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Financial distress and return: A finite mixture approach

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ABSTRACT

Using finite mixture models, we find that financial distress is related to realized return negatively (positively) for one (the other) latent group. The negative (positive) relation concentrates in firms with large negative (positive) realized return; the likelihood for a firm to be in the latent group with a positive relation is negatively related to its price-to-value ratio estimate and mispricing score, both of which measure relative mispricing. The mispricing-correction component of realized return is negative (positive) for overvalued (undervalued) firms and decreases (increases) with corrected overvaluation (undervaluation). Overall, our findings are consistent with the view that mispricing—undervaluation and overvaluation—is larger for firms with higher financial distress. Evident in our findings, an overall negative relation between financial distress and realized return is driven by the negative relation between financial distress and the mispricing-correction component for overvalued firms and, therefore, it is not at odds with the risk-reward paradigm.

1. Introduction

The relation between financial distress and realized return is one of the most puzzling ones in asset pricing research. Several studies document a negative relation between financial distress and realized return (e.g., Dichev, 1998; Campbell et al., 2008). This finding of a negative relation between financial distress and realized return is disturbing for at least two interrelated reasons. First, because distressed firms appear riskier on nearly every observable dimension,[1] a negative relation between financial distress and realized return seems to be at odds with the fundamental risk-reward paradigm in financial economics. Second, the notion of a financial distress premium has been invoked to explain the well-known size and value effects, which motivates the development of the well-adopted Fama-French three-factor model.[2] Moreover, the standard risk adjustment for the size and value effects worsens the under-performance of distressed stocks (Campbell et al., 2008). Because of all this, a negative relation between financial distress and realized return is considered an asset pricing puzzle (Avramov et al., 2022; Chen et al., 2022).

Although the finding of a negative relation between financial distress and realized return is disturbing, findings about the relation

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[1] On average, distressed firms are small and unprofitable and have high market betas, high return volatility, high financial leverage, and low asset liquidity (Campbell et al., 2008).

[2] The three-factor model arguably is "the most successful asset pricing model in empirical tests" because it "can't be avoided in tests of competing asset pricing models" and "has shaped the thinking of practitioners" (Fama, 2014, p.1482).

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between financial distress and realized return are indeed inconsistent among studies.[3] Conceivably, uncovering what drives this inconsistency of findings helps to expose the economic mechanism that underlies the negative relation between financial distress and realized return. That is, knowledge about what drives this inconsistency of findings helps us to know whether a negative relation between financial distress and realized return contradicts the fundamental risk-reward paradigm.

We aim to shed light on the puzzling findings about the relation between financial distress and realized return by noticing that several regularities about distressed firms suggest a positive relation between financial distress and mispricing. First, distressed firms have inherently uncertain economic prospects because financial distress is both costly and beneficial (Wruck, 1990). Because of this, future profitability is more volatile and historical information is less useful for predicting future profitability for more distressed firms. Moreover, distressed firms tend to report losses. The volatile future profitability and proclivity for reporting losses render standard profitability prediction models and multiples-based valuation techniques unsuitable for pricing distressed firms. Additionally, because different reorganization policies for resolving distress distribute wealth across claimholders differently, claimholders have incentives to present biased and inaccurate data, which aggravates the complex information and inference problems faced by investors (Wruck, 1990). Because of all this, market participants face considerable valuation uncertainty when pricing the stocks of distressed firms. Worse, information and arbitrage frictions are larger for more distressed firms (Campbell et al., 2008).[4] Collectively, all this suggests a positive relation between financial distress and the degree of mispricing.

We reason that the positive relation between financial distress and the degree of mispricing suggests a nonlinear relation between financial distress and realized return. Our reasoning builds on Fischer Black's (1986) observation that stock price often deviates from equity value substantially.[5] This suggests that realized return (R_{t+1}) has a considerable mispricing-correction component (C_{t+1}) (see also Frankel and Lee (1998)). For undervalued firms, the mispricing-correction component (C_{t+1}) is positive and increases with the degree of undervaluation, while for overvalued firms, it is negative and decreases with the degree of overvaluation. Collectively, the prominence of the mispricing-correction component in realized return and the positive relation between financial distress and the degree of mispricing suggest that the relation between financial distress and realized return is negative for overvalued firms and positive for undervalued firms.

Because the mispricing status of a firm is unobservable, it is infeasible to use traditional methods to show that the relation between financial distress and realized return is negative (positive) for overvalued (undervalued) firms. We thus apply the finite mixture normal regression (FMNR)—a widely used form of finite mixture models—to estimate the relation between financial distress and realized return. As an unsupervised machine learning method, FMNR allows us to model hidden heterogeneity in the relation between realized return and financial distress across unobservable latent homogeneous groups (e.g., undervalued firms versus overvalued firms) (Deb, 2009; Gelman et al., 2013). FMNR splits the sample into latent homogeneous groups probabilistically and reveals the relation between financial distress and realized return within each group. Using FMNR, we expect to observe that the relation between financial distress and realized return is characterized better by a negative relation for one latent group and a positive relation for the other latent group than by a single relation.

Using FMNR, we find robust evidence that the relation between financial distress and realized return is negative for one latent group and positive for the other latent group. We interpret the finding as evidence consistent with the notion that the degree of mispricing is larger for more distressed firms. Consistent with our mispricing-based interpretation, the intercept is negative for the latent group ($C_{t+1} < 0$) with a negative relation and positive for the latent group ($C_{t+1} > 0$) with a positive relation. Moreover, consistent with the view that a disproportionate portion of mispricing is resolved by the information in earnings announcements, the coefficient estimates obtained using earnings announcement realized return are much larger in magnitude than those obtained using non-earnings announcement realized return.

To further support our mispricing-based interpretation, we perform three analyses. In the first analysis, we sort observations into three groups: firms in the bottom two quintiles of realized return (Low), in the third quintile (Medium), and in the top two quintiles (High). We then estimate the relation between financial distress and realized return separately for each group. We find cross-sectional and time-series evidence that the negative relation between financial distress and realized return concentrates in the Low group and the positive relation concentrates in the High group. Rationally formed expected return cannot be negative (Merton, 1980; Elton, 1999); the large positive realized returns for firms in the High group cannot be rationalized because they would imply unreasonably high levels of risk aversion among investors (Mehra and Prescott, 1985). Moreover, we find that firms in the High group experienced improvement in profitability, decrease in leverage and the incidence of loss and increase in the incidence of positive earnings surprise and, in contrast, firms in the Low group experienced deterioration in profitability, increase in leverage and the incidence of loss and decrease in the incidence of positive earnings surprise. Collectively, the findings from this analysis are well aligned with our mispricing-based interpretation.

In the second analysis, we construct a mispricing score based on ten return anomalies. These ten stock characteristics are net stock issues, composite equity issues, accruals, net operating assets, momentum, gross profitability, asset growth, return on assets, investment-to-assets, and the market-to-book ratio. For each characteristic, we rank each stock, with the highest ranking being associated with the lowest average return. A stock's mispricing score is the arithmetic average of its ranking for each of the ten

[3] Using the distance-to-default measure of distress, Vassalou and Xing (2004) find some evidence of a positive relation, while Campbell et al. (2008) find a negative relation; using the Ohlson bankruptcy risk score, Dichev (1998) finds a negative relation, while Hou et al. (2020) do not.

[4] Campbell et al. (2008) show that analyst coverage, institutional ownership, and stock liquidity are lower for more distressed firms.

[5] Similarly, Warren Buffett (2023, p.4) notes that "stocks often trade at truly foolish prices, both high and low." Source: https://www.berkshirehathaway.com/letters/2022ltr.pdf.

characteristics. Stambaugh et al. (2012) show that this mispricing score measures relative mispricing. Consistent with our mispricing-based interpretation, we find that the likelihood for a firm to be in the latent group with a positive relation is negatively related to its mispricing score.

In the third analysis, we use FMNR to estimate the relation between financial distress and a price-to-value (P/V) ratio estimate constructed using the method in Lee et al. (1999). A larger P/V value indicates larger overvaluation for overvalued firms (P/V > 1) and a smaller P/V value indicates larger undervaluation for undervalued firms (P/V < 1). We thus expect to observe that the relation between financial distress and the P/V estimate is positive for the latent group (P/V > 1) with a larger intercept and negative for the latent group (P/V < 1) with a smaller intercept. Moreover, firms with a larger P/V estimate are more likely to be overvalued (Frankel and Lee, 1998). We thus expect that the likelihood for a firm to be in the latent group with a positive relation between financial distress and realized return is negatively related to its P/V estimate. Our expectations are confirmed by the results.

Our study makes at least three contributions. First, our study offers new insights into the relation between financial distress and realized return. We show that the relation between financial distress and realized return is negative for overvalued firms and positive for undervalued firms. Moreover, because expected return cannot be negative, our finding that the negative relation concentrates in firms with large negative realized return poses a direct challenge to rational explanations for an overall negative relation between financial distress and realized return. That is, our findings suggest that an overall negative relation between financial distress and realized return is not at odds with the fundamental risk-reward paradigm. Given the central role of the financial distress premium notion in asset pricing research, our findings call for research on innovation in expected return proxies and testing methods for investigating the financial distress premium notion.

Second, the switching of sign between undervalued firms and overvalued firms suggests that the relation between financial distress and realized return is inherently unreliable. Using screen for price as an example, we show that seemingly immaterial variations in research design can significantly alter the overall estimated relation between financial distress and realized return due to their effects on the relative importance of undervalued firms and overvalued firms in the estimated relation between financial distress and realized return. These variations can even cause the switching of the sign. In summary, our study suggests that variations in research design drive the inconsistency of findings about the relation between financial distress and realized return.

Third, our study adds to the scant but growing research that uses machine learning methods to study topics in accounting and finance research. Our study is among the first ones that apply finite mixture models (FMM) to asset pricing research.[6] Our study demonstrates that as an unsupervised machine learning method, FMM is a powerful tool for uncovering unobserved heterogeneity in the relation between realized return and explanatory variables. Using FMM, we avoid using ad-hoc stock characteristics to determine a firm's mispricing status because it "introduces unobserved heterogeneity into the empirical specification by partitioning the sample *endogenously*" (Durand et al., 2022, p.2). This is important because ad-hoc stock characteristics are notorious for misclassification errors in gauging firms' mispricing status. Misclassification errors not only cause coefficient estimates to underestimate the magnitude of the relation between realized return and explanatory variables for undervalued and overvalued firms, but they also can cause inference issues.[7] Although our study focuses on the puzzling relation between financial distress and realized return, fragile, puzzling anomalous relations permeate the asset pricing literature (Hou et al., 2020). We anticipate that our study will stimulate further research that uses FMM to unravel empirical puzzles in asset pricing research.

2. Research hypothesis

2.1. Financial distress and mispricing

Several regularities about distressed firms suggest that distressed firms are prone to mispricing. First, distressed firms have inherently uncertain economic prospects because financial distress has both costs and benefits (Wruck, 1990). Financial distress can be costly to a firm because it can (a) cause the firm to lose the right to make certain decisions autonomously, (b) reduce demand for the firm's products and increase its production costs, and (c) consume considerable managerial time that might otherwise be spent more productively. Yet financial distress can also be beneficial to a firm because it can (a) catalyze change in management, governance, and strategy, (b) enable the firm to negotiate for favorable terms with contracting parties such as employees and labor unions, creditors, and suppliers, and (c) press managers to be prudent about investments (Wruck, 1990; DeAngelo and DeAngelo, 1991; John et al., 1992). These benefits can lead to improved operating efficiency and organizational effectiveness and turnarounds (Wruck, 1990).

