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Non-Linear Impact of Growth Opportunity and Firm Size on the Capital Structure

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Abstracts

One of the focuses in capital structure studies is to identify economic forces influencing corporate capital structure. We investigated the non-linear effects of the firm-specific factors to the leverage of the firm of the US-listed firms. In the partial-adjusted model, growth opportunity and the size of the firm had non-linear effects on the leverage of the firm. Growth opportunity showed quadratic effects on leverage with a negative linear term but a positive quadratic term. It meant if the growth opportunity of a firm reached a certain level, fund providers can relatively detect it and subsequently causes a decrease in asymmetric information. This detection of ample growth opportunity will increase the accessibility of external funding. Firm size also exhibits quadratic effects on leverage with a positive linear term but a negative quadratic term. In other words, if the firm size as a proxy of various omitted variables was imminent, the financial market has been applied diversification discount that will decrease the accessibility of external funding.

Keywords: Firm Size; Growth Opportunity; Leverage; Non-linear

JEL Classification: G32, D92

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Abstrak

Salah satu fokus kajian dalam bidang struktur modal adalah mempelajari faktor-faktor yang memengaruhi struktur modal perusahaan. Kami meneliti efek non-linear *faktor spesifik perusahaan pada tingkat utang perusahaan-perusahaan publik di Amerika Serikat. Pada model* partial-adjusted*, kesempatan bertumbuh dan ukuran perusahaan menunjukkan efek* non-linear *pada tingkat utang perusahaan. Faktor kesempatan bertumbuh menunjukkan efek kuadratik positif dan pengaruh linear negatif pada tingkat utang. Hal ini menunjukan bahwa penyedia dana dapat mendeteksi penurunan tingkat asimetri informasi perusahaan ketika perusahaan telah mencapai tingkat kesempatan bertumbuh yang optimal. Penurunan asimetri informasi akan meningkatkan akses perusahaan pada pendanaan eksternal. Sebaliknya, ukuran perusahaan menunjukkan efek kuadratik negatif dan efek linear positif pada tingkat utang perusahaan. Hal ini berarti bahwa ketika ukuran perusahaan melewati titik optimalnya, pasar keuangan cenderung menerapkan diskon diversifikasi yang akan menurunkan aksesibilitas pendanaan eksternal. Ukuran perusahaan juga merupakan proksi berbagai variabel yang belum masuk dalam model.*

***Kata Kunci**: Ukuran Perusahaan; Kesempatan Bertumbuh; Tingkat Utang;* Non-Linear

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Identifying economic forces to determine capital structure is one of the major concerns in capital structure studies. Efforts to find the firm-specific determinants of financial policy have shown ample results (de Jong, Kabir, & Nguyen, 2008; Frank & Goyal, 2009). At the same time, a group of researchers tries to explain the dynamics of capital structures using various types of speed of adjustments models (Huang & Ritter, 2009; Hovakimian & Li, 2011, 2012; Faulkender et al., 2012; Castro, Tascón, & Amor-Tapia, 2015; Chang & Dasgupta, 2018; Gebauer, Setzer, & Westphal, 2018). Another strand of literature focuses on improving the prediction power of various types of leverage measures (Welch, 2011; Faulkender et al., 2012; Ferris et al., 2018), and the empirical studies tend to use longer periods (Graham, Leary, & Roberts, 2015).

However, the empirical models attempting to explain the variations of the capital structure still exhibit relatively low R^2 (Lemmon, Roberts, & Zender, 2008; Graham & Leary, 2011). Moreover, Hang et al. (2018) argue that the measurement of capital structure determinants is important. Standard proxies are effective in explaining the variations across industries. Nonetheless, Graham & Leary (2011) and Lemmon et al. (2008) show that the standard variables struggle to explain within-firm debt ratio variation in book (market) leverage. Ogden & Wu (2013) also argue that the test results of both static and dynamic trade-off theories suggest under-fitting of the essential and stable factors.

Lemmon et al. (2008) also opine that much of the leverage variation is time-invariant. They also argue that most of the well-known firm-specific determinants cannot explain the leverage variation since there are still some significant omitted components of leverage. They show that between firm variation is approximately 50 percent larger than within-firm variation (Lemmon et al., 2008; Graham & Leary, 2011) and the majority of the across-firm variation is within a given industry (Graham & Leary, 2011; Leary & Roberts, 2014). Using the past century dataset, Graham, Leary, & Roberts (2015) also verify that the firm-specific determinants have limited power to explain the observed capital structure. Hovakimian & Li (2011) use simulated data to show that the results of adding time-invariant components must be interpreted cautiously. Then, Lemmon et al. (2008) argue that a dynamic specification is necessary due to the presence of a significant unobserved transitory component.

