 8 we double-sort, first on the book-market ratio using NYSE quintile breakpoints, and then on failure risk.

Table 7 shows that distressed stocks underperform whether they are small stocks or large stocks. The underperformance is, however, considerably stronger among small stocks. The average return difference between the safest and most distressed quintiles is three times larger when the stocks are in the smallest quintile as opposed to the largest quintile. If we correct for risk using the Fama-French three-factor model, the alpha difference between the safest and most distressed quintiles is about 50% greater in the smallest quintile than in the largest quintile. The table also shows that in this sample period, there is only a weak size effect among safe stocks, and among distressed stocks large stocks outperform small stocks.

Table 8 shows that distressed stocks underperform whether they are growth stocks or value stocks. The raw underperformance is more extreme and statistically significant among growth stocks, but this difference disappears when we correct for risk using the Fama-French three-factor model. The value effect is absent in the safest stocks, similar to a result reported by Griffin and Lemmon (2002) using Ohlson's O-score to proxy for financial distress. However this result may result from differences in three-factor loadings, as it largely disappears when we correct for risk using the three-factor model.

As a final specification check, we have sorted stocks on our measure of distance to default. Contrary to the findings of Vassalou and Xing (2004), this sort also generates low returns for distressed stocks, particularly after correction for risk using the Fama-French three-factor model.

Overall, these results are discouraging for the view that distress risk is positively priced in the US stock market. We find that stocks with a high risk of failure have low average returns, despite their high loadings on small-cap and value risk factors.

## 4.1 What explains the low returns of distressed stocks?

What can explain the anomalous underperformance of distressed stocks? Perhaps the most obvious explanation is that our predictors of financial distress are correlated with valuation errors. For example, investors may not have fully understood the relation between our predictive variables and failure risk, and so may not have discounted the prices of high-risk stocks enough to offset their failure probability. Or, more simply, investors may not have understood that the variables in our model predict low future profitability.

It is natural to suppose that valuation errors will disproportionately be resolved by the information revealed in earnings announcements. La Porta (1996) and La Porta, Lakonishok, Shleifer, and Vishny (1997) showed that a large fraction of the superior returns to value stocks are earned in short periods of time around earnings announcements, and used this observation to argue that the value premium results from mispricing. We have conducted a similar analysis for financially distressed stocks, reporting the results in Table 9. Panel A of the table shows the average excess returns on the distressed-stock portfolios of Table 6, using only the returns realized during a three-day window around earnings announcements. There is no tendency for distressed-stock portfolios to do particularly poorly around earnings announcements; instead, the most distressed stocks actually outperform at these times, possibly because the ability to announce earnings is itself good news for companies that are in severe financial difficulty. Panel B of Table 9 calculates excess returns and alphas to distressed-stock portfolios, taking out the three-day windows around earnings announcements. That is, we calculate the alphas for an investment strategy that holds distressed stocks most of the time, but replaces them with factor portfolios for three days around each stock's earnings announcement. The alphas shown in Panel B of Table 9 are almost identical to those reported in Table 6. These results do not support the view that distressed stocks underperform because investors are overoptimistic about their future earnings.

One might also suppose that valuation errors are more likely to be correlated with sophisticated failure predictors, such as those we added to Shumway's (2001)



model, than with obvious predictors such as leverage and profitability.<sup>15</sup> The latter variables have always been followed by practitioners, and academics have used them to predict failure at least since the late 1960's (Beaver 1966, Altman 1968). To explore the relative importance of obvious and sophisticated variables, in Table 10 we report disaggregated estimates of the ability of each of our failure predictors to forecast future stock returns. These estimates are based on repeated cross-sectional multiple regressions of returns on the full set of failure predictors; following Fama and MacBeth (1973), we report the time-series means of the cross-sectional coefficients, and standard errors computed from the time-series variability of those coefficients. For comparison, Table 10 also repeats the failure coefficients reported in Table 4.

Column 1 of Table 10 predicts monthly returns using variables measured at the start of each year, analogous to the sorting procedure we used in Table 9. In this regression, all the explanatory variables enter significantly with the exception of market capitalization. Of the significant variables, five enter with a sign opposite to that in the failure prediction regression—that is, they contribute to the low returns on distressed stocks—and two, leverage and stock price, enter with the same sign that they have in the failure prediction regression. Highly leveraged stocks are more likely to fail, but have delivered high average returns, while stocks with high prices are less likely to fail, but have delivered low average returns. The former pattern may result from the salience of leverage to even unsophisticated investors, while the latter may reflect the value effect, imperfectly captured by the market-book ratio, or the size effect, imperfectly captured by our measure of relative market capitalization. Column 2 of Table 10 repeats the regression using predictor variables measured at the start of each month. Results are similar except that lagged returns no longer enter the regression significantly, perhaps because short-term reversal now offsets medium-term momentum.

Overall, Table 10 shows that the low returns to distressed stocks result from many of the variables in our failure prediction model. They reflect more than just momentum in stocks with bad news (Hong, Lim, and Stein 2000) or low returns to volatile stocks (Ang, Hodrick, Xing, and Zhang 2005). Some of the standard variables we include in our model, such as recent profitability, are significant return predictors, implying that low returns to distressed stocks are not just the result of sophisticated variables identified by our econometric analysis.

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<sup>15</sup>In a similar spirit, Franzoni and Marin (2005) argue that firms with underfunded pension plans underperform because pension plan funding status is not of obvious significance to investors.

More generally, the stocks that our model identifies as distressed move with aggregate market conditions in the way that one would expect if investors understand them to be risky. Figure 5 plots the cumulative return to our portfolio long the safest decile of stocks and short the riskiest decile, together with the implied volatility (VIX) on the S&P 500 index, over the period since 1990 for which we have VIX data. The correlation of the monthly portfolio return with the change in the VIX is 0.23. This positive correlation is consistent with the view that investors “flee to quality”, selling distressed stocks, when market risk or risk aversion increase as measured by the VIX. It is also consistent with the positive correlation between credit spreads and the VIX documented in the literature on corporate bonds and credit default swaps (Berndt, Douglas, Duffie, Ferguson, and Schranz 2005, Pan and Singleton 2005, Schaefer and Strebulaev 2004). If investors were unable to distinguish between stocks with high and low failure probabilities we would not expect this pattern.

Some investors may have motives to hold distressed stocks despite their tendency to underperform. These motives are not captured by standard models of risk and return, since we have shown that risk adjustment for size and value effects worsens the underperformance of distressed stocks, and adjustment for momentum reduces but does not eliminate it. Adjustment for volatility risk (Ang, Hodrick, Xing, and Zhang 2006) would also worsen the underperformance of distressed stocks since these stocks do poorly when the VIX increases, and investors normally require compensation for such a correlation.

Two other motives may be relevant, however. First, Barberis and Huang (2004) model the behavior of investors whose preferences satisfy the cumulative prospect theory of Tversky and Kahneman (1992). Such investors have a strong desire to hold positively skewed portfolios, and may even hold undiversified positions in positively skewed assets. Barberis and Huang argue that this effect can explain the high prices and low average returns on IPO’s, whose returns are positively skewed. In a related study, Zhang (2006) finds that industries with a positively skewed cross-sectional return distribution tend to have low average returns. The same effect could be at work here, because Table 6 shows that both individual distressed stocks and our portfolios of distressed stocks offer returns with strong positive skewness. Second, von Kalckreuth (2005) argues that majority owners of distressed companies can extract private benefits, for example by buying the company’s output or assets at bargain prices. The incentive to extract such benefits is greater when the company is unlikely to survive and generate future profits for its shareholders. Thus majority owners may hold distressed stock, rather than selling it, because they earn a greater return than

the return we measure to outside shareholders.

These hypotheses have the potential to explain why some investors hold distressed stocks despite their low average returns, but they do not explain why other rational investors fail to arbitrage the distress anomaly. Some distressed stocks may be unusually expensive or difficult to short, but more important limits to arbitrage are likely to be the reluctance of some investors to short stocks and the limited capital that arbitrageurs have available.

