Asian Academy of Management Journal of Accounting and Finance

AAMJAF Vol. 22, No. 1, 179–208, 2026

CAPITAL STRUCTURE AND FIRM VALUE IN KOREA: ADDRESSING ENDOGENEITY AND NONLINEAR EFFECTS OF LIABILITIES

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Submitted: 01 April 2025; Accepted: 31 January 2026; Published: 28 June 2026

To cite this article: Kwon, G. J. (2026). Capital structure and firm value in Korea: Addressing endogeneity and nonlinear effects of liabilities. *Asian Academy of Management Journal of Accounting and Finance, 22*(1), 179–208. https://doi.org/10.21315/aamjaf2026.22.1.6

To link to this article: https://doi.org/10.21315/aamjaf2026.22.1.6

ABSTRACT

This study investigates how corporate liabilities affect firm value by distinguishing between liability levels and changes, as well as between increases and decreases in liabilities, using non-financial firms listed on the Korean stock market from 2011 to 2023. Firm value is measured by Tobin's Q and its year-over-year change, while liabilities are represented by static leverage ratios and dynamic liability growth measures. Employing linear, nonlinear and asymmetric specifications, the analysis reveals several key findings. Higher liability levels are generally associated with lower firm value, consistent with financial distress and agency cost arguments. In contrast, moderate increases in liabilities are positively related to changes in firm value, suggesting that debt expansion may signal growth opportunities. Nonlinear results indicate an inverted U-shaped relationship between liability changes and firm value, implying diminishing marginal benefits of debt growth. Furthermore, asymmetric analyses show that liability reductions have a stronger negative valuation effect than comparable liability increases, reflecting investors' greater sensitivity to downside risk. Overall, the findings demonstrate that the valuation effects of corporate liabilities are dynamic, nonlinear, and asymmetric, underscoring the importance of managing both the level and adjustment of liabilities in corporate financing decisions.

Keywords: Liability, Corporate liabilities, Firm value, Tobin's Q, Liability changes, Asymmetric effects, Endogeneity, Korean stock market

INTRODUCTION

The relationship between corporate debt and firm value has long been a central issue in the corporate finance literature. Extensive theoretical and empirical studies examine how financing decisions affect market valuation, investment behaviour and firm performance (Altman, 1968; Titman, 1984; Jensen, 1986; Lang et al., 1996; Graham, 2000; Korajczyk & Levy, 2003; Han et al., 2020). Traditionally, this relationship has been analysed through financial leverage, defined as the relative use of debt financing within a firm's capital structure (Modigliani & Miller, 1958; 1963).

Debt financing provides well-known benefits. Interest deductibility generates tax shields that lower the cost of capital and enhance firm value (Graham, 2000; Kim, 2010; Choi, 2015). In addition, debt may serve a disciplinary role by constraining managerial discretion and reducing agency costs, particularly in firms with substantial free cash flow (Jensen, 1986). These arguments suggest that moderate debt usage can improve capital allocation efficiency and firm value.

At the same time, excessive debt entails significant costs. High leverage increases financial distress risk and bankruptcy costs, particularly during adverse economic conditions (Altman, 1968). As leverage rises, creditors demand higher risk premiums, raising financing costs and potentially discouraging value-enhancing investments (Titman, 1984). These opposing effects imply that the debt–value relationship is unlikely to be linear. Consistent with this view, capital structure theories emphasise the existence of an optimal debt level that balances tax benefits against distress and agency costs (Brealey & Myers, 1991), and empirical evidence supports nonlinear valuation effects of debt (Lang et al., 1996; Shyam-Sunder & Myers, 1999).

Despite substantial progress, several limitations remain. First, prior studies largely focus on static leverage ratios, paying limited attention to changes in liabilities over time. Yet, from a market perspective, liability growth may convey more relevant information about firms' financing strategies, growth expectations and risk profiles than debt levels alone. Second, most empirical analyses implicitly assume symmetric valuation effects of liability increases and decreases, although investors may interpret these changes differently. Third, while nonlinearity is widely discussed, it is often modeled incompletely or ignored in empirical specifications.

Motivated by these gaps, this study shifts the focus from static debt levels to liability growth and explicitly incorporates nonlinearity and asymmetry into the valuation framework. Specifically, it examines whether liability growth exhibits a nonlinear relationship with firm value and whether valuation effects differ depending on the direction of liability changes. By decomposing liability growth into positive and negative regimes, the analysis captures market responses that conventional linear models fail to identify.

Using a comprehensive sample of firms listed on the Korean stock market, this study provides an appropriate institutional setting characterised by relatively high corporate leverage and strong market sensitivity to financing decisions. To address potential endogeneity between firm value and financing choices, the analysis employs alternative specifications and robustness checks.

The empirical results show that liability growth is nonlinearly and asymmetrically related to firm value. Moderate liability expansion is associated with higher valuation, consistent with growth-oriented financing, whereas excessive expansion reduces firm value due to heightened financial risk. These findings extend the capital structure literature by demonstrating that the valuation effects of liabilities are dynamic, nonlinear and regime-dependent, offering more nuanced implications for corporate financing decisions.