Consistent with the economic prospects of distressed firms being uncertain, we find that future profitability is more volatile for more distressed firms. We also find that, consistent with distressed firms tending to deliver disappointing performance, future

[6] Durand et al. (2022) use finite mixture models to uncover the heterogeneity in the speed of leverage adjustment; Dou et al. (2022) use finite mixture models to probabilistically split borrowers into latent homogenous groups characterized by similar loan demand curves; Cheng et al. (2023) use finite mixture models to revisit the nonlinear relation between idiosyncratic volatility and realized return documented in Stambaugh et al. (2015); noticing that security analysts' Bloomberg usage patterns resemble the mixture of two normal distributions, Ben-Rephael et al. (2023, 2025) apply finite mixture models to quantify security analysts' time spent on hard information collection and processing in a given quarter based on their Bloomberg usage patterns.

[7] To see this, assume that using some stock characteristics to determine a firm's mispricing status, we find no evidence that the relation between realized return and financial distress is positive for "undervalued" firms and negative for "overvalued" firms. We cannot know whether this null finding is inconsistent with a positive relation between financial distress and mispricing because it can be driven by misclassification errors.

profitability is lower and the incidence of losses is higher for more distressed firms. For those firms, their volatile future profitability and proclivity for incurring losses render standard profitability prediction models and multiples-based valuation techniques unsuitable for pricing them (Penman, 2013). Moreover, historical information is expected to be less useful for predicting their future profitability due to their high economic prospect uncertainty. We find that, as expected, future probability predictions obtained using historical information are less accurate for more distressed firms.[8]

Moreover, there are unavoidable conflicts of interests among claimholders to a distressed firm because different reorganization policies for resolving the distress will distribute wealth across claimholders including managers, creditors, and shareholders differently. Reorganization policies thus reflect both concern for value maximization and self-interest; needless to say, these are not always aligned (Wruck, 1990). In maximizing their own interests, claimholders have incentives to present biased and inaccurate data (Wruck, 1990). Thus, market participants face complex information and inference problems when pricing the stock of a distressed firm (Wruck, 1990). Consistent with this, we find that analysts' earnings forecasts are more dispersed and less accurate for more distressed firms.

Worse, information and arbitrage frictions are larger for more distressed firms (Campbell et al., 2008). Specifically, Campbell et al. (2008) show that analyst coverage, institutional ownership, and stock liquidity are lower for more distressed firms. Low analyst coverage, low institutional ownership, and low stock liquidity will lead to low stock pricing efficiency.

In summary, these regularities suggest a positive relation between financial distress and mispricing. That is, the extent to which stock price deviates from equity value is larger for more distressed firms. Next, we elaborate how the positive relation between financial distress and mispricing shapes the relation between financial distress and realized return.

2.2. Financial distress and realized return

We reason that the positive relation between financial distress and mispricing suggests a nonlinear relation between financial distress and realized return. Our reasoning builds on Fischer Black's (1986) observation that stock price often deviates from equity value substantially. Similarly, Warren Buffett (2023, p.4) notes that "stocks often trade at truly foolish prices, both high and low." These observations suggest that realized return—the outcome of stock price movements—has a prominent mispricing-correction component (C_{t+1}) (see also Frankel and Lee (1998) and Lee et al. (1999)). For undervalued firms, the mispricing-correction component (C_{t+1}) is positive and increases with the degree of undervaluation; for overvalued firms, it is negative and decreases with the degree of overvaluation.

Because financial distress is positively related to mispricing (undervaluation and overvaluation), $COV(\text{Financial Distress}, |C_{t+1}|) > 0$, where $COV(\bullet)$ denotes covariance and $|C_{t+1}|$ denotes the absolute value of C_{t+1}. For undervalued firms ($C_{t+1} > 0$), $COV(\text{Financial Distress}, C_{t+1} \mid C_{t+1} > 0) > 0$; for overvalued firms ($C_{t+1} < 0$), $COV(\text{Financial Distress}, C_{t+1} \mid C_{t+1} < 0) < 0$. Consistent with the prominence of the mispricing-correction component (C_{t+1}) in realized return (R_{t+1}), we expect financial distress to be related to realized return negatively for overvalued firms ($C_{t+1} < 0$) and positively for undervalued firms ($C_{t+1} > 0$): $COV(\text{Financial Distress}, R_{t+1} \mid C_{t+1} > 0) > 0$ and $COV(\text{Financial Distress}, R_{t+1} \mid C_{t+1} < 0) < 0$. Consistent with our expectation, we have the following hypothesis:

Hypothesis 1. (H1): Financial distress is related to realized return negatively for overvalued firms and positively for undervalued firms.

3. Research design

3.1. The hypothesis testing method

We cannot observe a firm's mispricing status due to the unobservability of equity value (Black, 1986). It is thus difficult to use traditional methods to test the hypothesis since it requires us to differentiate between undervalued and overvalued firms. To overcome this problem, we apply the finite mixture normal regression (FMNR)—a widely used form of finite mixture models—to test the hypothesis.[9] As an unsupervised machine learning technique, FMNR allows us to model hidden heterogeneity in the relation between realized return and financial distress across unobservable latent homogeneous groups (see Deb, 2009; Gelman et al., 2013). According to the hypothesis, there are two unobservable homogenous groups: undervalued firms versus overvalued firms, and the relation between financial distress and realized return is negative (positive) for overvalued (undervalued) firms. FMNR is thus an appropriate method for testing the hypothesis.

The FMNR model assumes that the distribution of realized return is as follows:

[8] The prediction equation, adopted from Hou et al. (2012), is $IB/AT_{t+\tau} = \alpha_0 + \alpha_1 LnAT_t + \alpha_2 IB/AT_t + \alpha_3 NegIB/AT_t + \alpha_4 CmnDiv_t + \alpha_5 DivPayer_t + \alpha_6 Acc_t + \varepsilon_{t+\tau}$ where $IB/AT_{t+\tau}$ is income before extraordinary items scaled by average assets, $\tau = 0, 1, 2, 3$; $LnAT_t$ is the natural logarithm of assets; $NegIB/AT_t$ is an indicator variable that equals 1 if $IB/AT_t < 0$ (0 otherwise); $CmnDiv_t$ is dividends paid to common equity holders scaled by average assets; $DivPayer_t$ is an indicator variable that equals 1 if $CmnDiv_t > 0$ (0 otherwise); and Acc_t is accruals scaled by average assets.

[9] Finite mixture models form the basis for a variety of important statistical techniques, including cluster and latent class analyses, discriminant analysis, image analysis, and survival analysis and have been successfully applied to research in a variety of areas, including agriculture, astronomy, bioinformatics, biology, engineering, genetics, imaging, marketing, medicine, neuroscience, psychiatry, and psychology (McLachlan et al., 2019).

$$R_{i,t+1} \sim \sum_{g=1}^{G} \pi_g N\left(X_{i,t}^T \beta_g, \sigma_g^2\right), i = 1, \cdots, N \tag{1}$$

where $R_{i,t+1}$ is realized return for firm i over the 12-month period starting in the fourth month after fiscal year t; $X_{i,t} = (1, x_{i,t,1}, \cdots, x_{i,t,p})^T$ is the set of explanatory variables including financial distress for firm i, measured at the end of the third month after fiscal year t; N is the number of observations; G is the number of latent homogeneous groups; π_g is the mixing proportion that measures the proportion of observations in latent group g, where $0 < \pi_g < 1$ and $\sum_{g=1}^{G} \pi_g = 1$; β_g is the regression coefficient vector for the g-th group with the first element being the intercept; $N\left(x_{i,t}^T \beta_g, \sigma_g^2\right)$ is the normal distribution with mean $x_{i,t}^T \beta_g$ and variance σ_g^2. According to the hypothesis, conditional on financial distress and other return determinants, the distribution of realized return is a mixture of two normal distributions: $\pi_1 N\left(X_{i,t}^T \beta_1, \sigma_1^2\right) + \pi_2 N\left(X_{i,t}^T \beta_2, \sigma_2^2\right)$, where $\pi_1 + \pi_2 = 1$ and the relation between financial distress and realized return is negative for one group and positive for the other group.

The FMNR model maximizes the following likelihood function (Cameron and Trivedi, 2022):

$$\prod_{i=1}^{N} \prod_{g=1}^{G} \left(\pi_g \frac{1}{\sqrt{2\pi}\,\sigma_g} exp\left\{ -\frac{\left(R_{i,t+1} - X_{i,t}^T \beta_g\right)^2}{2\sigma_g^2} \right\} \right)^{G_{i,g,t}} \tag{2}$$

where $G_{i,g,t}$ is an indicator variable that equals 1 if firm i belongs to group g and 0 otherwise, $P(G_{i,g,t} = 1) = \pi_g$, and other symbols are as defined in Eq. (1). To ensure that $\pi_g > 0$ and $\sum_{g=1}^{G} \pi_g = 1$, the mixing proportions for the latent groups are modelled using the multinomial logistic distribution. Specifically, the mixing proportion (π_g) for the g-th latent group is given by $exp\left(\gamma_g\right) / \sum_{g=1}^{G} exp\left(\gamma_g\right)$, where γ_g is the linear prediction for the g-th latent group. By default, the first latent group is the base level so that $\gamma_1 = 0$ and $exp(\gamma_1) = 1$.

We use Stata command *fmm* to estimate Eq. (2). *fmm* fits Eq. (2) using a two-part maximum likelihood (ML) algorithm that consists of the expectation–maximization (EM) algorithm in the first part and a gradient-based algorithm in the second part.[10] Specifically, *fmm* first uses the EM method for 20 iterations to refine starting values and then switches to a gradient-based algorithm for iterations until convergence. This two-part ML algorithm explores the parameter space efficiently: "the global optimizer provides the exploration strategy while EM does the actual local searches", which helps to find the global maximum of the likelihood function (Gupta and Chen, 2011, p.284).

As an unsupervised machine learning method, FMNR lets the data endogenously determine the group membership. FMNR allows us to identify unobservable homogenous groups of firms that share a similar relation between financial distress and realized return. Using FMNR, our hypothesis predicts that the relation between financial distress and realized return is depicted better by a negative relation for one latent group and a positive relation for the other latent group than by an overall negative or positive or null relation.

3.2. Measuring financial distress

We use three financial distress measures: the distress measure (*FinancialDistress*) introduced in Campbell et al. (2008), the Ohlson bankruptcy risk score (*O-Score*) introduced in Ohlson (1980), and − 1 x the distance to default (*NegDistToDef*) that is based on the Black–Scholes–Merton option-pricing model and estimated using the method in Hillegeist et al. (2004). We provide construction details for these measures in Appendix A. By construction, larger values of these measures indicate greater financial distress. As shown in Section B of the Internet Appendix, consistent with all of them measuring financial distress, they are highly positively correlated with each other and vary with firm characteristics that are indicative of financial distress, and, importantly, all of them—especially *FinancialDistress*—well predict corporate failures.

We use *FinancialDistress* as our primary measure of financial distress because it has several desirable features. First, as shown in Campbell et al. (2008) as well as Section B of the Internet Appendix, it better captures the probability of a broadly defined failure. Campbell et al. (2008) define failure as bankruptcy, financially driven delisting,[11] or a default rating issued by a leading credit rating agency. This broad definition allows researchers to capture cases in which firms avoid bankruptcy by negotiating with creditors out of court or perform so poorly that their stocks are delisted, an event that often precedes bankruptcy or formal default. Second, as shown in Campbell et al. (2008), this measure has meaningful advantages over other measures including the bankruptcy risk scores introduced in Altman (1968) and Ohlson (1980) and the two distance-to-default measures based respectively on Moody's practitioner model (Bohn

[10] EM is an iterative method for finding local maximum likelihood estimates of parameters that depend on unobserved latent variables (Gupta and Chen, 2010). The EM iteration alternates between an expectation (E) step that creates a function for the expectation of the log-likelihood evaluated using the current parameter estimates and a maximization (M) step that obtains parameters maximizing the expected log-likelihood created in the E step.

