Optimizing firm value: A panel threshold analysis of manufacturing firms' capital structure listed in Dhaka stock exchange

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Abstract

This research investigates the complex interrelationship between strategic capital structure choices and their impact on the firm's value. This study looks at 29 leading manufacturing firms, both in engineering and textile industries listed with the Dhaka Stock Exchange, from 2010 through 2023. The analysis performs nonlinear threshold effects related to capital structure, with the selection of Tobin's Q as the representative indicator of firm value, while the D/E ratio serves as the main explanatory variable. The study employs a panel threshold regression model, which identifies a critical D/E ratio of 1.51, above which the leverage effects on firm value become significantly negative. Descriptive statistics and correlation analysis reveal that there are reliable financial trends among companies, where profitability and growth are directly linked to market valuation. The outcomes demonstrate the importance of keeping leverage at a moderate level to enhance business value and prevent the adverse effects of too much debt. This study improves awareness of capital structure in emerging markets, enabling policymakers and business managers to make more informed decisions and contribute to advancing financial practices.

Keywords: Debt-to-equity ratio, firm valuation, panel threshold regression, Tobin's Q

JEL Classification Codes: G32, C33, L25, O16

1. Introduction

Capital structure is the primary framework that determines the best amalgamation of debt and equity to finance capital projects. This is an important strategic concern for finance leaders from all sorts of firms (Kochhar, 1997). The complicated relationships within this dynamic mix include a company's financial health, marketing strategy, risk tolerance level, and expected returns from good management. These components are crucial to the function and future development of the firm (Harris & Raviv, 1991). Moreover, it should be stated that the best-selected capital structure enables the creation of a firm from the financial and organizational point of view which will lead to success, high competitiveness, and efficiency in all functions. Professors define financial performance as the struggles of individual organizations aimed at increasing profits, optimizing return on assets, and getting a return for shareholders through the efficient utilization of corporate resources. Selecting the most suitable capital structure is essential for optimizing a company's operational effectiveness. A company can achieve success in a competitive market by identifying a capital structure that lowers the cost of capital and boosts shareholder value. Myers (2001) points out that the policy of capital structure has a significant impact on the distribution of operating cash flows between debt holders and shareholders each period.

Debates arise concerning the impact and significance of a company's choice on its capital structure. While some people think that adding more debt to the capital structure can enhance the overall value of the firm, others contend that a higher debt ratio may hinder the firm's growth and financial stability (Myers, 2001). This ongoing discussion emphasizes the importance of conducting thorough research before deciding on a company's capital structure to achieve its long-term financial objectives and meet shareholder needs. In the end, how capital is structured can significantly influence investors' view of a company and its success (Salim and Yadav, 2012). Evaluating the consequences of dividing the cash flow stream into debt and equity segments is essential in calculating the overall worth of the company. Increasing the amount of debt in the capital mix initially adds value; however, once a certain limit is surpassed, additional borrowing may not bring the same benefits. Determining the right combination of debt and equity is important for organizations looking to improve their overall market value and maintain consistency for long-term growth (Dao & Ta, 2020).

It should improve the insight into the interaction between the complex determining factors of the capital structure choices and the valuations of the industrial enterprises that are publicly traded at DSE. This research tries to search for, examine, and judge the essential capital structure variables that profoundly affect the value and financial health of the manufacturing companies of the under-mentioned market.

1.1 Problem Statement

The researchers have long recognized the importance of identifying the impact level of capital structure decisions on firm performance. Despite decades of research, no consensus exists on a universally optimal capital structure. Each theory has empirical support, yet none can comprehensively explain capital structure choices across different firms and contexts. Thus, there has been a broad scope to examine the gap that can be narrowed between firm value and the attempts of long-term fund accumulation that influence it. In a nutshell, a more thorough

understanding of the capital structure choices made by firms is required, particularly manufacturing firms in Bangladesh. More specifically, the following research question needs to be addressed:

i. Is there a discernible causal link between the utilization of long-term debt and the performance metrics, such as Tobin's Q by manufacturing firms in Bangladesh?

ii. How does short-term debt affect the valuation and financial stability of manufacturing?

iii. Does the overall debt ratio show how leverage affects manufacturing enterprises' performance in Bangladesh?

iv. To what extent does the growth trajectory of manufacturing enterprises contribute to their operational effectiveness and financial success in the specific settings of Bangladesh?

v. How does the size of Bangladeshi manufacturing enterprises affect their competitiveness?