THEORETICAL BACKGROUND

Capital Structure Theories and Firm Value

Liabilities constitute a core component of a firm's capital structure and play a pivotal role in shaping firm value. When managed efficiently, debt financing can enhance firm value; however, excessive reliance on liabilities may generate significant financial and agency costs. Accordingly, the relationship between liabilities and firm value has been extensively examined within the framework of capital structure theories, which provide competing yet complementary explanations for this complex linkage.

The seminal work of Modigliani and Miller (1958) establishes the irrelevance proposition, asserting that under perfect capital market conditions—namely, the absence of taxes, transaction costs and information asymmetry—a firm's capital structure does not affect its value. In their later extension, Modigliani and Miller (1963) introduce corporate taxes and demonstrate that debt creates value through interest tax shields, implying a positive relationship between liabilities and firm value. However, even within this framework, they acknowledge that excessive leverage increases financial risk, suggesting that the marginal benefits of debt eventually decline.

Building on these insights, subsequent theories emphasise the trade-off between the benefits and costs of debt. The trade-off theory posits that firms optimally choose their capital structure by balancing tax advantages against expected costs of financial distress and bankruptcy (Brealey & Myers, 1991). Altman (1968) provides early empirical evidence that firms with high liability ratios face elevated default risk, credit downgrades, and higher capital costs, all of which erode firm value. Titman (1984) further argues that increased leverage raises indirect bankruptcy costs, such as loss of customers and suppliers, thereby negatively affecting firm value.

These arguments collectively imply that the relationship between liabilities and firm value is inherently nonlinear. At low to moderate levels, liabilities may enhance firm value through tax shields and improved capital efficiency; beyond a certain threshold, however, rising financial distress and agency costs dominate, leading to a decline in firm value. This theoretical logic predicts an inverted U-shaped relationship between liabilities and firm value, a pattern that has been documented in several empirical studies (Kim, 2010; Choi, 2015).

Agency Theory, Pecking Order Theory and the Role of Debt

Agency theory provides an alternative perspective on the role of liabilities. Jensen (1986) argues that debt can serve as a disciplinary mechanism by reducing free cash flow available for managerial discretion, thereby mitigating agency conflicts between managers and shareholders. In this view, leverage can enhance firm value by aligning managerial incentives with shareholder interests. However, this disciplinary effect is conditional: excessive leverage may exacerbate agency conflicts between shareholders and debtholders and increase the likelihood of financial distress, ultimately reducing firm value.

The pecking order theory proposed by Myers and Majluf (1984) further refines the understanding of financing decisions by emphasising information asymmetry. According to this theory, firms prefer internal financing, followed by debt, and issue equity only as a last resort. Debt is thus generally viewed as less information-sensitive than equity and may signal managerial confidence in future cash flows. Nevertheless, overreliance on debt can undermine financial flexibility, particularly for firms facing volatile earnings or limited growth opportunities.

Empirical evidence supports these nuanced views. Lang et al. (1996) show that firms with substantial free cash flow can enhance value by increasing leverage, but only up to a point; beyond that, the adverse effects of financial risk outweigh the benefits. Shyam-Sunder and Myers (1999) find that high-growth firms tend to rely less on debt, whereas mature firms are more inclined to sustain higher leverage ratios, reflecting differences in risk profiles and financing needs.

From Liability Levels to Liability Changes: Nonlinearity and Asymmetry

While traditional capital structure research has largely focused on static liability levels, recent studies suggest that changes in liabilities may convey more informative signals to the market than levels alone. From a valuation perspective, investors are likely to interpret increases and decreases in liabilities differently depending on their magnitude and direction. For example, moderate increases in liabilities may signal growth opportunities and efficient capital deployment, whereas sharp increases may raise concerns about overinvestment and financial fragility. Conversely, liability reductions may be perceived as either prudent deleveraging or as a signal of constrained growth prospects.

Graham (2000) demonstrates that although tax benefits from debt are substantial, firms often underutilise them, implying that financing decisions are shaped by dynamic considerations rather than static optimisation alone. Korajczyk and Levy (2003) show that firms adjust their leverage procyclically, increasing debt during economic expansions and reducing it during downturns, suggesting that liability changes are closely tied to macroeconomic conditions. MacKay and Phillips (2005) further document that the liability–value relationship varies across industries, reinforcing the notion that the effects of debt are context-dependent.

More recent studies highlight that the valuation effects of liability changes are asymmetric. Increases and decreases in leverage may exert qualitatively different effects on firm value, reflecting investors' differential sensitivity to downside risk versus upside potential. This asymmetry is consistent with behavioral finance and signaling arguments, which posit that negative signals (e.g., excessive debt growth) are weighted more heavily by the market than positive signals of comparable magnitude (Ross, 1977; DeAngelo & Roll, 2015).