[11] Typical financial reasons for delisting a stock include failure to maintain minimum market capitalization or stock price, to file financial statements, or to pay exchange fees.

and Crosbie, 2003) and on Merton's (1974) structural default model.

3.3. Control variables

We mainly refer to Fama and French (2008) to identify control variables. Specifically, we control for these equity attributes: firm size (*Size*), the book-to-market ratio (*B/M*), momentum (*Momentum*), net stock issues (*NetStkIssues*), zero net stock issues (*ZeroNetStkIssues*), asset growth (*AssetGrowth*), positive profitability (*PosIB/BE*), loss incident (*NegIB*), and accruals (*NegAcc* and *PosAcc*). We also control for firms' sensitivity to return factors. Specifically, we control for *Beta-MktRf*, *Beta-SMB*, *Beta-HML*, *Beta-UMD*, *Beta-CMA*, and *Beta-RMW*; these are factor loadings on the market factor, the small-minus-big (SMB) factor, the high-minus-low (HML) factor, the momentum (UMD) factor, the conservative-minus-aggressive (CMA) factor, and the robust-minus-weak (RMW) factor, respectively. Definitions of these control variables are in Appendix B. We also control for industry fixed effects because expected return seems to vary across industries (Fama and French, 1997) and for year fixed effects because expected return seems to vary over time (Campbell and Viceira, 1999). We define industry membership using the Fama-French 49 industries.

3.4. Sample construction and descriptive statistics

We gather accounting and industry information and earnings announcement dates from Compustat, stock information from CRSP, the Fama-French industry classification and factor return and risk-free rate data from Kenneth R. French's online data library, and analyst data from I/B/E/S. We only require that to enter the estimation sample, a firm-year observation has values for required variables. This requirement helps alleviate concerns about data mining and snooping.

Table 1 reports descriptive statistics of realized return (R_{t+1}) and financial distress (*FinancialDistress*) for the sample used in the main analysis.[12] The sample consists of 209,342 observations from the 1981–2020 period. The sample period starts in 1981 following Campbell et al. (2008). *FinancialDistress* is computed using the latest accounting and market information available by the end of the third month after fiscal year t; R_{t+1} is stock return over the 12-month period that starts in the fourth month after fiscal year t. *FinancialDistress* is winsorized at the 1st and 99th percentiles of its pooled distribution.

The Pearson correlation between financial distress (*FinancialDistress*) and realized return (R_{t+1}) is positive, at 0.065, while the Spearman correlation is negative, at −0.106. This contrast between the Pearson and Spearman correlations may seem perplexing. However, this is well expected. R_{t+1} is significantly positively skewed, with a skewness of 23.036. For the correction of undervaluation, the mispricing-correction component (C_{t+1}) can be very large, but for the correction of overvaluation, it is at most −1. Therefore, large positive realized returns that drive the right-skewness more than likely result from the correction of substantial undervaluation. Financial distress is related to the mispricing-correction component (C_{t+1}) positively for undervalued firms and negatively for overvalued firms. The Spearman correlation between financial distress and realized return is essentially the Pearson correlation between their rankings. Hence, observations experiencing the correction of substantial undervaluation carry more statistical weight in the calculation of the Pearson correlation than in the calculation of the Spearman correlation. Because of this, the Pearson correlation between financial distress and realized return is expected to be larger than the Spearman correlation between them. In summary, the difference between the Pearson correlation and the Spearman correlation is consistent with the positive relation between financial distress and mispricing.

4. Results

4.1. Main results

Table 2 presents results from the main analysis. To account for both the cross-sectional correlations and the time-series correlations in realized returns, test statistics are calculated using two-way cluster-robust standard errors clustered on firm and year (Petersen, 2009).[13] The overall estimated relation between financial distress (*FinancialDistress*) and realized return (R_{t+1}) is positive, though not statistically significant. This overall positive relation seems to contradict the overall negative relation documented in some studies (e.g., Campbell et al. (2008)).[14] This is not unexpected. First, findings about the relation between financial distress and realized return are indeed inconsistent among studies. Second, importantly, the estimated relation between financial distress and realized return is inherently unstable because its sign differs between overvalued firms and undervalued firms. We later show that after we exclude observations with low ex-ante stock price as per prior studies, the overall estimated relation between financial distress and realized return decreases and becomes negative due to change in the relation between financial distress and the mispricing-correction component.

[12] For brevity, we only report descriptive statistics of realized return (R_{t+1}) and distress (*FinancialDistress*). The descriptive statistics of control variables are available on request.

[13] We use the method in Thompson (2011) to compute two-way cluster-robust standard errors because the Stata command *fmm* only reports one-way cluster-robust standard errors.

[14] Under the one-latent-group specification, the sign of the coefficient estimates for control variables is generally consistent with that reported in prior studies (e.g., Fama and French (2008)). Specifically, realized return is negatively related to firm size (*Size*), net stock issues (*NetStkIssues*), asset growth (*AssetGrowth*), and accruals (*NegAcc* and *PosAcc*) and it is positively related to the book-to-market ratio (*B/M*) and profitability (*PosIB/BE*).

Table 1
Descriptive Statistics.

Variable	Summary Statistics												Correlation	
	Mean	SD	Skew	Min	P1	P5	P25	P50	P75	P95	P99	Max		
R_{t+1}	0.162	0.964	23.036	−1.000	−0.877	−0.682	−0.248	0.046	0.355	1.284	3.162	106.536		**0.065**
FinancialDistress	−7.429	1.003	0.911	−9.154	−9.154	−8.729	−8.157	−7.606	−6.918	−5.395	−4.315	−4.315	**−0.106**	

This table presents descriptive statistics of financial distress and realized return for the sample used in the main analysis. The sample has 209,342 observations from the 1981–2020 period. Pearson (Spearman) correlations are in the upper (lower) triangle. Correlations that are significantly different from 0 at p-value <5 % are in boldface. R_{t+1} is stock return over the 12-month period starting in the fourth month after fiscal year t; *FinancialDistress*—the financial distress measure—is a function of accounting and market variables with coefficients obtained from Table IV in Campbell et al. (2008), computed using the latest accounting and market information available by the end of the third month after fiscal year t. *FinancialDistress* is winsorized at the 1st and 99th percentiles of its pooled distribution.

Table 2
Financial Distress and Realized Return.

Variable	# of latent groups					
	1	2		1	2	
FinancialDistress	0.049	−0.097***	0.463***	0.018	−0.098***	0.305***
	(1.22)	(−8.55)	(8.18)	(0.62)	(−10.50)	(5.67)
Size				−0.017***	0.015***	−0.172***
				(−3.09)	(4.89)	(−9.71)
B/M				0.066***	0.052***	0.044
				(3.89)	(7.58)	(1.16)
Momentum				−0.039*	−0.050***	0.043
				(−1.92)	(−3.64)	(1.24)
NetStkIssues				−0.194***	−0.152***	−0.162
				(−5.68)	(−13.22)	(−1.63)
ZeroNetStkIssues				−0.015	−0.009	−0.022
				(−1.13)	(−1.61)	(−0.52)
AssetGrowth				−0.119***	−0.073***	−0.232***
				(−5.22)	(−8.03)	(−5.21)
NegIB				0.017	−0.025***	0.144***
				(1.30)	(−3.12)	(4.44)
PosIB/BE				0.297***	0.166***	0.564***
				(4.60)	(5.79)	(2.99)
NegAcc				−0.067	0.011	−0.081
				(−1.08)	(0.59)	(−0.35)
PosAcc				−0.135***	−0.195***	−0.092
				(−2.85)	(−7.27)	(−0.49)
Beta-MktRf				0.007	−0.020***	0.060*
				(0.57)	(−2.58)	(1.70)
Beta-SMB				−0.005	−0.009**	−0.006
				(−0.76)	(−2.30)	(−0.28)
Beta-HML				−0.003	0.005	−0.027
				(−0.36)	(1.13)	(−1.61)
Beta-UMD				−0.007	0.004	−0.040**
				(−0.78)	(0.80)	(−2.24)
Beta-CMA				−0.019**	−0.001	−0.064***
				(−2.29)	(−0.14)	(−4.15)
Beta-RMW				0.019***	0.014***	0.013
				(4.28)	(4.67)	(1.18)
Intercept	0.516	−0.720***	4.736***	0.361*	−0.555***	3.013***
	(1.58)	(−7.15)	(10.81)	(1.72)	(−7.76)	(7.52)
Industry fixed effects	NO	NO	NO	YES	YES	YES
Year fixed effects	NO	NO	NO	YES	YES	YES
N	209,342			147,059		
Log likelihood	−246,470.90	−170,218.30		−167,594.10	−107,829.00	
ΔLog likelihood		76,252.60			59,765.10	
% ΔLog likelihood		30.94 %			35.66 %	
AIC	492,947.80	340,450.60		335,400.30	216,084.00	
ΔAIC		−152,497.20			−119,316.30	
% ΔAIC		−30.94 %			−35.57 %	
BIC	492,978.60	340,522.30		336,449.50	218,192.40	
ΔBIC		−152,456.30			−118,257.10	
% ΔBIC		−30.93 %			−35.15 %	

This table presents results from the main analysis that uses the finite mixture normal regression to estimate the relation between financial distress and realized return. Variables are defined in Appendix B. The *t*-statistics in parentheses are computed using standard errors clustered on firm and year. ***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % levels, respectively, using a 2-tailed test.

Importantly, changes in the magnitude of the coefficient estimate on *FinancialDistress*, log likelihood (*LL*), the Akaike information criterion (AIC), and the Bayesian information criterion (BIC)[15] suggest that the empirical relation between financial distress (*FinancialDistress*) and realized return (R_{t+1}) is depicted better by a negative relation for one latent group and a positive relation for the other latent group than an overall positive relation. When the model specification does not include control variables and industry and year fixed effects, the coefficient estimate on *FinancialDistress* is 0.049 ($t = 1.22$) under the one-latent-group specification and − 0.097 ($t = -8.55$) for one latent group and 0.463 ($t = 8.18$) for the other latent group under the two-latent-group specification. Moreover, *LL*

[15] AIC = $2k - 2LL$ and BIC = $kLn(N) - 2LL$, where k is the number of estimated parameters in the model, N is the number of observations, $Ln(\bullet)$ is the natural logarithm operator, and LL is the natural logarithm of the maximized value of the likelihood function for the model. AIC and BIC include a penalty term ($2k$ and $kLn(N)$) for the number of parameters in the model to mitigate the overfitting problem. A model specification with a smaller AIC or BIC value and a larger LL value is generally preferred.

increases by 30.94 %, AIC decreases by 30.94 %, and BIC decreases by 30.93 % when the number of latent groups increases from one to two.[16] We observe the same patterns when the model specification includes control variables and industry and year fixed effects.

In the absence of control variables and industry and year fixed effects, the intercept measures the average of realized returns that are unexplained by financial distress.[17] The mispricing-correction component (C_{t+1}) of realized return (R_{t+1}) is positive for undervalued firms and negative for overvalued firms. Ceteris paribus, the intercept is expected to be larger for the latent group with a positive relation ($C_{t+1} > 0$) than for the latent group ($C_{t+1} < 0$) with a negative relation. As expected, the intercept is −0.720 (t = −7.15) for the latent group with a negative relation and 4.736 (t = 10.81) for the latent group with a positive relation.[18] In summary, the difference between the intercepts of the two latent groups is in line with the positive relation between financial distress and mispricing.