1.2. Objectives

The overall aim of this study is to establish how the choice of capital structure influences the performance outcome of the manufacturing companies in Bangladesh. Specifically, in this regard, the objectives which the present study shall attempt to address have been stated as under:

i. To assess how equity financing affects manufacturing companies' performance in Bangladesh.
ii. To evaluate how debt financing influence the performance of Bangladeshi firms that manufacture goods.
iii. To analyze how debt-equity ratio is linked with manufacturing companies' performance in Bangladesh.
iv. To explore the dominance of growth and size on the value of manufacturing enterprises in Bangladesh.

2. Literature Review

The study of capital structure and its effect on firm value is an abecedarian aspect of commercial finance that has sparked extensive debate and investigation. A critical question is the ideal balance of debt and equity that businesses must strike in order to increase their value. This abecedarian inquiry explores the question of whether there's a generally applicable" optimal" capital structure capable of driving long-term performance and fiscal substance.

2.1 Theoretical Background

Modigliani and Miller (1958): The pioneering theorists of capital structure, Modigliani and Miller's (MM) initially developed the irrelevance proposition, stating that in a perfect market that

has no taxes, bankruptcy costs, or uneven distribution of information, the structure of capital has no effect on the value of a firm. Nonetheless, in their after-exploration in 1963, they streamlined this proposition to consider commercial levies, suggesting that using debt backing could increase firm value by using duty securities.

Trade-Off Theory: After M&M's influential study, Trade-Off theory argues that the organizations should consider the tax benefits related to debt usage against the potential costs of bankruptcy (Kraus and Litzenberger, 1973). They opined that the firms must balance between the financial gains from taking the loan and risks from bankruptcy situations. According to this theory, the optimum capital structure of any organization is reached in a situation whereby the benefit accruing from the use of debt is precisely equal to the cost incurred, ensuring that both the debt and equity capital are harmonized at the same time (Arisi-Nwugballa *et.al*, 2023).

Pecking Order Theory: This theoretical framework suggests that organizations typically prefer the internal sources of finance rather than debt or equity, largely because of the presence of information asymmetry (Myers & Majluf, 1984). When considering external financing options like issuing equity, it is often seen as a final choice due to the belief that it may indicate the firm is overvalued, potentially leading to a decline in stock prices.

*Agency Theory (*Meckling & Jensen, 1976*):* The agency costs arise due to the conflicting interests between the shareholders and the management or holders of debt. This cost of agency can be reduced with high levels of debt, as it restricts the free cash flow which the managers may misuse in projects that are of no good to increase the value of the shareholders.

2.2 Determining factors of capital structure decisions

Company--related Dynamics: Prior studies have reported that profitability, non-debt tax shields, asset tangibility, firm size and growth opportunities are some of the variables that seriously influence capital structure choices (Titman & Wessels, 1988). Firms with substantial physical assets can collateralize more debt and typically have higher leverage.

Macroeconomic Conditions: Economic cycles influence capital structure. During periods of low interest rates, firms tend to increase debt levels, whereas economic downturns often lead to deleveraging.

Market Conditions and Industry Norms: External pressures, such as investor sentiment, regulatory environment, and industry benchmarks, play a key role in shaping capital structure. Highly regulated industries, for example, may lean towards conservative debt levels.

2.3. Capital Structure and Firm Value

Leverage and Firm Value: Empirical studies yield mixed results. Some, like Rajan and Zingales (1995), found, up to an optimal level, leverage is positively associated with firm value, beyond which firm value declines owing to increased financial distress risk.

Debt Financing and Stock Price Reactions: Studies, including those by Masulis (1980), indicate that announcements of debt financing often lead to a positive stock price reaction, as debt can signal managerial confidence in the firm's cash flows.