Finally, the distress anomaly may result from unexpected developments during our sample period. That is, it may be an in-sample phenomenon that is unlikely to continue in the future. Our sample period generally had strong economic growth, so it is not likely that macroeconomic news was worse than expected, but debtholders may have become more adept at forcing bankruptcy or transferring resources from equityholders to debtholders after default occurs.<sup>16</sup>

Another development that may have been unexpected is the strong shift of equity ownership from individuals to institutions during this period. Kovtunen and Sosner (2003) have documented that institutions prefer to hold profitable stocks, and that this preference helped institutional performance during the 1980's and 1990's because profitable stocks outperformed the market. It is possible that the strong performance of profitable stocks in this period was endogenous, the result of demand for these stocks by rapidly growing institutional investors. If institutions more generally prefer stocks with low failure risk, and tend to sell stocks that enter financial distress, then a similar mechanism could drive our results.

Suggestive informal evidence in favor of this hypothesis is presented in Figure 6. The figure shows the share of institutional ownership in the U.S. equity market, taken from Binay (2005), along with the cumulative log return on a portfolio that is long the 10% safest stocks, and short the 10% most distressed stocks. The figure shows that safe stocks outperformed distressed stocks most strongly in periods such as the late 1980's when institutional ownership was growing rapidly, and underperformed in periods such as the early 1990's when institutional ownership was stable. The correlation between the raw excess return to the 10% long-short portfolio and the change in the institutional share is positive at 0.31.

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<sup>16</sup>We thank Myron Scholes for suggesting this explanation of our results. Garlappi, Shu, and Yan (2006) also emphasize the bargaining between equityholders and debtholders in bankruptcy.

A full exploration of this hypothesis would require data on institutional ownership at the firm level rather than the aggregate level, and would have to take account of shifting institutional equity preferences (Bennett, Sias, and Starks 2003). Such an exploration is beyond the scope of this paper, but appears to be an interesting direction for future research.

## 5 Conclusion

This paper makes two main contributions to the literature on financial distress. First, we carefully implement a reduced-form econometric model to predict corporate bankruptcies and failures at short and long horizons. Our best model has greater explanatory power than the existing state-of-the-art models estimated by Shumway (2001) and Chava and Jarrow (2004), and includes additional variables with sensible economic motivation. We believe that models of the sort estimated here have meaningful empirical advantages over the bankruptcy risk scores proposed by Altman (1968) and Ohlson (1980). While Altman's Z-score and Ohlson's O-score were seminal early contributions, better measures of bankruptcy risk are available today. We have also presented evidence that failure risk cannot be adequately summarized by a measure of distance to default inspired by Merton's (1974) pioneering structural model. While our distance to default measure is not exactly the same as those used by Crosbie and Bohn (2001) and Vassalou and Xing (2004), we believe that this result, similar to that reported independently by Bharath and Shumway (2004), is robust to alternative measures of distance to default.

Second, we show that stocks with a high risk of failure tend to deliver anomalously low average returns. We sort stocks by our 12-month-ahead estimate of failure risk, calculated from a model that uses only historically available data at each point in time. We calculate returns and risks on portfolios sorted by failure risk over the period 1981-2003. Distressed portfolios have low average returns, but high standard deviations, market betas, and loadings on Fama and French's (1993) small-cap and value risk factors. They also tend to do poorly when marketwide implied volatility increases. Thus, from the perspective of any of the leading empirical asset pricing models, these stocks have negative alphas. This result is a significant challenge to the conjecture that the value and size effects are proxies for a financial distress premium. More generally, it is a challenge to standard models of rational asset pricing in which the structure of the economy is stable and well understood by investors.

Some previous authors have reported evidence that distressed stocks underperform the market, but results have varied with the measure of financial distress that is used. Our results are consistent with the findings of Dichev (1998), who uses Altman's Z-score and Ohlson's O-score to measure financial distress, and Garlappi, Shu, and Yan (2006), who obtain default risk measures from Moody's KMV. Vassalou and Xing (2004) calculate distance to default; they find some evidence that distressed stocks with a low distance to default have higher returns, but this evidence comes entirely from small value stocks. Da and Gao (2004) argue that Vassalou and Xing's distressed-stock returns are biased upwards by one-month reversal and bid-ask bounce. Griffin and Lemmon (2002), using O-score to measure distress, find that distressed growth stocks have particularly low returns. Our measure of financial distress generates underperformance among distressed stocks in all quintiles of the size and value distributions, but the underperformance is more dramatic among small stocks and growth stocks.

We have discussed a number of possible explanations for the anomalously low returns on distressed stocks. One simple story is that investors make valuation errors, overpricing these stocks because they fail to understand their poor prospects. This simple story may be correct, but we do not find that valuation errors are corrected when distressed stocks make earnings announcements, and we do not find any strong tendency for poor returns to be associated with the more subtle and less obvious variables in our failure prediction model. Another possibility is that distressed stocks have characteristics that appeal to certain investors, such as increased opportunities to extract private benefits of control (von Kalckreuth 2005) or positive skewness of returns (Barberis and Huang 2004, Zhang 2006). We have no direct evidence that distressed stocks offer private benefits to majority shareholders, but we do find that these stocks offer positively skewed returns whether they are held in concentrated or diversified portfolios. Finally, it is possible that unexpected developments during our sample period—such as increased power to debtholders in bankruptcy, or increased equity ownership by institutions with a preference for safe stocks—have driven down the prices of distressed stocks. We have shown that indeed distressed stocks have tended to perform particularly poorly in periods when institutional equity ownership is increasing rapidly. To the extent that this explanation is important, the poor performance of distressed stocks is a transitional phenomenon that could disappear or even reverse if institutional ownership stabilizes.

## Appendix

In this appendix we discuss issues related to the construction of our dataset. All variables are constructed using COMPUSTAT and CRSP data. Relative size, excess return, and accounting ratios are defined as follows:

$$\begin{aligned}
 RSIZE_{i,t} &= \log \left( \frac{Firm\ Market\ Equity_{i,t}}{Total\ S\&P500\ Market\ Value_t} \right) \\
 EXRET_{i,t} &= \log(1 + R_{i,t}) - \log(1 + R_{S\&P500,t}) \\
 NITA_{i,t} &= \frac{Net\ Income_{i,t}}{Total\ Assets(adjusted)_{i,t}} \\
 TLTA_{i,t} &= \frac{Total\ Liabilities_{i,t}}{Total\ Assets(adjusted)_{i,t}} \\
 NIMTA_{i,t} &= \frac{Net\ Income_{i,t}}{(Firm\ Market\ Equity_{i,t} + Total\ Liabilities_{i,t})} \\
 TLMTA_{i,t} &= \frac{Total\ Liabilities_{i,t}}{(Firm\ Market\ Equity_{i,t} + Total\ Liabilities_{i,t})} \\
 CASHMTA_{i,t} &= \frac{Cash\ and\ Short\ Term\ Investments_{i,t}}{(Firm\ Market\ Equity_{i,t} + Total\ Liabilities_{i,t})}
 \end{aligned}$$

The COMPUSTAT quarterly data items used are Data44 for total assets, Data69 for net income, and Data54 for total liabilities.

To deal with outliers in the data, we correct both NITA and TLTA using the difference between book equity (BE) and market equity (ME) to adjust the value of total assets:

$$Total\ Assets\ (adjusted)_{i,t} = TA_{i,t} + 0.1 * (BE_{i,t} - ME_{i,t})$$

Book equity is as defined in Davis, Fama and French (2000) and outlined in detail in Cohen, Polk and Vuolteenaho (2003). This transformation helps with the values of total assets that are very small, probably mismeasured and lead to very large values of NITA. After total assets are adjusted, each of the seven explanatory variables is winsorized using a 5/95 percentile interval in order to eliminate outliers.

To measure the volatility of a firm's stock returns, we use a proxy, centered around zero rather than the rolling three-month mean, for daily variation of returns computed

as an annualized three-month rolling sample standard deviation:

$$SIGMA_{i,t-1,t-3} = \left( 252 * \frac{1}{N-1} \sum_{k \in \{t-1, t-2, t-3\}} r_{i,k}^2 \right)^{\frac{1}{2}}$$

To eliminate cases where few observations are available, SIGMA is coded as missing if there are fewer than five non-zero observations over the three months used in the rolling-window computation. In calculating summary statistics and estimating regressions, we replace missing SIGMA observations with the cross-sectional mean of SIGMA; this helps us avoid losing some failure observations for infrequently traded companies. A dummy for missing SIGMA does not enter our regressions significantly. We use a similar procedure for missing lags of NIMTA and EXRET in constructing the moving average variables NIMTAAVG and EXRETAVG.

