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Investigation of optimal capital structure in Malaysia: a panel threshold estimation

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Abstract

Purpose – The purpose of this paper is to investigate the effect of leverage on Malaysian listed firms' value and the optimal level of debt at which a firm could maximize its value.

Design/methodology/approach – The authors employ an advanced panel threshold regression estimation developed in 1999 by Hansen that will indicate whether there are positive and negative impacts of leverage on firm value. This estimation procedure has the advantage of quantifying the threshold level of debt as compared to the *ad hoc* classification procedure of splitting the sample.

Findings – The results show that debt is only pertinent to the firm value up to a threshold level of 64.33 per cent. Additional debt beyond the threshold level does not add to a firm's value. The appropriate level of debt should be applied, which would thus maximize the firm and stockholders' value.

Originality/value – To the best of the authors' knowledge, this is the first study to look at this issue for Malaysian listed firms. The findings from this paper may provide a critical analysis of the usage of debt in firms' capital structure. An excessive level of debt could lead to a debt overhang situation and insolvency at the microeconomic firm level; this could eventually could cause vulnerability in financial systems and thus lead to the financial catastrophes.

Keywords Capital structure, Malaysia, Gearing, Public companies, Panel threshold, Optimal leverage, Firm value

Paper type Research paper

1. Introduction

Literature has stressed that excessive leverage or uncontrolled usage of debt has resulted in a situation where East Asian companies become vulnerable to economic downturn, as seen in the effects of the Asian Economic Crisis in 1997 (Corsetti *et al.*, 1999). Domestic banks were burdened with high non-performing loans stemming from the debt-servicing problem of corporate sector and macroeconomic weaknesses (Krugman, 1999). An adequate monitoring environment on the level of debt at the firm level is much needed (Driffield and Pal, 2010). However, this issue has not been given much attention in the literature. Hence, the purpose of this study is to determine the optimal level of debt at which a firm could maximize its value and to examine the effect of leverage on Malaysian firms listed on the Main Market[1] of Bursa Malaysia during the period 2005-2009.

It is important to know the optimal debt ratio as it could help financial managers formulate an appropriate financing policy and take preventive measures to avoid a debt overhang situation. Furthermore, policymakers might need to adjust the existing debt-equity ratio of listed companies to protect investors' interest and well-being. This bridges the gap in the finance literature by providing evidence on how capital structure affects firm value in an emerging market such as Malaysia.

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In addition, the methodological issues associated with a short period sample in the previous studies can be resolved by the use of panel data. Previous studies using traditional linear models have proved a mixed relationship between leverage and firm value (Friend and Lang, 1988; Barton *et al.*, 1989; Petersen and Rajan, 1994; Molik, 2005; Berger and Bonaccorsi, 2006). Therefore, the usage of a non-linear panel threshold model developed by Hansen (1999) could possibly solve the puzzle of the firm's optimal debt level or the trade-off between the benefits of tax shields for debt financing. This would mean examining the optimal balance between the tax benefits of leverage and the disadvantages of costs incurred from additional debt that might reduce a firm's value. The use of an advanced panel estimation technique in this article improves the statistical power and efficiency of the econometric estimation. Thus, it reduces the parameter estimation bias associated with a short period sample and homogeneous assumption across the sample.

In order to examine our issues, we use Hansen's (1999) panel threshold regression method to quantify the regimes that would indicate the relationship between leverage and firm value. This estimation procedure has the advantage of quantifying the threshold level of debt rather than assuming the level of debt and hence using a subjective classification procedure to split the sample. The usage of a non-linear framework in determining the optimal level of debt has been utilized in the studies by Nieh *et al.* (2008), Lin and Chang (2009) and Cheng *et al.* (2010). Nieh *et al.* (2008) and Lin and Chang (2009) prove that debt ratios exceeding the threshold levels of 75.31 per cent and 40.15 per cent, respectively, would not increase a firm's value in Taiwan. However, there has been very little research on the appropriate level of debt among firms, especially in emerging economies such as Malaysia. In addition, differences in accounting procedures, unique diverse institutional structures particularly in tax rates, strength of creditors and equity rights, heterogeneity in the economic environment, and different legal systems could lead to diverse financing structures (Rajan and Zingales, 1995; Demirguc-Kunt and Maksimovic, 1996; Claessens *et al.*, 2000; Booth *et al.*, 2001; Alves and Ferreira, 2011).

