International Journal of Science and Business 2026, 54(1), 90-99
ISSN: 2520-4750 (Online) 2521-3040 (Print)
Journal: ijsab.com/ijsb

Leverage and Firm Value under Financial Health: Pharmaceutical and Chemical Industry in Bangladesh

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Abstract

In this study, the effect of financial leverage on firm value has been explored, and whether financial health affects this relationship in the pharmaceutical and chemical industry of Bangladesh has also been assessed. The study employs fixed-effects regression using panel data of 21 listed companies from 2014 to 2023, a total of 210 firm-year observations, to investigate the association between leverage, firm value, and other control variables. The findings indicate that the leverage ratio, firm size, and growth opportunities are positively correlated with firm value. The coefficient of leverage remains positive and statistically significant when the financial health variable (Altman's Z-score) is included, and the interaction between leverage and Z-score is also positive and statistically significant. This suggests that the value-enhancing impact of leverage is larger for financially healthier firms and smaller for financially vulnerable firms. Adding financial health also enhances the explanatory power of the model. The results emphasize the need to take into account the financial health of firms when determining the capital structure of the company and offer implications for managers, investors, and policymakers on how to make prudent choices in capital structure management and value creation.

Keywords: *Financial Leverage, Firm Value, Financial Health, Capital Structure, Growth Opportunities, Pharmaceutical and Chemical Industry.*

ARTICLE INFO

Research paper
Received: 12 June 2026
Accepted: 20 September 2026
Published: 27 September 2026
DOI: 10.58970/IJSB.2720

CITATION

Tasnim, R. (2026). Leverage and Firm Value under Financial Health: Pharmaceutical and Chemical Industry in Bangladesh , *International Journal of Science and Business*, 54(1), 90-99.

1. Introduction

Capital structure remains a central issue in corporate finance because the use of debt can create both benefits and costs for firms. Interest tax shields can enhance the value of debt financing, and financial distress, bankruptcy costs, and agency problems can decrease the value of the firm when debt financing is too significant (Modigliani & Miller, 1963; Kraus & Litzenberger, 1973; Jensen & Meckling, 1976). The trade-off perspective therefore suggests that firms may have an economically meaningful range of leverage in which the marginal benefits of debt are balanced against the marginal costs of financial distress. The pecking order view further suggests that financial decisions may also reflect information asymmetry and firms' desire to use internal funds before external funds (Myers, 1984). Further, arguments indicate that financing decisions can provide information about managers' expectations regarding the firm's future prospects (Ross, 1977). The empirical relationship between leverage and firm value, however, is not uniform across firms and markets. Cheng and Tzeng (2011) found that the value-enhancing effect of leverage becomes stronger when firms have better financial quality, suggesting that financial condition can alter the consequences of debt financing. More recent evidence also indicates that leverage and firm value can depend on the level and structure of debt. For instance, Roy and

Bandopadhyay (2022) found a negative relationship between financial risk and firm value in non-financial companies in India and provided evidence of a threshold-type relationship. Evianti et al. (2024) further examine financial leverage and firm value in an emerging-market setting, reinforcing the importance of context when interpreting leverage effects. Likewise, Biplob (2025) found a nonlinear threshold in manufacturing companies listed on the Dhaka Stock Exchange, suggesting that the relationship between leverage and value may shift at higher levels of debt. Bangladesh-specific evidence remains important because financing structures, capital-market conditions, and firm characteristics in an emerging economy may differ from those in developed markets. Uddin et al. (2022) studied the relationship between leverage and firm value in Bangladesh and found evidence supporting the trade-off theory. Maniruzzaman (2023), using DSE-listed manufacturing companies, also reported a positive and statistically significant association between financial leverage and firm value when Tobin's Q measured firm value. At the same time, evidence from the pharmaceutical industry shows that debt can have adverse effects on operating performance: Karim et al. (2023) found that long-term debt negatively affected ROCE and ROE among DSE-listed pharmaceutical firms. The results suggest that the effects of leverage can vary by dependent variable, firm type, and industry environment.