4.2. Robustness

4.2.1. Three and four latent groups

Table IA1 of the Internet Appendix presents results from the three-latent-group and four-latent-group specifications.[19] When the number of latent groups is three, the coefficient estimates on financial distress (*FinancialDistress*) and the intercept are: −0.136 (t = −19.49) and − 1.093 (t = −18.15), 0.212 (t = 6.84) and 2.088 (t = 8.99), and 0.860 (t = 15.37) and 8.695 (t = 18.72); when the number of latent groups is four, the coefficient estimates on *FiancialDistress* and the intercept are: −0.147 (t = −22.79) and − 1.230 (t = −22.99), 0.112 (t = 4.45) and 1.130 (t = 5.78), 0.382 (t = 8.41) and 3.812 (t = 10.60), and 1.110 (t = 15.91) and 11.267 (t = 19.43). In summary, even under a three-latent-group or four-latent-group specification, the intercept is consistently negative for the latent group with a negative coefficient estimate on financial distress and consistently positive for the latent groups with a positive coefficient estimate.

As the number of latent groups increases from two to three to four, BIC only slightly decreases: BIC decreases by 3.61 % of the one-latent-group BIC as the number of latent groups increases from two to three and by 0.97 % of the one-latent-group BIC as the number of latent groups increases from three to four. While the results in Table IA1 suggest nonlinearity about the relation between financial distress and realized return for undervalued firms ($C_{t+1} > 0$), a two-latent-group specification provides a parsimonious description of the relation between financial distress and realized return. We adopt finite mixture models to obtain better approximation to the distribution of realized return conditional on financial distress. For our research purpose, a specification with a small number of latent groups is preferrable for being parsimonious (Cameron and Trivedi, 2022). Hence, we adopt the two-latent-group specification for subsequent analyses unless stated otherwise.

4.2.2. Alternative financial distress measures

Table IA2 presents results obtained using the other two financial distress measures: the Ohlson bankruptcy risk score (*O-Score*) and − 1 x the distance to default (*NegDistToDef*). As shown in Table IA2, we obtain consistent inferences using these two financial distress measures.

4.2.3. Alternative quantification of realized return

We adopt several alternative ways of quantifying realized return to ensure the robustness of our inferences. Realized return is highly positively skewed. To ensure that our inferences are not unduly influenced by a handful of observations with very large positive realized return, we use the ranking of realized return to conduct the analysis. Table IA3, Panel A shows that, in contrast to an overall positive relation between financial distress and realized return, the overall estimated relation between financial distress and the ranking of realized return is significantly negative. As explained for the contrast between the Pearson and Spearman correlations between financial distress and realized return, this is expected. Firms with very large positive realized return—firms that more than likely experience the correction of substantial undervaluation—are expected to weigh more econometrically when realized return is the dependent variable than when its ranking is the dependent variable. Importantly, using the ranking of realized return does not alter our inferences.

There may be concerns about our use of annual realized return since some firms may not have a 12-month realized return due to delisting and other reasons. To address this concern, we exclude 2567 observations lacking a 12-month realized return from the

[16] In subsequent analyses, the percentage change remains similar for *LL*, AIC, and BIC when the number of latent groups increases. Hence, for brevity, we report only BIC and percentage change in BIC for subsequent analyses.

[17] The intercept is difficult to interpret when the model specification includes industry and year fixed effects. Nevertheless, we always obtain consistent inferences about the relation between financial distress and realized return regardless of whether the model specification includes control variables and industry and year fixed effects. Moreover, the inclusion of control variables results in a substantial loss of observations. For instance, it results in a loss of 29.75 % (= 147,059 / 209,342–1) of observations for the main analysis. Considering all this, we present only results obtained without control variables and industry and year fixed effects for all subsequent analyses. Results obtained with control variables and industry and year fixed effects are available on request.

[18] Centering *FinancialDistress* on its sample mean reduces the difference between the intercepts of the two latent groups because *FinancialDistress* has a negative mean. We find that, after centering *FinancialDistress* on its mean, the intercept is 0.000 (t = 0.01) for the latent group with a negative relation and 1.297 (t = 13.17) for the latent group with a positive relation.

[19] Table IA# always denotes Table IA# of the Internet Appendix.

estimation sample. Table IA3, Panel B shows that we obtain consistent inferences after dropping those observations. To further allay this concern, we examine the relation between financial distress and monthly realized return. Table IA3, Panel C shows that we also obtain consistent inferences using monthly realized return.[20]

To ensure that our inferences are not driven only by observations with very large mispricing, following Black (1986), p.533) definition of an efficient market—one in which "the price is more than *half* of value and less than *twice* value", we use only observations with realized return between −0.5 and 1 inclusive for estimation.[21] Table IA3, Panel D shows that we obtain consistent inferences. Interestingly, after dropping observations experiencing the correction of large mispricing, the overall estimated relation between financial distress and realized return becomes significantly negative. This is not surprising. Once observations with large mispricing are dropped, the skewness of realized return decreases from 23.036 to 0.431 and its mean decreases from 0.162 to 0.097, suggesting that firms with very large positive realized return (i.e., those experiencing the correction of very large undervaluation) drop out of the sample. As expected, the estimated relation between financial distress and realized return decreases dramatically for the group with a positive relation: 0.463 ($t = 8.18$) before dropping versus 0.038 ($t = 4.30$) after dropping. In contrast, the estimated relation changes much less dramatically for the group with a negative relation: −0.097 ($t = -8.55$) before dropping versus −0.057 ($t = -14.11$) after dropping.

We follow Brennan et al. (1998) and adjust a firm's realized return for its exposure to the market factor, the small-minus-big factor, the high-minus-low factor, the robust-minus-weak factor, the conservative-minus-aggressive factor, the momentum factor, the management factor, the performance factor, the financing factor, and the PEAD factor.[22] Table IA3, Panel E shows that our inferences remain unchanged using the risk-adjusted realized return.[23]

Prior studies suggest that a disproportionate portion of mispricing is resolved by the information in earnings announcements (La Porta et al., 1997). We separate realized return into earnings announcement realized return ($AnnR_{t+1}$) and non-earnings announcement realized return ($NonAnnR_{t+1}$). $AnnR_{t+1}$ is the cumulative return over the twelve trading days around the four quarterly earnings announcements made during the 12-month period starting in the fourth month after fiscal year t, where the compounding of the earnings announcement return starts in the trading day right before the announcement date; $NonAnnR_{t+1}$ is the component of realized return (R_{t+1}) other than $AnnR_{t+1}$. Table IA3, Panel F shows that we obtain consistent inferences using both $NonAnnR_{t+1}$ and $AnnR_{t+1}$, suggesting that the correction of mispricing occurs during both earnings announcement and non-earnings announcement periods. Importantly, the coefficient estimates obtained using $AnnR_{t+1}$ are much larger in magnitude than those obtained using $NonAnnR_{t+1}$.[24] This is consistent with the important role of earnings announcements in resolving mispricing.

4.2.4. Financial versus non-financial firms

While leverage is a key driver of financial distress, financial firms seem able to reduce leverage-induced distress despite their high leverage. That is, the leverage-distress relation differs between financial and non-financial firms. It is thus of interest to see whether this affects our inferences. We conduct the analysis separately for financial firms (SIC codes 6000–6999) and non-financial firms. As shown in Table IA4, our inferences hold equally well for both financial and non-financial firms.

4.2.5. Random starting values

Because the log-likelihood function for FMNR may not be concave, a concern is that the FMNR coefficient estimates reflect the local maximum—rather than the global maximum—of the log-likelihood function. The two-part ML algorithm used by the Stata command helps to find the global maximum of the log-likelihood function (Gupta and Chen, 2011). Nevertheless, to further ensure that the coefficient estimates from the main analysis do not reflect the local maximum of the log-likelihood function, we use multiple draws of random starting values with different seeds and different number of draws to conduct the analysis. Using random starting values helps to prevent convergence at a local maximum of the log-likelihood function (Gupta and Chen, 2011; Cameron and Trivedi, 2022). As shown in Table IA5, we obtain the same coefficient estimates using random starting values, suggesting that the coefficient estimates from the main analysis reflect the global maximum of the log-likelihood function.

4.3. Mispricing-based interpretation: further evidence

We find robust evidence that the relation between financial distress and realized return is negative for one latent group and positive for the other latent group. We interpret the finding as evidence consistent with the view that mispricing—undervaluation and overvaluation—is larger for more distressed firms. Specifically, the negative relation between financial distress and realized return from one latent group is driven by the negative relation between financial distress and the mispricing-correction component for overvalued

[20] We multiply coefficient estimates obtained using monthly realized return by 12 to ensure comparability.

[21] 39,167 observations with realized return smaller than −0.5 or greater than 1.0 drop out of the estimation sample.

[22] See Fama and French (2015) for the construction of the market factor, the small-minus-big factor, the high-minus-low factor, the robust-minus-weak factor, and the conservative-minus-aggressive factor, Carhart (1997) for the construction of the momentum factor, Stambaugh and Yuan (2017) for the construction of the management factor and the performance factor, and Daniel et al. (2020) for the construction of the financing factor and the PEAD factor.

[23] Because of limited availability of factor return data, the sample period is 1981–2014.

[24] Because a 12-month period generally has 252 trading days, we multiply the coefficient estimates obtained using $NonAnnR_{t+1}$ by 252 / 240 and the coefficient estimates obtained using $AnnR_{t+1}$ by 252 / 12 to ensure comparability.

Table 3
Realized Return: Low, Medium, and High.

Panel A: R_{t+1}: Low, Medium, and High

Group	Summary Statistics											Correlations with *FinancialDistress*	
	N	Mean	SD	Skew	Min	P1	P25	P50	P75	P99	Max	Pearson	Spearman
Low	83,736	−0.372	0.230	−0.627	−1.000	−0.929	−0.532	−0.327	−0.178	−0.063	−0.058	**−0.323**	**−0.311**
Medium	41,869	0.047	0.060	0.026	−0.058	−0.056	−0.004	0.046	0.098	0.151	0.153	**−0.028**	**−0.026**
High	83,737	0.754	1.275	23.499	0.153	0.158	0.278	0.452	0.809	4.983	106.536	**0.259**	**0.256**

Panel B: Financial Distress and Realized Return: Low R_{t+1}

Variable	# of latent groups									
	1	2		3			4			
FinancialDistress	−0.072***	−0.017***	−0.080***	−0.005***	−0.037***	−0.084***	−0.003***	−0.020***	−0.055***	−0.087***
	(−21.06)	(−17.09)	(−23.54)	(−9.97)	(−17.17)	(−22.95)	(−5.23)	(−11.17)	(−15.44)	(−22.20)
Intercept	−0.894***	−0.288***	−1.056***	−0.148***	−0.516***	−1.132***	−0.107***	−0.309***	−0.700***	−1.183***
	(−29.00)	(−31.59)	(−33.96)	(−29.19)	(−28.23)	(−35.27)	(−18.96)	(−17.53)	(−22.21)	(−34.84)
N	83,736									
BIC	−17,801.73	−35,167.34		−40,963.69			−43,473.78			
ΔBIC		−17,365.61		−5796.35			−2510.09			
% ΔBIC		−97.55 %		−32.56 %			−14.10 %			