There are a few studies in Malaysia that look into the effect of debt issuance and determinants of capital structure. This includes Krishnan and Moyer (1997) who examine 81 firms from Hong Kong, Malaysia, Singapore and Korea. They find capital structure is influenced by institutional or country set ups. Suto (2003) assesses 375 non-financial listed companies on the Kuala Lumpur Stock Exchange (presently known as Bursa Malaysia) from 1995 to 1999. He tests whether capital structure could be determined by governance variables such as dependency on banks, ethnic ownership structure and controlling ownership concentration. Suto suggests that ethnic ownership is not related to debt ratio, which implies that ethnic ownership could not discipline the management as compared to foreign ownership. Deesomsak *et al.* (2004) analyze the determinants of capital structure of firms in four countries namely Thailand, Malaysia, Singapore and Australia for the period 1993-2001. They show that there is a significant difference on the determinants of capital structure across countries since these countries have different set ups in term of financial markets, legal traditions, bankruptcy codes and corporate structure. In addition, they also find that financial crisis of 1997 has changed the determinants of firm's capital structure decision and the impact varies across the sample. However, none of these studies could suggest the optimal debt ratio. Collectively, the present study significantly contributes to the finance literature by

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upgrading the method, data and analysis as compared to the previous studies. To the best of our knowledge, there are no studies examining the optimal debt level in Malaysia using a non-linear panel threshold model.

Based on a panel sample consists of 467 firms with 2,335 observations, our results show an existence of a threshold debt ratio of 64.33 per cent for listed firms in Malaysia. This indicates that raising the level of debt beyond the threshold level should be avoided as it does not add value to a firm, and excessive usage of debt could lead a firm into a debt overhang situation.

The remainder of the article is organized as follows. Section 2 covers the literature on capital structure. Section 3 explains the data and econometric methodology. Section 4 presents and discusses the estimation and testing results. Finally, Section 5 concludes the article.

2. Review of the literature

Most of the previous theoretical and empirical studies have been undertaken following the seminal work by Modigliani and Miller (MM, 1958) who offered the capital structure irrelevance proposition. According to them, there is no optimal level of debt at which a firm could maximize its value. However, MM's perfect market assumption is contradictory and unrealistic in real-world practices. Subsequently, MM (1963) introduce the taxation effect where firms should take on a maximum amount of debt to increase a firm value through tax shield, but this could only be true at a lower financing rate (Miller, 1977). Based on the trade-off theory (Myers, 1984), firms could borrow up to the level that equates to the marginal costs and benefits of each additional unit of financing. As for the pecking order theory, Myers (1984) and Myers and Majluf (1984) hypothesize that there is no well-defined target debt ratio since asymmetric information problem exists between the firm and the financiers. Firms would normally use internal generated funds and, if additional funds are needed, they would then go for external financing that carries a higher rate.

A number of empirical works on leverage and firm value measured by performance have produced conflicting evidence. Kyerboach-Coleman (2007) finds that capital structure has a positive impact on the performance of microfinance institutions. In addition, Berger and Bonaccorsi (2006) prove that higher leverage could reduce the agency cost of outside equity and therefore increase a firm's value. Bos and Fetherston (1993), Petersen and Rajan (1994) and Molik (2005) also report a positive relationship between leverage and firm performance. Nevertheless, some studies also find a negative link between leverage and performance (Friend and Lang, 1988; Barton *et al.*, 1989; Booth *et al.*, 2001). While there is considerable empirical evidence to show the relationship between leverage and firm value, little work has been done on the evidence of non-linearity between leverage and firm value. The exceptions are the studies by Nieh *et al.* (2008), Lin and Chang (2009) and Cheng *et al.* (2010). Nieh *et al.* (2008) investigate the optimal level of debt ratio for listed electronic firms in Taiwan from 1999 to 2004. The study finds that the appropriate debt ratio for the listed electronic firms in Taiwan should not be more than 51.57 per cent or less than 12.37 per cent. Nieh *et al.* (2008) also prove that the optimal debt ratio should be within the range of 12.37-28.70 per cent. Using a larger set of sample with different industries in Taiwan, Lin and Chang (2009) prove that a debt ratio of more than 33 per cent would not increase the firm value in Taiwan. However, Cheng *et al.* (2010) suggest that there is a significant

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reduction of firm value in China if the debt ratio is more than 70 per cent. The different optimal levels of debt in previous empirical studies show that the right level of leverage depends on the development of institutional structure in the country as well as differences in tax policies and legal systems. This has been supported by the study by Wald (1999) who finds that firms' capital structure choices are different across the sample study countries (France, Germany, Japan, UK and the USA).