The pharmaceutical and chemical industry is a suitable context for this question. The production capacity, R&D, product registration, technological upgrading, and market expansion of companies in this industry need a lot of capital. Debt can therefore support investment and growth, but excessive debt can also increase repayment pressure and financial vulnerability. A firm's financial health is particularly relevant because financially stronger firms may be better able to service debt and convert borrowed funds into productive investment, whereas financially weaker firms may face greater distress costs. The measure of financial health in this study is based on Altman's Z-Score. Altman et al. (2017) provide international evidence on the usefulness of Z-score models for assessing financial distress, while recent studies continue to use Z-score-based measures when examining corporate stability and firm value. For example, Uddin and Barai (2025) use Z-scores and solvency measures to study the stability of manufacturing firms in Bangladesh, and Yosawiyata and Pujiono (2026) report a positive association between Altman Z-score and Tobin's Q in Indonesian property firms. These studies reinforce the relevance of financial health as a firm-level condition associated with market valuation, although their settings and model structures differ from the present study. The specific gap addressed here is the limited integration of leverage, firm value, and financial health within an industry-focused Bangladesh framework. The reviewed studies in Bangladesh have included leverage along with firm value, leverage and performance, or larger manufacturing samples, but the present study directly models financial health as a moderator between leverage and firm value in the listed pharmaceutical and chemical firms. This method is different than simply seeing if there is a correlation between leverage and firm value, and finding out if that correlation strengthens or weakens when financial conditions change. Therefore, the study has three contributions. First, it makes a theoretical contribution by moving the trade-off approach from a leverage–value relationship to a conditional leverage–value relationship that depends on financial health. Second, it adds a methodological contribution by estimating an explicit leverage × Z-score interaction, instead of financial health being an independent control per se. Thirdly, it provides context-specific evidence from the listed pharmaceutical and chemical industries in Bangladesh, where financing decisions are more relevant to expansion and investment. The study covers 21 listed companies for the period from 2014 to 2023, for which we have 210 firm-year observations. Tobin's Q is used as a measure of the firm value, the debt/asset ratio is used as a measure of leverage, and Altman's Z-score is used as a measure of the financial health of the firm. Firm size, profitability, growth opportunity, liquidity, and effective tax rate are included as controls. The remainder of the paper is organized as follows. Section 2 develops the literature review and hypotheses. The methodology is presented in Section 3. Section 4 presents the empirical results. Section 5 discusses the theoretical and managerial implications. Section 6 summarizes the study and outlines suggestions for further research.

2. Literature Review and Hypothesis Development

2.1 Theoretical Foundations

The theoretical relationship between leverage and firm value begins with the capital-structure irrelevance proposition under restrictive perfect-market assumptions. Once corporate taxes and market frictions are introduced, debt can generate tax-related benefits, while bankruptcy and distress costs can reduce value (Modigliani & Miller, 1963; Kraus & Litzenberger, 1973). The trade-off theory therefore predicts that firms balance the marginal tax benefits of debt against the marginal costs of financial distress. This logic is particularly relevant when the financial health of firms varies because the expected costs of financial distress are not necessarily the same between a financially strong and financially weak company. Agency theory provides an additional mechanism. Debt can discipline managers by reducing the amount of discretionary cash available for inefficient investment, but excessive debt can also create conflicts between shareholders and creditors and increase the costs associated with financial constraints (Jensen & Meckling, 1976). According to signaling theory, there may be instances where the information a manager possesses but the external investors are not directly recording, in which case financing decisions can be used to communicate that information (Ross, 1977). The Pecking Order Theory, on the other hand, argues that information asymmetry affects the choices of financing and that firms are likely to finance their projects from within before they will take on debt or go public (Myers, 1984). New studies suggest that none of these theories offers a comprehensive explanation of financing behavior in any context. Ju (2024), using a large Korean panel, finds that trade-off, pecking-order, and market-timing mechanisms can operate together. Further, the valuation effects of leverage are found to be dependent upon debt composition and the emerging market environment in Nabi (2026), using listed non-financial firms across BRICS economies. This supports the view that the leverage–value relationship is context-dependent rather than mechanical. This context-dependent aspect might be especially relevant in emerging markets, where financing requirements, market imperfections, and financial conditions of individual firms may vary significantly among them.

