DISTRESS RISK AND LEVERAGE PUZZLES: EVIDENCE FROM TAIWAN

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Abstract

Financial distress has been invoked in the asset pricing literature to explain the anomalous patterns in the cross-section of stock returns. The risk of financial distress can be measured using indexes. George and Hwang (2010) suggest that leverage can explain the distress risk puzzle and that firms with high costs choose low leverage to reduce distress intensities and earn high returns. This study investigates whether this relationship exists in the Taiwan market. When examined separately, distress intensity is found to be negatively related to stock returns, but leverage is found to not be significantly related to stock returns. The results are the same when distress intensity and leverage are examined simultaneously. After assessing the robustness by using O-scores, distress risk puzzle is found to exist in the Taiwan market, but the leverage puzzle is not.

Keywords: Leverage Ratio, Bankruptcy Cost, Distress Intensity, Financial Distress

1. INTRODUCTION

Financial distress has been discussed in the asset pricing literature to explain anomalous patterns in the cross-section of stock returns (Chan and Chen, 1991; Fama and French, 1996). Previous studies imply that the risk of the stocks of financially distressed firms cannot be diversified. Fama and French (1993) suggest that two stock market factors related to size and book-to-market equity ratios capture firms' sensitivities to a systematic distress factor by forming a pricing model. Other studies examine financial distress risk by using indexes, such as the probability of default (PD), and then use the index to measure the risk of firms (Dichev, 1998; Griffin and Lemmon, 2002; Vassalou and Xing, 2004; Campbell, Hilscher, and Szilagyi, 2008; Maria, C. et al, 2011; Claassen et al, 2012). For example, Griffin and Lemmon (2002) use O-score as a proxy to measure the likelihood of bankruptcy (distress risk) and find that high distress risk firms earn low returns, and that low book-to-market ratios mediate this relationship (the so-called "default risk puzzle"). However, these research fail to provide consistent evidence that owners of high distress risk firms receive higher returns.

Globalization has proved to be an inevitable trend in recent decades. The cooperators have faced increasing competition worldwide, increasing the difficulty for firms to have strong performance and profitability. Thus, managers attempt to determine means of maximizing benefits. Bhandari (1988) measures leverage ratio by examining the debt-to-equity ratio and shows a positive relationship between returns and leverage ratio after controlling for beta and firm size. Hsu (2007) suggests that financial leverage is positively associated with stock returns in the Taiwan electronics industry when firms have good profitability. In addition, if the firms are large and have a high growth opportunity, they are assumed to be skillful at utilizing financial leverage to increase operating performance and reduce costs. In such a situation, altering the degree of leverage is a methods for increasing firm profit. Generally, high leverage brings high risk, which may be compensated for by high returns. This is a widely accepted view; however, whether this is always the case is the focus of much debate.

As mentioned, most people believe that high leverage leads to high positive returns. However, other empirical evidence indicates a negative relationship between leverage and positive returns. Penman, Richardson, and Tuna (2007) show that a firm's book-to-market equity ratio can be decomposed into asset and leverage components, and illustrate that the returns are positive to assets, but negative to leverage. George and Hwang (2010) report that returns are negatively related to financial distress intensity (O-score) and the book value of leverage (long-term debts/total assets). According to these studies, the leverage–returns relationship can be explained by frictionless capital market assumptions. The negative relationship between returns and leverage has been called "leverage puzzle."

Financial distress is a process, and the cost will emerge only when the firms are in distress. Kayhan and Titman (2007) suggest that high distress cost firms will optimally utilize their leverage, but that low distress cost firms will not. George and Hwang (2010) consider the cost of financial distress as a possible explanation of the distress intensity and financial leverage puzzles. High distress cost firms choose low leverage to avoid distress but require high returns. In addition, because high distress cost firms choose low leverage, they have low default probabilities of financial distress whose returns are also negative with default measure. These negative relationships describe the puzzle.

In this paper, the distress risk and leverage puzzles are investigated in terms of the listed, unlisted, and over-the-counter (OTC) companies in Taiwan. In this investigation, financial companies and firms in the 1% and 99% extremes in terms of returns and book-to-market ratios are excluded. Furthermore, year and industry dummies are included to determine whether the puzzles exist after the effects are controlled for. Finally, whether the distress risk and leverage puzzles exist in the Taiwan market is also examined.

According to the literature, two puzzles exist in the Taiwan market: a distress risk puzzle under the control of year and industry dummies and a leverage puzzle under the control of year and industry dummies. However, the leverage puzzle is not found after controlling. We report that the relationship between distress intensity and stock returns is significantly negative whereas that between leverage and returns is nonsignificant. The robustness of these two similarities reveals the index used to measure the distress risk in terms of O-score. Therefore, we suggest that there is a distress risk puzzle in Taiwan but no leverage puzzle, which supports Hypothesis 1 but not Hypothesis 2.