On the other hand, Graham & Leary (2011) contend that the standard model's ineffectiveness to explain the leverage variation lies not in the models themselves, but the biased measurement of empirical leverage and proxies for firm characteristics. Ogden & Wu (2013) show a meaningful increase of R^2 by altering linear growth opportunities to a non-linear one. Graham & Leary (2011) also show an empirical non-linear pattern of size and leverage level. Besides the tax-based model, Kale, Noe, & Ramirez (1991) suggest that the relation between the volatility of the cash flow and leverage ratio might be non-monotonic. Their model has not yet captured the dynamic aspect of the target leverage.

Although research emphasizing the nonlinearity of each variable has been published, attempts to incorporate misspecification errors together with nonlinearity of each variable are still rare. Therefore, we try to analyze how much variation of existing models can be improved by applying nonlinearity of the variables with the target leverage as one of the independent variables.

Our main contribution is to identify new nonlinear effects on the capital structure. We find a quadratic function of growth opportunity and firm size to the capital structure. Variable of growth opportunity has a negative linear term and positive quadratic term. It means until a certain level of growth opportunity, the usage of external funding (debts) decreases. This result is identical with the study by Ogden & Wu (2013). They show that the function of

inverse exponential to the leverage ratio. However, our model can explain the influence of big growth opportunity on the firm's leverage. Fund providers can detect if the growth opportunity of a firm reaches a certain level, which subsequently reduces the asymmetric information and increases the accessibility of external funding.

The firm size shows a positive linear term and a negative quadratic term in their polynomial function. It means that until certain level firm size has positive effects with decreasing rate to the leverage of the firm. It happens because, with an increase of the firm size, accessibility of the firm to external funding tends to increase due to the decline of asymmetric information (Titman & Wessels, 1988; Graham & Leary, 2011). However, after a certain level, the increase of firm size may reduce the leverage. Graham & Leary (2011) already describe the phenomenon, but they have not explained the reasons. If we agree with Parsons & Titman (2008) that firm size is a proxy of omitted factors, and one of the main omitted factors is diversification discount (Schmid & Walter, 2008; Ammann, Hoechle, & Schmid, 2012), then fund providers may apply the sizable diversification discount. Hence, when the firm size is too big, the accessibility of external funding will decrease attributable to the diversification discount and agency costs increase.

The rest of the paper is organized as follows. In Section 2, we discuss the relevant literature review related to non-linear and linear determinants of the leverage of the firm. In Section 3, we describe the data and non-linear model. In Section 4, we present the empirical results. In Section 5 we discuss the findings. In Section 5, we run robustness tests based on size and book to market ratio, and in Section 6 we conclude the paper.

HYPOTHESES DEVELOPMENT

Numerous empirical papers have found the major firm-specific factors influencing the leverage of the firm. In this study, we just focus on several major firm-specific factors: (1) target leverage (Huang & Ritter, 2009; Faulkender et al., 2012; Chauhan & Huseynov, 2018); (2) growth opportunity (Wu & Yeung, 2012; Li & Mauer, 2016); (3) size (Bharath, Pasquariello, & Wu, 2009; Frank & Goyal, 2009; Graham & Leary, 2011); (4) profitability (Danis, Rettl, & Whited, 2014; Frank & Goyal, 2015); (5) volatility earnings (Kale, Noe, & Ramirez, 1991; Graham & Leary, 2011;); and (6) median industry leverage (de Jong, Kabir, & Nguyen, 2008; Frank & Goyal, 2009).

Firms with high growth opportunities will have high market values relative to book values. They likely have good prospects relative to the value of assets in place. Growth opportunities add to firm values but do not generate current taxable income immediately because firms can invest heavily in the future. Therefore, firms with growth opportunities may choose to maintain financial slack to fund these future investments (Parsons & Titman, 2008). Alternatively, firms with high market-to-book ratios are overvalued and have an incentive to use more equity financing (Frank & Goyal, 2009; Dudley, 2012).

Meanwhile, Wu & Yeung (2012) propose a non-linear relationship between growth opportunities and leverage. They identify two types of asymmetric information, asset-in-place and growth opportunities. They say that if asymmetric information arises more from assets-in-place than from growth opportunities, such firms are more debt financing oriented. In contrast, if asymmetric information arises more from growth opportunities than from asset-in-place, these firms are more equity financing oriented.

