The impact of capital structure on corporate performance based on panel threshold model

Jin Wang[1]*, Weidong Zhu[2]

[1]*School of Management, Hefei University of Technology Hefei Anhui, China*

[2]*School of Management and School of Economics, Hefei University of Technology, Hefei Anhui, China*

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Abstract

This paper takes Value Added as an indicator of corporate performance. In considering the case of differences in growth opportunities, we use Panel Threshold Model to do an empirical analysis in the relationship between environmental management, capital structure and corporate performance of listed companies in China. The results show that: There is a weak positive correlation between environmental management and corporate performance, which means environmental management can improve corporate performance; there is a significant regime effects between capital structure and corporate performance relying on corporate growth opportunities. Capital structure and corporate performance are negatively related for low growth companies and positively related for high growth companies. This is consistent with the classical theory of capital structure, which means Value Added is more suitable as an indicator of corporate performance than profits in China.

Keywords: Panel Threshold Model, Value Added, Environmental Management, Capital Structure, Growth Opportunities

1 Introduction

As one of the important financing tools for listed companies, debt financing has a significant impact on corporate performance. Since Jensen and Meckling take Agent Theory into the framework of capital structure, debt plays more role in companies. On the one hand, debt can reduce the “Excessive Investment”, so it can enhance corporate performance; on the other hand, debt will also has a negative influence on corporate performance named “Insufficient Investment”. Since debt is closely related with corporate investment opportunities, and investment is limited by corporate growth opportunities, so considering the different growth opportunities between different companies to analysis the influence of debt on corporate performance is particularly necessary. In this issue, how to distinguish companies’ growth division has an important influence on the conclusion of this issue. The traditional method of subjective division often leads bias to the results of regression. Therefore, In order to make a further answer to this question, this paper adopts the method Lian. et.al (2006) [1] to use Panel Threshold Model which is developed by Hansen to determine the threshold value on the data automatically.

Different scholars have different definitions of corporate performance, research has shown that the current measurement of corporate performance is not very accurate [2-5]. This paper considers the reason is measurement method. Therefore, in the measure of corporate performance we should pay more attention to the interest of other stakeholders besides shareholders. Few scholars stand in the perspective of all stakeholders to measure corporate performance so far, and Value Added which reflects corporate value creation is a very important tool based on this perspective to evaluate corporate performance. Value Added realizes not only the interests of shareholders, but also other stakeholders to make contributions for corporate value [6], which has more broad vision than profits and has more power to encourage more stakeholders.

Environmental problems are paid more and more attention in recent years, most researches agree that environmental management is positively related to corporate performance, corporate environmental responsibility can promote corporate reputation advantages, enhance the confidence of investors, effectively use resources and market opportunities, these can also positively reflected in the capital markets; But opponents argue that, in order to improve the environment, externalities (such as the cost of dealing with pollution) was transferred into the internal of companies, this may increase the cost of operation and damage the companies’ profitability. Therefore, this paper will study the relationship between environmental management and corporate performance.

The rest of this paper is as follows: based on literature review, the second part lists the research content of this paper; the third part introduces the setting of Panel Threshold Model; the forth part shows the analysis and results of empirical research; the fifth part presents the conclusion.

* ***Corresponding author*** e-mail: wangjin-0115@163.com

2 The research content

Value Added is the essential form of profit and fully manifestation of the socialist labour value [7]. The modern enterprise is the combination of all kinds of contract, corporate need to rely on stakeholders cooperation in order to survive. Modern corporate in the pursuit of maximizing the interests of shareholders meanwhile must consider the interests of other stakeholders, thus, Value Added which is more generalized than profits should become a target of companies [8]. The ultimate goal of corporate should not simply the pursuit of profit, it will lead to failure if corporate ignore the interests of workers and pubic [9].

