E C O N O M I C S B U L L E T I N

Does a change in debt structure matter in earnings management? --the application of nonlinear panel threshold test

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Abstract

In this study, we apply Hansen¡¦s (1999) nonlinear panel threshold test, the most powerful test of its kind, to investigate the relationship between debt ratio and earnings management of 474 selected Taiwan-listed companies during the September 2002 - June 2005 period. Rather than a fixed positive relation that is determined from the OLS, our empirical results strongly suggest that when a firm¡¦s debt ratio exceeds 46.79% and 62.17%, its debt structure changes, which in turn leads to changes in earnings management. With an increase in debt ratio, managers tend to manage earnings to a greater extent and at a higher speed. In other words, the threshold effect of debt on the relationship between debt ratio and earnings management generates an increasingly positive impact. These empirical results provide concerned investors and authorities with an enhanced understanding of earnings management, as manipulated by managers confronted with different debt structures.

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1. Introduction

Recent allegations of accounting fraud such as Enron in the US and Procomp in Taiwan, have triggered a closer investigation of the topic of earnings management (EM) and have brought forth some proposals for revisiting the financial reporting process. For instance, the US promulgated the Sarbanes-Oxley Act in 2002, while Taiwan established Corporate Governance Reform Team at the same time.For any investors, banks, suppliers, and regulators, they would like to know how and why management opportunistically manages (or manipulates) earnings and how this can be constrained. Since the manager's EM behavior is hardly observable in real life, numerous studies have been done on it in two waves.

The first wave of research focused on manager's incentives of EM. One of the incentives that appear to influence managers to undertake EM is the firm's closeness to violate debt covenant restrictions. Watts and Zimmerman (1978) first proposed a positive relationship between debt and EM. They proposed that in order to protect the interest of creditors, creditors usually put strict restrictions in their contracts with obligors on annual net profit ratio and debt-to-asset ratio for the company run by the obligors. When the debt-to-asset ratio of the obligor's company runs higher than the standards stipulated in the contract, creditors may prohibit the obligor's company from further issuing corporate bonds or distributing the ongoing year's cash dividends to shareholders as stipulated in the debt contract. Therefore, to avert default on debt contracts, the managers have greater incentives to engage in EM through the choice of accounting policy or discretionary accruals (Dhaliwal, 1988; Press and Weintrop, 1990; Duke and Hunt, 1990Bartov, 1993). The second wave of research focused on earnings threshold. Burgstahler and Dichey (1997) and Degorege et al. (1999) put forward the threshold mentality of "attaining performance" as the driver of the manager's EM behavior. Burgstahler and Dichev (1997) showed a relatively smoothed single-peaked, bell-shaped distribution except in the area of zero earnings. Degeorge et al. (1999) also provided evidence of EM that exceeds each of the three "thresholds," namely, reported positive profits, sustained recent performance, and meeting of analysts' expectations.

From standpoint of the creditor, the bank will conclude an agreement with the obligor and stipulate the constraints on the obligor's profit and solvency (i.e. the earnings threshold and debt threshold) to ensure the creditor's equity. The earnings threshold has been demonstrated by Degeorge et al. (1999) and Burgstahler and Dichev (1997).However, similar research in debt threshold is rather scarce. Therefore, in this study, we investigate that whether debt threshold exists except earnings

threshold. In other words, what is the proper debt threshold? In what kind of debt threshold would the company have serious EM? In view of this, the present study captures the extent of the manager's EM from the view of debt threshold and provides a new perspective to regulators, investors, banks and academics.

The second wave of research focused on methodology. Since Watts and Zimmerman (1978) proposed the positive accounting theory, many researchers have investigated the relationship between debt ratio and earnings management (EM) using the ordinary least squares regression model (OLS) (eg, Dhaliwal, 1988; Defond and Jiambalvo, 1994; DeAngelo et al, 1994). But, do regression functions really fall into discrete classes? This prompts us to use panel threshold regression techniques to explore this relationship. The positive accounting theory and related literature suggest that there is a simple positive linearity between them when structural changes are not considered. Here, we examine whether a non-linear relationship exists when a structural change -- in this case, a firm's debt structure --is considered. As the conventional OLS probably cannot diagnose structural changes, our use of these techniques seems justified.