Ogden & Wu (2013) also suggest a convex relationship between growth opportunities and leverage of the firm based on benefits versus costs of debt with the change of the growth opportunities. They document an empirically non-linear relation-

ship between growth opportunities and leverage of the firm. If the growth opportunity of a firm is substantial enough, it reduces the asymmetric information that will increase accessibility and the possibility of external funding from financial institutions and the capital market. Graham & Leary (2011) also reveal a non-linear, quadratic relation where market-to-book ratio measures the growth opportunity of a firm. Therefore, the first hypothesis in this study is:

H_1: growth opportunity shows a negative linear impact and a positive curvilinear impact on the leverage of the firm

Many studies find the firm size to be positively related to leverage (de Jong, Kabir, & Nguyen, 2008; Graham & Leary, 2011; Dudley, 2012) because the fixed costs of refinancing are proportionally costlier for smaller firms. Firm size may also be inversely related to the costs a firm incurring financial distress or bankruptcy. Parsons & Titman (2008) mention that there is no "pure" size effect at all, but firm size is a proxy of some omitted factors that influence borrowing costs like the level of diversification. Because larger firms tend to be more diversified, it is likely that they have lower volatility in profits, cash flows, and firm values which will lower the probability of costly bankruptcy or financial distress and increase debt capacities.

However, Schmid & Walter (2008) report a sizable diversification discount. They mention that there is a trade-off between benefits and the costs related to the diversification level. Thus if the level of diversification is higher than optimal, diversification discount tends to decrease the value of the firm. This diversification discount can cause nonlinear relation between firm size and leverage level. Graham & Leary (2011) show an empirical non-linear pattern of size and leverage level over the period 1974-2009. Therefore, the second hypothesis in this study is:

H_2: firm size exhibits a positive linear impact and a negative curvilinear impact on the leverage of the firm

Previous studies have documented some factors affecting the firm capital structure. In this study, we employ volatility of earnings, profitability, asset tangibility, and the median of the industry leverage as the control variables.

Majority of the existing empirical work assumes that the relation between earnings' volatility and the leverage is monotonic (Wald, 1999; Faulkender et al., 2012). However, the tax-based model of Kale, Noe, & Ramirez (1991) suggest that the relation between the volatility of cash flow and leverage ratio may be non-monotonic. Kale, Noe, & Ramirez (1991) show that the value-maximizing firm minimizes the value of the government's option portfolio which is long in the corporate tax option and short in the personal tax option for creditors of the firm. Then cash flow volatility will have U-shaped effects on the debt level of the firm (Graham & Leary, 2011). Earnings volatility is measured by the standard deviation of earnings before interest and tax to total assets (at least 3 years) in 10 years.

Firms prefer raising capital from internal to external because of the costs issuing new equity and asymmetric information (Myers & Majluf, 1984). The profitability of a firm that increases the amount of retained earnings may decrease the usage of debts. This negative relation between profitability and leverage is documented in (de Jong, Verbeek, & Verwijmeren, 2011; Danis, Rettl, & Whited, 2014) and has been confirmed in numerous subsequent studies. The profitability of the firm is measured by earnings before interest and tax to total assets.

It is commonly said that tangible assets preserve their value better during a default, and as such, increase the recovery rates of creditors (Frank & Goyal, 2009). The closely related idea is that the costs of redeploying tangible assets are lower than for intangible assets (Campello & Giambona, 2013).

Graham & Leary (2011) show that higher PPE, however, is associated with higher leverage, but the PPE effect is non-monotonic. It is not clear also whether all forms of PPE are equally valuable as collaterals (Benmelech & Bergman, 2009; Campello & Giambona, 2013). They show that the portion of total re-deployable tangible assets instead of the total tangible assets affect the amount and structure of debt that can be borrowed. Benmelech & Bergman (2009) also find that collateral characteristics affect debt maturity. Firms with more saleable assets (the combination of asset deplorability and asset liquidity) may use longer-term debt. Campello & Giambona (2013) show that land and buildings, which are more deployable than other forms of PPE, support greater debt usage of the firm. PPE to total assets measures asset tangibility of the firm.

There are substantial cross-industry differences in leverage ratio dispersion (Almazan & Molina, 2005). Almazan & Molina (2005) show that the nature of the assets within an industry determines the level and dispersal of capital structure for that industry. Leary & Roberts (2014) show that peer effects for capital structure determination arise from a learning motive and are partially driven by a response to their peers. Peer effects of capital structure are stronger for smaller, less successful firms compared to the larger, more successful peers.

However, some research includes industry effects on their model to mitigate the omitted effect which may be correlated with one or more observable proxies, leading to biased coefficient estimates (Parsons & Titman, 2008; Ogden & Wu, 2013). Using a non-linear relationship of growth opportunities to the leverage, Ogden & Wu (2013) show that the explanatory power of industry median decreases significantly. Industry median leverage is measured by total debt to total assets based on 48 industrial classifications of Fama & French (2007).