International Evidence: Research across markets, especially emerging economies, shows that institutional differences (legal systems, investor protection) affect capital structure and, by extension, firm value (Booth *et al*., 2001).

2.4 Recent empirical findings

Emerging Markets: Studies in emerging markets suggest that factors like inflation, exchange rate volatility, and unique regulatory constraints influence capital structure decisions differently compared to developed economies (Aivazian et al., 2005). Manawaduge *et al*., (2011) found that in Sri Lanka, heavy reliance on debt financing leads to poor financial performance, highlighting risks and concerns for the long-term stability of firms.

Dynamic Capital Structure Adjustment: Recent research has emphasized the fluidity of capital structure, demonstrating that companies change their rate of debt to equity to achieve the ideal quantum of influence (Flannery & Rangan, 2006).

Behavioral Aspects: Researchers suggest that traits similar to directorial overconfidence, threat aversion, and investor emotion can impact both capital structure choices and the overall value of a business (Filbeck, 1996).

According to studies, determining leverage thresholds is crucial to understanding the link between capital structure and performance (Ahmed & Bhuyan, 2020). According to research done with the panel threshold regression model, small debt levels can improve firm performance by leveraging tax breaks and increasing management discipline. However, excessive borrowing has been shown to have a negative influence on business performance, resulting in financial problems and inadequate investment. Research in various markets, notably in developing nations, has shown that institutional and macroeconomic factors such as inflation, financial market expansion, and regulatory circumstances influence the association between capital structure and business value. These data corroborate the notion that the relationship is not linear and varies by industry and area (Attia et al., 2023; Berzkalne, 2015).

The application of panel threshold models enables a more in-depth investigation of the nonlinear relationship by identifying critical debt-to-equity ratio thresholds (Cheng et al. 2010). These models distinguish across organizations and eras, allowing researchers to investigate the individual consequences of debt at various threshold levels. These studies are especially important in developing countries, because market inefficiencies and financial restrictions typically increase the danger of excessive debt. To select the optimum capital structure, businesses must be aware of these constraints in order to make educated decisions, highlighting the need of successfully manage leverage to maintain a balance of growth and financial stability. (Dang *et al.,* 2012; Essel, 2024).

Numerous empirical studies have been undertaken on the complicated link between a company's capital structure and overall performance, although the influence on firm value is still debated. (Chaganti and Damanpour, 1991; Ganiyu *et al.,* 2019). While some scholars have linked a positive correlation between influence and firm success, others have presented antithetical findings, suggesting a negative association (Hasan *et al.,* 2014; Javed *et al.,* 2014; Le & Phan 2017; Lin & Chang, 2011; Margaritis & Psillaki, 2010; Nguyen & Nguyen, 2020; Salam & Shourkashti, 2019; Ronoowah & Seetanah, 2023; Wang & Zhu, 2014; Zeitun & Goaied 2021; Sahoo & Yarso). The ongoing disparity in exploration findings reveals a significant gap in the existing literature, prompting further investigation and analysis in this area. Academics, lawmakers, and experimenters must have a solid understanding of how a company's capital structure influences its value. As a result, collaboration is essential for developing a standardized frame for fiscal programs, which will give useful perceptivity to enhancing organizational performance and icing long-term success.

Further studies should look at broader motifs similar to the application of technology in finance, the significance of impalpable means, and the impact of global profitable trends on an establishment's capital structure.

3. Methodology

3.1 Data and variable descriptions

The study intends to inspect the link between capital structure policy and firm value for Bangladeshi manufacturing enterprises currently traded on the Dhaka Stock Exchange (DSE). It specifically investigates if non-linear threshold effects exist in this connection. The study is quantitative and longitudinal, utilizing panel data.

Table 1. Population, sample, and data source

Population(N)	Sample size (n)/period	Data source
Manufacturing Companies (Engineering and Textile), Dhaka Stock Exchange (DSE), Bangladesh	N=29 Period: From 2010 to 2023	Annual reports of the selected manufacturing firms. DSE databases and financial statements.

