THE IMPACT OF CAPITAL STRUCTURE ON PROFITABILITY OF LISTED FIRMS IN VIETNAM: LINEAR OR NON-LINEAR RELATIONSHIPS?

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Abstract: ***This paper contributes to the existing literature by developing a model examining both linear and nonlinear relationships while simultaneously evaluating the impact of short-term and long-term debt on firm profitability. To the best of our knowledge, this study is the first of its kind. Using data from 438 non-financial firms listed on the Hanoi Stock Exchange and Ho Chi Minh Stock Exchange from 2010 to 2018, our findings reveal that the impact of short-term debt and long-term debt ratios on Return on Assets (ROA) is linear and negative. Short-term debt's impact on Return on Equity (ROE) is nonlinear, displaying an inverted U-shape, while long-term debt's impact on ROE follows a nonlinear U-shape. These results enable a comprehensive analysis of the trade-off between these two types of debt. Furthermore, to highlight our contribution, we compare models that jointly and separately examine short-term and long-term debt, showing that omitting a debt component may bias the estimates and undermine the economic validity of the results.***

• Keywords: *capital structure, firm profitability, Vietnam-listed firms.*

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1. Introduction

There are various determinants of firm profitability, among which capital structure plays a significant role (Salim and Yadav, 2012). Inefficient use of debt may generate adverse leverage effects, leading to a negative relationship between capital structure and profitability (Salim and Yadav, 2012; Sheikh and Wang, 2013). In contrast, when borrowed funds are used effectively, firms can benefit from tax shields, resulting in a positive association between capital structure and profitability (Kyereboah and Coleman, 2007; Zeitun and Tian, 2014).

This study follows the research stream on the nonlinear impact of capital structure on firm profitability (Margaritis and Psillaki, 2010; Ghosh, 2017). Prior studies typically include the squared debt ratio in regression models to capture U-shaped or inverted U-shaped relationships, implying that debt is beneficial up to an optimal level but becomes detrimental beyond that point. If the squared term is insignificant, the relationship is considered linear.

However, existing studies mainly rely on the aggregate debt ratio (total debt over total assets), which combines short-term and long-term debt and may lead to biased estimates. To date, no study has simultaneously incorporated both squared short-term and squared long-term debt ratios in the same model. Therefore, this study extends prior research (Nieh et al., 2008; Margaritis and Psillaki, 2010; Ghosh, 2017) by decomposing the squared debt ratio into its short-term and long-term components.

This paper examines the nonlinear impact of capital structure on firm profitability using a sample of 438 non-financial firms listed on the Hanoi and Ho Chi Minh Stock Exchanges over 2010–2018. Capital structure is proxied by short-term and long-term debt ratios, while profitability is measured by return on assets (ROA) and return on equity (ROE). The results reveal statistically significant relationships, enabling an assessment of the trade-off between short-term and long-term debt. In addition, we compare baseline and historical model results to ensure robustness.

The remainder of the paper is structured as follows. Section 2 presents the theoretical background. Section 3 reviews prior studies and develops hypotheses. Section 4 describes the data and methodology. Section 5 reports empirical results, and Section 6 concludes.

2. Theoretical literature review

2.1. Trade-off theory

Determining the firm's optimal capital structure involves striking a balance between the benefits

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and drawbacks of debt financing (Myers, 1984). Consequently, there exists an optimal capital structure where the Weighted Average Cost of Capital (WACC) is minimized, and the enterprise's value is maximized.

According to this theory, firms with a financing structure close to the optimal point experience a low WACC, which translates into more investment opportunities. As a result, they tend to achieve higher profitability. Hence, the influence of the debt ratio on profitability hinges on its position relative to the optimal capital structure. It could have a positive impact up to a certain threshold, beyond which it may exert a negative influence.