METHODS

The data are obtained from COMPUSTAT and Center for Research in Security Prices (CRSP) covering the period from 1984-2011. Financial and utility industries are excluded from the sample because the former has a different financial structure, and the latter is under government regulation. We exclude the firms with zero or total negative assets from the data. All variables are winsorized at the 1st and 99th percentile to control for the outliers' effect.

We apply a target adjustment model in the line of (Huang & Ritter, 2009; Faulkender et al., 2012) to get the target leverage ($\widehat{LEV}_{i,t-1}$).

$$LEV_{it} = f(\widehat{LEV}_{it-1}, MB_{it}, MB_{it}^2, SIZE_{it}, SIZE_{it}^2, VOL_{it}, VOL_{it}^2, PROF_{it}, TANG_{it}, IN\_LEV_{it}) \quad (1)$$

Following Huang & Ritter (2009), we use growth opportunity (MB), size of the firm (SIZE), profitability (PROF), asset tangibility (TANG), and volatility of the earnings (VOL) as the determinants.

Titman & Wessels (1988) note that even if firms choose completely random "target" book leverages, a spurious statistical relation may arise between market leverage and variables similarly scaled by market value. When market values increase, both the right- and left-hand side variables are simultaneously affected, albeit by reasons that have little to do with the spirit of the test. For this reason, many researchers prefer to scale debt by the book value of assets instead. Managers appear to be concerned mostly with the book value of leverage, as indicated by survey evidence Graham & Harvey (2001). To reduce the measurement errors, we measure the leverage by total debt to total assets (Titman & Wessels, 1988).

RESULTS

Nonlinear Effects of Firm-Specific Factors on Leverage

Table 1 reports the descriptive statistics of the main variables. The sample indicates a mean leverage ratio of 29.4 percent which is a little higher than

the median. Industry leverage shows a little lower mean, but a higher median. The mean of earnings' volatility (VOL) is 0.06725 while the standard deviation is 0.58363. The high standard deviation shows a high variation of earnings volatility between firms. It can also be seen in the Q1, median, and Q3 where the Q3 (75 percentile) still smaller than mean. In another word, the observations that are bigger than 75 percentiles dominate the mean and standard deviation of earnings volatility.

Table 2 reports non-linear effects of the variable growth opportunity (MB) and the size of the firm (SIZE) on, and volatility of earnings (VOL). Effects of target leverage from (1) to (10) equation to current leverage are consistently significant at 1 percent, and there is no meaningful change of speed of adjustment. These results are consistent with other dynamic model results even if the magnitude of the speed of adjustment is different (Huang & Ritter, 2009).

Second equation of Table 2 indicates the non-linear effects of the MB on leverage. As MB increases, the leverage decreases until certain level with decreasing scale. After a certain level, with the increase of MB, the leverage of the firm also increases. This non-linear association between leverage and growth opportunity is a different pattern from Graham & Leary (2011) and Ogden & Wu (2013). They show a negative and convex association between growth opportunity and leverage.

Third, sixth, and ninth equations of Table 2 confirm non-linear, more specifically quadratic influence of growth opportunity and size on the leverage with well-known firm-specific determinants of capital structure. The profitability and asset tangibility variables show consistent evidence with much previous research (de Jong, Kabir, & Nguyen, 2008; Frank & Goyal, 2009). Growth opportunity has quadratic effects on leverage with a negative coefficient of the linear term and positive coefficient of the quadratic term. In contrast, size exhibits a positive coefficient of the linear term and a negative coefficient of the quadratic term.

Non-Linear Effects of the Firm-Specific Factors to Leverage in Financially Constrained and Non-Financially Constrained Firms

Previous studies have suggested various proxies to identify financially constrained firms even if there is no general agreement, dividend payout ratio (Almeida, Campello, & Weisbach, 2004), firm size, and KZ index based on qualitative information from financial reports (Hadlock & Pierce, 2016) as proxies of financially constrained and non-financially constrained firms. We use annual payout ratio as a proxy to separate financially constrained firms from the non-constrained firms.