The rest of this paper is organized as follows: Section 2 provides theoretical background and develops empirical hypotheses. Section 3 describes the data collection and analysis. Section 4 presents the empirical results. Section 5 is the conclusion.

2. LITERATURE REVIEW AND HYPOTHESIS DEVELOPMENT

In this section, we first review the literature on the relationships between stock returns and PD (the distress risk puzzle) and between stock returns and financial leverage (the leverage puzzle).

2.1. Distress risk puzzle

Traditionally, the cost of financial distress is closely associated with bankruptcy costs in various types of financial distress. Altman (1993) demonstrates that the probability of bankruptcy is a proxy for firm distress, and there is extensive literature on bankruptcy prediction that provides powerful measures of ex ante bankruptcy risk.

Various studies depict the relationship between financial distress risk and stock returns, and indicate that returns are lower for firms with greater distress intensity (the distress risk puzzle). Dichev (1998) uses the measurements of bankruptcy risk proposed by Ohlson (1980) and Altman (1968), namely the O-score and Z-score, respectively. They then employ Altman's score to identify the likelihood of firms being in financial distress and find that firms with a high likelihood tend to have low average stock returns. Campbell, Hilscher, and Szilagyi (2008) illustrate that financially distressed firms deliver anomalously low stock returns, as measured using a hazard model. Furthermore, George and Hwang (2010) define distress intensity by using the PD, as proposed by Vassalou and Xing (2004), and the O-score of Ohlson (1980) and use indexes to form portfolios. They conclude that firms with high distress intensity or near default earn low returns.

In addition, previous studies confirm that the measures can predict defaults for individual firms. Therefore, according to the aforementioned studies, we posit the following hypothesis:

Hypothesis 1: The relationship between stock returns and distress intensity is negative.

2.2. Leverage puzzle

Fama and French (1993) suggest that the book-to-market equity ratio captures the sensitivity of a firm to a systematic distress factor. Furthermore, Modigliani and Miller (1958) show that the market beta of equity can be decomposed into a firm's asset beta and leverage ratio. Similarly, Penman, Richardson, and Tuna (2007) find that returns are negatively related to leverage. In addition, Cai and Zhang (2011) document a significant and negative effect of the change in a firm's leverage ratio on its stock prices. Caskey, Hughes, and Liu (2012) examine the cross-sectional relationship between leverage and future returns and consider the dynamic nature of capital structure as well as potentially delayed market reactions, and reveal a negative correlation between leverage and future returns. These prior studies all demonstrate the leverage puzzle and, according to their findings, the following hypothesis is posited:

Hypothesis 2: The relationship between stock returns and financial leverage is negative.

3. DATA AND METHODOLOGY

3.1. Data

The data consist of the yearly prices, returns, and other characteristics of all the listed and OTC companies that are included in the Taiwan Economic Journal Database (TEJD). The TEJD data date back to 1986, and the information for the early years is incomplete. Thus, we use the sample period of January 1991 to December 2012. Financial company stocks are excluded from the sample because their leverage is constrained by government regulations that do not apply to nonfinancial companies and because their capital structure is different from that of the others which will affect the results. Prices, return data, and financial statement information are all obtained from the TEJD. The return and book-to-market ratio extremes (below 1% and over 99%) are eliminated to smooth the sample.

3.2. Methodology

In this paper, we examine the relationship between leverage and returns and that between default intensity and returns. To measure and compare returns with these different investment strategies, cross-sectional regression is conducted. The samples are divided into three groups. For Hypothesis 1, the samples are classified as having (1) a high or low PD or (2) a high or low O-score (to test for the presence of the distress risk puzzle); for Hypothesis 2, the samples are categorized as having (3) high or low leverage (to test for the presence of the leverage puzzle). We put the strategies on the right side of the equation; thus, the returns can be isolated by hedging (zeroing out) the effect of other strategies and other variables, enabling the study to focus on the effect on returns. Moreover, controlling for the effects of firm size, book-to-market ratio, and returns from the previous year enables us to compare the portfolios simultaneously.

According to George and Hwang (2010), we extend the regression by using year and industry

dummies. The year dummy (DY1992–DY2012) and industry dummy (DInd1–DInd18) are added into regression individually. DY1992 equals 1 in 1992 and 0 in other years; DY1993 equals 1 in 1993 and 0 in other years, etc. Therefore, 21 year dummies are used. Sample industry is divided into 19 groups; DInd1 equals 1 for cement manufacturing industry samples and 0 for the others; DInd2 equals 1 for food industry samples and 0 for the others, etc. Therefore, 18 industry dummies were used.