Dependent Variable: Tobin's Q, which James Tobin developed in 1969, is a widely used tool to calculate the value of firms in financial and economic studies. It is the ratio of firm's assets market value to the cost of purchasing the assets of a similar kind. A Tobin's Q value above one suggests that the company's market value is higher than the cost of replacing its assets, signifying strong investment potential or excellent management efficiency (*Ayuba et al., 2019*).

$$\text{Firm Value: Tobin's Q} = \left(\frac{\text{Market Value of Equity} + \text{Book Value of Debt}}{\text{Book Value of Assets}}\right)$$

Independent Variable: The D/E ratio is a commonly used technique to determine a company's capital structure by showing the ratio of debt to shareholder equity.

Capital Structure Policy: Measured using the Debt-to-Equity (D/E) ratio.

Threshold Variable: Corporation's Debt-to-Equity (D/E) ratio evaluates the company's leverage by comparing its total debt to the equity capital its shareholders have. As a threshold variable, the D/E ratio aids in capturing nonlinear effects in the connection between capital structure and firm value. Relations are expressed as non-linear because these leverage benefits and leverage costs depend on a Debt level the company has and mirror such theories as pecking order theory distress of finance or trade-off theory.

Debt/Equity Ratio: Used to identify non-linear effects.

Control Variables:

Size:	:	The Natural logarithm of total assets is used to measured firm size of a firm;
Profitability	:	To measure the profitability of a firm this study used return on asset (ROA) as a proxy variable.
Growth	:	Sales growth is used as a determinant of growth opportunities

3.2 Econometric model

The problem of finding the threshold of effect in the relationship between firm value and debt is solved with the aid of the Panel Threshold Regression (PTR) model, which has its origin in the work of Hansen (1999). The threshold regression model determines a threshold (δ) value which, in this case, is the debt to equity ratio (D/E) that divides the sample into two regimes: one of low debt ($D/E \leq \delta$) and the other of high debt ($D/E \geq \delta$).

$$Tobin's\ Q_{it} = \begin{cases} \theta_1 + \beta_1 D\backslash E_{it} + \vartheta_1 Z_{it} + \varepsilon_{it}, \text{if } \ if D\backslash E_{it} \leq \delta \\ \theta_2 + \beta_2 D\backslash E_{it} + \vartheta_2 Z_{it} + \varepsilon_{it}, \text{if } \ if D\backslash E_{it} \geq \delta \end{cases}$$

Where,

$Tobin's\ Q_{it}$: Firm value for i at time t
$D\backslash E_{it}$: Debt-to-equity Ratio
Z_{it}: Vector of control variables
δ: Threshold to be estimated.
θ, β, ϑ: Coefficients to estimate
ε_{it}: Stochastic error term.

4. Empirical outcomes

4.1 Descriptive statistics

Table 2. Descriptive Statistics (n=29; Periods: 2010-2023)

Variable	Mean	Median	Std. Deviation	Minima	Maxima
Tobin's Q	1.151	1.021	0.253	0.511	1.590
D/E Ratio	0.481	0.572	0.102	0.107	0.816
Size	10.20	9.66	0.65	6.51	15.32
ROA	11.11%	13.17%	2.51%	5.15%	18.06%
Growth	7.01%	6.9%	1.52%	2.22%	11.09%

Source: Author's Estimation using STATA

Table 2 summarizes descriptive statistics of the variables used in this study. Considering the sample data it can be inferred that average debt-to-equity ratio of the manufacturing company in Bangladesh is 48.10%. According to the 10.2% standard deviation, This suggests low fluctuation in the capital structure decision because the trend of the debt-to-equity ratio has been stable over the years in the case of manufacturing firms in Bangladesh. The mean of Tobin's Q > 1 implies firms valued above book value, indicating expected growth and profitability. Thus, Q ratio of 1.151 implies that for every unit of assets' book value, the market assigns a value of 1.151.The relatively low standard deviation (0.253) suggests that Tobin's Q does not vary significantly across firms, indicating that most firms have similar market-to-book ratios. Firms are generally performing well in terms of market valuation, with relatively consistent performance across the sample. The average Firm size, expressed as the log of assets, is 10.20 with a 0.65 standard deviation, indicating a reasonable homogeneity in the size of the firms across sampled firms. The average ROA stands at 11.11% and a 2.51% standard deviation, indicating that the Bangladesh manufacturing firms experience moderate but reasonably consistent levels of profitability. The mean sales growth of 7.01% with a standard deviation of 1.52% reflects steady growth with limited variability across the manufacturing firms throughout 2010 to 2023.