Equations of (1), (3), (5), (7), and (9) of Table 3 indicate non-linear effects of growth opportunity

Table 1. Descriptive Statistics of the Variables (N= 25.603 firm-year)

Variable	Mean	Std. Dev.	Q1	Median	Q3
LEV	0.29419	0.27703	0.03724	0.25438	0.45165
SIZE	6.41461	2.16045	4.89549	6.37860	7.88586
PROF	0.06418	0.15853	0.03514	0.08617	0.13884
MB	2.98052	3.73325	1.28193	2.10924	3.53049
TANG	0.12730	0.16703	0.00165	0.05254	0.19712
VOL	0.06725	0.58362	0.01965	0.03681	0.06649
IN_LEV	0.28572	0.15418	0.15500	0.30600	0.40000

LEV is measured by total debts to total assets; Size is measured by log (total assets); PROF is measured by earnings before interest and tax to total assets; MB is measured by market value of the equity to book value of equity; TANG is measured by property, plant, and equipment (PPE) to total assets; VOL is measured by standard deviation of the earnings before interest and tax to total assets in 10 years; IN_LEV is measured based on 48 Fama-French industrial classification.

and firm size to the leverage in financially constrained (FC) firms. Other equations of Table 3 show non-linear effects of growth opportunity and firm size to the leverage in non-financially constrained (NFC) firms. The coefficient of equation (9) and (10) of Table 3 indicate that growth opportunity and firm size from both financially constrained and non-financially constrained firms still have the same non-linear effects on the leverage of the firm.

We then focus on other pairs of equations which are (3) & (4), and (9) & (10). If we compare the coefficients of primary and quadratic terms from (3) & (4) and (9) & (10), they are almost identical. We expect growth opportunity for the financially constrained firm has more negative effects on the leverage of the firm. It could happen because financially constrained firms have more asymmetric information than non-financially constrained. However, these results are consistent with our main findings. We can argue that the financial condition of the firm does not change the non-linear effects of the growth opportunity to the leverage of the firm.

Equations (7) & (8) and (9) & (10) of Table 3 show almost identical non-linear effects of the size of the firm on leverage. These findings also support our arguments that the leverage of the firm increases

Table 2. Non-linear Effects of MB and SIZE to the Firm Leverage

LEV is measured by total debts to total assets; Size is measured by log(total assets); PROF is measured by earnings before interest and tax to total assets; MB is measured by the market value of the equity to book value of equity; TANG is measured by property, plant, and equipment to total assets; VOL is measured by standard deviation of the earnings before interest and tax to total assets in 10 years; IN_LEV is measured based on 48 Fama-French industrial classification. Each equation is estimated with two-stage GMM method in a dynamic panel model (N=25,603 firm-year). We estimate using xtdpdsys with the options of two-stage and vce(robust) to reduce the heteroskedastic problems. However, xtdpdsys cannot provide Sargan over-identification test results. Because Parente & Silva (2012) and Deaton (2010) mention the limitations of over-identification in instrument variables' test, we then focus on the heteroskedastic problem and autoregressive problem. We report only Arellano Bond test AR(2) results.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LEVt-1	0.815***	0.782***	0.785***	0.834***	0.827***	0.753***	0.814***	0.814***	0.723***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	-0.00092	-0.0144***	-0.0152***			-0.0153***			-0.0153***
	(0.428)	(0.000)	(0.000)			(0.000)			(0.000)
MBSQ		0.00077***	0.00080***			0.00081***			0.00081***
		(0.000)	(0.000)			(0.000)			(0.000)
SIZE		0.0211***	0.0188	0.0597***	0.121***				0.121***
		(0.000)	(0.000)	(0.000)	(0.000)				(0.000)
SIZESQ					-0.00306***	-0.00756***			-0.00775***
					(0.009)	(0.000)			(0.000)
VOL			-0.00311			0.00409	0.00220	-0.00921	-0.00640
			(0.649)			(0.396)	(0.479)	(0.565)	(0.700)
VOLSQ								0.000283	0.000268
								(0.414)	(0.453)
PROF			-0.138***			-0.203***			-0.203***
			(0.000)			(0.000)			(0.000)
TANG			0.0631			0.0847***			0.0838***
			(0.051)			(0.008)			(0.000)
IN_LEV			0.0594*			0.0490*			0.0491*
			(0.016)			(0.038)			(0.038)
_cons	0.0496***	0.0829***	-0.0603***	-0.1771***	-0.197***	-0.324***	0.0471***	0.0477***	-0.345***
	(0.000)	(0.000)	(0.072)	(0.002)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Wald chi2	1513.4	1976.6	1916.7	1342.6	1349.5	1908.4	1482.6	1491.7	1937.8
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Arellano Bond AR(2)	0.6007	0.6900	0.6544	0.6158	0.5868	0.6100	0.6096	0.6176	0.6202

p-values in parentheses * p<0.05, ** p<0.01, *** p<0.001

until the average size of the firm, but if the size of the firm increases more than the average, firm size tends to decrease the leverage because of the diversification discount effect (Schmid & Walter, 2008; Ammann, Hoechle, & Schmid, 2012).