The dependent variable in these regressions is the year t return for stock we ($R_{we,t}$). The independent variables are dummies that indicate whether stock we is held in year t as one of the three portfolios. To control the returns of the previous year and firm size, the independent variables include equity market capitalization, $size_{we,t-1}$, and previous year return, $R_{we,t-1}$, in the regression. In addition, Fama and French (1993) show that the book-to-market equity ratio captures a firm's sensitivity to a systematic distress factor. Griffin and Lemmon (2002) suggest that the firms with the highest distress risk include many firms with high book-to-market equity ratios and low past stock returns, but include more firms with low book-to-market equity ratios and high past stock returns. Thus, the ratio of the book and market values of equity, $book_{we,t-1}/mkt_{we,t-1}$, is used to control the influences of book-to-market ratio. Furthermore, according to George and Hwang (2004), momentum can be controlled by applying a 52-week high momentum measurement, which is widely used in the literature to capture momentum effects. As mentioned, the variables $R_{we,t-1}$, $size_{we,t-1}$, $book_{we,t-1}/mkt_{we,t-1}$, $52wkW_{we,t-1}$, and $52wkL_{we,t-1}$ are control variables.

Suppose that an investor forms portfolios every year and holds these portfolios for the next year, and that the portfolios contain high- and low-leverage firms or high- and low-distress firms, or both. The contribution of the portfolio formed the previous year can be obtained using the following regression:

$$R_{we,t} = \beta_0 + \beta_1 R_{we,t-1} + \beta_2 (book_{we,t-1}/mkt_{we,t-1}) + \beta_3 size_{we,t-1} + \beta_4 52wkW_{we,t-1} + \beta_5 52wkL_{we,t-1} + \beta_6 PDL_{we,t-1} + \beta_7 PDH_{we,t-1} + \beta_8 LevL_{we,t-1} + \beta_9 LevH_{we,t-1} + \gamma\, DY_{we,t} + \delta\, DInd_{we,t} + e_{we,t} \quad (1)$$

Where $R_{we,t-1}$, $(book_{we,t-1}/mkt_{we,t-1})$, $size_{we,t-1}$, $52wkW_{we,t-1}$, and $52wkL_{we,t-1}$ are all control variables and $\text{size}_{\text{we,t-1}}$ is the natural log of market capitalization. We use the following definitions, adopted from George and Hwang (2010): $52wkW_{we,t-1}$ ($52wkL_{we,t-1}$) equals 1 if $P_{we,t-1}/high_{we,t-1}$ is ranked among the top (bottom) 20% of all stocks in year t and equals 0 otherwise, where $P_{we,t-1}$ is the price for stock we at the end of year t and $high_{we,t-1}$ is the highest price for stock we during a given 12-month period. Dummies $LevH_{we,t-1}$ ($LevL_{we,t-1}$) equal 1 if stock we is among the top (bottom) 20% of stocks in year t-1, which is calculated using the ratio of the book value of total debt-to-book value of total assets. Thus, the leverage strategy is formed. The measurement for forming the portfolio of dummies $PDL_{we,t-1}$ and $PDH_{we,t-1}$ are similar to those for the leverage portfolio, equaling 1 if stock we is among the top (bottom) 20% of stocks in year t-1, which is computed used the method of Vassalou and Xing (2004), which is based on that of Merton (1974). Thus, the PD strategy is formed.

In regression (1), estimates of coefficient β_6 can be interpreted as the return in year t to the portfolio in excess of β_0, which was formed in year t-1. This means longing the low-leverage stocks and hedging the effects of all control variables to require the pure return of the portfolio. In addition, the difference $\beta_7 - \beta_6$ is the return in year t to a zero investment portfolio by longing a low-leverage portfolio and shorting a high-leverage portfolio which has holding for 1 year.

To test the robustness of the distress risk puzzle, we use another index (O-score) as an explanatory variable, as is widely seen in the literature:

$$R_{we,t} = \beta_0 + \beta_1 R_{we,t-1} + \beta_2 (book_{we,t-1}/mkt_{we,t-1}) + \beta_3 size_{we,t-1} + \beta_4 52wkW_{we,t-1} + \beta_5 52wkL_{we,t-1} + \beta_6 OscL_{we,t-1} + \beta_7 OscH_{we,t-1} + \beta_8 LevL_{we,t-1} + \beta_9 LevH_{we,t-1} + \gamma\, DY_{we,t} + \delta\, DInd_{we,t} + e_{we,t} \quad (2)$$

Where dummies $OscH_{we,t-1}$ and $OscL_{we,t-1}$ are defined by the similarly measurement according to an O-score ranking proposed by Ohlson (1980) that equals 1 if stock we is among the top (bottom) 20% of stocks in year t-1. However, because the Taiwan market differs from those elsewhere, we use the Taiwan-specific O-score measurement proposed by Li (2006).