2.2. Pecking order theory

Myers (1984) introduced the pecking order theory, explaining firms' preference for financing sources. Myers and Majluf (1984) argue that information asymmetry causes security misvaluation, influencing financing choices. Firms tend to issue equity when financial distress costs are high and rely on debt when such costs are low (Shyam-Sunder and Myers, 1999). Accordingly, when internal funds are insufficient, firms prioritize debt financing, increasing interest expenses and reducing profitability. Less profitable firms, with lower retained earnings, thus exhibit higher leverage. In contrast, firms with strong internal cash flows rely less on debt, using surplus funds to repay debt or repurchase shares, thereby adjusting their capital structure.

2.3. Agency theory

Jensen and Meckling (1976) advanced agency theory, emphasizing conflicts between shareholders and managers, as well as between debt holders and shareholders, as key determinants of capital structure. They argue that agency problems between principals and agents are central to firm performance and financing decisions. According to this theory, debt can act as a monitoring mechanism, reducing agency costs and improving efficiency. However, excessive leverage may discourage investment, increase financing costs, and lead to the rejection of risky projects. Beyond a threshold, higher debt raises bankruptcy risk, financial distress, and conflicts between shareholders and lenders, ultimately harming profitability.

3. Empirical literature review and hypothesis development

3.1. Studies applying linear models

Numerous studies have focused on the relationship between capital structure and firm profitability, yielding contradictory results (Abor, 2005; Salim and Yadav, 2012; Chadha and Sharma, 2015). Using various profitability measures and evaluation methods, these studies report mixed evidence on the impact of debt ratio on firm profitability, including negative, positive, and insignificant effects.

3.2. Studies applying nonlinear models

The trade-off theory provides the most significant theoretical foundation for the nonlinear relationship between capital structure and a firm's profitability. Several authors have examined the nonlinear impact of capital structure on firm value (Nieh et al., 2008; Margaritis and Psillaki, 2010; Ghosh, 2017). Increasing leverage can enhance a firm's profitability, reaching its highest value when the debt ratio reaches a certain level.

From the literature, we can summarize the following: (i) Linear models do not accurately reflect the nonlinear nature of the relationship between capital structure and profitability. (ii) Some studies examine nonlinearity but do not consider short-term and long-term debt simultaneously. Therefore, this study employs a comprehensive model including both components, excluding total debt to avoid multicollinearity.

We use short-term and long-term debt to represent capital structure, and ROE and ROA to measure profitability. Short-term debt is typically less costly but reduces liquidity and becomes harder to service during profit declines (Abor, 2005; Margaritis and Psillaki, 2010; Salim and Yadav, 2012). For ROE, debt lowers after-tax profits but also reduces equity, implying a positive effect up to a threshold and a negative effect beyond it. Thus, the hypothesis is stated as follows:

H1: The impact of the short-term debt ratio on ROE follows an inverse U-shaped relationship

For the ROA indicator, which is calculated as after-tax profit over total assets, the use of debt will reduce after-tax profit due to interest expenses but will not affect the denominator. Therefore, ROA is expected to decrease with the debt ratio, or in other words, the relationship between the debt ratio and ROA is linear. The hypothesis H2 is stated as follows:

H2: The short-term debt ratio has a negative impact on ROA

For the ROE indicator, the use of long-term debt will reduce after-tax profit in the numerator due to increased long-term interest expenses, but it will also decrease equity in the denominator as debt replaces

equity. Therefore, debt is expected to positively affect ROE up to a certain level but will have a negative impact when it exceeds that level. Thus, the hypothesis H3 is stated as follows:

H3: The impact of the long-term debt ratio on ROE follows an inverse U-shaped relationship

For the ROA indicator, which is calculated as after-tax profit over total assets, the use of long-term debt will reduce after-tax profit due to long-term interest expenses, but it will not affect the denominator. Therefore, ROA is expected to decrease with the long-term debt ratio, or in other words, the relationship between the long-term debt ratio and ROA is linear. Hypothesis H4 is stated as follows:

H4: The long-term debt ratio has a negative impact on ROA

In addition to the four main hypotheses, the study also includes some control variables in the model to assess the impact of independent variables (control variables are included as independent variables). The control variables include firm size, revenue growth, and asset tangibility.