Important to note, there are currently two mainstream approaches to investigate non-linear time sequences: the conventional one is the "piecewise in time" that uses "time" as structure change, while the other is Tong's (1978) threshold regression that uses the "piecewise in variable". Since the former must subjectively detect the precise time of a structure change, its results are not objective and are, in fact, relatively inconsistent; but, the latter avoids this shortcoming as a structure change in debt can be objectively observed. Thus, we employ the non-linear piecewise in variable method. Tong's (1978) model does not consider other explanatory variables, but Shen and Hakes' (1995) modified version allows for other explanatory variables on the right-hand side of the model. Hansen (1999) suggested the sequential OLS to estimate threshold values and regression parameters; he uses the observations of the threshold variable to estimate appropriate threshold values, divides the sample observations into several regimes on the basis of the threshold variable (higher or lower than the threshold values) and uses the OLS to estimate regression slopes, residuals and the sum of the square errors.

In this study, we use Hansen's (1999) nonlinear panel threshold test to determine whether one or more threshold effects exist in Taiwan-listed companies. Our empirical results confirm that two threshold effects exist. Bridging the gap of earnings management in previous studies, this study has some unique features. First, this study

provides a reference for the creditor and obligor in deciding the constraints on solvency. Second, an investor can find the reference for the appraisal of a company's EM extent. Finally, this study reminds the investor to pay more attention to the manager's EM behavior when the company's debt ratio is at the threshold.

The remainder of this study is organized as follows. Section 2 describes the methodology, and Section 3 presents the data. Section 4 discusses the findings and an important implication. Section 5 concludes.

2. Nonlinear Panel Threshold Methodology

As per Hansen (1999), our single threshold model is expressed as:

$$EM_{i,t} = \begin{cases} \mu_i + \theta' h_{i,t} + \beta_1 d_{i,t} + \varepsilon_{i,t} & if \quad d_{i,t} \le \gamma \\ \mu_i + \theta' h_{i,t} + \beta_2 d_{i,t} + \varepsilon_{i,t} & if \quad d_{i,t} > \gamma \end{cases} \quad \theta = (\theta_1)' \ , \quad h_{it} = (ZSCORE_{i,t})' \qquad (1)$$

where i denotes the *i*th firm; *t* denotes the *t*th period; $EM_{i,t}$ is the extent of EM, and its proxy is the absolute value of the discretionary accruals deflating beginning assets, as proposed by Warfield et al.(1995), Becker et al.(1998) and Reynolds and Francis(2001); $d_{i,t}$ is debt ratio (total debt /total asset); *r* is the hypothesized specific threshold value; μ_i is a given fixed effect used to capture the heterogeneity of companies in different industries; $\varepsilon_{i,t}$ is white noise in which β_1 is the threshold coefficient when the threshold value is lower than *r*; β_2 is the threshold coefficient when the threshold value is higher than *r*; $h_{i,t}$ is the 1x1 control variable vector which includes the ZSCORE, Altman's (1968) financial distress indicator (where the lower the score is, the higher is default risk, which may increase the possibility of EM; and θ_1 represent the estimates of the control variables.

For equation (1), the observations are split into two "regimes" depending on whether the threshold variable $d_{i,t}$ is smaller or larger than the threshold value(*r*).The regimes have different regression slopes, β_1 and β_2.

As our aim is to use the known data of $EM_{i,t}$, $d_{i,t}$ and the ZSCORE, we estimate the unknown parameters *r*, β and θ.