In order to calculate distance to default we need to estimate asset value and asset volatility, neither of which are directly observable. We construct measures of these variables by solving two equations simultaneously.

First, in the Merton model equity is valued as a European call option on the value of the firm's assets. Then:

$$\begin{aligned} ME &= TA_{DD}N(d_1) - BD \exp(-R_{BILL}T)N(d_2) \\ d_1 &= \frac{\log\left(\frac{TA_{DD}}{BD}\right) + (R_{BILL} + \frac{1}{2}SIGMA_{DD}^2)T}{SIGMA_{DD}\sqrt{T}} \\ d_2 &= d_1 - SIGMA_{DD}\sqrt{T}, \end{aligned}$$

where  $TA_{DD}$  is the value of assets,  $SIGMA_{DD}$  is the volatility of assets,  $ME$  is the value of equity, and  $BD$  is the face value of debt maturing at time  $T$ . Following convention in the literature on the Merton model (Crosbie and Bohn 2001, Vassalou and Xing 2004), we assume  $T = 1$ , and use short term plus one half long term book debt to proxy for the face value of debt  $BD$ . This convention is a simple way to take account of the fact that long-term debt may not mature until after the horizon of the distance to default calculation. We measure the risk free rate  $R_{BILL}$  as the Treasury bill rate.

The second equation is a relation between the volatility of equity and the volatility of assets, often referred to as the optimal hedge equation:

$$SIGMA = N(d_1) \frac{TA_{DD}}{ME} SIGMA_{DD}.$$

As starting values for asset value and asset volatility, we use  $TA_{DD} = ME + BD$ , and  $SIGMA_{DD} = SIGMA(ME/(ME + BD))$ .<sup>17</sup> We iterate until we have found values for  $TA_{DD}$  and  $SIGMA_{DD}$  that are consistent with the observed values of  $ME$ ,  $BD$ , and  $SIGMA$ .

Finally, we compute distance to default as

$$DD = \frac{-\log(BD/TA_{DD}) + 0.06 + R_{BILL} - \frac{1}{2}SIGMA_{DD}^2}{SIGMA_{DD}}.$$

The number 0.06 appears in the formula as an empirical proxy for the equity premium. Vassalou and Xing (2004) instead estimate the average return on each stock, while Hillegeist, Keating, Cram, and Lunstetd (2004) calculate the drift as the return on assets during the previous year. If the estimated expected return is negative, they replace it with the riskfree interest rate. We believe that it is better to use a common expected return for all stocks than a noisily estimated stock-specific number.

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<sup>17</sup>If  $BD$  is missing, we use  $BD = median(BD/TL) * TL$ , where the median is calculated for the entire data set. This captures the fact that empirically,  $BD$  tends to be much smaller than  $TL$ . If  $BD = 0$ , we use  $BD = median(BD/TL) * TL$ , where now we calculate the median only for small but nonzero values of  $BD$  ( $0 < BD < 0.01$ ). If  $SIGMA$  is missing, we replace it with its cross sectional mean. Before calculating asset value and volatility, we adjust  $BD$  so that  $BD/(ME+BD)$  is winsorized at the 0.5% level. We also winsorize  $SIGMA$  at the 0.5% level. This significantly reduces instances in which the search algorithm does not converge.



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**Table 1: Number of bankruptcies and failures per year**

The table lists the total number of active firms (Column 1), total number of bankruptcies (Column 2) and failures (Column 4) for every year of our sample period. The number of active firms is computed by averaging over the numbers of active firms across all months of the year.

<b>Year</b>	<b>Active Firms</b>	<b>Bankruptcy</b>	<b>(%)</b>	<b>Failure</b>	<b>(%)</b>
1963	1281	0	0.00	0	0.00
1964	1357	2	0.15	2	0.15
1965	1436	2	0.14	2	0.14
1966	1513	1	0.07	1	0.07
1967	1598	0	0.00	0	0.00
1968	1723	0	0.00	0	0.00
1969	1885	0	0.00	0	0.00
1970	2067	5	0.24	5	0.24
1971	2199	4	0.18	4	0.18
1972	2650	8	0.30	8	0.30
1973	3964	6	0.15	6	0.15
1974	4002	18	0.45	18	0.45
1975	4038	5	0.12	5	0.12
1976	4101	14	0.34	14	0.34
1977	4157	12	0.29	12	0.29
1978	4183	14	0.33	15	0.36
1979	4222	14	0.33	14	0.33
1980	4342	26	0.60	26	0.60
1981	4743	23	0.48	23	0.48
1982	4995	29	0.58	29	0.58
1983	5380	50	0.93	50	0.93
1984	5801	73	1.26	74	1.28
1985	5912	76	1.29	77	1.30
1986	6208	95	1.53	95	1.53
1987	6615	54	0.82	54	0.82
1988	6686	84	1.26	85	1.27
1989	6603	74	1.12	78	1.18
1990	6515	80	1.23	82	1.26
1991	6571	70	1.07	73	1.11
1992	6914	45	0.65	50	0.72
1993	7469	36	0.48	39	0.52
1994	8067	30	0.37	33	0.41
1995	8374	43	0.51	45	0.54
1996	8782	32	0.36	34	0.39
1997	9544	44	0.46	61	0.64
1998	9844	49	0.50	150	1.52
1999	9675	.	.	209	2.16
2000	9426	.	.	167	1.77
2001	8817	.	.	324	3.67
2002	8242	.	.	221	2.68
2003	7833	.	.	167	2.13

**Table 2: Summary statistics**

The tables include the following variables (various adjustments are described in the data description section): net income over book value of total assets (NITA), net income over market value of total assets (NIMTA), total liabilities over book value of total assets (TLTA), total liabilities over market value of total assets (TLMTA), log of gross excess return over value weighted S&P 500 return (EXRET) annualized, i.e.  $\log(1 + \text{simple excess return})$ , log of firm's market equity over the total valuation of S&P 500 (RSIZE), square root of a sum of squared firm stock returns over a three-month period (annualized) (SIGMA), stock of cash and short term investments over the market value of total assets (CASHMTA), market-to-book value of the firm (MB) and log of price per share winsorized above \$15 (PRICE). Market value of total assets was computed by adding market value of firm equity to its total liabilities. The first group reports summary statistics for all firm-month observations and the other two for bankruptcy and failure groups. We have a total of 1,695,036 observations, of which 797 are bankruptcy and 1614 are failure events. In both cases, the panels only contain statistics for values where all variables were non-missing.

<b>Entire dataset</b>										
	<b>NITA</b>	<b>NIMTA</b>	<b>TLTA</b>	<b>TLMTA</b>	<b>EXRET</b>	<b>RSIZE</b>	<b>SIGMA</b>	<b>CASHMTA</b>	<b>MB</b>	<b>PRICE</b>
<b>Mean</b>	-0.001	0.000	0.506	0.445	-0.011	-10.456	0.562	0.084	2.041	2.019
<b>Median</b>	0.007	0.006	0.511	0.427	-0.009	-10.570	0.471	0.045	1.557	2.474
<b>St. Dev</b>	0.034	0.023	0.252	0.280	0.117	1.922	0.332	0.097	1.579	0.883
<b>Min</b>	-0.102	-0.069	0.083	0.036	-0.243	-13.568	0.153	0.002	0.358	-0.065
<b>Max</b>	0.039	0.028	0.931	0.923	0.218	-6.773	1.353	0.358	6.471	2.708
Observations: 1,695,036										
<b>Bankruptcy group</b>										
	<b>NITA</b>	<b>NIMTA</b>	<b>TLTA</b>	<b>TLMTA</b>	<b>EXRET</b>	<b>RSIZE</b>	<b>SIGMA</b>	<b>CASHMTA</b>	<b>MB</b>	<b>PRICE</b>
<b>Mean</b>	-0.054	-0.040	0.796	0.763	-0.115	-12.416	1.061	0.044	2.430	0.432
<b>Median</b>	-0.054	-0.047	0.872	0.861	-0.171	-12.876	1.255	0.021	1.018	-0.065
<b>St. Dev</b>	0.043	0.030	0.174	0.210	0.148	1.345	0.352	0.062	2.509	0.760
Observations: 797										
<b>Failure group</b>										
	<b>NITA</b>	<b>NIMTA</b>	<b>TLTA</b>	<b>TLMTA</b>	<b>EXRET</b>	<b>RSIZE</b>	<b>SIGMA</b>	<b>CASHMTA</b>	<b>MB</b>	<b>PRICE</b>
<b>Mean</b>	-0.059	-0.044	0.738	0.731	-0.105	-12.832	1.167	0.072	2.104	0.277
<b>Median</b>	-0.066	-0.062	0.821	0.842	-0.179	-13.568	1.353	0.029	0.751	-0.065
<b>St. Dev</b>	0.043	0.030	0.228	0.239	0.162	1.168	0.303	0.099	2.389	0.643
Observations: 1614										



**Table 3: Logit regressions on predictor variables**

This table reports results from logit regressions of the bankruptcy and failure indicator on predictor variables. The value of the predictor variable is known at the beginning of the month over which bankruptcy is measured. Net income and total liabilities are scaled by accounting and market total assets.