4. Research design

4.1. Research data

The study relies on data provided by Vietstock, a specialized financial data company. Panel data is used, encompassing non-financial listed firms on the Vietnam stock exchange (HNX and HSX) between 2009 and 2018. The data is collected from audited financial reports publicly disclosed by these companies on the stock exchange. Initially, there were 490 listed firms included, but after eliminating unreliable observations and addressing missing data, the final dataset consists of 438 companies with 3942 observations. Due to the inclusion of the revenue growth variable in the model, certain observations for the year 2009 are excluded to ensure accurate calculations.

4.2. Research method

We use STATA software for analysis. Initially, we will perform regression using the Pooled Ordinary Least Squares (OLS) model. After running the Pooled OLS model, we will conduct various tests including the multicollinearity test, heteroscedasticity test, and autocorrelation test.

Subsequently, we will proceed with regression using the Fixed Effects and Random Effects models. The selection of the research model will be determined using the Hausman test, which compares the Fixed Effects and Random Effects models. Once the choice is made between the Fixed Effects and Random Effects models, we will further test for autocorrelation and heteroscedasticity. If these issues exist, the model will be adjusted using the Generalized Least Squares (GLS) model.

The variables are described in detail in Table 1. The simultaneous presence of both the squared term and the linear term of capital structure in the same model can lead to issues of multicollinearity and endogeneity. Therefore, we replace them with averaged variables (SLN: standardized short-term debt ratio, LLN: standardized long-term debt ratio) to minimize multicollinearity and endogeneity. These variables are calculated by demeaning the corresponding debt ratios while preserving their explanatory significance.

Table 1. Variables and measures

Variables	Measurement
Dependent variables	
ROE_{it}	Return on Equity
ROA_{it}	Return on Assets
Independent variables	
SL_{it}	Short-term Debt/Total Assets
$SL2_{it}$	(Square of Short-term Debt/Total Assets)
LL_{it}	Long-term Debt/Total Assets
$LL2_{it}$	(Square of Long-term Debt/Total Assets)
SLN_{it}	SL_{it} - Average of SL_{it}
$SLN2_{it}$	Square of SLN_{it}
LLN_{it}	LL_{it} - Average of LL_{it}
$LLN2_{it}$	Square of LLN_{it}
Control variables	
$SIZE_{i,t}$	Firm size = ln(total assets)
SO	State Ownership Ratio
$Growth_{i,t}$	(Net Revenue for the current period - Net Revenue for the previous period) / Net Revenue for the previous period

We will proceed with the regression of the following two baseline models:

$$ROAi,t = \psi o + \psi 1*SLNi,t + \psi 2*SLNi,t2 + \psi 3*LLNi,t + \psi 4*LLNi,t2 + \psi 5*SOi,t + \psi 6*GROWTHi,t + \psi 7*SIZEi,t + oi,t$$

$$ROEi,t = \omega o + \omega 1*SLNi,t + \omega 2*SLNi,t2 + \omega 3*LLNi,t + \omega 4*LLNi,t2 + \omega 5*SOi,t + \omega 6*GROWTHi,t + \omega 7*SIZEi,t + zi,t$$

The novelty of the models lies in jointly including both short-term and long-term debt ratios in linear and squared forms to avoid omitted variable bias. Prior studies typically examine only one capital structure variable, even in nonlinear models. To highlight this contribution, we further analyze the separate effects of short-term and long-term debt on firm profitability measured by ROA and ROE.

5. Empirical results and discussion

5.1. Descriptive statistics

From Table 2, mean ROA and ROE are 6.5% and 12.52%, with ROA ranging from −33% to 59%

and ROE showing greater variability from −78% to 76.4%. Firms mainly rely on short-term debt at 41.1% of total capital, use little long-term debt below 10%, and have average state ownership of 24.4% ranging from 0% to 98%.

