

How Does Bankruptcy Risk Affect Stock Values?

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ABSTRACT

Research in corporate restructuring argues that the risk of bankruptcy reduces firm value by the present value of both the direct and indirect costs of bankruptcy. Additionally, the potential for bankruptcy affects both the investment horizon of investors and the discount rate implicit in equity values. This paper empirically examines the effect of cross-sectional differences in the probability of bankruptcy on the determinants of firm value. We estimate bankruptcy probabilities for an extensive sample of more than 38,000 firm-year observations over a twelve-year period. Using a valuation model that employs both book value and earnings, we provide empirical evidence that earnings multiples decrease as the estimated probability of bankruptcy increases. These results imply that investors and analysts rely less on current earnings and more on book value (which proxies for the firm's liquidation value) as a firm's probability of bankruptcy increases.

INTRODUCTION

The development of empirical models to predict financial distress and bankruptcy has been an area of active research interest for over thirty years. Such models have been used in practice for many years by creditors, investors, and analysts as an aid in assessing risk. This research appears to be particularly relevant in today's business climate given the numerous large-scale bankruptcy filings in recent years. For instance, such well-known companies as WorldCom, Enron, Global Crossing, and UAL Corporation (the parent company of United Airlines) have each recently filed for bankruptcy protection. Yet, despite the widespread use of bankruptcy prediction models in credit analysis, very little research has focused on the effects of bankruptcy risk on equity values.

In this study, we examine the relationship between the risk of financial distress and the determinants of firm value. Using a variant of the Edwards-Bell-Ohlson (EBO) valuation model (Edwards and Bell, 1961; Ohlson, 1995), we empirically test the ability of book values and earnings to explain stock prices when earnings are conditioned on a firm's estimated probability of bankruptcy. We estimate the probability of bankruptcy and the EBO valuation relationship for a sample of over 38,000 firm-year observations over a twelve-year period. Our results indicate that when the EBO model is conditioned on bankruptcy risk, the effect of current earnings on firm value decreases as the probability of bankruptcy increases. In other words, our empirical findings indicate that earnings become less useful in the explanation of stock prices as a firm's bankruptcy risk increases. Correspondingly, the book value component of firm value (which may act as a proxy for the firm's liquidation value) becomes relatively more important in firm valuation as bankruptcy probabilities increase.

PRIOR RESEARCH

There is an extensive body of bankruptcy-related research in accounting and financial economics. In fact, there have been two published articles (Zavgren, 1983; Jones, 1987) that provide comprehensive reviews of this literature. Studies focused on the effects of financial distress on firm value have generally concentrated on the magnitude and effect of bankruptcy costs. Research in the area of corporate governance and corporate restructuring indicates that these costs can be significant (Warner, 1977). They include the costs of lawyers, accountants, and other administrative costs, as well as contracting and agency costs associated with the bankruptcy process. We argue that, in addition to potential bankruptcy

costs, financial distress introduces other factors which influence firm value. As bankruptcy risk increases, the investment horizon of current and potential investors decreases and the firm’s cost of capital increases. This increase in the cost of capital, in turn, reduces the contribution of discounted future earnings to overall firm value. Consequently, the value of a firm with a high probability of bankruptcy is largely based on its expected liquidation value, rather than future earnings. Using a valuation approach similar to the model we use, Gephardt, Lee, and Swaminathan (2001) use stock prices to identify variables that implicitly determine a firm’s cost of capital. They find that, in addition to market beta, variables such as earnings volatility, financial leverage, and firm size are reflected in a firm’s cost of capital. Although these variables are closely related to bankruptcy risk, Gephardt, et. al. do not examine bankruptcy risk directly. By focusing on the risk of bankruptcy, we develop a frame of reference for assessing the effect of various financial variables on the cost of capital and, ultimately, firm value.

The vast majority of the empirical research related to bankruptcy risk is concerned with developing models to *predict* financial distress. The seminal works in this area are by Beaver (1966) who employed univariate prediction models, Altman (1968) who utilized multivariate discriminate analysis, and Ohlson (1980) who developed a conditional logistic regression (logit) prediction model. Altman’s (1968) linear discriminate analysis model and the resulting “Z-Score” have been utilized extensively in practice as an aid in the prediction of financial distress and bankruptcy. While Altman’s Z-Scores allow one to discriminate between those firms likely to encounter financial distress and those unlikely to experience distress, they cannot be interpreted as bankruptcy probabilities. On the other hand, Ohlson’s (1980) logit bankruptcy prediction model allows for the estimation of the *probability* of bankruptcy conditional on the values of nine financial ratios. In this paper, we employ the Ohlson model in our estimation of each sample firm’s probability of bankruptcy.