	(1)	(2)	(3)	(4)	(5)	(6)
Dep variable:	Bankruptcy	Failure	Failure	Bankruptcy	Failure	Failure
Sample period:	1963-1998	1963-1998	1963-2003	1963-1998	1963-1998	1963-2003
<b>NITA</b>	-14.05 (16.03)**	-13.79 (17.06)**	-12.782 (21.26)**			
<b>NIMTAAVG</b>				-32.518 (17.65)**	-32.457 (19.01)**	-29.672 (23.37)**
<b>TLTA</b>	5.378 (25.91)**	4.62 (26.28)**	3.744 (32.32)**			
<b>TLMTA</b>				4.322 (22.82)**	3.865 (23.39)**	3.36 (27.80)**
<b>EXRET</b>	-3.297 (12.12)**	-2.903 (11.81)**	-2.319 (13.57)**			
<b>EXRETAVG</b>				-9.51 (12.05)**	-8.819 (12.08)**	-7.35 (14.03)**
<b>SIGMA</b>	2.148 (16.40)**	2.28 (18.34)**	2.763 (26.63)**	0.92 (6.66)**	1.15 (8.79)**	1.482 (13.54)**
<b>RSIZE</b>	-0.188 (5.56)**	-0.253 (7.60)**	-0.374 (13.26)**	0.246 (6.18)**	0.169 (4.32)**	0.082 (2.62)**
<b>CASHMTA</b>				-4.888 (7.96)**	-3.218 (6.59)**	-2.401 (8.64)**
<b>MB</b>				0.099 (6.72)**	0.095 (6.76)**	0.054 (4.87)**
<b>PRICE</b>				-0.882 (10.39)**	-0.807 (10.09)**	-0.937 (14.77)**
<b>Constant</b>	-15.214 (39.45)**	-15.41 (40.87)**	-16.576 (50.92)**	-7.648 (13.66)**	-8.45 (15.63)**	-9.079 (20.84)**
Observations	1282853	1302564	1695036	1282853	1302564	1695036
Failures	797	911	1614	797	911	1614
Pseudo R2	0.260	0.258	0.270	0.299	0.296	0.312

Absolute value of z statistics in parentheses

\* significant at 5%; \*\* significant at 1%

**Table 4: Logit regressions on lagged variables**

The table below takes our best-model variables and tests their predictive power as we lag them by 6, 12, 24, and 36 months. The dependent variable is failure and the sample period is 1963-2003.

	(1)	(2)	(3)	(4)	(5)
Lag (months)	0	6	12	24	36
<b>NIMTAAVG</b>	-29.672 (23.37)**	-23.915 (21.82)**	-20.264 (18.09)**	-13.232 (10.50)**	-14.061 (9.77)**
<b>TLMTA</b>	3.36 (27.80)**	2.057 (22.63)**	1.416 (16.23)**	0.917 (9.85)**	0.643 (6.25)**
<b>EXRETAVG</b>	-7.35 (14.03)**	-7.792 (15.97)**	-7.129 (14.15)**	-5.607 (10.14)**	-2.564 (4.14)**
<b>SIGMA</b>	1.482 (13.54)**	1.268 (14.57)**	1.411 (16.49)**	1.515 (16.92)**	1.334 (13.54)**
<b>RSIZE</b>	0.082 (2.62)**	0.047 (2.02)*	-0.045 (2.09)*	-0.132 (6.19)**	-0.18 (8.03)**
<b>CASHMTA</b>	-2.401 (8.64)**	-2.397 (9.77)**	-2.132 (8.53)**	-1.37 (5.09)**	-1.414 (4.61)**
<b>MB</b>	0.054 (4.87)**	0.047 (4.22)**	0.075 (6.33)**	0.108 (7.92)**	0.125 (8.17)**
<b>PRICE</b>	-0.937 (14.77)**	-0.468 (10.36)**	-0.058 (1.40)	0.212 (4.96)**	0.279 (6.00)**
<b>Constant</b>	-9.079 (20.84)**	-8.069 (25.00)**	-9.164 (30.89)**	-10.233 (34.48)**	-10.534 (33.53)**
Observations	1695036	1642006	1565634	1384951	1208610
Failures	1614	2008	1968	1730	1467
Pseudo R sq	0.312	0.188	0.114	0.061	0.044

Absolute value of z statistics in parentheses

\* significant at 5%; \*\* significant at 1%

**Table 5: Distance to default and our best model**

In panel A we report the coefficients on distance to default variable in a logit regression by itself and included in our best model. The dependent variable is failure and the sample period is 1963-2003. Regression results are reported for various horizons: 0, 12, and 36 months. Panel B reports the in-sample and out-of-sample pseudo-R squared for the regressions from panel A.

**Panel A - Coefficients**

	(1)	(2)	(3)
Lag (months)	0	12	36
<b>DD only</b>	-0.883 (39.73)**	-0.345 (33.73)**	-0.165 (20.88)**
<b>DD in best model</b>	0.048 (2.62)**	-0.091 (7.52)**	-0.09 (8.09)**
Observations	1695036	1565634	1208610
Failures	1614	1968	1467

**Panel B - R squared**

	(1)	(2)	(3)
In-sample (1963 - 2003)			
<b>DD only</b>	0.159	0.066	0.026
<b>Best model</b>	0.312	0.114	0.044
<b>DD in Best model</b>	0.312	0.117	0.045
Out-of-sample (1981 - 2003)			
<b>DD only</b>	0.156	0.064	0.025
<b>Best model</b>	0.310	0.108	0.039

**Table 6: Returns on distressed stock portfolios**

We sort all stocks based on the predicted 12-month probability of failure and divide them into 10 portfolios based on percentile cutoffs. For example, 0 to 5th percentile (0005) and 99th to 100th percentile (9900). In the table below we show results from regressions of value weighted excess returns over the market on a constant, market return (RM), as well as three (RM, HML, SMB) and four (RM, HML, SMB, UMD) FF factor regressions. Panel A shows monthly alphas (in annualized percent units) from these regressions and the corresponding t-stats below. Panel B shows loadings on the three factors, as well as corresponding t-stats below, from the 3-factor regression. Panel C reports annualized standard deviation and skewness of individual and portfolio returns, mean relative size (RSIZE), market-to-book (MB), and probability of failure (Phat) values for each portfolio.