4. DESCRIPTIVE STATISTICS

Table 1 details the correlation coefficient of variables used in regression. High leverage refers to the high-leverage dummy (LevH) defined in Eq. (1), and low leverage refers to the low-leverage dummy (LevL) defined in the same equation. Low PD (PDL) and high PD (PDH) are defined by the lowest and highest 20% ranked by PD according to the Vassalou and Xing (2004) method of estimating distress. Low O-score (OscL) and high O-score (OscH) are defined in the same manner as PD, but the index is computed by referring to Li (2006), who uses accounting variables as explanation variables to predict PD. Nineteen ratios, all from financial statements such as cash flow ratio, debt ratio, accounts receivable turnover, EBIT, EPS, and ROA, are included.

Column 1 of Table 1 shows the correlation between the returns and portfolios, revealing a significantly negative relationship between the return and high portfolios (high PD, high O-score). The high leverage classification is also negative with returns, but the relationship is nonsignificant. These negative relationships also exist in low portfolios. Column 1 implies that a distress risk puzzle exists in Taiwan but that a leverage puzzle does not because of the non-significance. Next, the low and high leverage data in columns 2 and 3, respectively, are greater for firms with a higher PD (0.350 for low leverage; 0.349 for high leverage). Comparing PDs and O-scores reveals that the relationship is stronger for PD than for O-score (0.349 versus 0.124 for high leverage and high distress index). From the correlation between the two distress indexes in columns 3 and 4, we observe that they are positive (0.128 and 0.291, respectively).

Table 1. Correlation coefficients

This table represents the descriptive statistics obtained using yearly data from January 1991 to December 2012. The low and high leverage dummies are separated by the firm stocks in the bottom (top) 20% of financial leverage, which are computed using the debt-to-book value of assets. The low and high probability of default (PD) dummies are separated by the firm stocks in the bottom (top) 20% of the distress index (PD), as proposed by Vassalou and Xing (2004). The low and high O-score variables are ranked in the bottom (top) 20% of a different distress risk measurement computed according to the method in Li (2006). ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Return	*Low leverage*	*High leverage*	*Low PD*	*High PD*	*Low O-score*	*High O-score*
Return	1						
Low leverage	0.008	1					
High leverage	-0.024	-0.236***	1				
Low PD	0.088***	0.350***	-0.185***	1			
High PD	-0.228***	-0.216***	0.349***	-0.242***	1		
Low O-score	0.120***	-0.061	0.018	0.128***	-0.136***	1	
High O-score	-0.113***	-0.008	0.124***	-0.141***	0.291***	-0.242***	1

Table 2 reports the descriptive statistics of the samples sorted by PD and leverage. The samples are separated into five quintiles by PD (20%, 40%, 60%, 80%, and 100%) and into three quintiles by leverage (33.3%, 66.6%, and 100%). The samples are sorted by year and the number in each category is obtained according to the average of all.

The panel labeled "Last year return" provides the return data for each category after the portfolio is formed. Firms with high distress intensity earned lower returns than those with low distress intensity did, and firms with high leverage have also had the same condition for the past 12 months. The results in the "Market capitalization" panel suggests that firms with low distress risk and high leverage are much larger (NT$33.98 billion) than those with high distress intensity and low leverage. In other words, the firms in the high PD and low leverage category are small firms (NT$1.30 billion). Generally, large firms might have a greater ability to issue debt; however, this debt is typically not utilized efficiently. The panel labeled "Number of firms per year" indicates the distribution of firms in each category. These data show that the firms are clustered in the upper left (low PD, low leverage; 97 firms per years) and lower right (high PD, high leverage; 100 firms per year). The panel reveals that firms typically choose leverage to control financial distress. The "PD" and "Leverage" panels also support this. In the PD panel, the quintile of high distress intensity has the highest financial leverage, and in the leverage panel, the quintile of high financial leverage has the highest PD. These conditions still exist after controlling for leverage and PD (see "All" row).

Table 2. Descriptive statistics

This table presents the descriptive statistics obtained using yearly data from January 1991 to December 2012. The firms are sorted into three categories according to the book value of leverage (debt/asset) and five quintiles based on the probability of default (PD). Each panel reports the time series numeral. The samples are ranked by year and all of them are averaged to acquire the number in each category.

	Leverage					*Leverage*		
PD	*Low*	*Medium*	*High*	*All*	*Low*	*Medium*	*High*	*All*
	PD (percent)				*Leverage*			
Low	0.00	0.00	0.00	0.00	0.21	0.41	0.60	0.41
2	0.05	0.07	0.07	0.07	0.25	0.43	0.58	0.42
3	0.37	0.41	0.42	0.40	0.27	0.43	0.59	0.43
4	1.55	1.67	1.75	1.66	0.28	0.43	0.60	0.44
High	6.32	7.10	14.15	9.19	0.29	0.44	0.71	0.48
All	1.66	1.85	3.28		0.26	0.43	0.62	
	Past 12 month return (percent)				*Book-to-market*			
Low	17.91	14.30	17.07	16.43	0.58	0.54	0.47	0.53
2	16.17	16.68	11.84	14.90	0.71	0.63	0.63	0.65
3	13.09	12.59	13.38	13.02	0.91	0.77	0.73	0.80
4	16.49	13.68	9.35	13.17	1.17	1.00	0.87	1.01
High	5.82	12.81	5.22	7.95	2.08	1.54	1.17	1.60
All	13.90	14.01	11.37		1.09	0.89	0.77	
	Market capitalization (millions)				*Number of firms (per year)*			
Low	25881	31552	33972	30468	97	33	12	142
2	9319	18886	25583	17929	69	49	24	142
3	8031	12302	18403	12912	43	61	38	142
4	3713	7477	11370	7520	20	58	63	141
High	1301	4143	5152	3532	7	34	100	141
All	9649	14872	18896		236	235	237	