The contradictory results that appeared in the previous studies and literature, which devoted little attention to the empirical evidence in emerging markets in this particular topic, have inspired us to undertake this study. In summary, the objective of this study is to test whether the use of debt in the capital structure will affect firm value of Malaysian listed companies. This study applies the panel threshold regression model to assess whether there is an optimal debt level at which point threshold effect and asymmetrical relationship between the debt and firm value may exist. The findings from this study shed light on whether or not the trade-off theory holds with respect to an emerging economy such as Malaysia.

3. Data and econometric methodology

The sample consists of the listed firms on the Main Market of Bursa Malaysia from 2005 to 2009. As has been the case in previous studies, financial institutions and insurance firms are excluded since the accounting presentations of their financial statements are significantly different from those in the other sectors. In addition, firms with missing values during the period are also excluded from the sample. After the screening procedure, the final balance panel sample consists of 467 firms with 2,335 firm-year observations for each variable[2]. The data are drawn from the Datastream International.

Following Nieh *et al.* (2008) and Cheng *et al.* (2010), we use return on equity (ROE) to represent the firm value. There are two categories of explanatory variables in the panel threshold estimation of Hansen (1999). The debt ratio (ratio of total liabilities to total assets) is treated as the threshold variable to determine whether there is an asymmetric threshold effect of leverage on the firm value. The second category of variable is used to control for other factors namely sales to income growth, annual percentage change in total assets and market value of equity to book value of equity that could hypothetically influence the firm value. These proxies have been used by Mak and Kusnadi (2005) and Simpson and Gleason (1999). Sales to income and annual percentage change in total assets are employed to represent the growth of the firm; market value of equity to book value of equity will capture the potential risk of the firm's equity market.

First, since the data series are in panel form, we employ panel unit root tests to determine whether or not the variables in the model are stationary. Among the panel data unit root tests are Levin *et al.* (2002), Im *et al.* (2003), augmented Dickey-Fuller (ADF) (Dickey and Fuller, 1979) and PP-Fisher χ^2 (Phillips and Perron, 1988). The tests are testing the null hypothesis of unit root.

After confirming that all variables are stationary, the threshold autoregressive model developed by Hansen (1999) is estimated. The panel threshold autoregressive model takes the following form:

$$V_{it} = \begin{cases} \mu_i + \theta' h_{it} + \beta_1 d_{it} + \varepsilon_{it} & if \quad d_{it} \leq \gamma \\ \mu_i + \theta' h_{it} + \beta_2 d_{it} + \varepsilon_{it} & if \quad d_{it} > \gamma \end{cases}$$

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$$\theta = (\theta_1, \theta_2, \theta_3)'$$

$$h_{it} = (s_{it}, g_{it}, p_{it})'$$

V_{it} represents a firm value which is measured by ROE; d_{it} (debt ratio) is the explanatory variable and also the threshold variable. There are three control variables h_{it} which may affect firm value. θ_1, θ_2, θ_3 represent the coefficient estimates of the control variables; μ_i is the fixed effect that represents the heterogeneity of firms under different operating conditions; β_1 is the threshold coefficient when the threshold value is lower than γ; β_2 is the threshold coefficient when the threshold value is higher than γ; the errors ε_{it} are assumed to be independent and identically distributed (i.i.d.), with mean zero and finite variance $\sigma^2(\varepsilon_{it} \sim \text{i.i.d.}(0, \sigma^2))$; i represents different firms and t represents different periods.

Hansen (1999) utilizes the simulation likelihood ratio to test for the asymptotic distribution of threshold estimate. Using the two-stage ordinary least squares (OLS) method and minimizing the sum of squares of errors, $S_1(\gamma)$, the estimators of the threshold value and the residual variance $\hat{\gamma}$ and $\hat{\sigma}^2$ can be obtained[3]. In the testing procedure, the null hypothesis of no threshold effect is tested, $H_0 = \beta_1 = \beta_2$, using likelihood ratio test where $F_1 = (S_0 - S_1(\hat{\gamma}))/\hat{\sigma}^2$ where S_0 and $S_1(\hat{\gamma})$ are sums of squared error for null hypothesis and alternative hypothesis, respectively. Since the F_1 has non-standard distribution, Hansen (1996) shows that the bootstrap procedure will construct p-values and critical values that are asymptotically valid. When the alternative hypothesis holds, $H_0 = \beta_1 \neq \beta_2$, it shows that there is a threshold effect between debt ratio and firm value. Thus, asymptotic distribution of threshold estimate is tested with the null hypothesis, $H_0 = \gamma = \gamma_0$, using the likelihood ratio statistics test of $LR_1(\gamma) = (S_1(\gamma) - S_1(\hat{\gamma}))/\hat{\sigma}^2$. The asymptotic confidence interval is shown as $c(\beta) = -2\log\left(1 - \sqrt{1-\beta}\right)$ where for a given asymptotic level β, the null hypothesis of $\gamma = \gamma_0$ is rejected if $LR_1(\gamma)$ exceeds $c(\beta)$.