**Panel A - Portfolio alphas**

Portfolios	0005	0510	1020	2040	4060	6080	8090	9095	9599	9900	LS1090	LS2080
Mean excess return	3.39	2.36	1.25	0.93	0.50	-0.16	-4.44	-8.07	-6.63	-16.30	10.20	6.72
	(1.45)	(1.08)	(1.06)	(1.02)	(0.34)	(0.07)	(1.26)	(1.72)	(1.24)	(1.98)*	(1.90)	(1.53)
CAPM alpha	2.74	2.04	1.40	1.50	0.46	-1.53	-6.67	-10.96	-9.45	-18.71	12.60	8.98
	(1.17)	(0.92)	(1.17)	(1.69)	(0.31)	(0.68)	(1.95)	(2.40)*	(1.79)	(2.27)*	(2.36)*	(2.08)*
3-factor alpha	5.70	5.30	2.65	0.76	-2.13	-5.77	-12.73	-18.15	-16.13	-24.25	22.89	17.43
	(2.95)**	(2.85)**	(2.34)*	(0.95)	(1.72)	(3.26)**	(4.64)**	(5.75)**	(3.93)**	(3.35)**	(6.15)**	(5.41)**
4-factor alpha	2.37	2.66	1.49	2.01	0.65	-1.21	-5.80	-10.01	-8.19	-20.39	12.18	8.19
	(1.19)	(1.37)	(1.24)	(2.42)*	(0.53)	(0.70)	(2.16)*	(3.26)**	(1.96)	(2.64)**	(3.45)**	(2.68)**

**Panel B - 3-factor regression coefficients**

Portfolios	0005	0510	1020	2040	4060	6080	8090	9095	9599	9900	LS1090	LS2080
RM	-0.083	-0.111	-0.058	-0.028	0.103	0.334	0.479	0.476	0.431	0.254	-0.563	-0.553
	(2.22)*	(3.10)**	(2.65)**	(1.82)	(4.33)**	(9.77)**	(9.04)**	(7.81)**	(5.45)**	(1.82)	(7.82)**	(8.88)**
HML	-0.474	-0.499	-0.176	0.122	0.379	0.613	0.849	0.918	0.831	0.608	-1.396	-1.183
	(9.68)**	(10.61)**	(6.16)**	(6.00)**	(12.14)**	(13.70)**	(12.23)**	(11.50)**	(8.02)**	(3.32)**	(14.82)**	(14.51)**
SMB	0.212	0.037	-0.117	-0.091	0.121	0.263	0.591	1.466	1.538	1.964	-1.394	-0.833
	(3.89)**	(0.71)	(3.68)**	(4.03)**	(3.49)**	(5.29)**	(7.66)**	(16.51)**	(13.34)**	(9.64)**	(13.31)**	(9.19)**

**Panel C - Portfolio characteristics**

Portfolios	0005	0510	1020	2040	4060	6080	8090	9095	9599	9900	LS1090	LS2080
Portfolio SD	0.112	0.105	0.057	0.044	0.071	0.111	0.169	0.225	0.257	0.394	0.258	0.211
Portfolio skewness	1.112	0.327	0.425	-0.262	-0.130	-0.275	1.040	1.749	2.393	1.856		
Individual SD	0.360	0.351	0.304	0.288	0.306	0.370	0.508	0.684	0.777	0.941		
Individual skewness	0.633	0.754	0.584	0.991	1.056	0.838	1.560	3.742	1.751	2.480		
Mean RSIZE	-7.786	-7.479	-7.236	-7.172	-7.371	-7.803	-8.744	-10.000	-10.584	-11.273		
Mean MB	2.648	3.089	2.945	2.499	2.117	1.989	2.256	2.611	3.114	3.783		
Mean Phat	0.011%	0.014%	0.018%	0.024%	0.036%	0.057%	0.11%	0.19%	0.34%	0.80%		

**Table 7: Double sorting on size and distress**

This table reports mean excess returns over the market and 3-factor alphas for portfolios sorted on size (ME) and fitted 12-month fitted probability of failure (Phat). We first sort stocks into size quintiles using NYSE breakpoints (following Fama-French) and then, within each quintile, sort stocks into predicted failure probability quintiles. All returns are in annualized percent units.

**Panel A - mean excess return**

ME\Phat	Low			High		Low - High
<b>Large</b>	3.91	-1.49	-0.32	0.35	0.89	3.02
	(2.01)*	(1.19)	(0.22)	(0.24)	(0.39)	(0.77)
	4.09	0.22	1.98	0.71	1.04	3.05
	(2.00)*	(0.16)	(1.36)	(0.52)	(0.40)	(0.78)
	4.58	2.86	-0.32	0.89	0.35	4.23
	(1.98)*	(1.48)	(0.21)	(0.57)	(0.14)	(1.25)
<b>Small</b>	6.01	2.46	1.62	0.84	-2.58	8.60
	(2.42)*	(1.16)	(0.77)	(0.43)	(0.93)	(2.91)**
	3.72	-0.32	-3.44	-6.09	-10.72	10.78
	(2.10)*	(1.21)	(1.14)	(0.24)	(1.26)	(3.05)**
<b>Large - Small</b>	-1.18	-4.48	-3.05	-0.37	6.59	
	(0.40)	(1.43)	(0.94)	(0.10)	(1.36)	

**Panel B - 3-factor alpha**

ME\Phat	Low			High		Low - High
<b>Large</b>	7.48	0.29	0.35	-1.66	-4.12	11.60
	(4.81)**	(0.27)	(0.31)	(1.47)	(2.44)*	(4.07)**
	6.15	0.91	1.40	-0.66	-5.43	11.58
	(3.93)**	(0.73)	(0.99)	(0.55)	(2.85)**	(4.06)**
	6.06	3.99	-1.24	-1.02	-5.92	11.98
	(3.98)**	(3.03)**	(1.11)	(0.82)	(3.90)**	(5.03)**
<b>Small</b>	6.50	2.41	0.59	-1.21	-8.69	15.19
	(4.92)**	(2.00)*	(0.53)	(1.13)	(6.01)**	(7.07)**
	5.07	2.80	0.97	-3.16	-12.34	17.42
	(4.24)**	(2.29)*	(0.81)	(1.95)	(4.21)**	(5.80)**
<b>Large - Small</b>	2.40	-2.52	-0.62	1.51	8.22	
	(1.34)	(1.55)	(0.39)	(0.79)	(2.65)**	

**Table 8: Double sorting on value and distress**

This table reports mean excess returns over the market and 3-factor alphas for portfolios sorted on book-to-market (BM) and fitted 12-month fitted probability of failure (Phat). We first sort stocks into book-to-market quintiles using NYSE breakpoints (following Fama-French) and then, within each quintile, sort stocks into predicted failure probability quintiles. All returns are in annualized percent units.

**Panel A - mean excess return**

<b>BMPfat</b>	<b>Low</b>				<b>High</b>	<b>Low - High</b>
<b>High</b>	4.34	3.06	6.41	-1.18	-5.19	9.53
	(2.39)*	(1.32)	(2.05)*	(0.28)	(0.97)	(1.67)
	5.62	3.80	3.13	6.60	-0.79	6.42
	(2.78)**	(1.86)	(1.50)	(2.41)*	(0.19)	(1.29)
	2.50	2.10	2.21	1.15	-4.53	7.02
	(1.54)	(1.22)	(1.27)	(0.48)	(1.33)	(1.84)
<b>Low</b>	2.64	-0.39	-0.53	-0.89	-3.34	5.98
	(1.31)	(0.33)	(0.36)	(0.36)	(0.92)	(1.24)
	3.72	-0.32	-3.44	-6.09	-10.72	14.44
	(1.70)	(0.20)	(1.80)	(2.34)*	(2.83)**	(3.02)**
<b>High - Low</b>	0.62	3.38	9.85	4.91	5.53	
	(0.19)	(1.06)	(2.81)**	(1.17)	(1.27)	

**Panel B - 3-factor alpha**

<b>BMPfat</b>	<b>Low</b>				<b>High</b>	<b>Low - High</b>
<b>High</b>	4.00	0.36	0.55	-10.51	-16.14	20.14
	(2.55)*	(0.20)	(0.22)	(3.15)**	(4.33)**	(4.89)**
	5.76	3.22	0.54	0.76	-9.32	15.08
	(3.29)**	(2.35)*	(0.33)	(0.38)	(2.84)**	(3.60)**
	2.90	2.36	0.20	-3.14	-12.00	14.90
	(1.88)	(1.64)	(0.14)	(1.60)	(4.38)**	(4.58)**
<b>Low</b>	4.47	-0.87	-2.37	-5.26	-10.54	15.01
	(2.66)**	(0.73)	(1.68)	(2.38)*	(3.36)**	(3.58)**
	7.21	1.12	-5.19	-10.52	-18.13	25.34
	(4.47)**	(0.78)	(2.73)**	(4.60)**	(6.00)**	(6.81)**
<b>High - Low</b>	-3.21	-0.77	5.74	0.01	1.99	
	(1.40)	(0.34)	(1.85)	(0.00)	(0.50)	

**Table 9: Earnings Announcement Returns**

We sort all stocks based on the predicted 12-month probability of failure and divide them into 10 portfolios based on percentile cutoffs (same as in Table 6). For example, 0 to 5th percentile (0005) and 99th to 100th percentile (9900). Panel A reports 3-day (t-1,t+1) excess returns over the equally weighted market index during earnings announcements. In Panel B we calculate portfolio returns assuming that we hold factor portfolios during earnings announcement windows using the estimated factor loadings from Table 6. We report earnings-announcement-adjusted mean excess returns over the market, as well as one factor (RM), three FF factor (RM, HML, SMB) and four factor (RM, HML, SMB, UMD) alphas (in annualized percent units) and the corresponding t-stat below.