The modern capital structure theory began in the Irrelevance Theorem proposed by Modigliani and Miller [10]. Then scholars introduce the tax effect factors, agency cost, information asymmetry to relax the strict hypotheses of MM theory, and they found that the choice of capital structure has an important influence on corporate performance [11-13]. Leland and Ross pointed out, the manager will put the debt ratio as a signal to deliver corporate performance. The evidence is that, for the companies with low market value, high debt means high bankruptcy risk and high bankruptcy cost, managers have the advantage of more information than outside investors, therefore, under no agency cost assumption, managers will choose high debt rate as far as possible. Companies with high value will try to increase debt to deliver the signal to the market, and companies with low value will try to avoid this behaviour. Therefore, debt ratio should be positively related to corporate performance [14]. Myers proposed “The Lack of Investment” base on the problem between shareholders and creditors which considers that when a company has more debt, managers will abandon the NPV is greater than zero but not enough to pay the principal and interest of the investment plan, because creditors has the priority right in claim of the cash flow. The idea is debt ratio is negatively correlated with corporate performance [15]. Jensen argues that managers usually have a tendency to grow the size of company. Therefore, there will be “Excessive Investment” [16]. This view emphasizes the conflict of interest between shareholders and managers, in order to avoid managers invest in invalid project, shareholders will force managers to use more debt to reduce free cash flow and improve corporate performance.

Integrating the perspective of Myers and Jensen, debt ratio has positive and negative two different influences on corporate performance. The fundamental reason lies in different focus. The former focus on the interest conflicts on shareholders and creditors, while the latter emphasizes the interest conflict on shareholders and managers. Stulz integrates these two kinds of relations, he argues that if managers do not hold shares in the corporation, they will increase control right through expansion of company, so they have “Excessive Investment” motivation. But in this case, shareholders will force managers to issue bonds to reduce the "Excessive Investment", this is the positive effect of debt. But the creditor's involvement will lead the company to give up some positive NPV investment plans; this is the negative effect of debt [17]. Therefore, the positive and negative effect of debt mutual trade-off may determine the optimal capital structure to biggest corporate performance. Based on this, McConnell takes corporate growth opportunities into account; he argues that the negative impact of debt on corporate performance will be quite intense in companies with more growth opportunities. On the contrary, the positive impact of debt on corporate performance is more significant in companies with fewer growth opportunities [18]. Jung further points out, company growth opportunities will influence the optimal capital structure, and then influence corporate performance. Because with the increase of growth opportunities, consistency of the interests of managers and shareholders will be enhanced and the agency cost between them will reduce. But the agency cost between creditors and shareholders will increase with the increase of growth opportunities [19].

We argue that the different results above are mainly for the following two reasons: 1. Most scholars use the traditional financial performance to represent corporate performance, due to traditional financial indicators are in the perspective to maximize the interests of shareholders, it may lead to bias to measure corporate performance; 2. There may be a nonlinear relationship between debt ratio and corporate performance, the traditional OLS regression analysis or subjective grouping regression analysis may produce bias in the results.

Therefore, in order to obtain robust results, we use the following methods to do empirical research: 1. In order to overcome measurement bias, we stand in the perspective of all stakeholders use Value Added indicators to measure corporate performance; 2. In order to overcome estimation bias, we use Panel Threshold Model which developed by Hansen to determine the threshold value on the data automatically. In addition, due to the relationship of environmental management on corporate performance has become a focus of many scholars, this paper also introduces environmental management variables to study its effects on corporate performance.

3 The model

The literatures above show that capital structure and corporate performance may exhibit a nonlinear relationship due to different growth opportunities, which shows range effect. Because the subjective division of growth ranges may bring up estimation bias. We use Panel Threshold Model to divide growth range according to the endogenous characteristics of the data itself, and then study the relationship between capital structure and corporate performance in different growth range. The model setting and estimation method are as follows:

3.1 SINGLE THRESHOLD MODEL

Single Threshold Model sets as follows:

$$Performance_{it} = u_i + \theta x_{it} + \beta_1 Lev_{it} I(grow_{it} \le \gamma) + \beta_2 Lev_{it} I(grow_{it} \ge \gamma) + \varepsilon_{it}, \quad (1)$$

where i is company, t is year, $Performance_{it}$ and Lev_{it} respectively represent corporate performance and capital structure. x_{it} is a group of control variables which influence corporate performance, including environmental management, company size, asset structure, the liquidity of shares and profitability. θ is the corresponding coefficient vector. $grow_{it}$ is the threshold variable, in this paper it is corporate growth opportunities, $\gamma$is a particular threshold value. $I(\cdot)$ is an index function. u_i reflects companies' individual effects, which are the unobservable factors such as corporate culture, management ability and leadership qualities etc. $\varepsilon_{it} \sim i\ i\ d\ N(0, \sigma^2)$is random disturbance. In order to estimate the values of parameters, we need each observation minus the average value within group to eliminate the individual effect u_i, e.g. $Performance^*_{it} = Performance_{it} - \frac{1}{T}\sum_{i=1}^{T} Performance_{it}$ the transformed model is:

$$Performance^*_{it} = \theta x^*_{it} + \beta_1 Lev^*_{it} I(grow_{it} \le \gamma) + \beta_2 Lev^*_{it} I(grow_{it} \ge \gamma) + \varepsilon^*_{it}. \quad (2)$$

Then we stack all observation and use the matrix form to express (2) as:

$$Performance^*_{it} = X^*(\gamma)\beta + \varepsilon^*. \quad (3)$$

For threshold value γ, we can use OLS regression to estimate (3) to obtain estimated value of β:

$$\hat{\beta}(\gamma) = (X^*(\gamma)' X^*(\gamma))^{-1} X^*(\gamma)' Performance^*. \quad (4)$$

Corresponding sum of squared residuals is:

$$S_1(\gamma) = \hat{e}^*(\gamma)' \hat{e}^*(\gamma), \quad (5)$$

where $\hat{e}^*(\gamma) = Performance^* - X^*(\gamma)\hat{\beta}(\gamma)$ is residual vector.

We can minimization $S_1(\gamma)$ in (5) to obtain the estimated value of γ, i.e.

$$\hat{\gamma} = \arg\min_{\gamma} S_1(\gamma), \quad (6)$$

Once we get $\hat{\gamma}$, we can then get $\hat{\beta} = \hat{\beta}(\hat{\gamma})$, residual vector $\hat{e}^* = \hat{e}^*(\hat{\gamma})$ and the square of residuals $\hat{\sigma}^2 = \hat{\sigma}^2(\hat{\gamma}) = \frac{1}{n(T-1)}\hat{e}^{*\prime}\hat{e}^* = \frac{1}{n(T-1)}S_1(\hat{\sigma})$, n is the number of companies.

We should do two hypotheses testing after we obtain the parameter estimated values. One is whether the threshold effect is significant; the other one is whether the threshold estimated value is equal to its real value. The null hypothesis of first test is $H_0{:}\beta_1{=}\beta_2$, corresponding alternative hypothesis is $H_1{:}\beta_1{\neq}\beta_2$, the test statistic is:

$$F_1 = \frac{S_0 - S_1(\hat{\gamma})}{\hat{\sigma}^2} = \frac{S_0 - S_1(\hat{\gamma})}{S_1(\hat{\gamma})/n(T-1)}, \quad (7)$$

where S_0 is sum of squared residuals under null hypothesis H_0. Under null hypothesis H_0, the value of threshold γ is unrecognized. Therefore, the distribution of F1 is not standard. Hansen (1999) shows that "Bootstrap" can obtain its asymptotic distribution; the p value based on this structure is also asymptotically valid [20]. The null hypothesis of second test is $H_0: \hat{\gamma} = \gamma_0$, corresponding likelihood ratio statistic is:

$$LR_1(\gamma) = \frac{S_1(\gamma) - S_1(\hat{\gamma})}{\hat{\sigma}^2}. \quad (8)$$

The distribution of this statistic is also not standard; Hansen provides a simple formula to calculate the non rejection region. That is we cannot reject the null hypothesis when $LR_1(\gamma_0) \le c(\alpha)$, where $c(\alpha) = -2\ln(1-\sqrt{1-\alpha})$, α is significant level.