In contrast to the many bankruptcy prediction studies, there is surprisingly little empirical evidence of the impact of the probability of bankruptcy on firm value. One study in this area, Burgstahler, Jimbalvo, and Noreen (1989), demonstrates that security returns are sensitive to *changes* in the probability of bankruptcy when this probability is extremely high. We extend the work of Burgstahler, et al. (1989) in two ways. First, our sample is not restricted to those firms with a high estimated probability of bankruptcy. In other words, we employ a more comprehensive sample than that used by Burgstahler, et al. since the vast majority of our sample firms have low bankruptcy probabilities. Second, we utilize the recently developed EBO valuation model that allows us to assess the relative role of information contained in the income statement (earnings) and the balance sheet (book value) when this information is conditioned on the firm’s estimated probability of bankruptcy. In other words, our empirical methodology allows us to assess how the earnings/market value relationship (and thereby the book value/market value relationship) varies with bankruptcy risk.

RESEARCH DESIGN

Edwards and Bell (1961) and Ohlson (1995) derive an accounting-based valuation model that expresses firm value as a function of book value and expected earnings,

$$V_t = b_t + \sum_{\tau=1}^{\infty} (1+r)^{-\tau} E_t [x_{t+\tau} - rb_{t+\tau-1}] \tag{1}$$

where V_t is the value of the firm at time t based on fundamental accounting data, b_t is the book value of net assets, x_t is the firm’s annual earnings, and r is the cost of capital. In essence, firm value depends on the current book value of net assets and the future earnings in excess of a normal return on the net assets. This model is often referred to as the residual income model since it expresses firm value as a function of the book value of net assets and the present value of expected residual earnings on those net assets. Ohlson (1995) and Feltham and Ohlson (1995) demonstrate that equation (1) is mathematically equivalent to the traditional valuation model based on discounted future dividends.

In this study, our objective is to examine how the residual earnings component of firm value varies with the probability of bankruptcy. Thus, the EBO valuation model described in Equation (1) appears to be well suited to our

purposes. Specifically, we hypothesize that as a firm’s bankruptcy risk (i.e., the probability of bankruptcy) increases, (1) its expected future residual earnings will decrease due to increased expected direct and indirect bankruptcy costs, (2) the investment horizon of current and potential investors decreases, and (3) its cost of capital increases to reflect the increased risk. Consequently, our expectation is that the residual income term in Equation (1) will be inversely related to the probability of bankruptcy. In other words, we hypothesize that earnings become less relevant for firm valuation as bankruptcy probabilities increase.

In order to test this hypothesis, we utilize the following empirical specification of the EBO residual income model:

$$MV_t = \alpha_0 + \alpha_1 BV_t + \alpha_2 EPS_t + \alpha_3 PROB * EPS_t + e_t \tag{2}$$

where MV_t is market value per share, BV_t is book value per share, EPS_t is earnings per share before nonrecurring items, and $PROB_t$ is the estimated probability of bankruptcy. In this empirical model, we utilize a firm’s current period earnings per share to proxy for its expected stream of abnormal or residual earnings. A large body of empirical research supports the use of current earnings as a proxy for expected future residual earnings. For example, Beaver, Lambert, and Morse (1980), Collins and Kothari (1989), and Easton and Harris (1991) each model the relationship between *expected* earnings and stock prices and then present empirical tests that assess the relationship between current earnings and returns. In each case, the empirical findings indicate that the level of current earnings is value-relevant because it serves as a proxy for expected future earnings.

In our empirical model, we include an interaction term between current earnings and the probability of bankruptcy. This term allows us to assess the effect of bankruptcy risk on the earnings/firm value relationship. Our hypothesis is that the coefficient on this interaction term will be negative, indicating a diminished role of earnings in determining value as bankruptcy risk increases.

We employ Ohlson’s (1980) bankruptcy prediction model to estimate the probability of bankruptcy ($PROB$) variable. A firm’s probability of bankruptcy is thus calculated by estimating the following logistic regression model:

$$PROB = [1 + \exp(-y)]^{-1} \tag{3}$$

where $y = -1.32 - 0.407(SIZE) + 6.03(TLTA) - 1.43(WCTA) + 0.0757(CLCA) - 2.37(NITA) - 1.83(FUTL) + 0.285(INTWO) - 1.72(OENEG) - 0.521(CHIN)$.

In Ohlson’s model,

$SIZE = \log(\text{total assets}/\text{GNP price-level index})$

$TLTA = \text{total liabilities}/\text{total assets}$

$WCTA = \text{working capital}/\text{total assets}$

$CLCA = \text{current liabilities}/\text{current assets}$

$NITA = \text{net income}/\text{total assets}$

$FUTL = \text{funds provided by operations}/\text{total liabilities}$

$INTWO = 1$ if net income < 0 for the last two years, 0 otherwise

$OENEG = 1$ if total liabilities > total assets, 0 otherwise and

$CHIN = (NI_t - NI_{t-1})/(|NI_t| + |NI_{t-1}|)$, where NI_t is net income in period t.