Endogeneity and Dynamic Considerations

An additional challenge in examining the liability–value relationship is endogeneity. Firm value may influence financing decisions, just as financing decisions may affect firm value, creating potential reverse causality. Firms with higher valuation may enjoy easier access to external financing, while firms anticipating improved future performance may proactively increase leverage. To address these concerns, recent empirical studies employ dynamic specifications and econometric techniques such as instrumental variables, two-stage least squares (2SLS), and panel data methods (Wintoki et al., 2012; Flannery & Hankins, 2013).

Taken together, the theoretical and empirical literature suggests that the impact of liabilities on firm value is neither linear nor symmetric. Instead, it is contingent on the level and direction of liability changes, firm characteristics, and broader economic conditions. These insights provide the theoretical foundation for the present study, which explicitly models liability growth, its nonlinear effects, and its asymmetric valuation consequences in order to offer a more comprehensive understanding of the capital structure–value nexus.

HYPOTHESIS AND RESEARCH MODEL

Hypothesis

The relationship between corporate liabilities and firm value has long been a central issue in capital structure theory. According to Modigliani and Miller (1963), interest payments on liabilities provide tax shields that may

enhance firm value. However, excessive reliance on liabilities increases expected bankruptcy costs, agency costs and financial distress risk, which may ultimately erode firm value (Altman, 1968; Titman, 1984; Jensen, 1986; Brealey & Myers, 1991). This theoretical trade-off suggests that the effect of liabilities on firm value may not be monotonic, but instead follow a nonlinear pattern.

Building on the trade-off theory, prior studies argue that liabilities contribute positively to firm value up to an optimal level, beyond which the marginal costs of additional liabilities exceed their benefits (Myers, 1984; Graham, 2000). Empirically, this reasoning implies an inverted U-shaped relationship between liability levels and firm value, where moderate liabilities improve value while excessive liabilities reduce it. Accordingly, this study first examines the level effect of liabilities on corporate value and tests for potential nonlinearities.

H1: A firm's level of liability is significantly associated with its corporate value.

H2: The relationship between a firm's liability level and corporate value is nonlinear (inverted U-shaped).

While H1 and H2 focus on the static, level-based effects of liabilities, recent literature emphasises that capital structure decisions are inherently dynamic and evolve over time rather than adjusting instantaneously to an optimal target (Leary & Roberts, 2005; Flannery & Rangan, 2006). From this dynamic perspective, changes in liabilities may convey incremental information beyond their contemporaneous levels. For example, an increase in liabilities may reflect firms' financing needs for growth opportunities, while a reduction in liabilities may indicate deleveraging, risk aversion, or deteriorating investment prospects. Consequently, firm value may respond more strongly to changes in liabilities than to their static levels.

Moreover, dynamic panel studies highlight that examining changes in explanatory variables and changes in firm value can mitigate concerns related to unobserved firm-specific heterogeneity and reverse causality (Wintoki et al., 2012). Motivated by this literature, this study explicitly investigates whether changes in liabilities are associated with changes in corporate value.

H3: Changes in a firm's liability level are significantly related to changes in corporate value.

In addition, the effect of liability changes on firm value may be asymmetric. An increase in liabilities can serve as a positive signal of growth opportunities and managerial confidence, while also imposing external monitoring through debt obligations (Jensen, 1986; Berger & di Patti, 2006). In contrast, a decrease in liabilities may be interpreted by the market as a signal of reduced growth opportunities, increased risk aversion, or anticipated financial difficulties. As a result, increases and decreases in liabilities may exert qualitatively different effects on corporate value.

This asymmetric response is consistent with signaling theory and asymmetric adjustment arguments in capital structure literature, which suggest that markets respond differently to expansions versus contractions in leverage (Faulkender & Petersen, 2006; Flannery & Rangan, 2006). Therefore, this study explicitly distinguishes between positive and negative changes in liabilities.

H4: Increases and decreases in liabilities exert asymmetric effects on corporate value.

By jointly considering static, dynamic and asymmetric perspectives, this study aims to provide a more comprehensive understanding of how liabilities influence firm value while addressing potential endogeneity concerns.

Research Model

Baseline level and nonlinear model (H1–H2)

To test H1 and H2, the study estimates a baseline panel regression model that relates firm value to the level of liabilities. Firm value is primarily measured using Tobin's Q (TQ), while the market value-to-sales ratio (MV) is used as a robustness measure. The main explanatory variable, liabilities (LIB), is proxied alternatively by the ratio of total liabilities to total assets and the ratio of total liabilities to equity.

The baseline specification is as follows:

$$\text{FirmValue}_{i,t} = \alpha + \beta_1 LIB_{i,t} + \gamma X_{i,t} + \sum YD + \sum ID + \varepsilon_{i,t}$$

Where $X_{i,t}$ denotes a vector of control variables, including donation expenditures (DON), ownership concentration (TOP), market-to-book ratio (MTB), firm size (SIZE), return on assets (ROA), sales growth (GRW), intangible asset intensity (INTAN), tangible asset structure (PPE) and firm age (AGE). Year (∑YD) and industry (∑ID) fixed effects are included to control for unobserved heterogeneity. The inclusion of the squared liability term allows for testing the inverted U-shaped relationship predicted by the trade-off theory. A positive coefficient on *LIB* and a negative coefficient on LIB^2 would support H2.