Table 2. Descriptive statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
ROE	3942	0.125257	0.119058	-0.77949	0.763947
ROA	3942	0.065358	0.070027	-0.33044	0.587561
SL	3942	0.411269	0.206603	0.00572	0.962629
LL	3942	0.0976	0.138231	0	0.800729
SO	3942	0.243946	0.253861	0	0.9811
GROWTH	3942	0.155902	0.574771	-0.93043	10.80467

5.2. Correlation coefficient matrix

Table 3. Correlation matrix

Variables	SLN	SLN2	LLN	LLN2	SO	GROWTH	SIZE
SLN	1						
SLN2	0.0925	1					
LLN	-0.2649	-0.0388	1				
LLN2	-0.2789	0.0973	0.8108	1			
SO	-0.0673	-0.0289	0.1188	0.079	1		
GROWTH	0.0012	-0.0226	0.0455	0.0369	-0.0721	1	
SIZE	0.0845	0.0066	0.3747	0.1959	-0.0009	0.0627	1

In the table, the variable pairs have correlation coefficients below 0.5, indicating no signal of multicollinearity. Table 4 displays the results of the Variance Inflation Factor (VIF) test. All VIF coefficients are below 4, suggesting that the model does not exhibit signs of multicollinearity.

Table 4. Variance inflation factor test

Variables	VIF	1/VIF
LLN	3.64	0.274502
LLN2	3.24	0.308185
SIZE	1.26	0.790918
SLN	1.14	0.875267
SLN2	1.07	0.934716
SO	1.03	0.975163
GROWTH	1.01	0.989032
Mean VIF	**1.77**	

5.3. Empirical results

5.3.1. Considering the simultaneous impact of short-term and long-term debt on ROA

Tests for multicollinearity, heteroscedasticity, and autocorrelation were conducted after the OLS regression. The test results indicated no multicollinearity, but there was evidence of autocorrelation and heteroscedasticity, as the p-values for both tests were less than 5%, leading to the rejection of the H_0 hypothesis at a significance level of 5%.

After the OLS regression, diagnostic tests show no multicollinearity but confirm the presence of autocorrelation and heteroscedasticity at the 5 percent level. We then estimate both Fixed Effects and Random Effects models and use the Hausman test to select the appropriate specification, which favors FEM. Given these issues, the model is subsequently estimated using GLS to obtain more reliable results. The detailed results are reported in Table 5.

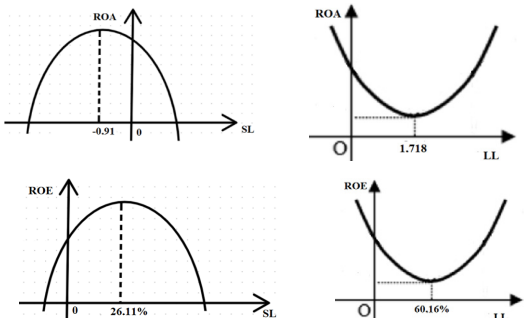
Table 5. Regression results

GLS model		
	ROA	**ROE**
SLN	-0,145*** [-37,62]	-0,0619*** [-8,10]
SLN2	-0,0548*** [-4,59]	-0,206*** [-7,25]
LLN	-0,171*** [-23,80]	-0,121*** [-6,88]
LLN2	0,0527*** [3,11]	0,120** [2,30]
SO	0,00619*** [2,86]	0,0188*** [3,37]
GROWTH	0,0104*** [15,58]	0,0238*** [13,91]
SIZE	0,00838*** [5,76]	0,0219*** [7,32]
_cons	0,0560*** [37,16]	0,108*** [31,54]
N	3942	3942

** p<0,1; ** p<0,05; *** p<0,01*

All regression coefficients are statistically significant at the 1% level, except for LLN^2, which is significant at the 5% level in the ROE model. The impact of short-term debt on ROA is predominantly linear and negative. Although the squared term of short-term debt is statistically significant, both the linear and quadratic coefficients are negative, indicating a concave quadratic relationship. The estimated turning point lies outside the feasible range, as it is located to the left of the vertical axis. After adjusting for variable standardization, the extremum point remains negative and economically irrelevant. Therefore, within the practical range of observation, short-term debt consistently exerts a negative effect on ROA, suggesting that higher short-term leverage reduces firms' profitability.

