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Panel Threshold Effect Analysis of Capital Structure of Electronic Listed Firms in Taiwan

Abstract

This paper aims at investigating whether application of financial leverage affects firm value of electronic listed firms in Taiwan. We employ advanced panel threshold regression model to test if there exists an optimal Debt/Total Assets ratio (D/TA ratio), which may result in threshold effects and asymmetrical relationships between the D/TA ratio and firm value. ROA, ROE, EPS and Tobing's q are adopted as proxy variables for firm value. The result shows that there exists single threshold effect between debt ratio and firm value only when Tobing's q is selected as the proxy variable for the firm value. The estimated threshold value (γ) is found to be 37.84% and two coefficients (α_1 and α_2) are all positive with the evidence that the α_1 in the low debt level is significant, while the α_2 in the high debt level is not. This suggests that financial managers should use financial leverage wisely in order to maximize the firm's value.

Key Words: Panel Threshold Effect, Firm Value, Debt to Asset Ratio, Capital Structure

I Introduction and Literature Review

Modern capital structure theory started in 1958, when Modigliani and Miller 1958 (M&M hereafter) first brought out "Capital Structure Irrelevance Theory", advocated that the firm value and weighted average cost of capital (WACC) is unaffected by the financial structure of the firm. However, M&M's perfect market assumptions: such as no transaction costs, no taxes, symmetric information and identical borrowing rates, and risk free debt, are contradictory to the operations in the real world. Modigliani and Miller (1963) later modified their original M&M's model and considered the tax deductibility of interest (tax shields effect). According to modified M&M theory with taxes, value of levered firm equals the value of un-levered plus the value of the tax shields. In this case, the more the debt in the capital structure, the higher will be the value of a levered firm. One can always increase firm value by increasing leverage, implying a capital structure of 100% debt is optimal to maximize the firm's value. Miller (1977) further added personal taxes to the analysis and demonstrated that tax deductibility of interest at the firm level is offset by personal income taxes at the investor level.

The extension of M&M and Miller's

model is the trade off theory between the tax advantage of debt and various leverage-related costs (such as debt-issuing costs, bankruptcy costs, agency costs, and loss of non-debt tax shields). Direct bankruptcy costs include the costs that are associated with bankruptcy, such as legal and administrative costs. In addition, though borrowing saves a firm's money on its corporate taxes, but the more a firm borrows, the firm increases its risk causing the firm's bond rating to decrease, and its costs of debt to increase. The more likely it is that the firm becomes bankrupt and finally even has to pay the "bankruptcy tax". Indirect bankruptcy costs include the difficulties of running a business that is experiencing financial distress. Moreover, Jensen and Meckling (1976) specified the existence of "agency costs" which arise due to the conflicts either between managers and shareholders (agency costs of equity) or between shareholders and debtholders (agency costs of debt).

In the Static Tradeoff Theory (Myers, 1977) there is a static or balance amount of debt and equity for the manager to decide, by analyzing the trade-off between the benefits of more debt versus the cost of additional debt in the form of financial distress or agency costs. Ultimately, finds the "optimal capital structure". This theory suggests that value-maximizing financial managers should employ capital structures composed of that mix of debt and equity for which the interest tax shield is equal to the incremental costs through debt financing. Kim and Sorensen (1986) investigated the presence of the agency costs and their relation to the debt policy of corporations. It is found that firms with higher insider ownership have greater debt ratios than firms with lower insider ownership, which may be explained by the agency costs of debt or the agency costs of equity. It is also found that high-growth firms use less debt rather than more debt, high-operating-risk firms use more debt rather than less debt, and firm size seems to be uncorrelated to the level of debt.

Literature concerning about the issue of the relationship between financial leverage and firm value can be found in Ross (1977), Castanias (1983), Altman (1984), Jensen (1986), Titman and Wessels (1988), Leland and Toft (1996), Burgman (1996), Goldstein, Ju and Leland (1998), Philosophov and Philosophov (1999), Shyam-Sunder and Myers (1999), Chirinko and Singha (2000), Morellec (2001), Lie (2002), Baker and Wurgler (2002), Welch (2003), Li and Cui (2003), and Frank and Goyal (2004) among others.

Taiwan, a typical island-style export-led country, is a main supplier of electronics and Information Technology (IT) related products to the U.S. and the rest of the world. Taiwanese economy is now relies more on capital-intensive goods than ever. Among different industries, Whiting (1991) pointed out that the weighted average debt as a percentage of total capital within the electronic industry is higher than within other type of industries. Therefore it is worth exploring the effect of the use of financial leverage on firm value of electronics

companies in Taiwan.

