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Explaining the default risk anomaly by the two-beta model

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ABSTRACT

This study attempts to explain the anomaly that firms with high-default risk earn low average realized returns. We measure default risk according to Ohlson's (1980) *O*-score and Campbell, Hilscher, and Szilagyi's (2008) failure probability and further implement Duffie, Saita, and Wang's (2007) doubly-stochastic intensity model to estimate default probabilities that incorporate the dynamics of the changes in covariates. We then employ Campbell and Vuolteenaho's (2004) two-beta model to estimate firms' cash-flow and discount-rate betas according to the default risk. The default risk anomaly persists when using Duffie el al.'s (2007) method. We show that cash-flow and discount-rate betas, respectively, earn a high and low premium and find that high-default firms tend to have relatively high discount-rate and low cash-flow betas. Hence, high-default firms deliver low expected returns. Importantly, 25.5% of the default risk anomaly can be explained by the two-beta model and that, on average, also accounts for 49.2% of the cross-sectional variation across the portfolios formed on default risk. This result implies that investors believe that high-default firms are unlikely to generate significantly extra cash flows when market-wide profitable opportunities improve.

1. Introduction

A number of studies have documented an anomaly in the capital market: stocks with a high likelihood of default (or distress risk) deliver greater market betas but lower average realized returns, regardless of the choice of risk measures (e.g., Dichev, 1998; Griffin and Lemmon, 2002; Hillegeist et al., 2004; Campbell et al., 2008; Garlappi et al., 2008; Garlappi and Yan, 2011; among others).[1] The negative relation between default risk and subsequent returns (hereafter referred to as the default risk anomaly) casts doubt on the notion of a market premium for financial distress risk (see Fama and French, 1993). This anomaly may impede a rational investor from properly measuring the risk premium of stock investments in the presence of default risk.

Recent research provides several explanations for the default risk anomaly, including mispricing (Barberis and Huang, 2008; Griffin and Lemmon, 2002), financial distress costs (George and Hwang, 2010), and the shareholder recovery or advantage

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[1] Dichev (1998) measures a firm's default risk by Altman's (1968) Z-score and Ohlson's (1980) O-score. Hillegeist et al. (2004) compute the probability of default using the Merton (1974) model based on the market value of a firm's equity and debt. Campbell et al. (2008) implement a dynamic logit model to estimate the probability of default among firms. Garlappi et al. (2008) and Garlappi and Yan (2011) use Moody's KMV estimated default frequencies (EDFs) to represent the probability of default. Note that Vssalou and Xing (2004) is one of the few papers that actually established a positive relation between default risk and future return. Da and Gao (2010) show that their results are driven by short-term reversals on distressed stocks.

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(Garlappi and Yan, 2011; Garlappi et al., 2008).[2] O'Doherty (2012) explains the default risk anomaly using the conditional CAPM.[3] Despite the insightful contributions of these explanations, they are still unable to clearly demonstrate how default risk is priced by the market.

This study attempts to explain the default risk anomaly. In addition to the Ohlson's (1980) *O*-score and the Campbell et al. (2008) failure probability that have been widely used to proxy for default risk in the literature (see Chen et al., 2013; O'Doherty, 2012), we also use Duffie et al. (2007) method to calculate firms' default probabilities as an alternative default measure. This is because Duffie et al. (2007) accommodates the dynamic relations among covariates and can provide multi-period-ahead forecasts. By contrast, Duffie et al.'s (2007) method has better predictability than Ohlson's (1980) static model, and is more flexible and informative than Shumway's (2001) and Campbell et al.'s (2008) models.[4] Using Duffie et al.'s (2007) method, we continue to find a negative relation between default probabilities and realized returns.