2.2 MULTIPLE THRESHOLD MODEL

There is only one threshold in Model (1), but there may be more than one threshold in many cases. E.g. Double Threshold Model is setting as follows:

$$Performance_{it} = \beta_1 Lev_{it} I(grow_{it} \le \gamma_1) + \beta_2 Lev_{it} I(\gamma_1 \le grow_{it} \le \gamma_2) \beta_3 Lev_{it} I(grow_{it} > \gamma_2) + u_i + \theta x_{it} + + \varepsilon_{it}, \quad (9)$$

where $\gamma_1 < \gamma_2$. Here we only focus on Double Threshold Model, because it can be extended easily to the case of Multiple Threshold Model. In order to reduce the computation, we use "Circulation Method" to estimate Model (9). In a model with structure mutation, this method can obtain the consistent estimation of parameters, such as Lian et al. (2006). The first step, let $S_1(\gamma)$ be sum of squared residuals in Single Threshold Model defined by (5), γ_1 is the estimated value of threshold when $S_1(\gamma)$ is minimum. Bai (1997) shows that

both for γ_1 and γ_2, $\hat{\gamma}_1$ is the consistent estimation of γ_1. Fixed $\hat{\gamma}_1$ obtained in the first step to estimate Model (9), the screening criteria for the second step is $S_2^{\gamma}(\gamma_2)=\begin{cases} S(\hat{\gamma}_1,\gamma_2)\ \text{if}\ \hat{\gamma}_1<\gamma_2 \\ S(\gamma_2,\hat{\gamma}_1)\ \text{if}\ \gamma_2<\hat{\gamma}_1 \end{cases}$, and the estimation of threshold in the second step is $\hat{\gamma}_2^{\gamma}=\arg\min_{\gamma_2} S_2^{\gamma}(\gamma_2)$.

Bai shows that $\hat{\gamma}_2^{\gamma}$ is asymptotically efficient, but the estimation of $\hat{\gamma}_1$ does not have the property [21]. This is because when we estimate $\hat{\gamma}_1$, sum of squared residuals contains the interval we ignored. But due to $\hat{\gamma}_2^{\gamma}$ is asymptotically efficient, we can fix $\hat{\gamma}_2^{\gamma}$, and then re-estimation, at this time, the screening criteria is $S_1^{\gamma}(\gamma_1)=\begin{cases} S(\gamma_1,\hat{\gamma}_2^{\gamma})\ \text{if}\ \gamma_1<\hat{\gamma}_2 \\ S(\hat{\gamma}_2,\gamma_1)\ \text{if}\ \hat{\gamma}_2<\gamma_1 \end{cases}$, final we get the optimized consistent estimation $\hat{\gamma}_1=\arg\min_{\gamma_1} S_1^{\gamma}(\gamma_1)$. Hypothesis Test in Double Threshold Model is similar to Single Threshold Model, we do not repeat it here.

4 Empirical analyses

4.1 SAMPLES AND PROXY VARIABLES

Our data is obtained from CSMAR developed by Shenzhen GTA Information Technology Company. In this paper we select Shanghai and Shenzhen A-share listed companies as samples, studying period is 2003-2011. We screen the data according to the following steps: (1) remove Financial Companies; (2) remove companies whose asset-liability ratio exceeds 100% (3) remove companies whose growth rate of total assets surpasses 150% for there may exist merger behaviour in these companies; (4) the key financial variables are winsored at 1st and 99th percentiles to avoid the influence of outliers. Ultimately, we obtain 1002 companies and 9018 observations.

Table 1 lists the definition and descriptive statistics of proxy variables in Model (1), considering the profit index is easy to control, we use Value Added index as corporate performance. We adopt "add algorithm" to calculate Value Added [6], the calculation method is:

$$\begin{aligned} &Value\ Added = Employees\ Income + Creditors\ Income + \\ &Shareholder\ Income + Governmenr\ Income + Corporate\ Income \end{aligned} \quad (10)$$

Due to the data of environmental management is not easy to get, in this paper the proxy variable of environmental management is taken from the companies' annual report and financial statements. If they mention of the behaviour of environmental management such as environmental governance, environmental protection, environmental technology etc., the environmental management variable is 1, otherwise 0.

TABLE 1 Descriptive statistics of samples

Variable	Variable meaning	Calculation method	Maximum	Minimum	Mean	SD
Performance	Corporate performance	Value Added/ Total assets	0.314	-0.023	0.125	0.083
Environment	Environmental management	Manage the environment is 1, otherwise 0	1.000	0.000	0.037	0.188
Lev	Capital structure	Total liabilities/ Total assets	0.857	0.189	0.526	0.181
Lnasset	Company size	LN(total assets)	23.814	19.874	21.598	1.048
Tang	Asset structure	(Fixed assets + Inventories)/ Total assets	0.756	0.158	0.467	0.168
Tshr	Share liquidity	Shares outstanding/ Total share capital	1.000	0.273	0.608	0.247
Prof	Profitability	Net profit/ Main business revenue	0.308	-0.234	0.057	0.113
Grow	Growth opportunities	Growth rate of total assets	0.580	-0.189	0.114	0.188