**Panel A - 3 day returns**

Portfolios	0005	0510	1020	2040	4060	6080	8090	9095	9599	9900
Mean excess return	0.413 (7.37)**	0.104 (1.89)	0.024 (0.64)	0.034 (1.29)	-0.010 (0.37)	0.101 (3.16)**	0.146 (2.61)**	0.424 (4.39)**	0.197 (1.53)	0.111 (0.34)

**Panel B - Earnings-Announcement-Adjusted Portfolio Alphas**

Portfolios	0005	0510	1020	2040	4060	6080	8090	9095	9599	9900	LS1090	LS2080
Mean excess return	2.61 (1.18)	2.31 (1.13)	0.74 (0.65)	0.35 (0.39)	-0.46 (0.33)	-0.29 (0.13)	-3.49 (1.00)	-9.25 (2.07)*	-6.20 (1.17)	-15.17 (1.91)	10.49 (2.03)*	5.65 (1.31)
CAPM alpha	1.99 (0.91)	2.01 (0.99)	0.87 (0.76)	0.90 (1.02)	-0.49 (0.35)	-1.71 (0.77)	-5.64 (1.67)	-12.14 (2.82)**	-8.88 (1.72)	-17.28 (2.19)*	12.88 (2.54)*	7.84 (1.87)
3-factor alpha	4.87 (2.78)**	5.18 (3.07)**	2.13 (2.02)*	0.20 (0.25)	-3.04 (2.74)**	-5.84 (3.43)**	-11.58 (4.43)**	-19.03 (6.36)**	-15.36 (3.94)**	-23.16 (3.36)**	22.79 (6.51)**	16.10 (5.29)**
4-factor alpha	1.59 (0.93)	2.62 (1.59)	0.99 (0.94)	1.43 (1.84)	-0.31 (0.29)	-1.32 (0.86)	-4.81 (1.99)*	-11.02 (4.00)**	-7.53 (2.03)*	-19.41 (2.82)**	12.27 (3.90)**	7.03 (2.56)*

**Table 10: Comparison of equity return and failure predictors**

This table reports coefficients on explanatory variables when predicting failure and equity returns. Panel A reports coefficients from Fama-MacBeth return prediction regressions. We run monthly regressions of returns on characteristics and a constant for the sample of returns included in portfolios in Table 6, i.e. for the period 1981-2003. We average the individual coefficients over time and report the mean and standard error of the mean in percent. We run regressions both using beginning of year and beginning of month characteristics. In Panel B we report coefficients from taking our best-model variables and predicting failure at different horizons. The numbers correspond to Table 4.

characteristic observed:	<i>Panel A - Return prediction</i>		<i>Panel B - Failure prediction</i>			
	(1) beginning of year	(2) beginning of month	Lag (months)	(3) 0	(4) 6	(5) 12
<b>NIMTAAVG</b>	14.55 (4.09)**	38.99 (11.02)**		-29.67 (23.37)**	-23.92 (21.82)**	-20.26 (18.09)**
<b>TLMTA</b>	0.58 (2.76)**	0.74 (3.65)**		3.36 (27.80)**	2.06 (22.63)**	1.42 (16.23)**
<b>EXRETAVG</b>	11.50 (6.78)**	0.88 (0.40)		-7.35 (14.03)**	-7.79 (15.97)**	-7.13 (14.15)**
<b>SIGMA</b>	-0.96 (2.68)**	-2.05 (5.85)**		1.48 (13.54)**	1.27 (14.57)**	1.41 (16.49)**
<b>RSIZE</b>	0.02 (0.48)	-0.02 (0.45)		0.08 (2.62)**	0.05 (2.02)*	-0.05 (2.09)*
<b>CASHMTA</b>	2.93 (8.49)**	4.33 (11.42)**		-2.40 (8.64)**	-2.40 (9.77)**	-2.13 (8.53)**
<b>MB</b>	-0.19 (6.61)**	-0.05 (1.59)		0.05 (4.87)**	0.05 (4.22)**	0.08 (6.33)**
<b>PRICE</b>	-0.62 (5.41)**	-0.80 (6.64)**		-0.94 (14.77)**	-0.47 (10.36)**	-0.06 (1.40)