EMPIRICAL RESULTS

Sample And Data

Our sample consists of 38,160 firm-year observations over the 1989 - 2000 time period. In addition to the full sample, in our empirical tests we also examine four 3-year sub-periods over the entire twelve-year time horizon. All of our data were collected from Compustat’s Research Insight Database. In order for a firm to be included in the sample in a given year, we required complete data for the year in question for all the necessary variables to estimate firm value and the probability of bankruptcy. Therefore, if a firm had missing data for earnings, book value, or any of the nine independent variables in the Ohlson bankruptcy model for a given year, that firm-year observation was discarded. Even with the requirement of a complete set of data, our sample size of over 38,000 firm-year observations is quite large.

Descriptive Statistics

Table 1 provides the means of the variables used in our primary empirical tests. In addition, data reflecting the distribution of the estimated probability of bankruptcy (*PROB*) for our sample firms are provided. The median value of *PROB* is slightly over 1% (0.013). Thus, the majority of our sample firms have an extremely low probability of bankruptcy, as estimated according to the Ohlson prediction model. It is interesting to note that the 75th percentile value reflects only a 12% probability of bankruptcy. While the vast majority of our sample firms have a low estimated probability of bankruptcy, approximately 10% of our sample does have a relatively high bankruptcy probability, as indicated by the 84.4% probability of the 90th percentile firm. The skewed distribution of *PROB* results in a mean bankruptcy probability value of 0.172 for our sample.

Table 1: Descriptive Statistics

	<u>1989-2000</u>	<u>1989-91</u>	<u>1992-94</u>	<u>1995-97</u>	<u>1998-2000</u>
Number of firm-year observations	38,160	6,206	7,902	11,098	12,954
Sample Means Of Variables					
MV	14.280	12.949	13.314	14.922	14.955
BV	6.532	6.700	6.448	6.354	6.654
EPS	0.041	-0.137	0.086	0.109	0.042
PROB	0.172	0.112	0.281	0.136	0.167
BETA	0.920	0.913	0.885	0.904	0.959
Percentile Distribution Of Bankruptcy Probability (PROB)					
50th	0.013	0.010	0.039	0.010	0.014
75th	0.122	0.052	0.598	0.066	0.100
90th	0.844	0.417	0.951	0.652	0.889
95th	0.994	0.883	0.996	0.985	0.998
99th	0.999	0.999	0.999	0.999	0.999
Correlation Coefficients (With PROB)					
BV	-0.164	-0.172	-0.074	-0.184	-0.225
EPS	-0.258	-0.292	-0.211	-0.303	-0.291
BETA	0.011	0.001	0.005	0.004	0.033

MV: the market value of the firm’s stock, or stock price, at year-end

BV: the year-end book value per share of the firm’s net assets

EPS: the firms reported primary or basic earnings per share before nonrecurring items

PROB: the probability of bankruptcy estimated using a LOGIT regression estimation procedure

BETA: the market beta estimated over the sixty-month period prior to the end of the year

The last panel in Table 1 presents sample coefficients of correlation between *PROB* and the other independent variables in Equation (2). The highest correlations are between *PROB* and *EPS* and these coefficients are consistently negative. In contrast, the correlations between *PROB* and book value (*BV*) and between *PROB* and market beta (*BETA*) are relatively small.

Empirical Results

Table 2, Panel A provides the results of the estimation of our empirical model, as specified in Equation (2) over the entire 12-year sample period and four 3-year sub-periods. The results indicate that each of the independent variables is significant at the 0.01 confidence level. The only exception is that the coefficient on the *EPS* variable is not significant in the 1992 - 1994 time period. Overall, the table demonstrates that both the book value and earnings variables are positively related to firm value. These results are not surprising since both are predicted to be positive components of firm value in the EBO valuation framework. However, the variable of interest in this regression model is the interaction term between earnings and a firm’s probability of bankruptcy. Consistent with our hypothesis, the coefficient on this interaction term is significantly negative. Therefore, our results indicate that the impact of earnings on firm value decreases as the firm’s probability of bankruptcy increases. Our findings indicate that this result holds over the entire sample period as well as over each of the four 3-year sub-periods. These results are therefore consistent with the notion that investors discount a firm’s future earnings and rely more heavily on estimates of the firm’s liquidation value as the probability of bankruptcy increases.