Figure 1. Impact of capital structure on firm profitability



Within the economically relevant range [0,1), short-term debt shows a consistently negative and nearly linear relationship with ROA, indicating that higher leverage reduces profitability. Although long-term debt exhibits a nonlinear pattern, its turning point

lies outside the feasible range, so it also negatively affects ROA in practice. For ROE, short-term debt follows an inverted U-shaped relationship with a peak at 26.11%, implying that moderate borrowing enhances returns while excessive use reduces performance.

Long-term debt follows a U-shaped relationship with ROE, with a minimum around 60.16%. At low levels, it increases financing costs and reduces ROE, whereas beyond this threshold it becomes more cost-efficient and improves performance. This reflects firms' substitution between short-term and long-term financing, while the turning points represent sample averages rather than firm-specific optima. Finally, state ownership, firm size, and revenue growth are positively and significantly associated with both ROA and ROE.

5.3.2. Considering separately the impact of short-term and long-term debt on ROA and ROE

To compare the results of our analysis with the findings of previous studies, we regress the counter-baseline models in which each regression equation includes either short-term or long-ter debt ratio. After performing OLS, FEM, and REM regressions, along with similar tests conducted in the two baseline models. The analysis results indicate that the GLS regression with adjustments is the most suitable model. The synthesis of results from the adjusted GLS regression for these models is as follows:

Table 6. Results of GLS regression for either SLN or LLN

Variables	ROA	ROE	ROA	ROE
SLN	-0,0936***	-0,0366***		
	[-24,15]	[-5,22]		
SLN2	-0,0266**	-0,181***		
	[-2,07]	[-6,67]		
LLN			-0,0676***	-0,0529***
			[-8,28]	[-3,16]
LLN2			0,0476**	0,0342
			[2,44]	[0,68]
SO	0,00212	0,0150***	0,00528*	0,0188***
	[0,86]	[2,76]	[1,87]	[3,45]
GROWTH	0,0106***	0,0234***	0,00964***	0,0232***
	[14,03]	[14,07]	[12,30]	[13,95]
SIZE	-0,00917***	0,0105***	-0,0105***	0,0113***
	[-6,07]	[3,83]	[-6,01]	[1,99]
_cons	0,0647***	0,118***	0,0611***	0,107***
	[39,63]	[38,07]	[31,21]	[33,23]
N	3942	3942	3942	3942
t statistics in brackets				
** p<0,1; ** p<0,05; *** p<0,01*				

The impact of short-term debt is similar to that of the two baseline models

The impact of the short-term debt ratio on ROA follows an inverted U-shaped curve, with the maximum point located on the left side of the vertical axis. In essence, this implies a linear relationship within the economically relevant range where the short-term debt ratio is positive. The maximum point for SLN is −1.7594 using 0.0936/[2×(−0.0266)], and for SL is −1.7594 + 0.4113 = −1.35 < 0. Therefore, within the relevant range of SL [0,1), short-term debt is inversely related to ROA, meaning that higher short-term debt reduces ROA.

The impact of the short-term debt ratio on ROE remains nonlinear, following an inverted U-shaped curve with the maximum point on the right side of the vertical axis. The maximum point for SLN is −0.1011 using 0.0366/[2×(−0.181)], and for SL is −0.1011 + 0.4113 = 0.3102 = 31.02% < 1. Thus, short-term debt initially increases ROE, but beyond a certain threshold, further increases reduce ROE.

The impact of long-term debt is different from that of the two baseline models

The impact of long-term debt differs from the baseline models. It remains statistically significant for ROA and follows a U-shaped relationship, but the turning point at 171.8% lies outside the 0%–100% range, implying a negative effect within the feasible range. When variables are omitted, the turning point shifts to 0.0676/(2×0.0476) = 71%, and with the mean LL of 0.0976 becomes 80.76%, within the relevant range, suggesting a positive impact on ROA up to a threshold and negative thereafter. The impact of long-term debt on ROE in Table 5 above shows that the squared long-term debt variable is not statistically significant, leading to results that lack economic consistency with ROA. The results indicate that long-term debt has a positive impact on ROA up to a certain level and an even stronger effect on ROE, as it also reduces the equity denominator.