2.2 Leverage and firm value

The correlation between leverage and firm value is open to interpretation. While moderate debt levels can enhance firm value via tax savings, they may also lead to more disciplined management, while high debt levels can drive up financial distress and bankruptcy costs. Cheng and Tzeng (2011) found that leverage can be positively associated with firm value before the optimal capital-structure level is reached and that the positive effect is stronger for firms with better financial quality. Roy and Bandopadhyay (2022) similarly reported that the relationship between financial risk and firm value can change with the level of leverage. Recent Bangladesh evidence provides a useful basis for the present study. Uddin et al. (2022) reported that leverage structure influences firm value and found evidence consistent with the trade-off theory. Maniruzzaman (2023) found a positive and statistically significant relationship between financial leverage and firm value (Tobin's Q) for manufacturing companies listed in the DSE. However, Karim et al. (2023), focusing on DSE-listed pharmaceutical firms, found that long-term debt had a negative effect on ROCE and ROE. Therefore, there can be a positive relationship between leverage and market valuation, and at the same time, costs are associated with accounting-based performance. The distinction between market valuation and accounting performance is important for the present study. Tobin's Q indicates the market valuation of a firm's assets in comparison to its replacement cost or its book-value-based benchmark, while ROA or ROE indicates accounting performance. This same financing decision can thus be viewed in different ways when each outcome measure is analyzed. In addition, Biplob (2025) provides recent Bangladesh evidence of a nonlinear leverage–value relationship in manufacturing firms, indicating that the effect of leverage may not remain positive at all debt levels.

Based on the tax-shield, agency, signaling, and trade-off mechanisms, and supported by recent Bangladesh evidence, the first hypothesis is stated as:

H1: *Leverage, measured by the debt-to-asset ratio, is positively associated with firm value, measured by Tobin's Q.*

2.3 Effective tax rate and firm value

In the trade-off explanation of debt financing, tax is a key factor. Modigliani and Miller (1963) show that corporate taxation affects the implications of debt financing since interest payments can offer a tax advantage. A higher effective tax burden can therefore increase the potential value relevance of financing through debt when firms are able to use interest deductions. In the present model, the effective tax rate is included as a control variable to capture differences in firms' tax positions and the associated tax environment. This positive relationship also supports the overall body of literature that highlights the importance of tax-induced financing advantages in the capital-structure decision (Uddin et al., 2022). But the impact of effective tax rates may be modified by losses, tax incentives, deferred taxes, and industry-specific tax treatment. The hypothesis therefore represents the expected direction rather than a claim that the effect must be significant in every specification.

H2: *Effective tax rate is positively associated with firm value.*

2.4 Financial health and firm value

Financial health is a measure of a company's ability to meet its financial commitments and stay solvent. Altman et al. (2017) show that Z-score models can provide useful information for identifying financial distress across international settings. A higher Z-score tends to be associated with better financial traits for lower distress risk, and lower scores with higher financial vulnerability. There are two mechanisms that can explain how financial health relates to firm value: signaling and risk mechanisms. Financially healthier firms may face lower expected distress costs, greater access to external finance, and stronger capacity to undertake productive investment. A more robust financial condition can also be seen as reduced default risk and stability for investors. Recent empirical evidence is broadly consistent with this reasoning. Hermuningsih et al. (2022) find that financial distress is negatively related to firm value in Indonesian manufacturing firms. Indarto and Purwanto (2023) similarly report a negative effect of financial distress and a positive effect of financial leverage on firm value in Indonesian manufacturing companies. Yosawiyata and Pujiono (2026) report a positive and significant relationship between Altman Z-score and Tobin's Q in Indonesian property companies. In Bangladesh, Uddin and Barai (2025) show that the Z-score is relevant to assess the stability of the manufacturing firms listed on the DSE. These results validate the consideration of financial health as an economically significant feature, and not as a statistical control variable.