DISCUSSION

Our empirical results suggest that growth opportunity exhibit curvilinear impact on the firm capital structure. The linear (quadratic) term of the growth opportunity demonstrates a negative (positive) effect on the capital structure. It means that growth opportunity tends to positively impact leverage with a decreasing rate until the firm reaches its optimum capital structure level. When firms increase their leverage, the asymmetric information will also tend to increase. When the asymmetric information increases below its optimum level, it will send a negative signal to the financial market. Hence, the market may reduce the firm external funding. However, if the level of growth opportunity is substantial (beyond its optimum level), then the financial market will learn more about the firm which in turn will reduce the asymmetric information. Henceforth, the growth opportunity will have a positive effect on leverage with an increasing rate.

Wu & Yeung (2012) also report a non-linear association between growth opportunity and leverage without specific form. Perhaps this result is related to the financial market cognizance of certain firms' significant growth opportunity. High growth opportunity can be regarded as risk as well as good investment opportunities to get stable cash inflows.

Table 3. Non-Linear Effects to Financially Constrained (FC) and Non-Financially Constrained (NFC) Firms

LEV is measured by total debts to total assets; Size is measured by log(total assets); PROF is measured by earnings before interest and tax to total assets; MB is measured by the market value of the equity to book value of equity; TANG is measured by property, plant, and equipment to total assets; VOL is measured by standard deviation of the earnings before interest and tax to total assets in 10 years; IN_LEV is measured based on 48 Fama-French industrial classification. Equations (1), (3),(5),(7) and (9) are estimated based on non-divided paying firms (FC), while other equations are estimated based dividend-paying firms (NFC). Each equation is estimated with two-stage GMM method in a dynamic panel model (N=25,603 firm-year).

	FC	NFC	FC	NFC	FC	NFC	FC	NFC	FC	NFC
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LEVt-1	0.765***	0.806***	0.721***	0.768***	0.780***	0.830***	0.774***	0.819***	0.735***	0.713***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	-0.00112	-0.00256***	-0.0165***	-0.0174***					-0.0170***	-0.0160***
	(0.414)	(0.097)	(0.000)	(0.000)					(0.000)	(0.000)
MBSQ			0.00087***	0.00086***					0.0009***	0.0009***
			(0.000)	(0.000)					(0.000)	(0.000)
SIZE					0.0227***	0.0225***	0.0555***	0.0873***	0.150***	0.128***
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SIZESQ							-0.00253	-0.00488*	-0.0096***	-0.0079***
							(0.141)	(0.011)	(0.000)	(0.000)
PROF									-0.241***	-0.239***
									(0.000)	(0.000)
TANG									0.0828*	0.0917*
									(0.037)	(0.043)
VOL									0.0310	0.00433
									(0.526)	(0.267)
In_LEV									0.107**	0.0312
									(0.005)	(0.419)
_cons	0.0619***	0.0565***	0.102***	0.0926***	-0.0878***	-0.101*	-0.181*	-0.299***	-0.354***	-0.439***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.010)	(0.017)	(0.001)	(0.000)	(0.000)
N	12462	12741	12462	12741	12462	12741	12462	12741	12462	12741
Wald chi2	758.3	863.1	972.7	1436.3	720.1	673.6	728.2	711.0	1569.2	1121.4
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Arellano Bond AR(2)	0.5245	0.8026	0.4285	0.8149	0.5196	0.9518	0.5020	0.9208	0.3775	0.8925

p-values in parentheses * p<0.05, ** p<0.01, *** p<0.001

In other words, the firm with big enough growth opportunity can access the financial market with reduced risk. Then, the leverage of the firm can increase if and only if the firm's growth opportunity is increasing to more than a certain level.

Different from growth opportunity, we find firm size also exhibits quadratic effects on the leverage of the firm, but with a different pattern. Firm size shows a positive (negative) linear (quadratic) impact on leverage. The fourth equation of Table 2 indicates a linear impact of the firm size on the leverage. This result is consistent with almost all previous empirical evidence (de Jong, Kabir, & Nguyen, 2008; Frank & Goyal, 2009). The fifth equation of Table 2 shows a quadratic relation between the firm size and leverage. This result is consistent with Graham & Leary (2011). They show that when the size increases below the mean, then the leverage increases as well. When the size increases more than the mean, then the leverage decreases. This quadratic relationship between size and leverage can be explained if these two conditions are satisfied. First, there is no "pure" size effect at all, but firm size is a proxy of some of the omitted factors influencing borrowing costs Parsons & Titman (2007). Secondly, one of the dominant omitted variables is the diversification level of the firm. If the level of diversification is higher than optimal, then the diversification discount tends to decrease the value of the firm (Schmid & Walter, 2008; Ammann, Hoechle, & Schmid, 2012). Financial market can calculate the real value of the firm after sizable discount because of diversification. Hence, the quadratic relationship between the size of the firm and leverage exists.