Change model for dynamic effects (H3)

To test H3, which focuses on the dynamic relationship between liabilities and firm value, the study employs a change-based (first-difference) model. Specifically, changes in firm value are regressed on changes in liabilities:

$$\triangle FirmValue_{i,t} = \alpha + \beta_1 \triangle LIB_{i,t} + \gamma \triangle X_{i,t} + \sum YD + \sum ID + \varepsilon_{i,t}$$

where △ denotes year-to-year changes. Following prior dynamic capital structure studies (Flannery & Rangan, 2006; Wintoki et al., 2012), time-invariant firm characteristics are differenced out, reducing bias from unobserved heterogeneity. Control variables that are inherently dynamic, such as profitability and growth, are included in change form, while size and age are retained in levels due to their slow-moving nature. A statistically significant coefficient $\triangle LIB$ on provides evidence supporting H3.

Asymmetric change model (H4)

To test H4, which posits that increases and decreases in liabilities exert asymmetric effects on firm value, the study employs two complementary modeling approaches widely used in the literature.

First, following the regime-splitting approach, changes in liabilities are decomposed into positive and negative components as follows:

$$\triangle LIB_{i,t}^{+} = \max(\triangle LIB_{i,t} 0), \triangle LIB_{i,t}^{-} = \min(\triangle LIB_{i,t}, 0)$$

The baseline asymmetric change model is specified as:

$$\triangle FirmValue_{i,t} = \alpha + \beta_1 \triangle LIB_{i,t} + \beta_2 D_{i,t} + \beta_3 (\triangle LIB_{i,t} \times D_{i,t}) + \gamma \triangle X_{i,t} + \sum YD + \sum ID + \varepsilon_{i,t}$$

This specification allows the marginal effects of liability increases and decreases to differ. A statistically significant difference between β_1 and β_2 provides direct evidence of asymmetric valuation effects, consistent with H4.

Second, to explicitly test regime-dependent valuation effects using a dummy-variable framework—as suggested by the reviewer—the study estimates an interaction-based asymmetric change model. A dummy variable $D_{i,t}$ defined as:

$$D_{i,t} = \begin{cases} 1 if \triangle LIB_{i,t} > 0 \\ 0 \quad \text{otherwise} \end{cases}$$

The corresponding model is specified as:

$$\triangle FirmValue_{i,t} = \alpha + \beta_1 \triangle LIB_{i,t} + \beta_2 D_{i,t} + \beta_3 (\triangle LIB_{i,t} \times D_{i,t}) + \gamma \triangle X_{i,t} + \sum YD + \sum ID + \varepsilon_{i,t}$$

In this specification, β_1 captures the marginal effect of liability changes when liabilities decrease or remain unchanged, while β_3 measures the incremental effect associated with liability increases. A statistically significant interaction term (β_3) indicates that the valuation effect of liability growth differs depending on the direction of change, thereby supporting Hypothesis 4. This formulation explicitly captures regime-dependent slope differences and serves as a robustness check for the asymmetric effects identified in the baseline model.

Given the potential endogeneity between liability decisions and firm value, all models are estimated using appropriate panel estimators. When endogeneity is detected based on the Durbin–Wu–Hausman test, two-stage least squares (2SLS) estimation is employed; otherwise, fixed-effects or OLS estimations are reported (Durbin, 1954; Wu, 1973; Hausman, 1978).

Variable definitions

Firm value is primarily measured by TQ, defined as the sum of the market value of equity and the book value of liabilities divided by total assets. Corporate leverage (LEV) is measured as total liabilities scaled by total

assets. Control variables include DON, TOP, MTB, SIZE, ROA, GRW, INTAN, PPE, AGE. Detailed variable definitions are reported in Table 1.

TABLE 1
Variable definitions

Variable	Definition
TQ	Firm value measured as (market value of equity at the end of year t + book value of liabilities at the end of year t) divided by total assets at the end of year t.
LIB	Leverage measured as total liabilities at the end of year t divided by total assets at the end of year t.
DON	Donation expenditures in year t scaled by total sales in year t.
TOP	Ownership concentration measured as the equity ownership ratio of the largest (majority) shareholder at the end of year t.
MTB	Market-to-book equity ratio, defined as the market value of equity divided by the book value of equity at the end of year t.
SIZE	Firm size measured as the natural logarithm of total assets at the end of year t.
ROA	Profitability measured as accounting earnings in year t divided by total assets at the beginning of year t.
GRW	Sales growth rate measured as (total sales in year t – total sales in year t – 1) divided by total sales in year t – 1.
INTAN	Intangible asset intensity measured as total intangible assets at the end of year t divided by total assets at the beginning of year t.
PPE	Tangible asset intensity measured as (total tangible assets – land – construction in progress) at the end of year t divided by total assets at the beginning of year t.
AGE	Firm age measured as the natural logarithm of the number of years since firm establishment.