H3: *Financial health, measured by Altman's Z-score, is positively associated with firm value.*

2.5 Financial health as a moderator of the leverage–value relationship

This study's theoretical premise is that the impact of leverage is subject to financial condition. The trade-off theory implies that the net benefit of debt is determined not only by the tax advantages of borrowing but also by the expected cost of financial distress. Financially stronger companies are likely to be able to service their debt, while financially weaker companies will be more vulnerable to pressure for debt repayment and to distress costs. Consequently, the same increase in leverage may have different implications for two firms with different levels of financial health. Cheng and Tzeng (2011) provide direct empirical support for this conditional argument by showing that the positive leverage–value relationship is stronger for firms with higher financial quality. Recent studies also indicate that leverage effects may be conditional and/or nonlinear. Roy and Bandopadhyay (2022) identify a threshold-type pattern in the Indian context, while Biplob (2025) identifies a leverage threshold in Bangladeshi manufacturing firms. While these studies do not examine the same combination of interactions as explored here, they support the idea that the effect of leverage is dependent on financial conditions and the level of leverage of the firms. The present study therefore estimates the interaction term DTA × ZS. A positive interaction coefficient indicates that the marginal association between leverage and firm value becomes more positive as Z-score increases. This is an explicit test for the hypothesis that financial health influences the leverage–value relationship.

H4: *The relationship between leverage and firm value is moderated by financial health, such that the positive relationship is stronger when Z-scores are higher.*

2.6 Research gap and conceptual contribution

Based on the literature reviewed, three strands are identified. The first one discusses leverage and firm value along with Bangladesh evidence, such as Uddin et al., 2022; Maniruzzaman, 2023. The second focuses on leverage and performance in specific industries, such as the pharmaceutical industry in Bangladesh (Karim et al., 2023). The third examines financial distress or financial health in relation to firm value (Hermuningsih et al., 2022; Indarto & Purwanto, 2023; Yosawiyata & Pujiono, 2026). The present study ties these together by directly relating financial health to the leverage–firm value mechanism. The conceptual contribution is thus not merely the idea of adding an additional explanatory variable (Z-score). Instead, the study tests whether financial health changes the marginal value relevance of leverage. This distinction is relevant because a statistically significant main effect for leverage does not prove that leverage has the same impact on financially strong firms as it does on financially weak firms. The interaction specification provides a more explicit test of the conditional nature of capital-structure effects.

3. Methodology

3.1 Research design and data

The study follows a quantitative, explanatory research design and uses secondary panel data. The sample comprises 21 listed companies in the pharmaceutical and chemical industry in Bangladesh. The observation period is 2014–2023, resulting in 210 firm-year observations. The financial data have been gathered from the annual reports and corporate disclosures of the companies and also through the Dhaka Stock Exchange and other published sources. A panel data design is suitable because it has both time-series variation within firms over 10 years as well as cross-sectional variation between firms. This enables the analysis to include unobserved firm-specific attributes that are normally stable over time. The fixed-effects approach is selected based on the Hausman specification test reported below.

3.2 Variable measurement

Firm value (FV) is measured by Tobin's Q. Leverage (DTA) is measured as total debt divided by total assets. The independent variables include firm size (SIZE), measured by natural logarithm of total assets; profitability (ROA), measured by return on assets; growth opportunity (MTB), measured by the market-to-book ratio; liquidity (CR), measured by the current ratio; and the effective tax rate (TAX), defined as the effective tax rate used in the dataset. Financial health (ZS) is measured using Altman's Z-score. The interaction variable DTA × ZS captures the moderating effect of financial health on the leverage–firm value relationship.

3.3 Empirical Model and Estimation Strategy

Two fixed-effects specifications are estimated. In Model 1, the relationship between leverage and firm value is explored without considering financial health. Model 2 includes Z-score and the interaction between leverage and Z-score. The first empirical specification is the baseline fixed-effects model. It investigates the relationship between firm value and financial leverage while holding firm size, profitability, growth opportunity, liquidity, and effective tax rate constant. This specification is for evaluating the baseline leverage–firm value relationship prior to incorporating financial health. The second empirical specification includes financial health (Altman's Z-score) along with an interaction between financial leverage and financial health. The financial-health variable represents the direct relationship between financial condition and firm value, and the interaction term examines whether the leverage–firm value relationship is different under varying levels of financial health. In the extended specification, the coefficient on leverage represents the estimated association between leverage and firm value conditional on the interaction structure. The coefficient on Z-score represents the association between financial health and firm value. The interaction coefficient is the key moderation parameter: a positive and statistically significant coefficient indicates that the estimated positive association between leverage and firm value becomes stronger as financial health increases. The fixed-effects estimator controls for firm-specific effects, and the remaining unexplained variation is represented by the model disturbance term.