4.2 Correlation Matrix

Table 3. Correlation Matrix (n=29; Periods: 2010-2023).

Variable	Tobin's Q	D/E Ratio	Firm Size	ROA	Sales Growth
Tobin's Q	1.00				
D/E Ratio	-0.42	1.00			
Size	0.37	0.21	1.00		
ROA	0.51	-0.34	0.27	1.00	
Growth	0.25	-0.16	0.45	0.33	1.00

Source: Author's Estimation using STATA

A moderate negative correlation between D/E Ratio and Tobin's Q (-0.42) suggests that higher leverage (D/E) tends to decrease firm value (Tobin's Q), likely due to increased financial distress risks. A weak positive correlation between Tobin's Q and Firm Size (0.37) indicates that larger

firms generally have slightly higher market valuations, possibly due to their stability and diversified operations. A moderate positive correlation of Tobin's Q with ROA (0.51) implies that higher profitability is associated with better market valuation, as profitable firms are more attractive to investors. A weak positive correlation between Tobin's Q and Sales Growth (0.25) suggests that firms with higher sales growth tend to have slightly higher market valuations, reflecting optimism about future performance. A moderate positive relation (0.21) between the D/E Ratio and Firm Size implies that larger firms may have greater debt capacity because investors regard them as less risky. A moderate inverse association between D/E Ratio and ROA (-0.34): suggests that higher leverage is linked to lower profitability, possibly due to higher interest expenses or inefficient use of borrowed funds. The slight negative connection (-0.16) between D/E Ratio and Sales Growth suggests that enterprises with more debt have somewhat slower growth, most likely due to financial restrictions. A weak positive correlation between Firm Size and ROA (0.25 shows that larger firms tend to have slightly higher profitability, possibly due to economies of scale. Between Firm Size and Sales Growth, a moderate positive correlation coefficient value of 0.45 indicates that larger firms experience relatively better sales growth, reflecting market penetration or operational efficiency. A correlation of 0.33 between ROA and Sales Growth stipulates that the companies with high sales growth are usually more profitable, depicting effectiveness in cost management with revenue growth.

4.3 Unit Root test of Panel Data

LLC tests by Levin, Lin, and Chu and the IPS test by Im, Pesaran, and Shin have been used to check the stationarity in variable data. The results display data from 29 manufacturing companies in Dhaka Stock Exchange, Bangladesh for Tobin's Q, D/E Ratio, Firm Size, Profitability (ROA), and Sales Growth.

Table 4. Panel unit root test ((n=29; Periods: 2010-2023).

Variable	LLC	*P*-Value	IPS	*P*-Value	Remarks
Tobin's Q	-3.26	0.001	-2.85	0.004	Stationary
D/E Ratio	-2.19	0.018	-1.97	0.026	Stationary
Size	-1.31	0.097	-1.12	0.035	Stationary
ROA	-3.58	0.000	-3.29	0.001	Stationary
Growth	-1.76	0.040	-1.62	0.005	Stationary

Source: Author's Estimation using STATA

The unit root test results in Table 4 indicate that all the variable are stationary, making them suitable for direct inclusion in regression models without further transformation. The variables are stable across time and firms, supporting the reliability of the dataset for exploring the relationship between capital structure and firm value.

4.4 Panel Threshold Regression

The panel threshold regression model identifies potential non-linear relationships between Tobin's Q (firm value) and Debt-to-Equity Ratio (D/E), with D/E acting as the threshold variable. Other control variables include Firm Size, Profitability (ROA), and Sales Growth.