5. EMPIRICAL RESULTS

5.1. Returns, PD, and leverage

Table 3 presents the results of a cross-sectional regression for the distress risk and returns, revealing their relationship in supporting Hypothesis 1. Column (1) indicates that there is a strong and highly significant negative relationship between PD and returns. The coefficient of low PD portfolio and high PD portfolio is 0.062% per year and –0.123% per year, respectively, which hedged the other strategies. Both of these results are significant at the 1% level. The results run counter to generally accepted concepts. The zero investment portfolios are constructed by the long low PD stocks and the short high PD stocks, earning 0.185% per year. Column 2 adds a year dummy to control for the effect of the year in the regression. The results are similar to those in Column 1: two portfolios are still negative and highly significant. Column 3 adds an industry dummy,

classified into 19 categories, to control for the effects caused by different industries. The same results as those in the previous column are yielded. Finally, column 4 adds both year and industry dummies and not only is the coefficient but also significantly improved. The coefficient for the low PD portfolio decreases to 0.031% and that for the high PD portfolio decreases to –0.048%, but they are still significant at the 1% level. Thus, a zero investment portfolio earns 0.079% per year. Furthermore, R^2 is increased from 0.078 to 0.355.

Columns 5–8 show the relationship between leverage and returns. High leverage portfolio is formed by the top 20% of all stocks in year t-1. The coefficient of high leverage is negative and significant to returns (–0.037% per year at the 1% significance level), and low leverage is positive and weakly significant (0.029% per year at the 10% significance level). A zero investment portfolio is 0.066% per year. In this part, year dummy and industry dummy are added respectively. However, after adding the dummies, the leverage puzzles become nonsignificant, indicating that the relationship between the returns and leverage does not support Hypothesis 2. Moreover, R^2 increases from 0.078 to 0.347.

Table 3 also presents the data on leverage and distress index dummies, which are both included in Eq. (1). The table shows that the result is the same as that yielded when combining these two categories, thus supporting Hypothesis 1 but not Hypothesis 2. Leverage is a factor determining PD, which measures the distress intensity; therefore, it is unsurprising that leverage dummies become nonsignificant when both leverage and PD dummies are considered. The results are reported in columns 9–12. The return on a zero investment portfolio, which includes long low distress intensity stocks and short high distress intensity stocks, is 0.206% per year. After controlling for the year and industry dummies, the return on a zero investment portfolio decreases to 0.079%; furthermore, the results become more significant and R^2 increases from 0.078 to 0.355.

Table 3. Returns, PD, and leverage

This table presents the relationships between PD and leverage by using yearly data from January 1991 to December 2012 and by controlling for the previous year's returns, the book-to-market ratio, and size. The cross-sectional regression is run as follows:

$$R_{we,t} = \beta_0 + \beta_1 R_{we,t-1} + \beta_2 (book_{we,t-1}/mkt_{we,t-1}) + \beta_3 size_{we,t-1} + \beta_4 52wkW_{we,t-1} + \beta_5 52wkL_{we,t-1} + \beta_6 PDL_{we,t-1} + \beta_7 PDH_{we,t-1} + \\ + \beta_8 LevL_{we,t-1} + \beta_9 LevH_{we,t-1} + \gamma\ DY1992{\sim}DY2012_{we,t} + \delta\ DInd1{\sim}DInd18_{we,t} + e_{we,t}$$