If two thresholds exist, the model is modified as:

$$EM_{i,t} = \begin{cases} \mu_i + \theta' h_{i,t} + \beta_1 d_{i,t} + \varepsilon_{i,t} & if \quad d_{i,t} \le \gamma_1 \\ \mu_i + \theta' h_{i,t} + \beta_2 d_{i,t} + \varepsilon_{i,t} & if \quad \gamma_1 < d_{i,t} \le \gamma_2 \\ \mu_i + \theta' h_{i,t} + \beta_3 d_{i,t} + \varepsilon_{i,t} & if \quad \gamma_2 < d_{i,t} \end{cases} \qquad (2)$$

where r_1 is less than r_2. This is extended to the multiple threshold model (r_1,r_2,r_3,…,r_n).

Since we hypothesize that debt ratio and EM have an asymmetric nonlinear relationship, we set "H_0: $\beta_1 = \beta_2$ and H_1: $\beta_1 \neq \beta_2$." If we cannot reject the null, the regression coefficients between the two regimes are equal. Then, the regression equation regresses into a simple regression, and the threshold effect is nonexistent. However, when the null does not hold, the asymmetric threshold effect exists, i.e., β_1 and β_2 in the two regimes can be interpreted differently. We check for the threshold effect using the *F* test, and we use the sup-Wald statistic. Thus:

$$F_1 = \frac{(SSE_0 - SSE_1(\hat{\gamma}_1))/1}{SSE_1(\hat{\gamma})/n(T-1)} = \frac{SSE_0 - SSE_1(\hat{\gamma}_1)}{\hat{\sigma}^2} \qquad (3)$$

$$F_2 = \frac{(SSE_1(\hat{\gamma}_1) - SSE_2(\hat{\gamma}_2))/1}{SSE_2(\hat{\gamma})/n(T-1)} = \frac{SSE_1(\hat{\gamma}_1) - SSE_1(\hat{\gamma}_2)}{\hat{\sigma}^2} \qquad (4)$$

If the F_1 statistic significantly rejects the null without a threshold, at least one threshold exists. We continue to test how many thresholds exist until the *F* statistic (F_3, F_4…) is smaller than the critical value calculated from the bootstrap method.

3. Data

We employ September 2002 - June 2005 quarterly balanced panel data for EM, the financial distress indicator and the debt ratio that we collect from the Taiwan Stock Exchange and the *Taiwan Economic Journal* database.[1] Our sample is 474 selected companies (5,688 observations), of which 173 (2076 observations) are new economy industries and 301 (3612 observations) are traditional ones [2](Table 1). The mean of EM and debt ratio are 0.0308 and 0.4162, respectively. As concerns the cross-industry comparison, we find traditional industries generally have a higher debt ratio than the

[1] We choose Taiwan as the sample because Taiwan has superior geographical and cultural advancements although it has a small capital market compared with the UK and the US. Technological prowess and a healthy investment environment make Taiwan into a critical player in the global context.
[2] The former mainly includes electronics industries; the latter includes the construction, pulp & paper, food and steel & iron industries, etc.

electronics industry.

4. Empirical Results

We first examine the threshold effects. Table 2 reports the testing results and the bootstrap critical values. The statistics F_1, F_2 and F_3 are 33.6131, 16.9379 and 9.3978, respectively. F_1 and F_2 exceed the critical values at the 1% and 5% significance level, respectively, but F_3 is smaller at the 10% level. F_3 accepts the null of two thresholds, i.e., 0.4679 and 0.6217. We define the three categories as "low", "medium" and "high" debt structural regimes if their debt ratio falls between 0~0.4679, 0.4679~0.6217 and exceeds 0.6217, respectively. The wide range of the first regime suggests that most firms belong there.

Table 3 provides the distribution of the sample by regime. The first regime (low debt structure) contains the highest number of firms, around 298~319 each quarter. Roughly 117 firms fall in the second regime (medium debt structure) and about 44~57 in the last regime.