Table 7. The results of the counter-baseline models are not economically meaningful

LL→ROA	Increasing the long-term debt ratio up to a certain level has a positive impact on ROA, exceeding that level will have a negative impact on ROA.
LL→ROE	Increasing the long-term debt ratio reduces ROE.

The baseline models show that long-term debt and its squared term are statistically significant for ROE at the 1% and 5% levels, indicating a nonlinear relationship with a minimum point on the right side of the vertical axis and economic relevance. At low levels, long-term debt reduces ROE due to higher costs, but beyond a threshold it improves ROE as short-term financing becomes more costly. These results are economically meaningful, highlighting a trade-off between debt types that reduces financing costs, although long-term debt still negatively affects ROA within the range of 0 to 1.

Table 8. The results of the baseline models are economically meaningful

LL→ROA	Increasing the long-term debt ratio has a negative impact on ROA.
LL→ROE	Increasing the long-term debt ratio up to a certain level reduces ROE, but exceeding that level increases ROE.

The results exhibit both statistical and economic significance, of the baseline models and demonstrate the consequences of the omission of variables. The omission of variables in the counter-baseline models can harm the economically meaningful results of the regression models.

The regression coefficient of the SO variable is not statistically significant in the counter-baseline model assessing the impact of the short-term debt ratio on ROA, but it is highly statistically significant at the 1% level in the baseline model that includes both short-term and long-term debt. Thus, it reveals how the omission of variables can affect the statistical significance of the control variables in the model.

6. Summary and conclusion

This study develops an integrated empirical framework to examine both linear and nonlinear effects of capital structure on firm profitability by simultaneously considering short-term and long-term debt. Using a sample of 438 non-financial firms listed on the Hanoi Stock Exchange and Ho Chi Minh Stock Exchange during 2010–2018, the analysis provides comprehensive evidence on how debt maturity influences corporate performance in Vietnam.

Based on the analysis of the dataset of listed companies in the Vietnamese stock market, we will compare the findings with the research hypotheses to discuss the results. The hypothesis testing results are as follows:

Table 9. Testing hypotheses results

No	Research hypotheses	Results
H1	The impact of the short-term debt ratio on ROE exhibits an inverted U-shaped relationship.	Accepted
H2	Increasing the short-term debt ratio has a negative impact on ROA.	Accepted
H3	The impact of the long-term debt ratio on ROE has an inverted U-shaped relationship.	Accepted
H4	Increasing the long-term debt ratio has a negative impact on ROA.	Accepted

The results strongly support the research framework. H1 and H3 are accepted, confirming nonlinear effects of short-term and long-term debt on ROE. Short-term debt shows an inverted U-shaped relationship, implying that moderate use enhances ROE while excessive use reduces it. In contrast, long-term debt exhibits a U-shaped pattern, indicating initial costs but positive effects beyond a threshold. H2 and H4 are also supported, showing that both short-term and long-term debt negatively affect ROA. Although some relationships are quadratic, their turning points lie outside the economically relevant range; thus, within practical limits, higher leverage consistently reduces operating profitability.

By estimating models with separate and joint debt components, the study shows that omitting debt maturity leads to biased and economically implausible results, highlighting the need to consider both short-term and long-term debt simultaneously. This study contributes to the literature by providing novel evidence on the heterogeneous effects of debt maturity on profitability in an emerging market. The findings emphasize the trade-off between short-term and long-term financing and extend previous research that mainly focuses on total debt ratios.

From a managerial perspective, firms should use short-term debt cautiously, particularly interest-bearing liabilities, while leveraging low-cost sources such as trade payables; when short-term financing becomes costly, substituting with long-term debt may improve performance. Expanding firm size may also enhance profitability through economies of scale. For policymakers, the findings offer insights for promoting more efficient and sustainable financing practices in Vietnam, while future research may extend the analysis to longer time horizons, alternative profitability measures, and institutional or macroeconomic factors.

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