4.2 THE EMPIRICAL RESULTS

In order to determine the form of model we must determine the number of threshold. We successively estimate Model (9) under no threshold, one threshold, two thresholds and three thresholds, the F statistics and the Bootstrap P values are shown in Table 2. As shown in Table 2, the single threshold and double threshold effect is very significant, but the triple threshold effect is not significant, so we only analyse Double Threshold Model.

TABLE 2 The threshold effect test

				Critical value		
	F value	*P value*	*BS times*	*1%*	*5%*	*10%*
Single Threshold	47.643***	0.000	500	7.813	5.128	3.381
Double Threshold	11.061**	0.012	500	11.281	7.397	5.350
Triple Threshold	2.517	0.132	500	8.430	4.488	3.013

Note: ***, ** and * respectively at 1%, 5% and 10% significant level, same below.

Two threshold values of the model as well as the estimated 95% confidence intervals are shown in Table 3. With the likelihood ratio function drawn in Figure 1 and Figure 2, we can clearly see the constructing process of the estimation values and confidence intervals of threshold. The estimated value of the threshold refers the values of γ when the likelihood ratio test statistic LR is 0. In our Double Threshold Model are respectively 0.215 (Figure 1) and 0.560 (Figure 2). 95% confidence interval for each threshold value is the interval of γ for all LR less than the threshold level of 7.35, which is significantly at 5% level (corresponding to the broken line in Figure).

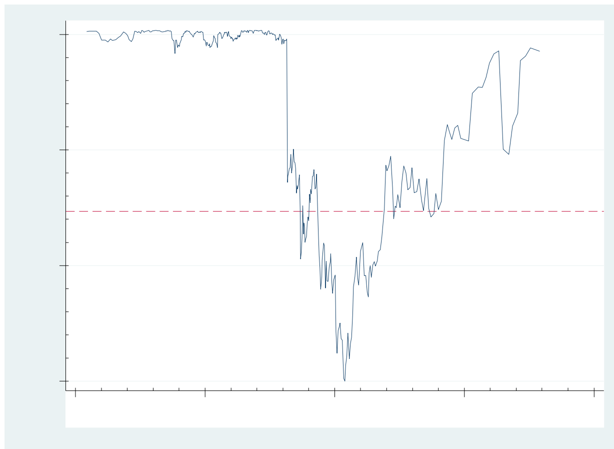

FIGURE 1 Estimation and Confidence Intervals for the First Threshold

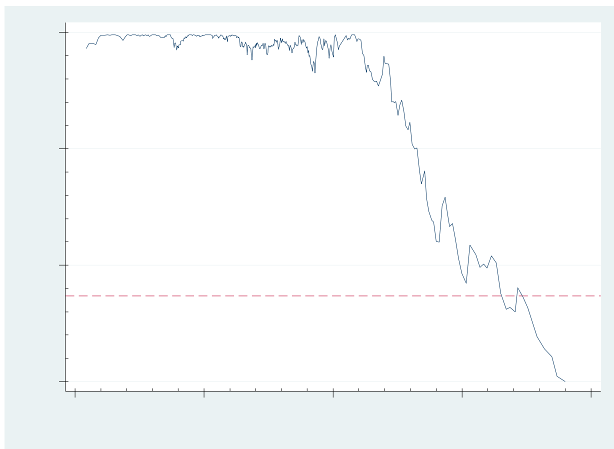

FIGURE 2 Estimation and confidence intervals for the second threshold

TABLE 3 Threshold estimation results

	Estimated value	95% Confidence interval
Threshold Value $\hat{\gamma}_1$	0.215	[0.147, 0.353]
Threshold Value $\hat{\gamma}_2$	0.560	[0.461, 0.560]

We can list companies in low growth (Grow $\leq$ 0.215), moderate growth (0.215<Grow $\leq$ 0.560) and high growth (Grow>0.560) three types according the two threshold values. And respectively do regression analysis according to the different growth interval. The parameter estimation, t value under constant variance (t_{OLS}) and t value under heteroscedastic variance (t_{White}) is in TABLE 4. As shown in Table 4, the result of four control variables used in this paper is: company size and corporate performance is negatively correlated, asset structure, share liquidity and profitability are positively related to corporate performance, this is consistent with previous scholars.