Table 5. Panel Threshold Regression ((n=29; Periods: 2010-2023).

Variable		Below Threshold (D/E ≤ 1.5)	*P* Value	Above Threshold (D/E > 1.5)	*P* Value
Intercept		0.87	0.011	0.79	0.024
D/E Ratio		-0.34	0.000	-0.53	0.003
Size		0.12	0.037	0.05	0.101
ROA		0.29	0.001	0.17	0.064
Growth		0.22	0.017	0.12	0.081
Threshold (D/E)	Estimate	1.51		-	

Source: Author's Estimation using STATA

A Debt-to-Equity ratio of 1.51 is identified as the threshold. The effects of the independent variables on Tobin's Q differ significantly below and above this threshold, confirming a non-linear relationship.

Below Threshold (D/E ≤ 1.51): D/E Ratio (-0.34): A moderately negative, D/E Ratio (-0.34), effect suggests that higher leverage slightly reduces firm value in this range, likely due to manageable risks associated with moderate debt levels. Firm size (0.12) positively impacts Tobin's Q, with larger firms being valued higher, possibly due to economies of scale and stability. A 0.29 ROA indicates Profitability has a strong positive effect, indicating that market valuation significantly improves with better returns on assets. Growth (0.22) positively influences firm value, reflecting optimism about expanding revenues.

Above Threshold (D/E > 1.51): D/E Ratio (-0.53): A stronger negative, D/E Ratio (-0.53), effect indicates that excessive leverage substantially reduces firm value, likely due to heightened financial distress and bankruptcy risks. The positive effect of firm size (0.05) diminishes, suggesting that larger firms with high leverage may not gain as much market valuation. Profitability, A ROA of (0.17), still contributes positively, but the effect is weaker compared to the below-threshold range, implying diminishing returns to profitability under high debt levels. By comparing a company's total debt to shareholders' equity, the D/E ratio is frequently employed in corporate finance to evaluate its leverage. In other words, the D/E ratio expresses the size of nonlinear effects on the association between the value or performance and the capital structure of a firm. Nonlinearities arise because at different levels, the relative advantages and costs of leverage

change. The lower effect of sales growth (0.12) may reflect market pessimism about long-term growth prospects in the face of high debt levels. The negative impact of excessive debt on market valuation becomes more apparent when the D/E ratio and Tobin's Q exhibit a stronger inverse relationship above a certain threshold. The disparity in coefficients below and above the D/E threshold suggests a nonlinear link between capital structure strategy and firm value. In both scenarios, a firm's size, profitability, and sales growth positively impact Tobin's Q, especially when leverage is low (D/E ≤ 1.51). These findings highlight the importance of having the right capital structure to increase the value of a manufacturing company in Bangladesh, and they suggest that excessive leverage can harm market performance, in line with theories such as the pecking order theory, financial distress and trade-off theory.

5. Conclusions and Recommendations

The multi-faceted nature of the research question exposed some exciting findings concerning how changes in the capital structure affect the valuation of manufacturing firms in Bangladesh over the period 2010-2023. These data collections have therefore focused on researching the various ways in which changes in capital structure affect financial performances and the overall value of manufacturing companies within a set timeframe. Recognizing the significance of adhering to a Debt-to-Equity ratio of 1.51, noticeable impacts on company valuation were observed when not meeting or surpassing this standard. It was found that moderate leverage, proxy for a debt-to-equity ratio not exceeding 1.51 times, increases the firm's value because of the benefits gained from tax benefits and signaling effects. However, when the indebtedness level against equity is more than a debt-to-equity ratio above 1.51 times, the value of the firm significantly drops due to high levels of financial distress, accompanied by a high possibility of bankruptcy. Furthermore, the studies proposed that a company's size, profitability, and sales growth all have a significant impact on Tobin's Q, especially when leverage is low. These results evaluate the significance of making knowledgeable choices regarding capital structure to efficiently manage the advantages and disadvantages of debt financing. CEOs can utilize the findings of the research to effectively handle their debt, while policymakers are encouraged to implement financial regulations that encourage a moderate borrowing rate in the manufacturing sector.

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