Table 4 presents the threshold regression estimations by regime. We focus on the sensitivity coefficients of the debt ratio ($d_{i,t}$) in the three debt structure regimes. They are 0.0350, 0.0547 and 0.0872. These positive coefficients are all significant at the 1% level, and the estimated model is:

$$EM_{it} = \begin{cases} \mu_i - 0.0015ZSCORE_{i,t} + 0.0350d_{i,t} & if \;\; d_{i.t} \le 0.4679 \\ \mu_i - 0.0015ZSCORE_{i,t} + 0.0547d_{i,t} & if \;\; 0.4679 < d_{i,t} \le 0.6217 \\ \mu_i - 0.0015ZSCORE_{i,t} + 0.0872d_{i,t} & if \;\; 0.6217 < d_{i,t} \end{cases}$$

We also find lower ZSCOREs and greater EM in all regimes. Finally, we compare the conventional OLS and the panel threshold results. Figure 1 depicts the sensitivity of the debt ratio to EM in the three regimes and shows the slope of the OLS results has a fixed value; the regression functions are identical across all observations, implying the margin effect of a firm's debt ratio in the different debt structures is equal. Obviously, the results ignore the possibility that a change in debt structure probably exists in the debt ratio and EM relation.

Unlike the OLS results, the observations from the panel threshold model fall into discrete classes, and changes in debt structure generate an increasingly positive

impact on debt ratio and EM. Figure 1 shows the slope values between debt ratio and EM in the low, medium and high regimes are 0.035, 0.0547 and 0.0872, respectively.

In short, our results indicate that when a firm's debt ratio moves into a different regime, its debt structure changes, in turn resulting in changes in EM. The implication is that to avoid making unwise decisions, investors and authorities should be very mindful of companies that have reached the thresholds.

5. Conclusions

We use Hansen's (1999) panel threshold test to investigate the non-linear properties between debt ratio and EM in 474 selected Taiwan-listed companies from September 2002 to June 2005. The results substantiate that two threshold effects exist. When the debt ratio exceeds 46.79% and 62.17%, those firms' debt structure changes, and this affects the extent to which they engage in EM i.e., the relationship between debt ratio and EM generates an accelerated and increasingly progressive impact when debt ratio exceeds these thresholds. Our findings imply that to avoid making unwise decisions, it is important for investors and authorities to be aware that changes occur in EM before and after companies reach the turning points.

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Table 1 Summary Statistics

SIC Code	Industry	Obs	EM		Debt ratio		ZSCORE	
			Mean	Std	Mean	Std	Mean	Std
11	Cement & Ceramics	8	0.0196	0.0330	0.3976	0.2027	1.0381	1.2891
12	Food	19	0.0275	0.3028	0.4274	0.1461	1.2265	0.8243
13	Plastics & Chemical	20	0.0243	0.0237	0.3846	0.1259	1.7097	0.9763
14	Textiles	48	0.0275	0.0328	0.4169	0.1897	1.1881	2.0469
15	Electric & Machinery	29	0.0303	0.0352	0.4608	0.1269	1.5788	1.0309
16	Elec. Appliance & Cable	15	0.0238	0.0212	0.4504	0.1971	0.9804	0.9583
17	Chemical	30	0.0244	0.0276	0.3367	0.1473	2.6698	3.1639
18	Ceramics & Glass Products	7	0.0373	0.0719	0.4522	0.2047	0.7436	2.0908
19	Pulp & Paper	7	0.0172	0.0209	0.3906	0.1148	1.2364	0.8345
20	Steel & Iron	24	0.0355	0.0446	0.4813	0.1470	1.3525	1.1018
21	Rubber	9	0.0184	0.0183	0.3474	0.1243	1.7988	0.9081
22	Automobiles	4	0.0208	0.0213	0.3694	0.0828	2.2323	1.1719
23	Electronics	173	0.0309	0.0406	0.3876	0.1490	2.4277	2.5099
25	Construction	27	0.0474	0.0645	0.5647	0.1949	1.3831	4.5828
27	Tourism	6	0.0110	0.0137	0.2994	0.0936	2.2595	2.3023
29	Department Stores	11	0.0176	0.0195	0.4969	0.1311	1.2578	1.2969
99	Other	37	0.0293	0.0322	0.4438	0.1765	1.9244	2.1960
	All Industries(11-99)	**474**	**0.0308**	**0.0388**	**0.4162**	**0.1666**	**1.8793**	**2.3880**