3.4 Model-selection and diagnostic procedures

Descriptive statistics and pairwise correlations are first used to summarize the variables. Variance Inflation Factors (VIF) are used to measure multicollinearity. The reported VIF values are below 5, with a mean VIF of 1.290. The heteroscedasticity test reports a p-value of 0.6298, indicating no evidence of heteroscedasticity in the reported diagnostic test. The unit root tests reported above show that all the variables are stationary with p-values below 0.05. A Hausman test results in a chi-squared value of 46.182, with a P-value of less than .001, which favors the fixed-effects specification, rather than the random-effects model. The regression results are interpreted using the coefficient signs, statistical significance, model fit, and changes across the two specifications. The coefficient of the product DTA × ZS is interpreted as the change in the marginal association between leverage and firm value due to a one-unit increase in the firm's Z-score in the interaction model.

4. Analysis and Findings

4.1 Descriptive Statistics

The descriptive statistics for the 210 firm-year observations are summarized in Table 1. The mean value of firm value (Tobin's Q) is 3.345, and the mean leverage ratio is 0.129. The average firm size is 8.405, and profitability is 0.099. The mean values of growth opportunity and liquidity are 2.621 and 0.593, respectively. The average Z score is 11.50, which is indicative of good financial health in the sampled companies.

Table 1: Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
FIRM VALUE	210	3.345	3.025	.383	14.835
DTA	210	.129	.53	-.071	7.629
SIZE	210	8.405	1.536	4.679	11.71
ROA	210	.099	.102	-.028	.537
MTB	210	2.621	1.438	-.218	6.172
CR	210	.593	.883	-1.723	3.339
TAX	210	.192	.175	-.572	1.565
ZS	210	11.5	9.685	-.06	24.717
DTA X ZS	210	.524	.928	-.456	8.947

4.2 Correlation Matrix

Pairwise correlations among the study variables are summarized in Table 2. Firm value is positively correlated with leverage (0.136), profitability (0.646), growth opportunity (0.417), Z-score (0.388), and the interaction effect (0.286), and negatively correlated with firm size (-0.202). The correlation between liquidity and firm value is weak and negative (-0.019). There is no serious correlation problem since the maximum value of the correlation between the explanatory variables is 0.512 between profitability and growth opportunity.

Table 2: Correlation Matrix

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
(1) FIRM VALUE	1.000								
(2) DTA	0.136*	1.000							
(3) SIZE	-0.202*	0.005	1.000						
(4) ROA	0.646*	-0.092	-0.071	1.000					
(5) MTB	0.417*	-0.130	0.071	0.512*	1.000				
(6) CR	-0.019	-0.171*	0.095	0.115	-0.197*	1.000			
(7) TAX	0.129	-0.081	-0.083	0.150*	0.287*	-0.087	1.000		
(8) ZS	0.388*	-0.046	-0.050	0.123	-0.106	0.393*	-0.092	1.000	
(9) DTA X ZS	0.286*	0.064	-0.109	0.133	-0.070	0.238*	-0.012	-0.024	1.000

**** p<0.01, ** p<0.05, *p<0.1*

4.3 Multicollinearity and Model Selection

The VIF diagnostics indicate that all variables have VIF values below 5, with a mean VIF of 1.290. The results therefore do not contain any evidence of severe multicollinearity as reported. The test value for heteroscedasticity is p = 0.6298, and the reported test does not reject homoscedasticity.

The unit-root test reported in the provided analysis shows that all variables are stationary. The Hausman test yields $\chi^2 = 46.182$ with $p < .001$. Accordingly, the fixed-effects estimator is preferred to the random-effects estimator.