Aiming at investigating whether application of financial leverage affects corporate performance or firm value of electronic listed firms in Taiwan, we apply threshold regression model to the observed "balanced panel data" to test if there exists an optimal Debt/Total Assets ratio (D/TA ratio hereafter) which may result in threshold effect and asymmetrical responses of the corporate performance to the D/TA ratio. If this "threshold" value of γ is verified, the financial managers should take steps to increase debt levels in the low debt regime of D/TA ratio lower than the γ. Conversely, they should take steps to reduce debt levels in the high debt regime of D/TA ratio higher than γ.

This paper contributes to previous literature in four aspects. First, we apply advanced panel threshold regression model developed by Hansen (1999) to test if there exists a "threshold" of optimal debt usage. In contrast with traditional linear model, this nonlinear threshold model can describes the "trade-off" between the benefits of tax shields of more debts and the disadvantages of costs from additional debts that may damage the corporate performance or value. Second, we consider panel data of electronic listed companies to fully examine the financial characteristics of the electronic industry and to solve the short period sample problem. Third, we use both accounting measurements of ROA, ROE and EPS and Tobin's q to serve as proxies for firm value. Finally, four related control variables are considered to make our nonlinear function form more persuadable.

The remainder of this paper is organized as follows: Section II describes the selected variables and data. Methodologies are introduced Section III. Section IV presents and analyzes the empirical results. Section V concludes this paper.

II Data Description

This paper explores if there exists an optimal D/TA ratio, which may result in threshold effect and asymmetrical responses of the firm value to the D/TA ratio through employing threshold regression model. The investigation has been performed using "balanced panel data" for a sample of 20 selected electronic companies listed on the Taiwan Stock Exchange during 1993 to 2002. A total of 200 observations are adopted for each variable considered.

For the firm value, we choose accounting financial ratios: Return on Assets (ROA), Return on Equity (ROE), Earnings Per Share (EPS) as the indicators or proxy variables to evaluate the corporate performance or firm value. Besides, in order to consider the effect of market valuation of a firm, Tobing's q, which defined as the ratio of the market value of a firm to the replacement cost of its assets, is also selected as the proxy variable for the firm performance or value. The calculations of the approximated q, following the suggestions by Chung and Pruitt (1994), is defined as follows:

Approximated q = (MVE + PS + DEBT)/TA,

where MVE is the product of a firm's share price and the number of common stock shares outstanding, PS is the liquidating value of the firm's outstanding preferred stock, DEBT is the value of the firm's short-term liabilities net of its short-term assets, plus the book value of the firm's long-term debt, and TA is the book value of the total assets of the firm.

There are two categories of explanatory variables in our panel data examination. The first is the threshold variable, which is the key variable to be investigated whether there exists an asymmetric threshold effect of the financial leverage on firm value. The debt to total assets ratio (D/TA Ratio) is selected as the indicator for the debt usage of the firms since it is widely used in the literature. Second category of explanatory variable is the control variables, which we adopt to make our function form more persuadable. In this paper, four control variables, including dividend payout ratio, management ownership ratio, growth rate of total assets, and switch-out investment ratio, which are presumed to have influences upon the firm value, are applied in our examination. All data sets are obtained from Taiwan Economic Journal (TEJ) Data Bank of Taiwan.

IV Empirical Results
1. Panel Unit Root Models

The result of the stationary test for each panel (explained variables, threshold variable, and control variables) is represented in Table 1. It shows that all the variables are most likely to be presumed to carry stationary characteristics since the null of unit root are mostly rejected, especially in the findings from LLC test. These stationary findings enable us to go further estimations of the panel threshold regression.

2. Panel Threshold Regressive Model

This paper applies the threshold theory proposed by Hansen (1999) and assumes that debt ratio and corporate performance have asymmetric nonlinear relationship. First we test if there exists threshold effect. We test double threshold and single threshold effect, respectively, and the formulas for both models are as follows:

$$v_{it} = \begin{cases} \mu_i + \theta' h_{it} + \alpha_1 d_{it} + \varepsilon_{it} & if \quad d_{it} \leq \gamma_1 \\ \mu_i + \theta' h_{it} + \alpha_2 d_{it} + \varepsilon_{it} & if \quad \gamma_1 < d_{it} \leq \gamma_2 \\ \mu_i + \theta' h_{it} + \alpha_3 d_{it} + \varepsilon_{it} & if \quad \gamma_2 \leq d_{it} \end{cases}$$

$$v_{it} = \begin{cases} \mu_i + \theta' h_{it} + \alpha_1 d_{it} + \varepsilon_{it} & if \quad d_{it} \leq \gamma \\ \mu_i + \theta' h_{it} + \alpha_2 d_{it} + \varepsilon_{it} & if \quad d_{it} > \gamma \end{cases}$$