Furthermore, the model is modified if double thresholds exist. It can be shown as:

$$V_{it} = \begin{cases} \mu_i + \theta' h_{it} + \beta_1 d_{it} + \varepsilon_{it} & if \quad d_{it} \leq \gamma_1 \\ \mu_i + \theta' h_{it} + \beta_2 d_{it} + \varepsilon_{it} & if \quad d_{it} \ \gamma_1 < d_{it} \leq \gamma_2 \\ \mu_i + \theta' h_{it} + \beta_3 d_{it} + \varepsilon_{it} & if \ \gamma_2 < d_{it} \end{cases}$$

where the threshold value is $\gamma_1 < \gamma_2$. The model can be extended to multiple thresholds using the same process $(\gamma_1, \gamma_2, \gamma_3, \ldots \gamma_n)$.

4. Empirical results

Following Hansen's (1999) panel threshold regression estimation procedure, panel unit root tests are adopted to confirm that the variables are stationary at I(0) in order to avoid incorrect inferences if the condition is not met. Table I shows the panel unit root tests of Levin *et al.* (2002), Im *et al.* (2003), ADF (Dickey and Fuller, 1979) and PP-Fisher χ^2 (Phillips and Perron, 1988). We find that all the variables are stationary at I(0) or have stationary characteristics since nulls of the unit root are rejected. This allows further analysis of the panel threshold regression.

Variables	LLC	IPS	ADF-Fisher χ^2	PP-Fisher χ^2
ROE	−72.417 (0.000)	−14.240 (0.000)	1,308.32 (0.000)	1,584.18 (0.000)
Debt ratio	−225.757 (0.000)	−28.354 (0.000)	1,193.53 (0.000)	1,498.07 (0.000)
MVBV	−41.362 (0.000)	−11.266 (0.000)	1,217.32 (0.000)	1,567.03 (0.000)
Sales to income growth	−50.624 (0.000)	−17.842 (0.000)	1,473.40 (0.000)	1,709.85 (0.000)
Asset growth	−243.685 (0.000)	−32.211 (0.000)	1,590.42 (0.000)	1,880.25 (0.000)

Notes: The numbers in brackets represent *p*-values; the sample comprises of 467 Main Market firms listed in Bursa Malaysia from 2005 to 2009; ROE is the ratio of net income and total equity; debt ratio is the ratio of total liabilities to total assets; MVBV is ratio of market value of equity to book value of equity; sales to income growth is the annual percentage change of sales to net income; asset growth is the annual percentage change in total assets

Table I.
Panel unit root tests

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Table II presents the *F*-statistics for the single, double and triple thresholds effect together with their bootstrap *p*-values. We apply 100 bootstrap replications for each of the three bootstrap tests. The *F*-statistics of 68.07 shows that the single threshold is significant at 1 per cent level since it is higher than the critical value of 28.97. However, the tests for double threshold and triple threshold effects are insignificant with the bootstrap *p*-values of 0.220 and 0.760, respectively. Hence, we conclude that there is evidence of a single threshold effect of debt ratio on a firm's value for Malaysian listed firms. Henceforth, we focus on the single threshold model for the rest of the estimation results. It is shown that the estimated value of the single threshold is found to be 64.33 per cent thus splitting all observations into two regimes.

Table III presents the estimated coefficients based on OLS standard errors and White-corrected standard errors. We see that the debt ratio has a negative and significant effect on firm value. The coefficient of our primary interest are those regression coefficients, β_1, β_2, by each regime. The first regime's estimated coefficient is 0.2586,

Test for single threshold	
64.33	
F_1	68.074
p-value	0.000***
(10%, 5%, 1% critical values)	(16.11, 21.93, 28.97)
Test for double threshold	
60.12	
64.33	
F_2	9.005
p-value	0.220
(10%, 5%, 1% critical values)	(13.19, 21.24, 29.33)
Test for triple threshold	
23.14	
60.12	
64.33	
F_3	2.735
p-value	0.760
(10%, 5%, 1% critical values)	(8.422, 9.205, 19.891)

Notes: Significant at: *10, **5 and ***1 per cent; *F*-statistics and *p*-values are from repeating bootstrap procedures 100 times for each of the three bootstrap tests