Absolute value of z or t statistics in parentheses

\* significant at 5%; \*\* significant at 1%



Figure 1: Predicted vs. actual failure rates

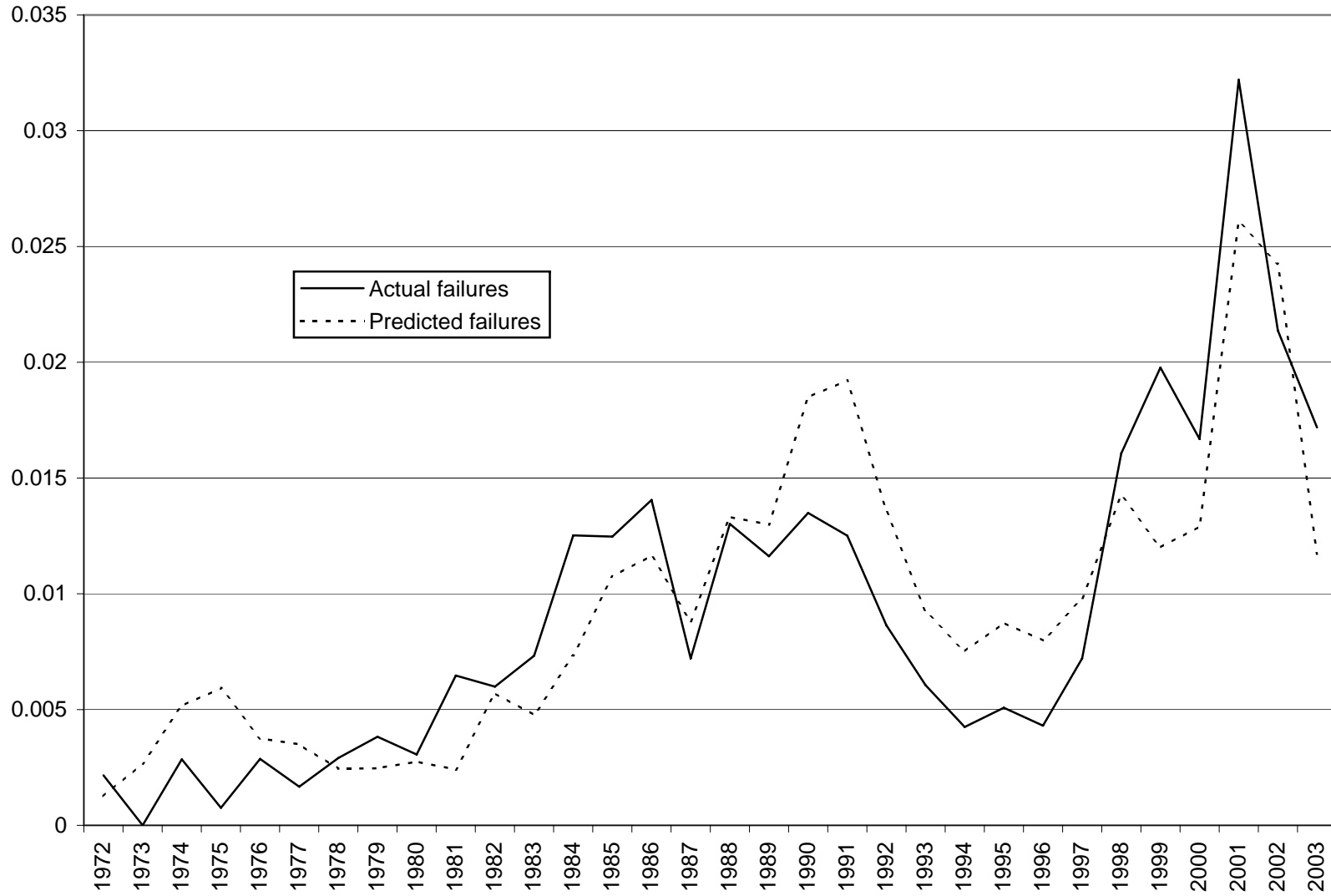


Figure 2: Alphas of distressed stock portfolios

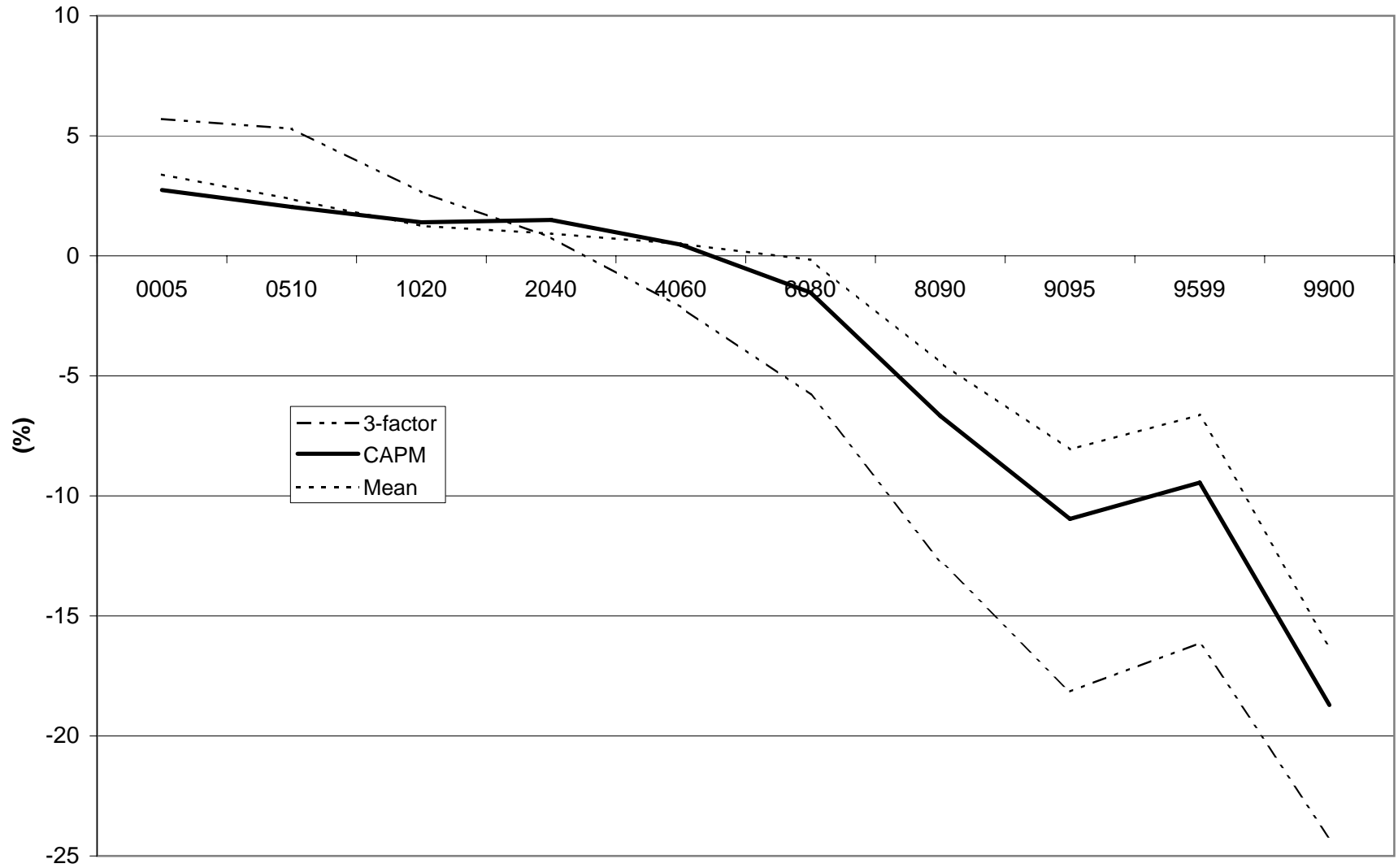


Figure 3: Factor loadings of distressed stock portfolios