Table 2: OLS Regression Of Price On Book Value, EPS, Beta And Bankruptcy Probability

	<u>1989-2000</u>	<u>1989-91</u>	<u>1992-94</u>	<u>1995-97</u>	<u>1998-2000</u>
Number of firm-year observations	38,160	6,206	7,902	11,098	12,954
Panel A:					
Intercept	6.0029 *	1.8810 *	6.1079 *	6.1027 *	7.9556 *
BV	1.1410 *	1.4212 *	1.0943 *	1.2428 *	0.9610 *
EPS	0.7537 *	0.9152 *	0.0804	0.8739 *	0.9104 *
PROB*EPS	-2.3909 *	-3.8547 *	-0.6356 *	-2.3629 *	-1.7083 *
Adj. R ²	0.5150 *	0.5487 *	0.6270 *	0.5978 *	0.3985 *
Panel B:					
Intercept	5.9760 *	1.7235 *	5.9995 *	6.1196 *	7.9678 *
BV	1.1449 *	1.4448 *	1.1173 *	1.2360 *	0.9588 *
EPS	0.8022 *	1.0057 *	0.0878	0.9891 *	0.9387 *
PROB*EPS	-2.3949 *	-3.8828 *	-0.5230 *	-2.4106 *	-1.7029 *
BETA*EPS	-0.0228 *	-0.0404 *	-0.0330 *	-0.0298 *	-0.0208 *
Adj. R ²	0.5157 *	0.5512 *	0.6296 *	0.5989 *	0.4091 *

* Significant at the 0.01 level.

As a sensitivity test, we estimated a modification of Equation (2) as follows:

$$MV_t = \alpha_0 + \alpha_1 BV_t + \alpha_2 EPS_t + \alpha_3 PROB * EPS_t + \alpha_4 BETA * EPS_t + e_t \tag{4}$$

Here, *BETA* refers to the market beta estimated over the 60 months prior to the year-end in which the market value (*MV*) was measured. Since a firm’s cost of capital should increase as risk increases, we would expect that the

coefficient on the interaction between *BETA* and *EPS* (\square_4) would be negative. However, what is unclear is whether including this variable in the specification would alter the earlier conclusions regarding the interaction between *PROB* and *EPS*. Table 2, Panel B presents the results of an OLS estimation of Equation (4). The coefficient on the interaction between *BETA* and *EPS* is negative and significant in all time periods. More importantly, the coefficients on the interaction between *PROB* and *EPS* are relatively unaltered. Thus our earlier results are robust to the inclusion of market risk measures.

Other Sensitivity Tests

In addition to the results that are presented in Table 2, we also performed numerous other empirical tests. These additional tests are not reported in the tables for the sake of brevity. In each case, the purpose of the test was to gauge the sensitivity of our main results to varying assumptions and empirical specifications. For example, we included an interaction term between book value and bankruptcy probability in some of our tests. In addition, we also attempted to measure a firm's abnormal earnings and we employed this measurement in our empirical specification of the EBO model in place of earnings in certain tests. In each case, our main results still held; namely that the relative importance of earnings decreases as the probability of bankruptcy increases.

CONCLUSION

This paper examines the relationship between bankruptcy risk and firm value. We equate bankruptcy risk with an estimated probability of bankruptcy. While such estimates are usually employed to assess credit risk by predicting potential default, we argue that these risk measures also have implications for stock valuation by investors and analysts. As the risk of financial distress increases, potential bankruptcy costs increase, investment horizons are shortened, and the implicit cost of capital used to discount future earnings is increased. Our empirical results indicate that as the probability of bankruptcy increases, the effect of discounted expected earnings diminishes as a determinant of value. As a consequence, the relative importance of book value as a determinant of stock price increases with the risk of bankruptcy.

As a firm approaches bankruptcy, the liquidation value of net assets is most likely the primary determinant of value to stockholders. We argue that, in these circumstances, the book value of net assets may serve as an imperfect proxy for liquidation value in valuation models. Moreover, even in the absence of imminent financial distress, the potential for future bankruptcy plays a role in determining firm value. For the vast majority of the firms in this study, the probability of bankruptcy was low. This bankruptcy probability, however small, affects a firm's cost of capital and therefore affects the valuation of the firm's discounted future abnormal earnings.

ENDNOTES

1. See Zavgren (1983) and Jones (1987) for extensive reviews of this literature.
2. Some of the bankruptcy prediction models identify stock prices as an *independent* variable that is useful in predicting bankruptcy. In these models, a decrease in the stock price is one indicator of increased bankruptcy risk. Because we argue that prices are *dependent* on the level of bankruptcy risk (among other things), we are careful in this study to estimate bankruptcy risk without relying on observed stock prices. Consequently, we are able to examine the effect of bankruptcy risk, measured using accounting data, on share values.
3. This equivalence is obtained with the additional assumption of clean surplus accounting. The clean surplus assumption requires that future changes in book value must relate to earnings, dividends, or the infusion of capital.

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