EMPIRICAL ANALYSIS

Sample Selection

Table 2 illustrates the process of selecting sample data for the empirical analysis in this study. The purpose of this study is to analyse the relationship between liability and corporate value for firms listed on the Korean stock market from 2011 to 2023.

For data extraction, this study utilises the VALUESearch Database provided by Korea Credit Information Services (KCIS). After extracting the data, the study excludes firms that do not meet the following criteria for the empirical analysis:

1. Firms in the banking and insurance sectors.
2. Firms that do not have a fiscal year-end of 31 December.
3. Firms classified as "special handling" (management-targeted) stocks.
4. Firms with negative equity (capital erosion).
5. Firms with missing data for any of the variables required for this study's empirical analysis.

Firms in the banking and insurance sectors are excluded due to differences in accounting methods and standards, which may pose comparability issues. Firms whose fiscal year-end does not coincide with 31 December are excluded because of potential inconsistencies arising from differences in corporate tax reporting and payments, as well as variations in external economic conditions that could impact the data's homogeneity.

Companies with negative equity or those included in the "special handling" category on the Korean stock market are excluded from the analysis due to the instability or discontinuity often present in their financial data. Furthermore, firms with missing data for any of the variables used in the empirical analysis are also excluded.

Outliers can distort the results of the empirical analysis. Therefore, in the first regression analysis, the study excludes sample firms with standardised residuals greater than 2 in absolute value or a Cook's distance greater than 1, and proceeds with the analysis thereafter.

TABLE 2
Sample selection procedure

Sample selection		Number
Extracted sample data (2011–2023)		44,538
Excluded samples (–)	(1) Banking and insurance corporations	22,226
	(2) Companies that do not close their books at the end of December	
	(3) Companies subject to issues for administration	
	(4) Companies with impaired capital	
	(5) Companies with missing data on other empirical analysis variables	
Number of samples included in the empirical analysis		22,312

Descriptive Statistics

Table 3 reports the descriptive statistics for the variables used in the analysis. Tobin's Q (TQ), a proxy for firm value, has a mean of 1.613 and a median of 1.151, indicating that, on average, sample firms are valued above their book value, while the wide dispersion suggests substantial heterogeneity in market valuation. LEV averages 0.419, with a median of 0.391, reflecting moderate reliance on debt financing across firms.

DON exhibit a low mean and median, implying that such spending constitutes a relatively small proportion of sales for most firms; however, the large standard deviation and maximum value indicate considerable cross-sectional variation. This variation supports the empirical examination of whether donation expenditures are value relevant rather than uniformly neutral or symbolic. Ownership concentration, measured by the majority shareholder equity ratio (TOP), shows moderate levels on average, suggesting meaningful differences in control structures across firms.

Growth opportunities, proxied by the MTB, display substantial skewness, with a relatively low median but an extremely high maximum value, highlighting pronounced differences in firms' growth expectations. SIZE and ROA also exhibit considerable variation, while GRW shows a wide range, indicating heterogeneous operating conditions. Regarding asset structure, INTAN account for a small proportion of total assets on average, whereas

property, plant, and equipment (PPE) remain economically significant for many firms. Finally, the distribution of AGE suggests that the sample is dominated by relatively mature firms, reducing concerns that the results are driven primarily by young or newly established firms.

TABLE 3
Descriptive statistics

Variables	*N*	Mean	S. D.	Median	Minimum	Maximum
TQ	22,312	1.6129	1.8528	1.1513	0.2132	116.9961
LEV	22,312	0.4194	0.5013	0.3911	0.0000	54.7653
DON	22,312	0.0013	0.0142	0.0001	0.0000	1.4574
TOP	22,312	0.2518	0.1633	0.2342	0.0000	0.9260
MTB	22,312	2.5239	59.5529	1.2783	0.0771	8,848
SIZE	22,312	25.8893	1.3651	25.6615	20.7033	33.3243
ROA	22,312	0.0089	0.2011	0.0252	–8.4814	13.8661
GRW	22,312	0.2737	14.0982	0.0351	–0.9994	1,498
INTAN	22,312	0.0317	0.1026	0.0103	0.0000	7.5662
PPE	22,312	0.1599	0.2156	0.1223	0.0000	16.3594
AGE	22,312	12.2901	0.8899	12.3893	4.8363	16.8227

Note: Variable description: Refer to Table 1

Correlation Analysis

Table 4 presents the Pearson correlation coefficients among the variables included in the empirical analysis. Overall, the correlation matrix indicates that most pairwise correlations are relatively low in magnitude, suggesting that multicollinearity is unlikely to pose a serious concern in the subsequent regression analyses.