The dependent variable v_{it} represents corporate performance or firm value, which uses ROA, ROE, EPS, and Tobin's q as proxies, respectively. The independent variable d_{it} represents debt ratio (D/TA ratio), which is indeed the threshold variable. h_{it} is a control variable vector that contains four variables of dividend payout ratio, management ownership ratio, growth rate of total assets, and switch-out investment ratio. Besides, μ_i, the fixed effect, represents the heterogeneity of companies under different operating conditions. The errors ε_{it} is assumed to be independent and identically distributed with mean zero and finite

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variance σ^2 ($\varepsilon_{it} \sim iid(0, \ \sigma^2)$). i and t are symbols for firms and time periods.

This paper follows the bootstrap method to get the approximation of F statistic and then calculate the p-value. Table 4 presents the empirical results of test for both single threshold and double threshold effects. After repeating bootstrap procedure 200 times for each of the two panel threshold tests, we find that the tests for double threshold are all statistically insignificant for any of the dependent variables-ROA, ROE, EPS, or Tobin's q served as the proxy variable of the firm value. However, the significant finding at the 10% level with a bootstrap p-value of 0.06 occurs only when Tobin's q is selected as the proxy for firm value in the testing of single threshold. We thus conclude that there exists a single threshold effect of the debt ratio on firm value when Tobin's q is selected. For the remainder of the analysis we work with this single threshold model.

When there exists a single threshold effect of the debt ratio on firm value, all observations are split into two regimes, a low debt level and a high debt level, depending on whether the threshold variable d_{it} is smaller or larger than the threshold value (γ). The regimes are distinguished by differing regression slopes, α_1 and α_2. Table 5 represents the regression slope estimates together with the conventional OLS standard errors and White-corrected standard errors for two regimes.

The estimated model from above empirical findings can be expressed as follows:

$$v_{it} = u_i + \underset{(0.0963)}{0.1848} d_{it} I\left(d_{it} \le \hat{\gamma}\right) + \underset{(0.0624)}{0.0319} d_{it}\left(d_{it} > \hat{\gamma}\right) + \varepsilon_{it}$$

The estimated threshold value (γ) is 37.84%, and thus all of the observations can be divided into two regimes depending on whether the D/TA ratio is smaller or larger than the threshold value. Two coefficients ($\alpha_1 = 0.1848$ and $\alpha_2 = 0.0319$) are all positive with the evidence that the α_1 in the low debt level is significant, while the α_2 in the high debt level is not.

This paper further investigates the influences of four control variables upon the firm value. The empirical results are observed in Table 6, which shows that only switch-out investment ratio when ROA is selected as the proxy for firm value has significant negative impact on firm value. Among the findings when ROE and EPS are selected as proxy, no apparent relationships between all of the four control variables and firm value are observed. Finally, dividend payout ratio is shown to have significant negative relationship with the firm value when Tobin's q is selected as the proxy for firm value.

V Conclusion

In contrast with traditional linear model, nonlinear relationship between variables is investigated in this study. We found out there exists single threshold effect between debt ratio and firm value only when Tobing's q is selected as the proxy variable for the firm value. The estimated threshold value (γ) is 37.84%, while all of the observations can be divided into two regimes, a low debt level and a high debt level,

depending on whether the D/TA ratio is smaller or larger than the specific threshold value. Two coefficients (α_1 and α_2) are all positive with the evidence that the α_1 in the low debt level is significant, while the α_2 in the high debt level is not. This suggests that the financial managers should take steps to increase debt levels when the current debt percentage of total assets is below the threshold value of 37.84 ; conversely, they should take steps to lower debt levels when the current debt usage is higher than the threshold value of 37.84 , for there is no further apparent net benefit due to the incremental leverage-related costs in the future.

The empirical results of testing for the influences of four control variables upon the firm value indicate that only switch-out investment ratio when ROA is selected as the proxy for firm value has significant negative impact on firm value. Among the findings when ROE and EPS are selected as proxy, no apparent relationships between all of the four control variables and firm value are observed. Finally, dividend payout ratio is shown to have significant negative relationship with the firm value when Tobin's q is selected as the proxy for firm value.

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