4.4 Regression Analysis

Table 3 reports the results of the fixed-effects regression for two specifications. Model 1 excludes financial health, whereas Model 2 incorporates Z-score and the leverage–Z-score interaction to examine whether financial health changes the leverage–firm value relationship.

Table 3: Fixed Effect Regression Results

Variables	Model 1 Without Financial Health	Model 2 With Financial Health
DTA	1.271***	1.047***
SIZE	1.640***	1.069***
ROA	2.811	-0.888
MTB	2.409***	1.975***
CR	0.192*	-0.461***
TAX	-0.099	-0.458**
ZS	—	0.032***
DTA X ZS	—	0.659***
Constant	10.241***	6.578***
R^2	0.5214	0.8164
Overall R^2	0.2787	0.4298
F-statistic	251.021***	492.687***
Observations	210	210

**** p<0.01, ** p<0.05, *p<0.1*

In Model 1, DTA is positive and statistically significant at the 1% level ($\beta = 1.271$), supporting H1 in the baseline specification. SIZE and MTB are also positive and statistically significant, while CR is positive and weakly significant at the 10% level. ROA and TAX are not statistically significant.
Model 2 generates the main evidence of the research. The coefficient on DTA is still positive and statistically significant at the 1% level, yet it drops to 1.047 from 1.271 when financial health and the interaction term are added to the model. SIZE and MTB are still positive and statistically significant. The coefficient on ZS is positive and statistically significant ($\beta = 0.032$), supporting H3. The interaction between DTA and ZS is also positive and statistically significant ($\beta = 0.659$), providing support for H4, which suggests that the positive relationship between leverage and firm value is strengthened when ZS increases. The coefficient on CR becomes negative and statistically significant at the 1% level in Model 2, while TAX becomes negative and statistically significant at the 5% level. The ROA is still not statistically significant. These changes reflect the sensitivity of the estimated association of control variables to the specification and the addition of financial-health information. When both the Z-score and interaction term are added, the fit of the model improves in terms of material. The reported overall R^2 rises from 0.2787 (27.87%) in Model 1 to 0.4298 (42.98%) in Model 2. The within R^2 also increases from 0.5214 to 0.8164. This improvement is consistent with the argument that financial health contains information relevant to the cross-firm and within-firm variation in firm value. H1 is supported because DTA is positive and statistically significant in both models. H2 is not supported because TAX is statistically insignificant in Model 1 and negative and significant in Model 2, contrary to the hypothesized positive direction. H3 is supported because ZS is positive and statistically significant in Model 2. H4 is supported because the DTA × ZS interaction is positive and statistically significant.

5. Discussion

The findings indicate that leverage is positively associated with firm value in the sampled pharmaceutical and chemical firms, but the association is not independent of financial health. The

positive DTA coefficient in both specifications is consistent with evidence from Bangladesh reported by Uddin et al. (2022) and Maniruzzaman (2023). It is also consistent with the tax-benefit and agency mechanisms emphasized by the trade-off and agency perspectives. The results should not be taken to mean that higher leverage is always value-enhancing. Evidence from India and Bangladesh shows that leverage effects can become adverse at higher levels of financial risk or debt (Roy & Bandopadhyay, 2022; Biplob, 2025), while Karim et al. (2023) report negative effects of long-term debt on accounting performance in pharmaceutical firms. The most important result is the positive interaction between DTA and ZS. This finding is consistent with Cheng and Tzeng's (2011) argument that leverage has a stronger value-enhancing effect for firms with better financial quality. The finding also extends the research works of recent studies focused on treating financial health and distress as an economically relevant factor to firm valuation (Hermuningsih et al., 2022; Indarto & Purwanto, 2023; Yosawiyata & Pujiono, 2026). The interaction effect implies that debt's valuation consequences vary with the firm's ability to endure financial stress.