Panel C: Financial Distress and Realized Return: Medium R_{t+1}

Variable	# of latent groups									
	1	2		3			4			
FinancialDistress	−0.002***	−0.001***	−0.001**	−0.001*	−0.002***	0.001	−0.000*	−0.002***	−0.002***	−0.000*
	(−4.25)	(−2.83)	(−2.23)	(−1.88)	(−3.75)	(1.09)	(−1.76)	(−3.08)	(−2.83)	(−1.89)
Intercept	0.031***	0.086***	−0.011***	0.125***	0.036***	−0.023***	0.132***	0.066***	−0.009***	−0.046***
	(8.45)	(17.75)	(−2.94)	(40.02)	(6.16)	(−5.53)	(60.12)	(10.85)	(−2.62)	(−27.01)
N	41,869									
BIC	−116,116.90	−122,051.40		−125,241.90			−126,921.70			
ΔBIC		−5934.50		−3190.50			−1679.80			
% ΔBIC		−5.11 %		−2.75 %			−1.45 %			

Panel D: Financial Distress and Realized Return: High R_{t+1}

Variable	# of latent groups									
	1	2		3			4			
FinancialDistress	0.292***	0.054***	0.479***	0.016***	0.145***	0.650***	0.007***	0.064***	0.225***	0.781***
	(7.31)	(5.52)	(10.85)	(5.66)	(8.07)	(14.18)	(4.00)	(5.44)	(7.64)	(13.57)
Intercept	2.916***	0.845***	5.243***	0.433***	1.855***	7.166***	0.296***	0.967***	2.709***	8.621***
	(8.91)	(9.68)	(13.22)	(15.75)	(11.94)	(16.64)	(15.25)	(8.88)	(10.50)	(15.82)
N	83,737									
BIC	217,241.90	107,716.40		82,371.21			72,029.47			
ΔBIC		−109,525.50		−25,345.19			−10,341.74			
% ΔBIC		−50.42 %		−11.67 %			−4.76 %			

This table presents results from the analysis that estimates the relation between financial distress and realized return separately for firms in the bottom two quintiles of realized return (Low), firms in the third quintile of realized return (Medium), and firms in the top two quintiles of realized return (High). Variables are defined in Appendix B. The *t*-statistics in parentheses are computed using standard errors clustered on firm and year. ***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % levels, respectively, using a 2-tailed test.

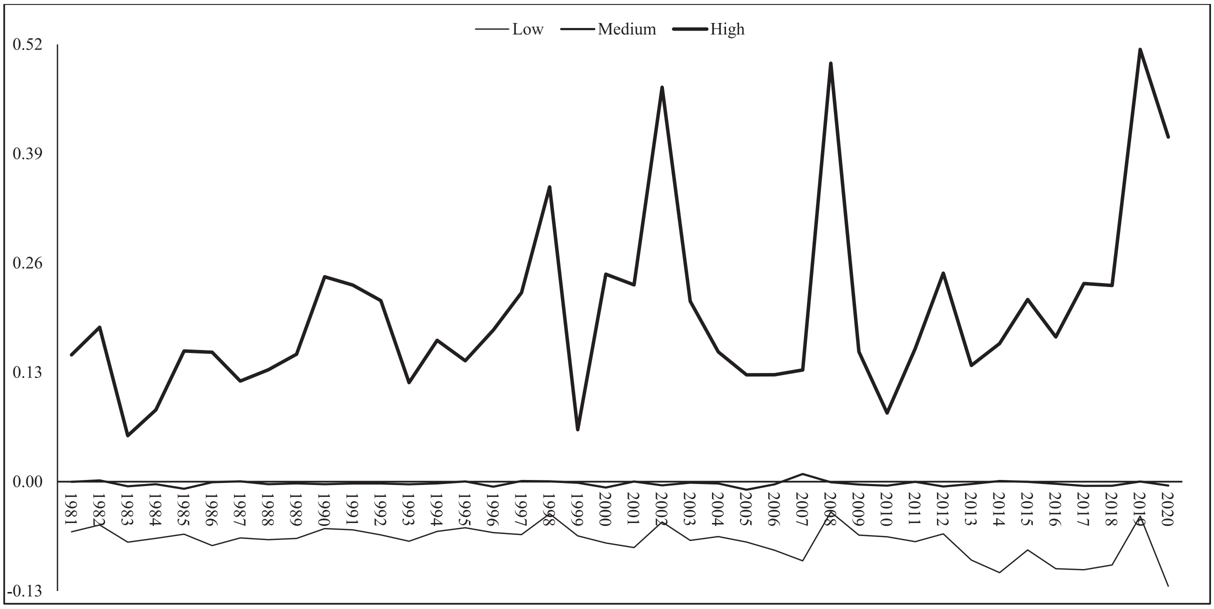

Fig. 1. Financial Distress and Realized Return: Time-Series Variation.
This figure depicts time-series variation in the estimated relation between financial distress (*FinancialDistress*) and realized return (R_{t+1}). R_{t+1} is stock return over the 12-month period starting in the fourth month after fiscal year *t*; *FinancialDistress*—the financial distress measure—is a function of accounting and market variables with coefficients obtained from Table IV in Campbell et al. (2008), computed using the latest accounting and market information available by the end of the third month after fiscal year *t*, $t = 1981$ to 2020. Low denotes the bottom two quintiles of realized return; Medium denotes the third quintile of realized return; High denotes the top two quintiles of realized return.

firms ($C_{t+1} < 0$) and the positive relation from the other latent group is driven by the positive relation between financial distress and the mispricing-correction component for undervalued firms ($C_{t+1} > 0$). Consistent with our mispricing-based interpretation, the intercept is negative for the latent group with a negative relation and positive for the latent group with a positive relation; consistent inferences are obtained after adjusting a firm's realized return for its exposure to a comprehensive set of ten return factors; the coefficient estimates obtained using earnings announcement realized return are much larger in magnitude than those obtained using non-announcement realized return.

To further substantiate our mispricing-based interpretation, we conduct three analyses: (a) estimating the relation between financial distress and realized return separately for firms in the bottom two quintiles of realized return (Low), in the third quintile (Medium), and in the top two quintiles (High), (b) estimating the relation between a mispricing score constructed using the method in Stambaugh et al. (2012) and the probability of having a positive relation between financial distress and realized return, and (c) estimating the relation between financial distress and a price-to-value ratio estimate as well as the relation between the price-to-value ratio estimate and the probability of having a positive relation.

4.3.1. Low, medium, and high realized return

The mispricing-correction component (C_{t+1}) is negative for overvalued firms and positive for undervalued firms. Consistent with the prominence of the mispricing-correction component in realized return, firms with large negative realized return ($R_{t+1} \ll 0$) tend to experience overvaluation correction ($C_{t+1} < 0$) and firms with large positive realized return ($R_{t+1} \gg 0$) tend to experience undervaluation correction ($C_{t+1} > 0$). Hence, consistent with our mispricing-based interpretation, the negative relation between financial distress and realized return is expected to concentrate in firms with large negative realized return and the positive relation is expected to concentrate in firms with large positive realized return. To demonstrate this, we split the sample into three groups: firms in the bottom two quintiles of realized returns (Low), firms in the third quintile (Medium), and firms in the top two quintiles (High). We then estimate the relation between financial distress and realized return separately for each group.[25]

[25] We agree with a referee that it offers a potential alternative way of testing the hypothesis to sort observations into groups on realized return and estimate the relation between financial distress and realized return separately for each group. Because firms with larger realized return are more likely to experience undervaluation correction than firms with smaller realized return, a higher realized return group consists of proportionally more undervalued firms than a lower realized return group does. Hence, the direct prediction of the hypothesis is that the estimated relation between financial distress and realized return increases as the estimation is moved from a lower to a higher realized return group. We analytically formalize the referee's observation and empirically show that, as the estimation is moved from the bottom to the top quintile of realized return, the estimated relation between financial distress and realized return increases monotonically from significantly negative to significantly positive. The derivations and results are provided in Section C of the Internet Appendix.

Table 4
Changes in Financial Distress, Profitability, Leverage, and Positive Earnings Surprise: High R_{t+1} versus Low R_{t+1} Firms.

Panel A: Change in Financial Distress

Group	Low R_{t+1}			High R_{t+1}			High R_{t+1} – Low R_{t+1}		
	t	$t+1$	Δ	t	$t+1$	Δ	t	$t+1$	Δ
FinancialDistress:T1	−8.385	−7.730	0.655***	−8.421	−8.390	0.031**	−0.036***	−0.660***	−0.624***
			(18.11)			(2.46)	(−5.36)	(−20.47)	(−20.00)
FinancialDistress:T2	−7.610	−6.942	0.668***	−7.622	−7.866	−0.244***	−0.012**	−0.924***	−0.912***
			(15.72)			(−14.23)	(−2.10)	(−21.23)	(−21.59)
FinancialDistress:T3	−6.302	−5.890	0.412***	−6.275	−7.255	−0.981***	0.028	−1.365***	−1.393***
			(10.57)			(−13.75)	(0.53)	(−35.14)	(−19.01)

Panel B: Change in Profitability

Group	Low R_{t+1}			High R_{t+1}			High R_{t+1} – Low R_{t+1}		
	t	$t+1$	Δ	t	$t+1$	Δ	t	$t+1$	Δ
FinancialDistress:T1	0.088	0.053	−0.035***	0.089	0.101	0.012***	0.001	0.048***	0.047***
			(−11.84)			(5.53)	(0.26)	(17.51)	(17.10)
FinancialDistress:T2	−0.024	−0.047	−0.022***	0.008	0.026	0.019***	0.032***	0.073***	0.041***
			(−6.31)			(9.78)	(4.93)	(14.84)	(12.87)
FinancialDistress:T3	−0.255	−0.249	0.007	−0.149	−0.106	0.043***	0.106***	0.143***	0.037***
			(0.90)			(6.01)	(4.93)	(8.33)	(4.14)

Panel C: Change in the Incidence of Loss

Group	Low R_{t+1}			High R_{t+1}			High R_{t+1} – Low R_{t+1}		
	t	$t+1$	Δ	t	$t+1$	Δ	t	$t+1$	Δ
FinancialDistress:T1	0.109	0.187	0.078***	0.076	0.056	−0.019***	−0.034***	−0.131***	−0.097***
			(12.73)			(−3.61)	(−4.21)	(−17.42)	(−13.94)
FinancialDistress:T2	0.282	0.403	0.121***	0.204	0.154	−0.050***	−0.078***	−0.249***	−0.171***
			(13.22)			(−6.40)	(−4.87)	(−15.14)	(−22.08)
FinancialDistress:T3	0.658	0.758	0.100***	0.569	0.469	−0.100***	−0.089***	−0.289***	−0.199***
			(12.45)			(−4.94)	(−2.95)	(−10.23)	(−9.58)

Panel D: Change in Leverage

Group	Low R_{t+1}			High R_{t+1}			High R_{t+1} – Low R_{t+1}		
	t	$t+1$	Δ	t	$t+1$	Δ	t	$t+1$	Δ
FinancialDistress:T1	0.149	0.164	0.015***	0.168	0.169	0.001	0.019***	0.006	−0.014***
			(7.20)			(0.71)	(4.08)	(1.03)	(−7.63)
FinancialDistress:T2	0.233	0.249	0.016***	0.249	0.241	−0.008***	0.016***	−0.008	−0.024***
			(7.22)			(−5.25)	(2.81)	(−1.25)	(−12.57)
FinancialDistress:T3	0.293	0.330	0.037***	0.294	0.284	−0.010***	0.001	−0.046***	−0.046***
			(12.08)			(−4.64)	(0.10)	(−6.57)	(−17.25)