Where $R_{we,t-1}$, $(book_{we,t-1}/mkt_{we,t-1})$, $size_{we,t-1}$, $52wkW_{we,t-1}$, and $52wkL_{we,t-1}$ are all control variables, and $R_{we,t-1}$ and $size_{we,t-1}$ are the returns and neutral log, respectively, of market capitalization of stock we in year *t*-1. Furthermore, $(book_{we,t-1}/mkt_{we,t-1})$ is computed by the book value of equity to the market value of equity in year *t*-1. The definitions of other variables are as follows: $52wkW_{we,t-1}$ ($52wkL_{we,t-1}$) equals 1 if $P_{we,t-1}/high_{we,t-1}$ is ranked among the top (bottom) 20% of all stocks in year t and equals 0 otherwise, where $P_{we,t-1}$ is the price of stock we at the end of year t and $high_{we,t-1}$ is the highest price of stock we during a given 12-month period. Dummies $PDH_{we,t-1}$ and $PDL_{we,t-1}$ equal 1 if stock we is among the top (bottom) 20% of stocks in year t-1, which is computed according to the method of Vassalou and Xing (2004), which is based on that of Merton (1974). Dummies $LevH_{we,t-1}$ ($LevL_{we,t-1}$) equal 1 if stock we is among the top (bottom) 20% of stocks in year t-1, which is calculated by the ratio of the book value of total debt-to-book value of total assets. DY1992–DY2012 and DInd1–DInd18 are used to control for the effects of year and industry. DY1992 equals 1 when the year is 1992 and equals 0 for other years; DY1993 equals 1 when the year is 1993 and equals 0 for others years, etc. Therefore, there are 21 year dummies. Industry is separated into 19 groups, DInd1 equals 1 when the portfolio is in the cement manufacturing industry and equals 0 when it is in another industry; DInd2 equals 1 when the portfolio is in the food industry and equals 0 when it is in another industry, etc. Columns 1, 5, and 9 exclude the year and industry dummies. Columns 2, 6, and 10 include the year dummy. Columns 3, 7, and 11 include the industry dummy. Columns 4, 8, and 12 include the year and industry dummies. In the last two rows, N and R-square refer to the number of observations for each model and R-square, respectively. The numbers in this table are the coefficients of each variable and the numbers in parentheses are t values. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Intercept	0.568***	0.507***	0.374***	0.442***	0.558***	0.561***	0.381***	0.508***	0.589***	0.516***	0.401***	0.456***
	(5.150)	(4.733)	(2.879)	(3.651)	(5.351)	(5.476)	(3.088)	(4.376)	(5.299)	(4.787)	(3.065)	(3.743)
$R_{we,(t-1)}$	-0.101***	-0.031**	-0.105***	-0.035***	-0.110***	-0.032***	-0.112***	-0.034***	-0.101***	-0.031***	-0.105***	-0.035***
	(-9.265)	(-2.487)	(-9.574)	(-2.820)	(-10.650)	(-2.807)	(-10.807)	(-2.970)	(-9.259)	(-2.446)	(-9.577)	(-2.793)
Book-to-market	0.286***	0.142***	0.309***	0.164***	0.265***	0.126***	0.288***	0.148***	0.287***	0.141***	0.310***	0.164***
	(24.395)	(13.076)	(25.743)	(14.391)	(25.653)	(13.356)	(27.227)	(14.907)	(24.404)	(12.982)	(25.773)	(14.268)
Size	-0.031***	-0.015***	-0.029***	-0.016***	-0.029***	-0.018***	-0.028***	-0.018***	-0.032***	-0.015***	-0.030***	-0.016***
	(-6.401)	(-3.593)	(-5.916)	(-3.727)	(-6.484)	(-4.567)	(-5.963)	(-4.565)	(-6.538)	(-3.623)	(-6.096)	(-3.798)
52-week high loser	0.017	0.021	0.000	0.010	-0.033**	0.011	-0.053***	-0.004	0.020	0.020	0.004	0.010
	(0.973)	(1.395)	(-0.017)	(0.662)	(-2.078)	(0.839)	(-3.296)	(-0.258)	(1.158)	(1.362)	(0.214)	(0.675)
52-week high winner	0.066***	0.019	0.076***	0.027*	0.107***	0.037***	0.115***	0.046***	0.062***	0.019	0.072***	0.027*
	(3.878)	(1.272)	(4.487)	(1.869)	(6.743)	(2.709)	(7.262)	(3.320)	(3.635)	(1.274)	(4.205)	(1.826)
Low PD	0.062***	0.023*	0.067***	0.031**					0.074***	0.025	0.082***	0.034**
	(3.716)	(1.672)	(3.978)	(2.190)					(4.079)	(1.603)	(4.504)	(2.226)
High PD	-0.123***	-0.037***	-0.127***	-0.048***					-0.132***	-0.033*	-0.139***	-0.045***
	(-6.853)	(-2.450)	(-7.027)	(-3.085)					(-6.795)	(-1.983)	(-7.167)	(-2.696)
Low leverage					0.029*	0.010	0.026*	0.010	-0.028	-0.009	-0.034*	-0.014
					(1.898)	(0.802)	(1.681)	(0.745)	(-1.578)	(-0.597)	(-1.945)	(-0.931)
High leverage					-0.037***	-0.023*	-0.029*	-0.022	0.007	-0.017	0.013	-0.016
					(-2.376)	(-1.789)	(-1.806)	(-1.637)	(0.379)	(-1.159)	(0.729)	(-1.057)
Year	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
Industry	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
N	13549	13549	13549	13549	16075	16075	16075	16075	13549	13549	13549	13549
R^2	0.078	0.352	0.086	0.355	0.078	0.344	0.086	0.347	0.078	0.352	0.086	0.355

5.2. Returns, O-score, and leverage

Table 4 reports the robustness results for the distress risk puzzle. Here, the O-score is used to replace the PD, which is another measurement for defining distress probability. The O-score is used in many papers and, unlike PD, is computed by

assessing accounting variables; therefore, it is incorporated to test the robustness of the results.