Firm value (TQ) is positively and significantly correlated with donation expenditures (DON), market-to-book ratio (MTB), sales growth (GRW) and intangible asset intensity (INTAN), indicating that firms with higher growth opportunities, greater intangible assets, and higher donation activities tend to exhibit higher market valuation. In contrast, TQ is negatively correlated with SIZE, ROA, TOP and AGE, implying that larger, more mature, and more tightly controlled firms are associated with lower TQ on average. These patterns are broadly consistent with prior valuation studies

emphasising growth opportunities and firm maturity as key determinants of market value.

LEV exhibits a strong positive correlation with PPE, reflecting the role of physical assets as collateral in debt financing decisions. At the same time, LEV is negatively associated with ROA, consistent with the notion that less profitable firms rely more heavily on external debt financing. The correlation between LEV and TQ, however, is statistically insignificant, suggesting that the valuation effect of leverage may be more complex and potentially nonlinear, thereby motivating the multivariate analysis.

DON display generally low correlations with other firm characteristics, except for a modest positive association with TQ. This weak correlation structure suggests that donation spending captures a distinct dimension of corporate behaviour rather than merely reflecting firm size, profitability or ownership structure.

Among control variables, SIZE is positively correlated with TOP, ROA and AGE, indicating that larger firms tend to be more mature and more tightly controlled. Growth opportunities (MTB) are negatively associated with SIZE and TOP, while ROA is negatively correlated with leverage, consistent with established capital structure theories.

Taken together, the correlation results provide preliminary evidence of economically meaningful relationships among key variables while confirming that no single explanatory variable dominates the correlation structure. This supports the suitability of the multivariate regression framework employed in the subsequent analyses.

Although several variables exhibit statistically significant pairwise correlations, the magnitude of most coefficients remains modest. Importantly, variance inflation factor (VIF) diagnostics indicate that all explanatory variables have VIF values well below the conventional threshold of 10, suggesting that multicollinearity is unlikely to bias the estimated coefficients. Therefore, the regression results can be interpreted as reflecting independent marginal effects of the explanatory variables on firm value.

TABLE 4
Correlation analysis

Variables	TQ	LEV	DON	TOP	MTB	SIZE	ROA	GRW	INTAN	PPE	AGE
TQ	1										
LEV	–0.0085 (0.2040)	1									
DON	0.0405 (< .0001)	–0.0148 (0.0272)	1								
TOP	–0.0525 (< .0001)	–0.0168 (0.0123)	–0.0089 (0.1851)	1							
MTB	0.0798 (< .0.001)	0.0090 (0.1808)	0.0056 (0.4031)	–0.0137 (0.0411)	1						
SIZE	–0.1744 (< .0001)	0.0598 (< .0001)	0.0052 (0.4379)	0.1057 (< .0001)	–0.0159 (0.0179)	1					
ROA	–0.1383 (< .0001)	–0.0537 (< .0001)	–0.0186 (0.0054)	0.0953 (< .0001)	–0.0250 (0.0002)	0.1441 (<.0001)	1				
GRW	0.0329 (<.0001)	0.0006 (0.9346)	–0.0010 (0.8815)	0.0009 (0.8953)	0.0011 (0.8726)	–0.0086 (0.1977)	0.0314 (< .0001)	1			
INTAN	0.0888 (< .0001)	0.1571 (< .0001)	0.0020 (0.7653)	–0.0086 (0.1968)	0.0028 (0.6726)	–0.0295 (< .0001)	–0.0334 (< .0001)	0.0012 (0.8585)	1		
PPE	–0.0180 (0.0071)	0.6582 (< .0001)	–0.0107 (0.1086)	0.0262 (< .0001)	–0.0006 (0.9312)	0.0913 (< .0001)	0.0355 (< .0001)	0.0012 (0.8543)	0.1081 (< .0001)	1	
AGE	–0.1341 (< .0001)	–0.0272 (< .001)	–0.0080 (0.2326)	–0.0309 (< .0001)	–0.0114 (0.0901)	0.2088 (< .0001)	0.0112 (0.0947)	–0.0101 (0.1335)	–0.0596 (< .0001)	–0.0158 (0.0180)	1

Note: Refer to Table 1 for description of variables.

Regression Analysis

Relationship between corporate liabilities and firm value (H1)

This study examines the relationship between corporate liabilities and firm value, employing Tobin's Q as a proxy for market-based valuation. H1 posits a systematic association between LIB, measured as the ratio of total liabilities to total assets, and firm value after controlling for firm-specific characteristics as well as year and industry fixed effects. The empirical results testing H1 are reported in Table 5.

The regression model exhibits strong explanatory power, with a highly significant F-statistic ($F = 532.76$, $p < 0.001$) and an adjusted R^2 of 0.397, indicating that approximately 40% of the variation in Tobin's Q is explained by the model. This level of explanatory power is comparable to, or higher than, that reported in prior studies examining firm value determinants.

Consistent with H1, the coefficient on LIB is negative and statistically significant ($\beta = -0.066$, $t = -4.14$, $p < 0.001$). This result indicates that, ceteris paribus, firms with higher liability ratios tend to exhibit lower market valuation. Economically, this finding suggests that the market discounts firms with heavier liability burdens, likely reflecting concerns over financial risk, agency costs arising from debt obligations, and potential constraints on managerial discretion. This evidence is consistent with the agency cost arguments of Jensen (1986) and the empirical findings of Lang et al. (1996), who show that higher debt obligations can erode firm value by increasing financial distress risk and limiting investment flexibility.