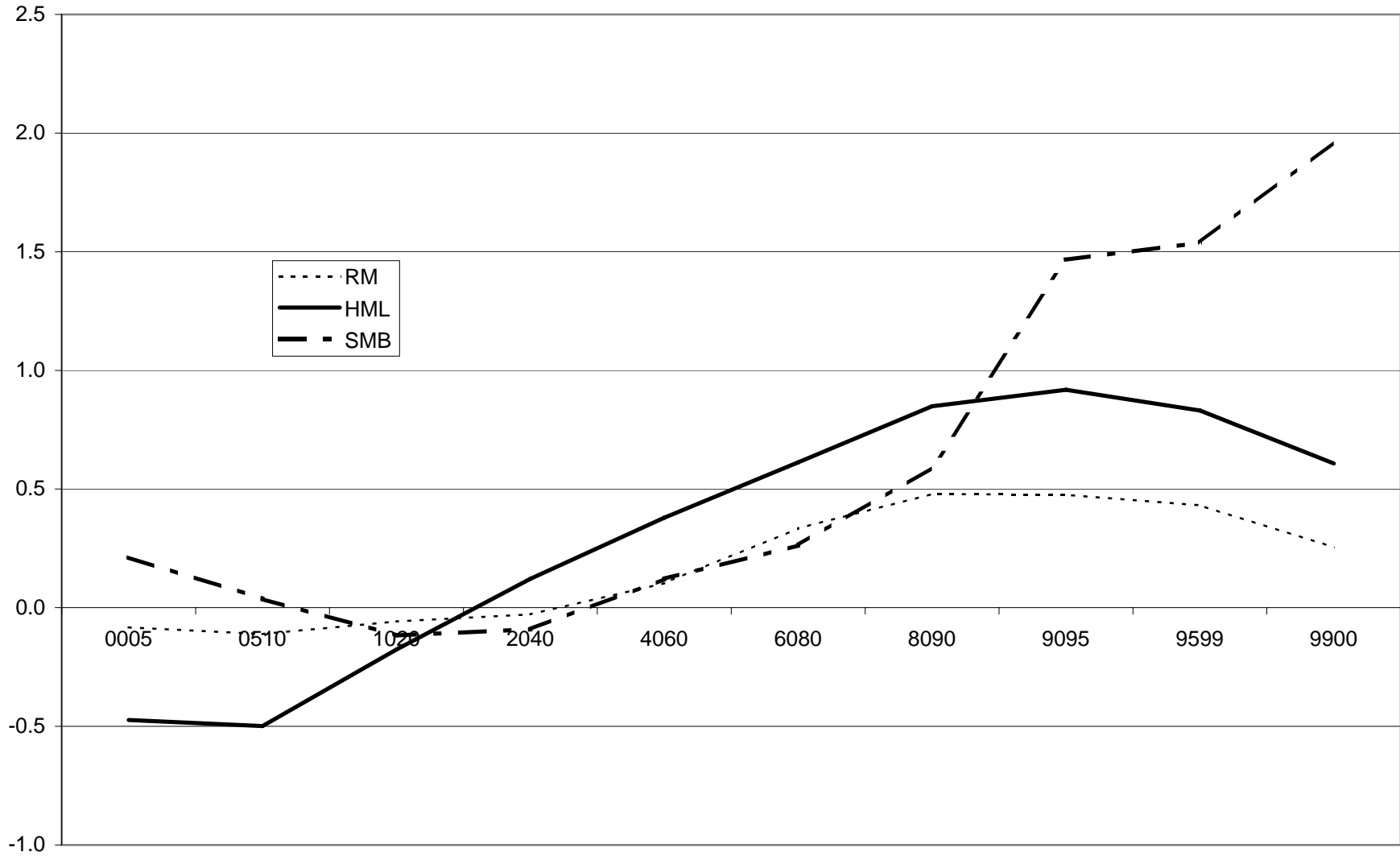


Figure 4: Returns on long-short distressed stock portfolios

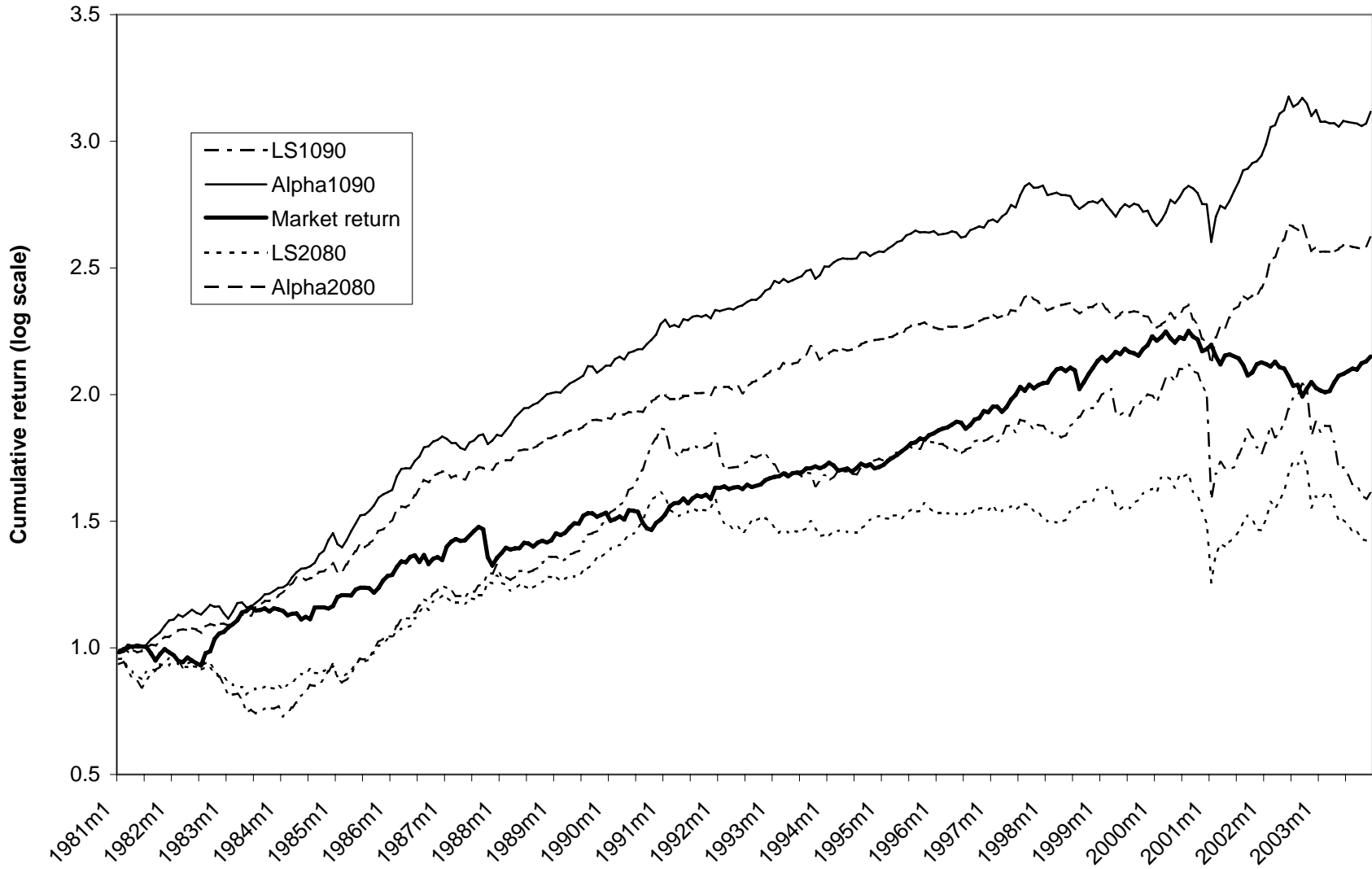


Figure 5: VIX and returns on long-short distressed stock portfolio

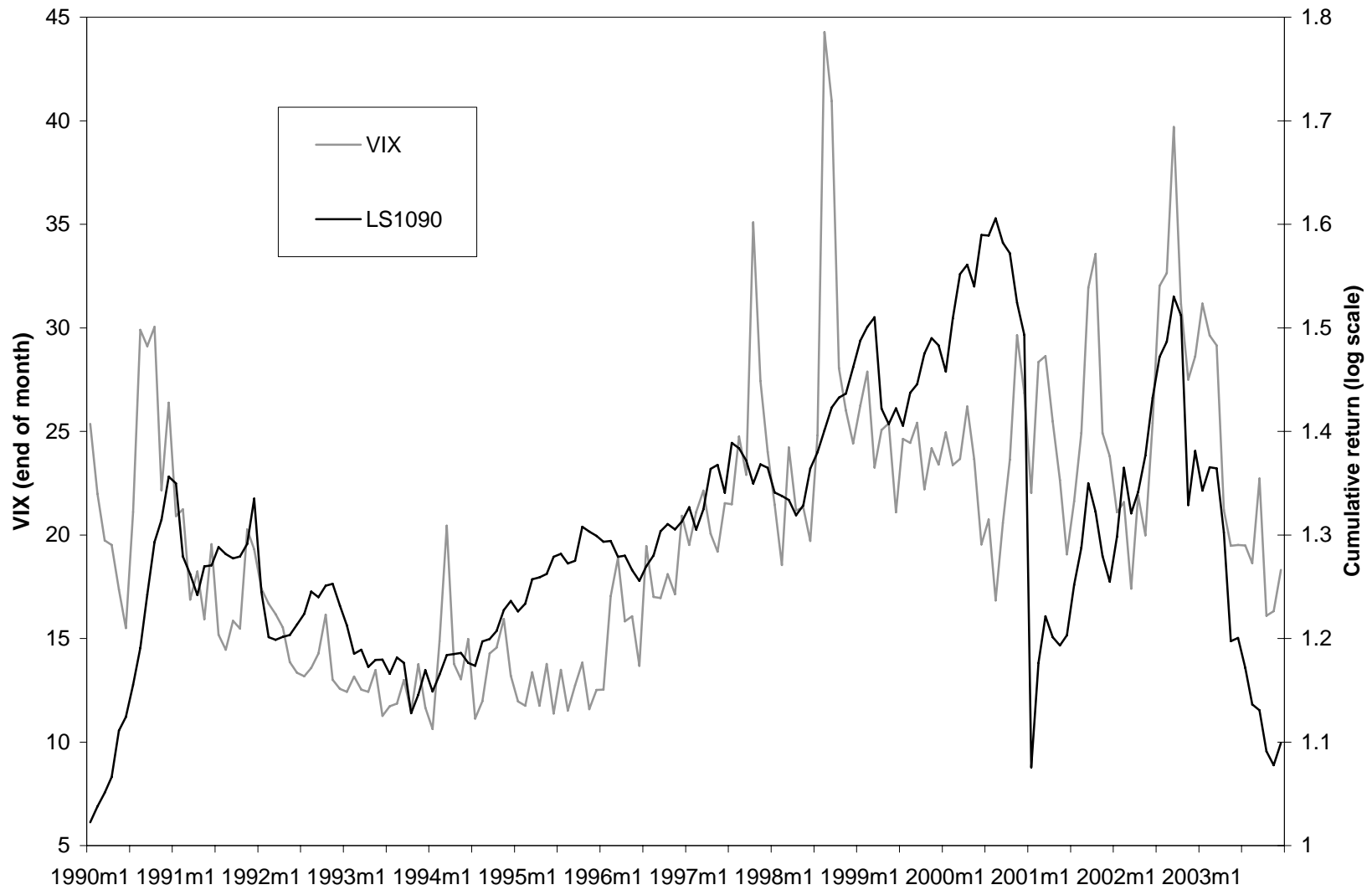


Figure 6: Institutional holdings and returns on long-short distressed stock portfolio