Panel E: Change in the Incidence of Positive Earnings Surprises

Group	Low R_{t+1}			High R_{t+1}			High R_{t+1} – Low R_{t+1}		
	t	$t+1$	Δ	t	$t+1$	Δ	t	$t+1$	Δ
FinancialDistress:T1	0.639	0.518	−0.121***	0.650	0.669	0.019***	0.011	0.151***	0.140***
			(−17.01)			(2.87)	(1.06)	(11.92)	(14.71)
FinancialDistress:T2	0.548	0.471	−0.077***	0.562	0.633	0.071***	0.014	0.163***	0.148***
			(−8.69)			(8.76)	(1.27)	(12.16)	(12.39)
FinancialDistress:T3	0.419	0.393	−0.026***	0.458	0.571	0.113***	0.039**	0.178***	0.139***
			(−2.80)			(10.56)	(2.22)	(11.15)	(10.27)

This table presents the contrast between firms in the bottom two quintiles of realized return (Low R_{t+1}) and firms in the top two quintiles of realized return (High R_{t+1}) regarding change from year t to year $t+1$ in financial distress (*FinancialDistress*, Panel A), in profitability (*NI/AT*, Panel B), in the incidence of loss (*Loss*, Panel C), in leverage (*Leverage*, Panel D), and in the incidence of positive earnings surprises (*PosUE*, Panel E). *FinancialDistress*—the financial distress measure—is a function of accounting and market variables with coefficients obtained from Table IV in Campbell et al. (2008), computed using the latest accounting and market information available by the end of the third month after fiscal year t; *FinancialDistress:Tj* indicates the j-th tercile of *FinancialDistress*, $j = 1$ to 3; *NI/AT* is net income scaled by the beginning-of-the-year assets; *Loss* is an indicator variable that equals 1 (0 otherwise) if the firm reports negative net income; *Leverage* is the ratio of the sum of long-term debts and debts in current liabilities to total assets; *PosUE* is an indicator variable that equals 1 (0 otherwise) if the actual earnings per share (EPS) is larger than the mean analyst forecast that is computed using each analyst's latest EPS forecast made during the 12-month period ending in the earnings announcement month of fiscal year *t*. The *t*-statistics in parentheses are computed using standard errors clustered on firm and year. ***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % levels, respectively, using a 2-tailed test.

Table 5
Mispricing Score and Probability of Having a Positive Relation between Financial Distress and Realized Return.

Variable	# of latent groups			
	1	2		
FinancialDistress	0.049		−0.106***	0.334***
	(1.22)		(−9.98)	(5.89)
MispricingScore		−3.202***		
		(−6.26)		
Intercept	0.518	−0.766***	−0.790***	3.815***
	(1.58)	(−2.83)	(−8.32)	(8.90)
N	208,756			
BIC	491,669.10	335,860.30		
ΔBIC		−155,808.80		
% ΔBIC		−31.69 %		

This table presents results from the analysis that uses the finite mixture normal regression to estimate the relation between the mispricing score and the probability of having a positive relation between financial distress and realized return. *MispricingScore* is a stock's mispricing score, computed as the arithmetic average of its rankings for ten characteristics (see Appendix B). Other variables are defined in Appendix B. The coefficient on *MispricingScore* is obtained after modelling the probability of being in the latent group with a positive relation between financial distress (*FinancialDistress*) and realized return (R_{t+1}) as a logistic function of *MispricingScore*. The *t*-statistics in parentheses are computed using standard errors clustered on firm and year. ***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % levels, respectively, using a 2-tailed test.

Table 3, Panel A shows that realized return is not larger than −0.058 in the Low group, it ranges between −0.058 and 0.153 in the Medium group, and it is not smaller than 0.153 in the High group. Consistent with our mispricing-based interpretation, financial distress and realized return are strongly negatively correlated in the Low group: −0.323 (Pearson) and − 0.311 (Spearman) and strongly positively correlated in the High group: 0.259 (Pearson) and 0.256 (Spearman). In contrast, financial distress and realized return are only weakly negatively correlated in the Medium group: −0.028 (Pearson) and − 0.026 (Spearman).

Table 3, Panels B—D present results from the analysis that estimates the relation between financial distress and realized return separately for the Low, Medium, and High groups. The estimated relation between financial distress (*FinancialDistress*) and realized return (R_{t+1}) is always negative in the Low group and positive in the High group, when the number of latent groups increases from one to four. In contrast, the estimated relation between financial distress and realized return is far weaker in magnitude in the Medium group.

Fig. 1 presents the time-series variation in the estimated relation between financial distress and realized return. The estimated relation between financial distress and realized return is always negative in the Low group and always positive in the High group. In contrast, in the Medium group, the estimated relation between financial distress and realized return fluctuates around zero in a narrow range.

“Having a risky asset with an expected return above the riskless rate is an extremely weak condition for realized returns to be an appropriate proxy for expected return” (Elton, 1999, p.1199). That is, expected return cannot be negative (Merton, 1980; Elton, 1999). Hence, the finding that the negative relation between financial distress and realized return concentrates in firms with large negative realized return poses a direct challenge to rational explanations for an overall negative relation between financial distress and realized return. Mehra and Prescott (1985) show that an equity premium of 5 %–8 % is “an order of magnitude greater than can be rationalized in the context of the standard neoclassical paradigm of financial economics” because it implies an unreasonably high level of risk aversion among investors (Mehra, 2007, p.1). Evidently, the large positive realized returns for firms in the High group are difficult to be rationalized in the context of the classical risk-reward paradigm. In summary, the cross-section evidence in Table 3 and the time-series evidence in Fig. 1 support our mispricing-based interpretation.

Although a firm's mispricing status is unobservable, the results in Table 3 and Fig. 1 suggest that undervalued firms concentrate in the High group and overvalued firms concentrate in the Low group. To further corroborate our mispricing-based interpretation, we examine change in financial distress (*FinancialDistress*) separately for firms in the High and Low groups.[26] Poor performance and high leverage are key drivers of financial distress (Ohlson, 1980; Campbell et al., 2008). We thus also examine changes in profitability (*NI/AT*), the incidence of loss (*Loss*), and leverage (*Leverage*) separately for firms in the High and Low groups.[27] Consistent with our mispricing-based interpretation, we expect firms in the High group to experience improvement in profitability and decrease in the

[26] We thank one referee for suggesting this analysis to us.

[27] *NI/AT* is net income scaled by the beginning-of-the-year assets; *Loss* is an indicator variable that equals 1 (0 otherwise) if the firm reports negative net income; *Leverage* is the ratio of the sum of long-term debts and debts in current liabilities to total assets.

Table 6
Financial Distress, Price-to-Value Ratio Estimate, and Probability of Having a Positive Relation between Financial Distress and Realized Return.

Panel A: Financial Distress and Price-to-Value Ratio Estimate

Variable	# of latent groups		
	1	2	
FinancialDistress	−0.076***	−0.091***	0.021***
	(−13.36)	(−16.69)	(8.51)
Intercept	−0.083*	−0.324***	1.014***
	(−1.95)	(−10.57)	(38.05)
N	113,137		
BIC	34,615.21	14,379.13	
ΔBIC		−20,236.08	
% ΔBIC		−58.46 %	

Panel B: Price-to-Value Ratio Estimate and Probability of Having a Positive Relation between Financial Distress and Realized Return

Variable	# of latent groups			
	1	2		
FinancialDistress	0.078		−0.081***	0.456***
	(1.33)		(−4.52)	(7.14)
P/V:LMS		−1.241***		
		(−3.07)		
Intercept	0.747	−1.789***	−0.585***	4.581***
	(1.57)	(−5.53)	(−3.69)	(9.93)
N	113,137			
BIC	223,950.60	156,694.10		
ΔBIC		−67,256.50		
% ΔBIC		−30.03 %		

This table presents results from the analysis that uses the finite mixture normal regression to estimate the relation between financial distress and the price-to-value ratio estimate (Panel A) and to examine the relation between the price-to-value ratio estimate and the probability of having a positive relation between financial distress and realized return (Panel B). *P/V:LMS* is the ranking of the ratio of the market value (*P*) of equity at the end of the third month after fiscal year *t* to the estimated intrinsic value (*V:LMS*) of equity obtained using the method in Lee et al. (1999). *P/V:LMS* is scaled to range between 0 (minimum) and 1 (maximum). Other variables are as defined in Appendix B. In Panel B, the coefficient on *P/V:LMS* is obtained after modelling the probability of being in the latent group with a positive relation between financial distress (*FinancialDistress*) and realized return (R_{t+1}) as a logistic function of *P/V:LMS*. The *t*-statistics in parentheses are computed using standard errors clustered on firm and year. ***, **, and * denote statistical significance at the 1 %, 5 %, and 10 % levels, respectively, using a 2-tailed test.

incidence of loss, leverage, and financial distress and firms in the Low group to experience deterioration in profitability and increase in the incidence of loss, leverage, and financial distress. We also examine change in the incidence of positive earnings surprises (*PosUE*) separately for firms in the High and Low groups.[28] Consistent with our mispricing-based interpretation, we expect firms in the High group to experience increase in positive earnings surprises and firms in the Low group to experience decrease in positive earnings surprises. As shown in Table 4, we find strong support for our expectations.

4.3.2. *Mispricing score and the probability of having a positive relation between financial distress and realized return*

Following Stambaugh et al. (2012), we construct a mispricing score (*MispricingScore*) based on ten stock characteristics. These ten stock characteristics include net stock issues, composite equity issues, accruals, net operating assets, momentum, gross profitability, asset growth, return on assets, investment-to-assets, and the market-to-book ratio.[29] For each characteristic, we assign a ranking—scaled to range between 0 (minimum) and 1 (maximum)—to each stock, with the highest ranking being associated with the lowest return, as documented in the literature. A stock's mispricing score is the arithmetic average of its ranking for each of the ten characteristics. Stambaugh et al. (2012) show that *MispricingScore* captures the potential relative mispricing. That is, stocks with a larger (smaller) *MispricingScore* are more likely to be overvalued (undervalued).

[28] *PosUE* is an indicator variable that equals 1 (0 otherwise) if the actual earnings per share (EPS) is greater than the mean analyst forecast that is computed using each analyst's latest EPS forecast made during the 12-month period ending in the earnings announcement month of fiscal year *t*.

[29] Stambaugh et al. (2012) include financial distress (*FinancialDistress*) and the Ohlson bankruptcy risk score (*O-Score*) in their construction of the mispricing score. We do not include both because our study demonstrates that they do not represent relative mispricing and, instead, they represent relative undervaluation for undervalued firms and relative overvaluation for overvalued firms. In addition, we include the market-to-book ratio (M/B) because the book-to-market ratio—the inverse of M/B—has consistently been found to be positively related to realized return (Piotroski and So, 2012).

Modelling the probability of being in the latent group with a positive relation as a logistic function of *MispricingScore*, consistent with our mispricing-based interpretation, we expect *MispricingScore* to be negatively related to the probability of having a positive relation between financial distress (*FinancialDistress*) and realized return (R_{t+1}). Table 5 shows that as expected, the coefficient on *MispricingScore* is negative and statistically significant, which is consistent with the notion that firms with a larger *MispricingScore* are less likely to be in the latent group with a positive relation. In summary, the negative relation between the mispricing score and the probability of having a positive relation between financial distress and realized return supports our mispricing-based interpretation.