We employ Campbell and Vuolteenaho's (2004) two-beta model to estimate firms' risks. Importantly, we assess how much of the default risk anomaly can be explained by this two-beta model. This model builds on the intertemporal capital asset pricing model (ICAPM) derived by Merton (1973), who suggests that the CAPM might fail to capture default risk premium if corporate defaults are correlated with decline in investment opportunities.[5] The two-beta model decomposes the market beta of a firm into two parts: cash-flow and discount-rate components. The cash-flow component reflects the price movement in response to changes in market expectation for corporate cash flows. In this sense, the cash-flow component is a single measure of the change in the permanent component of the stock price. On the other hand, the discount-rate component reflects changes in the temporary component of the stock price when market expected returns move. Changes in market expected returns may be caused by different reasons, such as changes in macroeconomic conditions and investors' views. In the extreme, irrational investor sentiment can cause stock prices to move, a fact unrelated to the characteristics of cash flows.[6] Campbell and Vuolteenaho (2004) show that required return on a firm is determined primarily by its cash-flow beta rather than by its market beta, in that its cash-flow shocks earn a high premium and its discount-rate shocks earn a low premium. We hypothesize that high-default stocks have low cash-flow and high discount-rate betas since investors are likely to have low expectations for the cash-flow improvement of these stocks when economic conditions improve.[7] Hence, stocks with very high default probabilities deliver low cross-sectional returns. Our empirical results verify this hypothesis.

We empirically find that the increase in default risk will be mostly reflected in the discount-rate beta, and that high financially-distressed stocks have higher discount-rate betas and lower cash-flow betas than low financially-distressed stocks. The findings are significant and robust even after controlling for the firm's financial constraints, macroeconomic variables, and Fama–French factors.[8] We then perform cross-sectional regressions for the portfolios formed on default risk using two betas and find that cash-flow beta earns a high premium and dominates discount-rate beta that earns a low premium. Moreover, approximately 25.5% of the default risk anomaly can be incrementally explained by the two-beta model relative to the CAPM and that, on average, accounts for 49.2% of the cross-sectional variation across the portfolios formed on default risk and generates smaller pricing errors than the CAPM model.[9] According to the results, the two-beta model provides a partial explanation to lower average returns and large market betas for financially distressed stocks.

It is worth noting that a factor with a similar characteristic to default risk is financial constraints, which refers to firms' inabilities to obtain funds to satisfy all their investment demands due to their credit limitations, lack of collateral, and difficulties in issuing equity. Lamont et al. (2001) find that firms with large financial constraints tend to have high betas and low average returns, sharing a pattern similar to default risk. This phenomenon can be ascribed to the low likelihood of firms with insufficient cash winning market share from their competitors, improving their operations, and undertaking profitable projects. However, firms facing the same degree of financial constraints can differ in default risk. For instance, both a mature firm with low profitability and a newly established hi-tech firm with good growth opportunities face financial constraints, but the latter has greater default risk. It is possible that the effect of financial constraints on betas and returns dominates that of default risk. In addition, Lewellen and Nagel (2006) advocate that the

[2] The mispricing argument posits that investors are incapable of correctly assessing the prospects of high-default firms and thus do not require an extra premium. The distress cost rationale contends that firms with high distress costs choose low leverage to avoid distress, but are still exposed to the systematic risk relating to distress costs, resulting in the default risk anomaly. The shareholder-recovery proposition advocates that shareholders with stronger renegotiation power in case of distress would ask for a lower risk premium, which results in a hump-shaped relation between default probabilities and returns.

[3] Financially-distressed stocks have lower market risk exposure in bad times. If bad times are associated with poor cash flow prospects, then his explanation is related.

[4] As discussed in Duffie et al. (2007), during the period 1999–2003, the out-of-sample accuracy ratio for default prediction based on Moody's credit ratings is about 65%, and, for 1991–2003, based on KMV estimated default frequencies (EDFs) is about 69%.

[5] The CAPM may also fail to reflect default risk premium when firm failures are associated with unmeasured wealth factors such as human capital (Fama and French, 1996) and debt securities (Ferguson and Shockley, 2003).

[6] Campbell et al. (2013) investigation of the good and hard times of the US stock market provides an intuitive understanding of the two-beta model. They document that the recession in 2000–02 arose from an increase in discount rates, and the one in 2007–09 resulted from poor cash flow prospects, with discount rates playing little part until late 2008. The boom of the 1990s was mainly driven by changes in discount rates, while the boom in the mid-2000s was driven by a mix of changes in cash flows and discount rates.

[7] We interpret the results as reflecting investors' beliefs that high financially-distressed firms are unlikely to generate extra cash flows when market-wide profitable opportunities improve.

[8] As suggested by one of referees, we also control for the firm size as well as the book-to-market ratio. The results (not reported but available upon request) are consistent with the findings and do not change our conclusions.

[9] We thank one of the referees for suggesting this direction; it greatly improves the paper.