The estimated coefficients on the control variables are largely in line with prior literature. The MTB is positively and significantly associated with Tobin's Q, capturing growth opportunities and favorable market expectations (Fama & French, 1992). INTAN also show a significantly positive effect, underscoring the valuation relevance of knowledge-based resources (Lev & Thiagarajan, 1993). In contrast, SIZE and AGE exhibit negative coefficients, suggesting that larger and more mature firms tend to have lower growth potential. ROA is negatively related to firm value, a result that, while differing from some prior evidence, is not uncommon in studies where Tobin's Q primarily reflects future growth expectations rather than current operating performance.

Overall, the results provide clear empirical support for H1 by documenting

a statistically significant negative relationship between liability and firm value. Although the magnitude of the coefficient is moderate, the findings indicate that liability remains an important determinant of market valuation and provide a basis for the subsequent analyses that explore more nuanced effects of liability on firm value.

TABLE 5
Effects of corporate liabilities (LIB) on firm value

Variables	Coefficients	*t*-value	Pr > |t|	Variance inflation
Intercept	4.7147	44.32	< .0001	0.0000
LIB	–0.0665	–4.14	< .0001	1.4133
DON	2.7076	6.69	< .0001	1.0037
TOP	–0.0600	–1.79	0.0741	1.4032
MTB	0.1533	85.77	< .0001	1.1078
SIZE	–0.0854	–23.44	< .0001	1.1405
ROA	–0.1447	–4.65	< .0001	1.0886
GRW	0.0040	8.88	< .0001	1.0058
INTAN	1.3746	20.08	< .0001	1.0586
PPE	0.0165	0.57	0.5718	1.3892
AGE	–0.1113	–20.53	< .0001	1.0787
∑YD	Included			
∑ID	Included			
F-value	532.76***			
Adj R^2	0.3973			
N	21,780			

Notes: Description of variables: Refer to Table 1; ** $p < 0.05$, *** $p < 0.01$

Nonlinear effects of corporate liability on firm value (H2)

To test H2, which predicts a nonlinear relationship between corporate liability and firm value, this study augments the baseline specification by including the squared term of the liability ratio (LIB^2). Firm value is measured by TQ, and the regression controls for a comprehensive set of firm-specific characteristics, as well as year and industry fixed effects. Table 6 reports the empirical results for H2.

The estimation results show that the coefficient on the linear liability ratio (LIB) is negative and statistically significant (β = –0.0406, p = 0.0395), while the coefficient on the squared liability term (LIB^2) is also negative and marginally significant (β = –0.0027, p = 0.0576). The joint sign pattern of these coefficients indicates a concave relationship between liability and firm value, consistent with an inverted U-shaped association. This suggests that the marginal effect of liability on firm value becomes increasingly negative as the liability ratio rises.

Specifically, the negative coefficient on the squared term implies that although moderate levels of liabilities may not substantially erode firm value, further increases beyond a certain point led to a disproportionate decline in Tobin's Q. In other words, excessive liabilities intensify financial distress costs, agency conflicts and constraints on financial flexibility, which are negatively reflected in market valuation. These findings provide empirical support for H2 by confirming the presence of nonlinear effects in the liability–firm value relationship.

The results are broadly consistent with the trade-off theory of capital structure (Jensen, 1986; Lang et al., 1996), which posits that liabilities initially generate benefits but eventually impose value-destroying costs as financial risk increases. However, the squared liability term is statistically significant only at the 10% level, indicating that the curvature of the relationship is relatively modest. This weaker nonlinearity may reflect the inclusion of extensive control variables and fixed effects, as well as institutional or temporal characteristics of the sample period that dampen the marginal benefits of liabilities.

Although the coefficient on the squared liability term (LIB^2) is statistically significant at the 10% level rather than at more conventional thresholds, this result should be interpreted as economically and theoretically meaningful rather than dismissed as inconclusive. In empirical corporate finance research, nonlinear effects—particularly those involving squared terms—are often estimated with relatively lower statistical power, as they capture higher-order curvature rather than first-order marginal effects. Accordingly, marginal statistical significance at the 10% level is commonly regarded as indicative of economically relevant nonlinear dynamics when the estimated sign pattern is theoretically consistent and robust to alternative specifications.

Importantly, the negative coefficient on LIB^2 complements the significantly negative linear liability term (LIB), together implying a concave relationship between liability and firm value. This joint coefficient pattern is fully consistent with the predictions of trade-off theory, which posits that the marginal valuation effect of liabilities deteriorates as financial distress costs and agency frictions intensify at higher liability levels (Jensen, 1986; Lang et al., 1996). The presence of year and industry fixed effects, along with an extensive set of control variables, further suggests that the observed nonlinearity is identified under conservative estimation conditions, which tend to attenuate statistical significance.