TABLE 4 The result of regression

Variable	Coefficient	t_{OLS}	t_{White}
Environment	0.006	0.99	0.68
Lnasset	-0.015	-12.61***	-7.39***
Tang	0.021	4.35***	3.05***
Tshr	0.036	14.77***	9.78***
Prof	0.439	76.22***	40.17***
Lev_a	0.009	3.72***	3.03***
Lev_b	-0.007	-2.69***	-1.76*
Lev_c	-0.025	-5.59***	3.03***
CONS	0.389	15.62***	9.19***

Note: (1) Lev_a, Lev_b and Lev_c is the debt ratio in low, moderate and high growth interval respectively; (2) t_{OLS} is t value under constant variance, t_{White} is t value under heteroscedastic variance; (3) R^2 of this model is 0.435, p value of F test is 0.000.

Our focus is the relationship between environmental management, capital structure and corporate performance. We find that the environment variable has positive effect on corporate performance, but not significant, which may be because the measurement of environmental management is not accurate. As Table 4 shows, the debt ratio is positively correlated with corporate performance in low growth companies, and the significant level is 1%; but for the moderate growth and high growth companies, debt ratio and corporate performance is significantly positive correlation. Our results is just opposite with Lian et al. (2006)'s, but consistent with McConnell and Jung's. This proves that Value Added is more suitable for corporate performance than traditional financial index. Classical capital structure theory could not be confirmed when taking profit as proxy variable of corporate performance, but the theory is confirmed when taking Value Added as proxy variable of corporate performance.

5 Conclusions

5.1 ENVIRONMENTAL MANAGEMENT CAN IMPROVE CORPORATE PERFORMANCE

As shown in Table 4, environmental management has a positive effect on corporate performance, although this effect is not significant. We argue that the reason of not significant may be the measurement of environmental management. Due to the data we extracted is according to companies' annual report and financial statements, we will not be able to collect the data if many companies conducted in environmental management work, but its annual report and financial statements were not mentioned. This may cause bias on measurement of environmental management, which lead coefficient is not significant. Recently environmental issues have become a major problem affecting corporate performance; the

leader of company should not only pay attention to the company's operating performance, but also should pay attention to environment protection, ecology, etc. Because it is also possible to improve corporate performance when the environment is protected.

5.2 THE IMPACT OF CAPITAL STRUCTURE ON CORPORATE PERFORMANCE CHANGES ALONG WITH THE GROWTH OF COMPANIES

As the results shown in TABLE 4, there is a significant positive correlation between debt ratio and corporate performance in low growth companies, but there is a significant negative correlation between debt ratio and corporate performance in moderate growth and high growth companies. This is consistent with the view proposed by McConnell:" The negative impact of debt on corporate performance will be quite intense in companies with more growth opportunities. On the contrary, the positive impact of debt on corporate performance is more significant in companies with fewer growth opportunities." This reflects that Value Added is more suitable for corporate performance than profits in China, because the result is consistent with classical capital structure theory when we use Value Added index to measure corporate performance.

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Authors

Jin Wang, born on January 15, 1985, Shenyang Liaoning China

Current position, grades: Doctoral student of School of Management
University studies: Hefei University of Technology
Scientific interest: Finance and Accounting, Value Added Accounting, and Decision Making Evaluation
Publications: 2
Experience: He received master degree of Accounting at Hefei University of Technology and now he is a doctoral student of School of Management, Hefei University of Technology.

Weidong Zhu, born on January 25, 1962, Xianju Zhejiang China

Current position, grades: professor at School of Economics
University studies: Hefei University of Technology
Scientific interest: Artificial Intelligence, Decision Support Systems, Accounting Information, and Decision Making.
Publications: Very Much
Experience: He received the Ph.D. degree in management science and engineering from Hefei University of Technology. Currently, he is a professor at Hefei University of Technology, School of Economics. And he is a doctoral supervisor in School of Management, Hefei University of Technology.