Table 4. Robustness Test of Non-linear Effects on Small vs. Big Firms

LEV is measured by total debts to total assets; Size is measured by log(total assets); PROF is measured by earnings before interest and tax to total assets; MB is measured by the market value of the equity to book value of equity; TANG is measured by property, plant, and equipment to total assets; VOL is measured by standard deviation of the earnings before interest and tax to total assets in 10 years; IN_LEV is measured based on 48 Fama-French industrial classification. Equations of (1), (3),(5),(7) and (9) are estimated using small firms and others are big firms. Each equation is estimated with two-stage GMM method in a dynamic panel model (N=25,603 firm-year).

	SMALL	BIG	SMALL	BIG	SMALL	BIG	SMALL	BIG	SMALL	BIG
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LEVt-1	0.763***	0.807***	0.721***	0.769***	0.779***	0.829***	0.778***	0.820***	0.714***	0.735***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	-0.00118	-0.00265	-0.0160***	-0.0177***					-0.0159***	-0.0172***
	(0.356)	(0.091)	(0.000)	(0.000)					(0.000)	(0.000)
MBSQ			0.00084***	0.00086***					0.0009***	0.0009***
			(0.000)	(0.000)					(0.000)	(0.000)
SIZE					0.0230***	0.0230***	0.0522*	0.0843***	0.124***	0.150***
					(0.000)	(0.000)	(0.022)	(0.001)	(0.000)	(0.000)
SIZESQ							-0.00224	-0.00462*	-0.0076***	-0.0096***
							(0.176)	(0.015)	(0.000)	(0.000)
PROF									-0.230***	-0.247***
									(0.000)	(0.000)
TANG									0.0918*	0.0941*
									(0.043)	(0.034)
VOL									0.00429	0.0354
									(0.269)	0.475)
IN_LEV									0.0330	0.105**
									(0.378)	(0.007)
_cons	0.0623***	0.0564***	0.100***	0.093***	-0.0896**	-0.0104*	-0.174*	-0.284***	-0.356***	-0.449***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.009)	(0.000)	(0.020)	(0.001)	(0.000)	(0.000)
N	12579	12624	12579	12624	12579	12624	12579	12624	12579	12624
Wald chi2	747.9	862.2	946.8	1436.8	699.1	658.9	749.1	700.5	1107.5	1560.2
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Arellano Bond AR(2)	0.5272	0.8187	0.4348	0.9494	0.5225	0.9494	0.5088	0.9208	0.8586	0.8969

p-values in parentheses * p<0.05, ** p<0.01, *** p<0.001

The impact of growth opportunity and size on the capital structure is robust for dividend-paying firms and non-dividend paying firms. In the next section, we provide further robustness tests based on different firm sizes and book to market ratios.

Further Robustness Tests

To check the sensitivity of our empirical model, we use two types of robustness tests. Firstly, we divide firms based on firm size. Firm size can be regarded as a proxy for the financial constraints of the firm (Almeida, Campello, & Weisbach, 2004). Simultaneously firm size can represent other determinants of capital structure (Parsons & Titman, 2008). Equations of (1), (3), (5), (7), and (9) of Table 4 indicate non-linear effects of variable growth opportunity and firm size to the leverage of small firms. Other equations of Table 4 show non-linear effects of variable growth opportunities and firm size of big firms to the leverage. We cannot find any different evidence with our main findings. Growth opportunity (firm size) has consistently unveiled quadratic effects on the leverage of the firm with a negative (positive) linear term and positive (negative) quadratic term.

Secondly, we run an alternative robustness check based on the book to market ratio. (Fama & French, 1993) mention that book to market ratio is related to the bankruptcy probability. It is reasonable to think that the growth opportunity of a high book to the market firm is undervalued compared to a low book to the market firm. A firm with low book to market has higher potential bankruptcy

Table 5. Robustness Test of Non-linear Effects on Firms with High Market to Book Ratio vs. Low Market to Book Ratio

LEV is measured by total debts to total assets; Size is measured by log(total assets); PROF is measured by earnings before interest and tax to total assets; MB is measured by the market value of the equity to book value of equity; TANG is measured by property, plant, and equipment to total assets; VOL is measured by standard deviation of the earnings before interest and tax to total assets in 10 years; IN_LEV is measured based on 39 Fama-French industrial classification. Equations of (1), (3),(5),(7) and (9) are estimated using firms with a high book to market ratio and others are firms with low book to market ratio. Each equation is estimated with two-stage GMM method in a dynamic panel model (N=25,603 firm-year).