Table 4 is formed by running Eq. (2). Column 1 reveals that the coefficient of the low O-score dummy is 0.164% per year, which is highly significant (t statistic = 9.99) at the 1% level, and that the coefficient of the high O-score dummy is –0.152% per year, which is also highly significant (t statistic = –9.162) at the 1% level. A zero investment portfolio earns 0.306% per year. The year and industry dummies are then added. In Column 4, in which both dummies are controlled for, the coefficient of the high and low O-score dummies is still strongly negative and highly significant. Therefore, the results show that the relationship between leverage and O-score support Hypothesis 1. Moreover, R^2 increases from 0.095 to 0.357 after controlling for the year and industry dummies.

Columns 9–12 of Table 4 present the financial leverage and O-score dummy data. The results are similar to those of the previous test, which uses PD to measure distress intensity. The relationship between returns and distress intensity is significantly negative, but that between returns and leverage is nonsignificant. Although the year and industry dummies are controlled for, the results remain the same. Furthermore, R^2 increases from 0.095 to 0.357. As mentioned, the results do not support Hypothesis 2.

Table 4. Returns, O-scores, and leverage

This table presents the relationship between O-score and leverage obtained by using yearly data from January 1991 to December 2012 and by controlling prior year returns, the book-to-market ratio, and size. The cross-sectional regression is run as follows:

$$R_{we,t} = \beta_0 + \beta_1 R_{we,t-1} + \beta_2(book_{we,t-1}/mkt_{we,t-1}) + \beta_3 size_{we,t-1} + \beta_4 52wkW_{we,t-1} + \beta_5 52wkL_{we,t-1} + \beta_6 OscL_{we,t-1} + \beta_7 OscH_{we,t-1} + \beta_8 LevL_{we,t-1} + \beta_9 LevH_{we,t-1} + \gamma\ DY1992{\sim}DY2012_{we,t} + \delta\ DInd1{\sim}DInd18_{we,t} + e_{we,t}$$