5.1 Theoretical Applications

The results provide several theoretical implications. First, they extend the trade-off theory by showing that the leverage–value relationship is conditional on financial health. The positive interaction coefficient implies that the marginal association of leverage with firm value increases with Z-score. This is consistent with the central trade-off idea that the net benefit of debt depends on the balance between financing benefits and distress costs (Kraus & Litzenberger, 1973). Second, the findings are compatible with agency theory. Debt can provide discipline for managers, and debt can limit the use of free cash flow in inefficient ways, but financially weak firms may be less constrained when their debt obligations are more difficult to service (Jensen & Meckling, 1976). The positive interaction, then, occurs in a setting where the leverage potential benefits are more pronounced for the more financially healthy firms. Thirdly, the results are consistent with signaling theory. If a company or business is in good financial health, it may be able to take out loans without the same amount of risk of default. A positive association between leverage and firm value may therefore reflect investor interpretation of debt in conjunction with observable financial strength rather than debt alone (Ross, 1977). Finally, the findings validate a conditional (as opposed to general) interpretation of the theory of capital structure. Recent research also shows that trade-off and pecking-order mechanisms can operate simultaneously and that capital-structure decisions may be dynamically adjusted (Ju, 2024). The present interaction framework provides a practical empirical way to capture one source of that heterogeneity.

5.2 Managerial Implications

The results indicate that leverage should be considered together with financial health, not separately using the debt ratio. In this sample, leverage is positively related to firm value for firms with higher Z-scores, indicating that productive debt financing may be more consistent with value creation for these firms. However, this does not imply that managers should continuously increase debt, because the broader literature documents nonlinear and threshold effects. In making financing decisions, therefore, managers should keep an eye on profitability, liquidity, solvency, and debt servicing capacity. Debt can be used in the pharmaceutical and chemical industry to finance capacity expansion, research and development, technology and market development, but financing plans should be aligned with expected operating cash flows. The negative and significant liquidity coefficient in Model 2 further indicates that the role of liquidity deserves attention once financial health is incorporated. When assessing firm valuation, investors can leverage z-score and other cash-flow-related metrics. The debt ratio alone may not be a complete indicator of financial risk. Regulators and industry stakeholders may also encourage transparent disclosure of leverage, financial-health indicators, and debt-servicing capacity so that capital-market participants can evaluate financing decisions more effectively. The results should nevertheless be interpreted as associations rather than a prescriptive debt target. There are no estimates of an optimal leverage level for the sampled firms in the study. Recent Bangladesh

evidence suggests that nonlinear threshold analysis can provide additional information on this issue (Biplob, 2025). This is therefore a useful avenue for future research.

5. Conclusion

This study aims to explore the association of financial leverage and firm value, and whether financial health could moderate this association among 21 listed pharmaceutical & chemical firms in Bangladesh during 2014–2023. The study finds a positive relationship between leverage and firm value using 210 firm-year observations and fixed-effects regression, and the results are positive and significant in both models. Financial health, measured by Altman's Z-score, is also positively associated with firm value in the extended specification. Most importantly, the leverage × Z-score interaction is positive and statistically significant, indicating that the positive association between leverage and firm value is stronger at higher levels of financial health. The findings contribute to the literature in three ways. First, they extend the leverage–value discussion by incorporating financial health as a moderating condition. Second, they offer sector-specific evidence from the pharmaceutical and chemical industry in Bangladesh, alongside more general studies of capital structure and firm value in Bangladesh. Third, they find that the explanatory power of the model rises after adding financial health and the interaction term, with the overall R^2 rising from 27.87% to 42.98%. There are also limitations of the study. The results are limited to listed pharmaceutical and chemical companies and cannot be assumed to apply to unlisted companies or other sectors generally. The study period concludes in 2023, and thus does not include other changes in capital-market conditions. In addition, the analysis uses a single principal measure of financial health and a single market-based measure of firm value. Lastly, the fixed-effects specification allows for controlling for the time-invariant firm characteristics, but they do not necessarily remove all sources of endogeneity. Future research can address these limitations by using dynamic panel estimators such as system GMM, instrumental-variable approaches, or alternative identification strategies where appropriate. Further research may also examine the possibility of a nonlinear relationship or a threshold effect between leverage and firm value, as suggested by the recent study in Bangladesh (Biplob, 2025), and explore if the moderating effect of financial health varies by industry, ownership, firm size, or macroeconomic conditions. Another way to gauge the strength of the interaction effect is to use alternative measures of financial health of the firm and other market-based measures of firm value.

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