	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW	HIGH	LOW
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
LEVt-1	0.755***	0.811***	0.710***	0.772***	0.774***	0.837***	0.773***	0.828***	0.698***	0.742***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
MB	-0.00147*	-0.00187***	-0.0172***	-0.0172***					-0.0166***	-0.0170***
	(0.012)	(0.000)	(0.000)	(0.000)					(0.000)	(0.000)
MBSQ			0.000888***	0.000874***					0.000898***	0.000876***
			(0.000)	(0.000)					(0.000)	(0.000)
SIZE					0.0230***	0.0227***	0.0617***	0.0709***	0.143***	0.143***
					(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
SIZESQ							-0.00291**	-0.00366***	-0.00901***	-0.00893***
							(0.006)	(0.000)	(0.000)	(0.000)
PROF									-0.256***	-0.227***
									(0.000)	(0.000)
TANG									0.0994*	0.0657
									(0.024)	(0.087)
VOL									0.00406	0.0151
									(0.354)	(0.730)
IN_LEV									0.0415	0.102**
									(0.297)	(0.005)
_cons	0.0657***	0.0526***	0.106***	0.089***	-0.0887***	-0.0950***	-0.203*	-0.243***	-0.407***	-0.431***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.046)	(0.000)	(0.000)	(0.000)
N	12579	12624	12579	12624	12579	12624	12579	12624	12579	12624
Wald chi2	665.4	972.2	910.6	1445.6	4159.9	679.8	668.7	831.9	1028.4	1561.3
p-value	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Arellano Bond AR(2)	0.3599	0.9169	0.2810	0.6077	0.3564	0.8591	0.3436	0.8827	0.2532	0.7261

p-values in parentheses * p<0.05, ** p<0.01, *** p<0.001

costs. If then effects of the growth opportunity on the leverage are different in between the two groups, then firms with a higher book to market ratio receive a deeper discount than firms with a lower book to market ratio.

Equations (1), (3), (5), (7), and (9) of Table 5 indicate non-linear effects of growth opportunity and/or firm size to the leverage of firms with a high book to market ratios. Other equations of Table 5 show non-linear effects of growth opportunity and size on the leverage of firms with low book to market ratios. We do not find any different evidences with our main findings. Growth opportunity (firm size) has consistently displayed quadratic effects on the leverage of the firm with a negative (positive) linear term and positive (negative) quadratic term.

CONCLUSION AND SUGGESTIONS

Conclusion

We use total debts to total assets as a proxy for the capital structure to reduce the measurement errors (Titman & Wessels, 1988). We focus on the non-linear effects of growth opportunity and firm size on the capital structure. Based on a panel dataset of non-financial and non-utilities of the US-listed firms in 1984-2011, we learn that growth opportunity shows quadratic effects on the leverage of the firm. The linear (quadratic) term of the growth opportunity shows a negative (positive) effect on the leverage. It means that growth opportunity tends to positively impact leverage with a decreasing rate until the firm reaches its maximum leverage level. The increase of leverage is in line with the increase of growth opportunity and firm value along with the increase of asymmetric information.

The increase of asymmetric information will tend to reduce the firm external funding. However, if the level of growth opportunity is substantial, then the financial market will realize its potentials and reduce the asymmetric information. Henceforth, the growth opportunity will have a positive effect on leverage with an increasing rate because the firm can increase its accessibility to external funding.

Firm size also displays quadratic effects on the leverage of the firm, but with a different pattern. Firm size shows a positive (negative) linear (quadratic) effect on leverage. It means that until a certain level, firm size has a positive effect on the leverage of the firm with a decreasing rate. It happens because the increase in firm size will also increase the accessibility of external funding due to the reduction of asymmetric information. In contrast, if the firm size is too big, the firm size will negatively affect the leverage of the firm with an increasing rate. If the firm size is too big, the financial market will apply the diversification discount on the firm due to the agency cost increase.

The results are robust for firms with financial constraints and without financial constraints. The outcomes are also robust for small and big firms, as well as for firms with high and low market to book ratios.

Suggestions

The results suggest that the companies' management should strive to maintain the companies' growth. The financial market appreciates companies with ample growth opportunities by giving them better financing terms. On the other hand, companies should maintain their business focus because the financial market tends to apply diversification discount to highly diversified companies.

One of the limitations of this study is that we only focus on the internal firm factors that may impact the firm's capital structure. Further studies should attempt to find additional internal and external factors that may impact the capital structure of the firm. One of the external factors that may impact the behavior of the firm is the macroeconomic conditions in which it operates, e.g., crisis vs. non-crisis.

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