where $R_{we,t-1}$, $(book_{we,t-1}/mkt_{we,t-1})$, $size_{we,t-1}$, $52wkW_{we,t-1}$, and $52wkL_{we,t-1}$ are all control variables, and $R_{we,t-1}$ and $size_{we,t-1}$ are the returns and neutral log, respectively, of market capitalization of stock we in year *t*-1. $(book_{we,t-1}/mkt_{we,t-1})$ is computed using the book value of the equity to market value of equity in year *t*-1. The definitions of other variables are as follows: $52wkW_{we,t-1}$ ($52wkL_{we,t-1}$) equals 1 if $P_{we,t-1}/high_{we,t-1}$ is ranked among the top (bottom) 20% of all stocks in year *t* and equals 0 otherwise, where $P_{we,t-1}$ is the price of stock we at the end of year t and $high_{we,t-1}$ is the highest price of stock we during a given 12-month period. Dummies $OscH_{we,t-1}$ and $OscL_{we,t-1}$ equal 1 if stock we is among the top (bottom) 20% of stocks in year *t*-1, which is computed using accounting variables according to the method proposed by Li (2006). Dummies $LevH_{we,t-1}$ ($LevL_{we,t-1}$) equals 1 if stock we is among the top (bottom) 20% of stocks in year *t*-1, which is calculated by the ratio of the book value of total debt-to-book value of total assets. DY1992–DY2012 and DInd1–DInd18 are contained to control the effect of year and industry. DY1992 equals 1 when the year is 1992 and equals 0 for other years; DY1993 equals 1 when the year is 1993 and equals 0 for other years, etc. Therefore, there are 21 year dummies. Industry is separated into 19 groups, DInd1 equals 1 when the portfolio is in the cement manufacturing industry and equals 0 when it is in another industry; DInd2 equals 1 when the portfolio is in the food industry and equals 0 when it is in another industry, etc. Columns 1, 5, and 9 exclude the year and industry dummies. Columns 2, 6, and 10 include the year dummy. Columns 3, 7, and 11 include the industry dummy. Columns 4, 8, and 12 include the year and industry dummies. In the final two rows, N and R-square refer to the number of observations for each model and R-square, respectively. The numbers in this table are the coefficients of each variable and the numbers in parentheses are the t values. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*	*(10)*	*(11)*	*(12)*
Intercept	0.613***	0.650***	0.516***	0.634***	0.558***	0.561***	0.381***	0.508***	0.614***	0.656***	0.515***	0.638***
	(5.649)	(6.050)	(4.005)	(5.196)	(5.351)	(5.476)	(3.088)	(4.376)	(5.618)	(6.077)	(3.974)	(5.217)
$R_{we,(t-1)}$	-0.112***	-0.043***	-0.112***	-0.043***	-0.110***	-0.032***	-0.112***	-0.034***	-0.112***	-0.043***	-0.112***	-0.044***
	(-10.305)	(-3.501)	(-10.313)	(-3.539)	(-10.650)	(-2.807)	(-10.807)	(-2.970)	(-10.282)	(-3.508)	(-10.301)	(-3.559)
Book-to-market	0.310***	0.164***	0.328***	0.184***	0.265***	0.126***	0.288***	0.148***	0.312***	0.165***	0.329***	0.184***
	(28.155)	(15.958)	(29.164)	(17.094)	(25.653)	(13.356)	(27.227)	(14.907)	(28.224)	(15.974)	(29.188)	(17.084)
Size	-0.035***	-0.022***	-0.034***	-0.023***	-0.029***	-0.018***	-0.028***	-0.018***	-0.035***	-0.023***	-0.034***	-0.023***
	(-7.255)	(-5.475)	(-6.864)	(-5.490)	(-6.484)	(-4.567)	(-5.963)	(-4.565)	(-7.280)	(-5.522)	(-6.889)	(-5.539)
52-week high loser	-0.014	0.020	-0.031*	0.006	-0.033**	0.011	-0.053***	-0.004	-0.012	0.021	-0.029*	0.007
	(-0.845)	(1.406)	(-1.845)	(0.442)	(-2.078)	(0.839)	(-3.296)	(-0.258)	(-0.719)	(1.478)	(-1.745)	(0.510)
52-week high winner	0.093***	0.033**	0.100***	0.040***	0.107***	0.037***	0.115***	0.046***	0.094***	0.033**	0.101***	0.041***
	(5.598)	(2.262)	(6.041)	(2.769)	(6.743)	(2.709)	(7.262)	(3.320)	(5.660)	(2.310)	(6.077)	(2.806)
Low O-score	0.164***	0.102***	0.149***	0.095***					0.168***	0.104***	0.152***	0.097***
	(9.990)	(7.260)	(8.860)	(6.672)					(10.171)	(7.354)	(9.007)	(6.762)
High O-score	-0.152***	-0.114***	-0.148***	-0.115***					-0.147***	-0.111***	-0.145***	-0.113***
	(-9.162)	(-8.090)	(-8.883)	(-8.106)					(-8.822)	(-7.853)	(-8.647)	(-7.906)
Low leverage					0.029*	0.010	0.026*	0.010	0.024	0.007	0.022	0.007
					(1.898)	(0.802)	(1.681)	(0.745)	(1.497)	(0.496)	(1.363)	(0.478)
High leverage					-0.037***	-0.023*	-0.029*	-0.022	-0.026	-0.017	-0.019	-0.017
					(-2.376)	(-1.789)	(-1.806)	(-1.637)	(-1.565)	(-1.206)	(-1.168)	(-1.171)
Year	N	Y	N	Y	N	Y	N	Y	N	Y	N	Y
Industry	N	N	Y	Y	N	N	Y	Y	N	N	Y	Y
N	14402	14402	14402	14402	16075	16075	16075	16075	14402	14402	14402	14402
Adjusted R^2	0.095	0.354	0.102	0.357	0.078	0.344	0.086	0.347	0.095	0.354	0.102	0.357

Finally, regardless of whether PD or O-score is used as a proxy of distress probability, the results are consistent, indicating that the distress risk puzzle exists in the Taiwan market but that the leverage puzzle does not. We also find R^2 are smaller (0.086 and 0.102 in Table 3 and Table 4) after only controlling the industry dummies. These results imply that the year dummies would be better than the industry dummies to help explain 'goodness-of-fit' between the distress risk or leverage puzzles.

6. CONCLUSION

Previous papers have demonstrated that firms with high distress intensity earn low returns when examined using different measurements. In this paper, we investigate whether the distress risk puzzle exists in Taiwan. George and Hwang (2010) suggest that the puzzle can be explained by the book value of leverage. Therefore, we also examine whether the possible explanation of the distress risk puzzle is the leverage puzzle.

First, default probability is used as a proxy for distress intensity to examine the cross-sectional relationship between returns and distress intensity as well as returns and leverage. We find that, if the puzzles are examined separately, the distress risk puzzle exists but the leverage puzzle does not. In addition, the situation is the same when the puzzles are examined simultaneously. Next, the O-score is used to test robustness. The results are similar to those obtained when PD is used as the proxy. Therefore, the results support Hypothesis 1 but do not support Hypothesis 2.

In conclusion, this paper shows that the distress risk puzzle exists in Taiwan, which means

that firms with high distress intensity earn low stock returns. This finding is consistent with those of Dichev (1998), Griffin and Lemmon (2002), and George and Hwang (2010).

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