4.3.3. Financial distress and mispricing

Our research hypothesis builds on the positive relation between financial distress and the degree of mispricing. Let P_t be the market value of equity and V_t^I be the intrinsic value of equity. P_t/V_t^I measures the degree of mispricing. For overvalued firms ($P_t/V_t^I > 1$), a larger value of P_t/V_t^I indicates larger overvaluation; for undervalued firms ($P_t/V_t^I < 1$), a smaller value of P_t/V_t^I indicates larger undervaluation. Consistent with the degree of mispricing—undervaluation and overvaluation—being larger for more distressed firms, $COV(\text{Financial Distress}, P_t/V_t^I \mid P_t/V_t^I > 1) > 0$ for overvalued firms and $COV(\text{Financial Distress}, P_t/V_t^I \mid P_t/V_t^I < 1) < 0$ for undervalued firms.

Although the exact degree of mispricing (P_t/V_t^I) is unobservable due to the unobservability of the intrinsic value of equity (V_t^I), prior studies propose ways of estimating the intrinsic value of equity to construct price-to-value ratio (P/V) estimates (e.g., Frankel and Lee (1998) and Lee et al. (1999)). Let V_t^E be the intrinsic value estimate. P_t/V_t^E—the P/V estimate—is P_t/V_t^I plus a value estimation error.[30] Consistent with the positive relation between financial distress and mispricing, we expect to observe that the relation between financial distress and P_t/V_t^E is positive for one latent group (overvalued firms, $P_t/V_t^I > 1$) and negative for the other latent group (undervalued firms, $P_t/V_t^I < 1$). We use the method in Lee et al. (1999) to obtain our equity value estimate *V:LMS*.[31]

Table 6, Panel A presents results from the analysis that applies FMNR to estimate the relation between financial distress and the P/V estimate *P/V:LMS*. *P/V:LMS* is the ranking of the ratio of the market value of equity at the end of the third month after fiscal year *t* (*P*) to *V:LMS*, scaled to range between 0 (minimum) and 1 (maximum). According to change in BIC, the relation between financial distress (*FinancialDistress*) and the P/V estimate (*P/V:LMS*) is characterized by a positive relation for one latent group and a negative relation for the other latent group. Firms with larger (smaller) *P/V:LMS* are more likely to be overvalued (undervalued) to a larger extent (Frankel and Lee, 1998; Lee et al., 1999). Hence, ceteris paribus, the intercept for the latent group with a positive relation ($P_t/V_t^I > 1$) is expected to be larger than the intercept for the latent group with a negative relation ($P_t/V_t^I < 1$), which is what we find: 1.014 ($t = 38.05$) versus -0.324 ($t = -10.57$). In summary, the evidence based on *P/V:LMS* is consistent with the view that the degree of mispricing—overvaluation and undervaluation—is larger for more distressed firms.

Table 6, Panel A demonstrates that *P/V:LMS* is a reasonable P/V estimate. That is, firms with larger (smaller) *P/V:LMS* are more likely to be overvalued (undervalued). Hence, consistent with our mispricing-based interpretation, *P/V:LMS* is expected to be negatively related to the probability of having a positive relation between financial distress and realized return ($C_{t+1} > 0$), which is what we find as shown in Table 6, Panel B.

In summary, the negative relation between financial distress and realized return concentrates in firms with large negative realized return and the positive relation concentrates in firms with large positive realized return; the relation between financial distress and the P/V estimate is positive for the latent group with a larger intercept and negative for the other latent group with a smaller intercept; the likelihood for a firm to be in the latent group with a positive relation between financial distress and realized return is negatively related to its P/V estimate and mispricing score. Collectively, all this is consistent with the view that the degree of mispricing—undervaluation and overvaluation—is larger for more distressed firms, thereby substantiating our mispricing-based interpretation.

5. Implications

5.1. Financial distress and expected return

Our findings suggest that the negative relation between financial distress and the mispricing-correction component from overvalued firms drives the overall negative relation between financial distress and realized return documented in some studies. Evidently, an overall negative relation between financial distress and realized return does not indicate a negative relation between financial distress and expected return and, therefore, it is not at odds with the fundamental risk-reward paradigm. Nevertheless, our findings show that the mispricing-correction component (C_{t+1}) causes realized return (R_{t+1}) to be an inadequate expected return proxy for examining the relation between financial distress and expected return. The mispricing-correction component (C_{t+1}) is the measurement errors in realized return as the expected return proxy. Building on the return decomposition framework in Campbell and Shiller (1988), some studies propose methods for removing measurement errors from the realized return (e.g., Ogneva, 2012; Hou and Van Dijk, 2019), Under this return decomposition framework, realized return (R_{t+1}) has three components: expected return, discount rate news (shocks to discount rates), and cash flow news (shocks to expected cash flows). Because there is some evidence that the cash-flow-

[30] $Ln(P_t/V_t^E) = Ln(P_t/V_t^I) + (-Ln(V_t^E/V_t^I)) = Ln(P_t/V_t^I) + (-(Ln(V_t^E) - Ln(V_t^I)))$, where *Ln()* is the natural logarithm operator.

[31] We incorporate analysts' forecasts of earnings and earnings growth and industry-specific cost of equity into the empirical implementation of the residual income valuation model used in Lee et al. (1999) to obtain *V:LMS*. Following Lee et al. (1999), we adopt the Fama–French three-factor model to estimate the industry-specific cost of equity.

news variance outweighs the discount-rate-news variance, these methods focus on removing the cash flow news from realized return.

To examine the effectiveness of these methods, following prior studies, we include the cash flow news estimate in the model specification. Specifically, we adopt the method in Ogneva (2012) to estimate the cash flow news (*CashFlowNews*) and the method in Hou and Van Dijk (2019) to compute profitability shock (*ProfitabilityShock*). *CashFlowNews* is the fitted value from the cross-sectional regression of realized returns on earnings surprises with the earnings expectation derived from a statistical earnings prediction model (Ogneva, 2012); *ProfitabilityShock* is the difference between the actual and expected profitability of fiscal year $t+1$, with the latter calculated using the method in Hou and Van Dijk's (2019). Consistent with both capturing the cash flow news, *CashFlowNews* and *ProfitabilityShock* are strongly correlated: 0.400 (Pearson) and 0.389 (Spearman).

Table IA6 shows that, consistent with the findings in Ogneva (2012) and Hou and Van Dijk (2019), *CashFlowNews* and *ProfitabilityShock* are positively related to realized return. Importantly, including them in the model specification does not alter our inferences. This may not be unexpected because both cash flow news and discount rate news seem to capture things other than the mispricing-correction component. Discount rate news and cash flow news capture change in investors' expected return and change in investors' expectations of future cash flows, respectively. In principle, they jointly reflect change in investors' estimate of the equity value.

In summary, the mispricing-correction component (C_{t+1}) causes realized return (R_{t+1}) to be an inadequate expected return proxy for examining the relation between financial distress and expected return. Controlling for the cash flow news does not address this inadequacy. Because the financial distress premium notion plays a central role in asset pricing research, our findings suggest that innovation in expected return proxies is needed to investigate the validity of the financial distress premium notion.

5.2. Sensitivity to research design choices

Findings about the relation between financial distress and realized return are inconsistent. This is not surprising because the estimated relation between financial distress and realized return is inherently unstable due to the sign switching between undervalued firms and overvalued firms. We speculate that variations in research design cause the estimated relation between financial distress and realized return to vary and even switch sign due to their effects on the relative influence of undervalued firms and overvalued firms. To show this, we examine the effect of screen for price on the estimated relation between financial distress and realized return. Prior studies typically drop stocks with low prices, arguing that returns of such stocks are prone to microstructure biases. However, these studies differ with respect to the price threshold for exclusion and the timing for measuring stock price.

Table IA7, Panel A shows that, as the exclusion threshold for the ex-ante stock price at the beginning of the return period increases from $0 to $1 to $5, the right tail of realized return shrinks much more than its left tail does and, consequently, realized return becomes less positively skewed and its mean decreases. These changes suggest that, as the exclusion threshold for the ex-ante stock price increases, undervalued firms, especially substantially undervalued ones, weigh less in the sample and, as a result, the estimated relation between financial distress and realized return is expected to decrease. Table IA7, Panel B shows that, as the exclusion threshold for the average stock price over the return period increases from $0 to $1 to $5, the left tail of realized return shrinks more than its right tail does and, consequently, realized return becomes more positively skewed and its mean increases. These changes suggest that, as the exclusion threshold for the average stock price increases, undervalued firms, especially substantially undervalued ones, tend to remain in the sample and overvalued firms tend to drop out of the sample and, as a result, the estimated relation between financial distress and realized return is expected to increase.

Table IA7, Panel C presents the effect of screen for price on the estimated relation between financial distress and realized return. As expected, as the exclusion threshold for the ex-ante stock price increases from $0 to $1 to $5, the estimated relation between financial distress and realized return monotonically decreases from 0.049 ($t = 1.22$) to 0.019 ($t = 0.53$) to -0.012 ($t = -0.31$); as the exclusion threshold for the average stock price increases from $0 to $1 to $5, the estimated relation between distress and realized return monotonically increases from 0.049 ($t = 1.22$) to 0.080 ($t = 1.81$) to 0.158 ($t = 2.81$).

In summary, the evidence based on screen for stock price demonstrates that, consistent with our speculation, seemingly immaterial variations in research design can cause the estimated relation between financial distress and realized return to vary and even switch sign due to their effects on the relation between financial distress and the mispricing-correction component.

5.3. Other explanations

The literature offers several explanations—behavioral or rational—for an overall negative relation between financial distress and realized return. A popular behavioral explanation is the conjecture made in Campbell et al. (2008) that investors with a preference for lottery-like payoffs bid up stock prices of distressed firms, leading to low realized returns. Campbell et al. (2008) base their conjecture on Barberis and Huang's (2008) theoretical result that when investors have cumulative prospect theory preferences, positively skewed securities can become overpriced and thus earn negative average excess returns. Noting that distressed firms exhibit positive return skewness, Campbell et al. (2008) speculate that investors with a preference for lottery-like payoffs bid up the stock prices of distressed firms and this in turn drives an overall negative relation between financial distress and realized return. Consistent with Campbell et al.'s (2008) conjecture as well as the notion that retail investors tend to have preferences for lottery-like payoffs, Conrad et al. (2014) find that distressed firms have relatively low institutional ownership.

Investors' preferences—especially retail investors' preferences—for lottery-like stocks offer a potential explanation for the negative relation between financial distress and realized return for overvalued firms. However, as shown in Table IA8, controlling for return skewness has no material impacts on the estimated relation between financial distress and realized return in our sample, even under a nonlinear specification. These results cast doubt on investors' preferences for lottery-like stocks as an explanation for an overall negative relation between financial distress and realized return. Nevertheless, this behavioral explanation also suggests that the negative relation between financial distress and the mispricing-correction component (C_{t+1}) from overvalued firms drives the observed negative relation between financial distress and realized return.

Prior studies also attempt to develop theories for rationalizing an overall negative relation between financial distress and realized return. For instance, Garlappi et al. (2008) show that, within a model of bargaining between equity holders and debt holders, as the probability of default increases, equity holders with a strong advantage over debt holders are able to extract more value from renegotiation, leading to lower risk for equity—relative to the risk of the assets—and hence lower expected returns (see also Garlappi and Yan (2011)); Chen et al. (2022) argue that levered equity betas decrease with the market risk premium, especially for distressed firms, and this negative covariance between levered equity betas and the market risk premium in turn leads to a negative relation between financial distress and expected return.[32] The crucial assumption behind these rational explanations is that realized return is an adequate proxy for expected return. However, expected return cannot be negative (Elton, 1999) and, therefore, our finding that the negative relation between financial distress and realized return concentrates in firms with large negative realized returns poses a direct challenge to these rational explanations.