Table II.
Test for threshold effects between debt ratio and ROE

Regressors	Coefficients	OLS SE	t_{ols}	White SE	t_{white}
Asset growth	0.00089	0.00037	2.4054**	0.00034	2.6176**
Sales to income growth	4.21×10^{-05}	0.000134	0.3151	0.000067	0.6312
MVBV	0.086145	0.009438	9.1275**	0.032175	2.6774**
Debt ratio	−0.006026	0.001690	3.5657**	0.001882	3.2019**
$\gamma_1 \leq 64.33\%$	0.2586	0.1093	2.3660**	0.1390	1.8604*
$\gamma_2 > 64.33\%$	0.0079	0.1113	0.0709	0.1265	0.0624

Notes: Significant at: *10, **5 and ***1 per cent; the sample comprises of 467 Main Market firms listed in Bursa Malaysia from 2005 to 2009; debt ratio is the ratio of total liabilities to total assets; MVBV is ratio of market value of equity to book value of equity; sales to income growth is the annual percentage change of sales to net income; asset growth is the annual percentage change in total assets; γ_1 refers to the first regime and γ_2 refers to the second regime; OLS SE and White SE are the conventional OLS standard errors (considering homoscedasticity) and White-corrected standard errors (considering heteroscedasticity)

Table III.
Estimated coefficients: single threshold model

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which is significant at 5 per cent. This implies that ROE increases by 0.2586 per cent with an increase of 1 per cent in debt ratio for firms that have a debt ratio of less than or equal to 64.33 per cent. In the second regime, if debt ratio is greater than 64.33 per cent, the estimated coefficient is 0.0079. Nevertheless, it is insignificant which implies that there is no relationship between debt ratio and firm value when debt ratio is greater than 64.33 per cent. The result is intuitive; suggesting that increasing debt ratio beyond the threshold value of more than 64.33 per cent would have no impact on the firm value and would just add to the existing level of the firm leverage. Our findings of single threshold effect of debt ratio on firm value corroborate the findings of Nieh *et al.* (2008) for electronic firms in Taiwan with 75.31 per cent as the threshold value. The control variables considered in this paper show that annual changes in total assets and market to book value are significantly and positively related to ROE or firm value. This implies that the greater the assets growth rate and the higher the market to book value ratio, the higher the firm's value. The estimated coefficients of total assets growth rate and the market to book value are 0.00089 and 0.0861, respectively. Although the sales to income growth variable shows that it positively influences firm value, it is not significant from both the results of both OLS standard errors and White-corrected standard errors.

5. Conclusions

The decision to allow for a certain level of leverage lies with the financial managers and this important decision may have an impact on the performance of the firm. The objective of this study is to investigate whether financial leverage has an effect on the firm value and whether there is an optimal level of debt at which a firm could maximize its value in the context of listed firms in Malaysia. An advanced panel threshold regression model by Hansen (1999) is employed to test the effect of debt ratio on the firm value among 467 Malaysian listed firms from 2005 to 2009. The estimations have shown that there is a single threshold effect between debt ratio and firm value. Thus, the threshold value split the observation into two regimes with only the coefficient of the lower regime being significant.

This article provides new evidence on the existence of threshold debt ratio of 64.33 per cent for listed firms in Malaysia. This result partly supports the trade-off theory

that firms seek a level of debt that balances the benefits of interest tax shield and the incremental cost of debt financing. However, this is only true when the debt ratio is equal or below the threshold level. Beyond this, the marginal costs might exceed the marginal benefits. In this case, the level of debt is 64.33 per cent. If a firm has a low debt ratio, the financial managers are advised to increase the respective debt level to 64.33 per cent. However, raising the level of debt beyond the threshold level should be avoided as it does not add value to the firm and there is a potential for the firm to find itself in financial distress should the cost exceed the benefits of debt financing. Other variables that significantly explain the performance in this study are assets growth rate and the market to book value ratio. Future work needs to be carried out to further clarify how ownership, firm-specific and market variables affect firms' value in order to confirm the present study.

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Notes

1. The Main Market of Bursa Malaysia comprises of listed firms from all sectors such as consumer products, industrial products, construction, trading and services, technology, finance, hotel, properties, plantation and mining. Companies that are listed in the Main Market are financially stable that have a proven track record.
2. Hansen (1999) panel threshold specifically designed for a balanced panel dataset. It is uncertain whether the asymptotic properties could be extended to unbalanced data.
3. The first stage estimates the sum of the square errors for any given threshold (γ). In the second stage, ($\hat{\gamma}$) is obtained by minimizing the sum of the squares.

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