Table 2 Tests for Threshold Effects and Threshold Estimates

	F Statistics	*P*-Value
Single-threshold	F_1=33.6131*** [a] (14.5575, 17.3351, 24.8348)	0.0000
Double-threshold	F_2=16.9379** (14.0009, 16.7940, 22.9871)	0.0420
Triple-threshold	F_3=9.3978 (12.7035, 15.3047, 18.5170)	0.2900
Threshold estimates	$\hat{\gamma}_1$=0.4679, $\hat{\gamma}_2$=0.6217	

Notes: 1. [a] indicates 10%, 5% and 1% critical values.

2. 500 bootstrap replications are used for each bootstrap test.

3.* , ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Table 3 Firms (%) in Each Regime

	Regime 1 Low d_{it} ≦0.4679	Regime 2 Moderate 0.4679< d_{it} ≦ 0.6217	Regime 3 High d_{it} > 0.6217	Sum
94.06	307	113	54	474
03	320	101	53	474
93.12	304	113	57	474
09	301	119	54	474
06	298	119	57	474
03	319	102	53	474
92.12	312	112	50	474
09	309	117	48	474
06	307	117	50	474
03	313	117	44	474
91.12	313	112	49	474
09	312	117	45	474
Sum	3,715	1,359	614	5,688

Table 4 Threshold Regression Results

	Estimate	OLS SE	t_{OLS}	White SE	t_{White}
$d_{i,t}$ ($d_{i,t}$≦0.4679)	0.0350	0.0150	2.3333***	0.0179	1.9553*
$d_{i,t}$ (0.4679＜$d_{i,t}$≦0.6217)	0.0547	0.0128	4.2734***	0.0163	3.3558***
$d_{i,t}$ (0.6217＜$d_{i,t}$)	0.0872	0.0117	7.4530***	0.0205	4.2537***
ZSCORE	-0.0015	0.0005	-3***	0.0008	-1.875*

Notes:

1. OLS SE and White SE represent homoscedasticity and heteroscedasticity standard errors, respectively.
2..* , ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

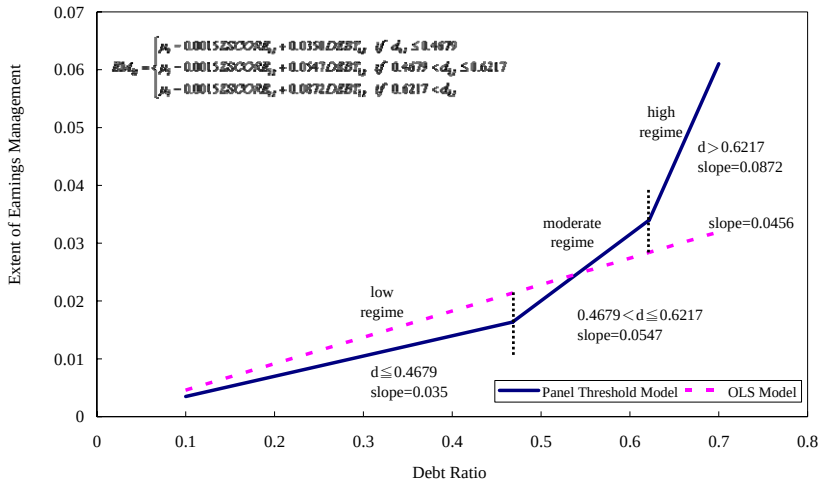

Figure 1 Panel Threshold vs. OLS Model Results