In summary, the explanations offered in the literature do not seem able to do a satisfactory job in explaining the negative relation between financial distress and realized return. Moreover, the positive relation between financial distress and realized return does not draw much attention, possibly because a positive relation appears to be consistent with the fundamental risk-reward paradigm. However, our finding that the positive relation concentrates in firms with large positive realized return sets a huge hurdle for risk-reward explanations because such large positive realized returns imply unreasonably high levels of risk aversion among investors.

6. Conclusion

We study the relation between financial distress and realized return. We hypothesize that the relation between financial distress and realized return is nonlinear. Our hypothesis builds on two regularities. First, the degree of mispricing is larger for more distressed firms. Second, realized return has a prominent mispricing-correction component that is negative (positive) for overvalued (undervalued) firms and decreases (increases) with the degree of overvaluation (undervaluation). Collectively, these two regularities suggest that the relation between financial distress and realized return is negative (positive) for overvalued (undervalued) firms.

Using finite mixture models, we find robust evidence that financial distress is related to realized return negatively for one latent group and positively for the other latent group. Moreover, the intercept is negative (positive) for the latent group with a negative (positive) relation; the coefficient estimates obtained using earnings announcement realized return are much larger in magnitude than those obtained using non-earnings announcement realized return; the negative (positive) relation concentrates in firms with large negative (positive) realized return; firms with large negative (positive) realized return experience deterioration (improvement) in profitability, increase (decrease) in leverage and the incidence of loss, and decrease (increase) in the incidence of positive earnings surprises; the probability for a firm to be in the latent group with a positive relation is negatively related to its price-to-value ratio estimate and mispricing score. In summary, all this is consistent with our mispricing-based explanation.

Our study advances our understanding of the relation between financial distress and realized return in at least two ways. First, our study unravels the puzzling negative relation between financial distress and realized return. Our findings suggest that the negative relation between financial distress and the mispricing-correction component for overvalued firms drives an overall negative relation between financial distress and realized return. Evidently, an overall negative relation between financial distress and realized return is not at odds with the risk-reward paradigm. Second, our study sheds light on the inconsistency of findings about the relation between financial distress and realized return. The sign switching between undervalued firms and overvalued firms suggests that the relation between financial distress and realized return is inherently unstable. Our study shows that seemingly immaterial variations in research design can cause the estimated relation between financial distress and realized return to vary significantly and even switch sign due to their effects on the relation between financial distress and the mispricing-correction component.

Finally, our study demonstrates that as an unsupervised machine learning method, finite mixture models are a powerful tool for uncovering unobserved heterogeneity in the relation between a dependent variable and independent variables across unobservable homogeneous groups. We anticipate that our study will stimulate further research that uses finite mixture models to unravel puzzling inconsistent findings in financial economics.

CRediT authorship contribution statement

Zhuo Cheng: Writing – review & editing, Writing – original draft, Project administration, Methodology. **Jing Fang:** Writing – review & editing, Writing – original draft, Visualization, Validation, Supervision, Software, Resources, Project administration, Methodology, Investigation, Funding acquisition, Formal analysis, Data curation, Conceptualization.

[32] Chen et al. (2024b) offer a risk-based explanation for the financial distress anomaly across industries. Building on the competition-distress feedback mechanism proposed in Chen et al. (2024a), they theoretically show that because the competition-distress feedback mechanism is weaker in more distressed industries, more distressed industries are less exposed to aggregate discount-rate shocks.

Appendix A. Financial distress measures

We use three financial distress measures: the financial distress measure (*FinancialDistress*) introduced in Campbell et al. (2008), −1 x the distance-to-default measure (*NegDistToDef*) introduced in Hillegeist et al. (2004), and the bankruptcy risk score (*O-Score*) introduced in Ohlson (1980). These three measures are used in prior studies to examine the relation between financial distress and realized return (e.g., Dichev, 1998; Vassalou and Xing, 2004; Campbell et al., 2008).

The construction of *FinancialDistress*—our primary financial distress measure—is as follows:

$$-20.26\,NIMTAAVG_t + 1.42\,TLMTA_t - 7.13\,EXRETAVG_t + 1.41\,SIGMA_t - 0.045\,RSIZE_t - 2.13\,CASHMTA_t + 0.075\,MTB_t - 0.058\,PRICE_t - 9.16 \tag{A1}$$

where.

$$NIMTAAVG_t = \frac{1-\varnothing^3}{1-\varnothing^{12}} \times \left(NIMTA_{t,t-2} + \cdots + \varnothing^9 NIMTA_{t-9,t-11}\right), \varnothing = 2^{-\frac{1}{3}}$$

$$NIMTA_{t-j,t-j-2} = \frac{Net\ Income_{t-j,t-j-2}}{\left(Firm\ Market\ Equity_{t-j} + Total\ Liabilities_{t-j}\right)}, j = 0, 3, 6, 9$$

$$TLMTA_t = \frac{Total\ Liabilities_t}{(Firm\ Market\ Equity_t + Total\ Liabilities_t)}$$

$$EXRETAVG_t = \frac{1-\varnothing}{1-\varnothing^{12}} \times \left(EXRET_t + \cdots + \varnothing^{11} EXRET_{t-11}\right), \varnothing = 2^{-\frac{1}{3}}$$

$$EXRET_t = log(1 + Return_t) - log\left(1 + Return_{S\&P500,t}\right)$$

$$SIGMA_t = \left(252 \times \frac{1}{N-1} \times \sum_{k \in \{t,t-1,t-2\}} Return_k^2\right)^{\frac{1}{2}}$$

$$RSIZE_t = log\left(\frac{Firm\ Market\ Equity_t}{Total\ S\&P500\ Market\ Value_t}\right)$$

$$CASHMTA_t = \frac{Cash\ and\ Short\ Term\ Investments_t}{(Firm\ Market\ Equity_t + Total\ Liabilities_t)}$$

$$MTB_t = Firm\ Market\ Equity_t / Firm\ Book\ Equity_t$$

$$PRICE_t = log(Stock\ Price_t)$$

where *t* refers to the end of fiscal year *t* and *t-j* refers to the *j*-th month before the end of fiscal year *t*.

The construction of the distance to default (*DistToDef*) is as follows:

$$ln(V_A/X) + \left(\mu - \delta - \sigma_A^2/2\right)T \Big/ \sigma_A\sqrt{T} \tag{A2}$$

where V_A is the current market value of assets, *X* is the face value of debt maturing at time *T*, μ is the expected market return on assets, δ is the continuous dividend rate expressed in terms of V_A, and σ_A is the standard deviation of the firm's asset value. We use Hillegeist et al.'s (2004) procedure to compute *DistToDef*. Because a smaller value of *DistToDef* indicates greater financial distress, we use −1 x *DistToDef* (*NegDistToDef*) to gauge financial distress. A larger value of *NegDistToDef* indicates greater financial distress.

The construction of *O-Score* is as follows:

$$-0.407SIZE + 6.03TLTA - 1.43WCTA + 0.0757CLCA - 2.37NITA - 1.83FUTL + 0.285INTWO - 1.72OENEG - 0.521CHIN - 1.32 \tag{A3}$$

where *SIZE* is the natural logarithm of total assets (dollars) scaled by the *GNP* price-level index with a base value of 100 for 1968, *TLTA* is total liabilities divided by total assets, *WCTA* is working capital divided by total assets, *CLCA* is current liabilities divided by current assets, *NITA* is net income divided by total assets, *FUTL* is funds provided by operations divided by total liabilities, *INTWO* is an indicator variable that equals 1 if net income was negative for the last two years (0 otherwise), *OENEG* is an indicator variable that equals 1 if total liabilities exceed total assets (0 otherwise), *CHIN* is $(NI_t - NI_{t-1}) / (|NI_t| + |NI_{t-1}|)$, and *NI* is net income.

Appendix B. Variable definitions

Acc	Change in operating working capital per split-adjusted share divided by total assets per split-adjusted share.
AssetGrowth	Change in the natural logarithm of assets per split-adjusted share from fiscal year *t*-1 to fiscal year *t*.
AvgPrice	Average of stock price at the end of the third month after fiscal year *t* and stock price at the end of the fifteenth month after fiscal year *t*.
B/M	Natural logarithm of the ratio of book value to market value of equity.
Beta-MktRf, *Beta-SMB*, *Beta-HML*, *Beta-UMD*, *Beta-RMW*, *Beta-CMA*	Factor loadings on the market factor, the small-minus-big (SMB) factor, the high-minus-low (HML) factor, the momentum (UMD) factor, the robust-minus-weak (RMW) factor, and the conservative-minus-aggressive (CMA) factor, respectively, computed using daily data from the 12-month period ending in the third month after fiscal year *t*.
CashFlowNews	The cash flow news component of realized return (R_{t+1}), estimated using the method in Ogneva (2012).
FinancialDistress	A function of accounting and market variables with coefficients obtained from Table IV in Campbell et al. (2008), computed using the latest accounting and market information available by the end of the third month after fiscal year *t*. See Appendix A for details.
Leverage	Ratio of the sum of long-term debts and debts in current liabilities to total assets.
Loss	An indicator variable that equals 1 (0 otherwise) if the firm reports negative net income.
MispricingScore	Arithmetic average of rankings for the following ten characteristics: net stock issues, composite equity issues, annual accruals, net operating assets, momentum, gross profitability, asset growth, return on assets, investment-to-assets, and the market-to-book ratio. For each characteristic, a ranking—scaled to range between 0 (minimum) and 1 (maximum)—is assigned to each stock, with the highest ranking being associated with the lowest average abnormal return.
Momentum	Stock return over the 11-month period ending in the second month after fiscal year *t*.
NegAcc	*Acc* for firms with negative accruals (0 otherwise).
NegIB	An indicator variable that equals 1 if income before extraordinary items of fiscal year *t* is negative (0 otherwise).
NetStkIssues	Change in the natural logarithm of split-adjusted shares outstanding from fiscal year *t*-1 to fiscal year *t*.
NI/AT	Net income scaled by the beginning-of-the-year assets.
P/V:LMS	Ranking of the ratio of the market value (*P*) of equity at the end of the third month after fiscal year *t* to the estimated intrinsic value (*V:LMS*) of equity obtained using the method in Lee et al. (1999), scaled to range between 0 (minimum) and 1 (maximum).
PosAcc	*Acc* for firms with positive accruals (0 otherwise).
PosIB/BE	*IB/BE* for firms with positive *IB/BE* (0 otherwise), where *IB/BE* is income before extraordinary items of fiscal year *t* divided by book equity at the beginning of the year.
PosUE	An indicator variable that equals 1 (0 otherwise) if the actual earnings per share (EPS) is larger than the mean analyst forecast that is computed using each analyst's latest EPS forecast made during the 12-month period ending in the earnings announcement month of fiscal year *t*.
Price	Stock price at the end of the third month after fiscal year *t*.
ProfitabilityShock	Difference between profitability of $t+1$ and the expected profitability of $t+1$ obtained using the method introduced in Hou and Van Dijk (2019).
R_{t+1}	Stock return over the 12-month period that starts in the fourth month after fiscal year *t*.
Size	Natural logarithm of the market value of equity at the end of the third month after fiscal year *t*.
ZeroNetStkIssues	An indicator variable that equals 1 if *NetStkIssues* equals 0 (0 otherwise).

Appendix C. Supplementary data

Internet Appendix for "Financial distress and return: A finite mixture approach" can be found online at https://doi.org/10.1016/j.jcorpfin.2025.102779.

Data availability

Data will be made available on request.

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