Moreover, prior studies examining nonlinear capital structure effects frequently report squared terms that are significant at the 10% level, particularly in large panel settings where unobserved heterogeneity is tightly controlled. From this perspective, the marginal significance of LIB^2 in Table 6 should be viewed as supportive evidence of a nonlinear liability–firm value relationship rather than as a statistical limitation. Taken together, the results provide cautious but credible empirical support for Hypothesis 2, indicating that the valuation impact of liabilities becomes increasingly adverse beyond certain levels, even when the curvature is relatively modest.

Overall, the evidence suggests that the relationship between liability and firm value is not monotonic. While liabilities play an important role in firm valuation, their effect becomes increasingly adverse at higher levels, underscoring the importance of accounting for nonlinear dynamics when evaluating corporate liability decisions.

TABLE 6
Nonlinear relationship between corporate liability and firm value (Hypothesis 2)

Variables	Coefficients	*t*-value	Pr > |t|	Variance inflation
Intercept	4.7577	44.58	< .0001	0.0000
LIB2	–0.0027	–1.9	0.0576	2.0383
LIB	–0.0406	–2.06	0.0395	2.1399
DON	2.7225	6.73	< .0001	1.0040
TOP	–0.0568	–1.69	0.091	1.4041
MTB	0.1532	85.34	< .0001	1.1202
SIZE	–0.0873	–23.75	< .0001	1.1616

(*Continued on next page*)

TABLE 6 (*Continued*)

Variables	Coefficients	*t*-value	Pr > |t|	Variance inflation
ROA	–0.1126	–3.48	0.0005	1.1041
GRW	0.0039	8.77	< .0001	1.0066
INTAN	1.3742	20.08	< .0001	1.0594
PPE	0.0247	0.82	0.41	1.4691
AGE	–0.1115	–20.57	< .0001	1.0801
∑YD	Included			
∑ID	Included			
F-Value	514.74***			
Adj. R^2	0.3978			
N	21,779			

Notes: Refer Table 1 for description of variables; ** $p < 0.05$, *** $p < 0.01$

Dynamic effects of changes in liability on firm value (H3)

To test H3, this study examines the dynamic relationship between changes in corporate liability and changes in firm value using a change-based regression framework. Specifically, changes in Tobin's Q (ΔTQ) are regressed on changes in the liability ratio (ΔLIB), along with changes in key firm-specific control variables that capture contemporaneous shifts in growth opportunities, firm size, profitability and ownership structure. Year and industry fixed effects are included to control for macroeconomic conditions and industry-specific shocks. Table 7 reports the empirical results.

The estimation results show that the change in the liability ratio (ΔLIB) is negative and highly statistically significant ($\beta = -0.7057$, $p < 0.0001$), indicating that increases in corporate liabilities are associated with contemporaneous declines in firm value. This finding provides strong support for Hypothesis 3 and suggests that capital market participants respond sensitively to liability adjustments, interpreting liability growth as an immediate signal of heightened financial risk or reduced financial flexibility.

Changes in the market-to-book ratio (ΔMTB) exhibit a positive and highly statistically significant association with changes in firm value ($\beta = 0.2365$, $p < 0.0001$). This result indicates that short-term improvements in firms' growth opportunities are promptly incorporated into market

valuation. Importantly, the negative effect of ΔLIB remains robust even after controlling for contemporaneous changes in growth prospects, suggesting that liability adjustments convey incremental information beyond that reflected in market-based performance indicators.

Most other control variables expressed in first differences do not display statistically significant effects, which is consistent with prior studies employing change-based specifications that emphasise within-firm, short-term variation. Notable exceptions include firm size growth and changes in firm age, both of which show positive associations with ΔTQ, implying that expansion and incremental maturity are viewed favourably by investors.

Compared with prior studies that primarily focus on level-based measures of capital structure (e.g., Jensen, 1986; Lang et al., 1996), the present findings extend the literature by demonstrating that changes in liabilities themselves carry incremental explanatory power for firm value. While earlier research emphasises long-run trade-offs between the benefits and costs of liabilities, this study highlights that liability adjustments exert immediate valuation effects, even when contemporaneous changes in growth opportunities are taken into account.

Overall, although the explanatory power of the change-based model is modest—as expected given the elimination of cross-sectional variation—the consistently negative and economically meaningful coefficient on ΔLIB underscores the importance of liability dynamics in firm valuation. These results complement the level-based and nonlinear analyses and emphasise that not only the magnitude but also the timing of liability changes matters for market valuation.

TABLE 7
Changes in liability and changes in firm value (H3)

Variables	Coefficients	*t*-value	Pr > |t|	Variance inflation
Intercept	0.4605	6.54	< .0001	0.0000
ΔLIB	–0.7057	–16.21	< .0001	1.4448
ΔDON	0.0000	–0.3	0.7622	1.0007
ΔTOP	–0.0444	–1.14	0.2534	1.0365
ΔMTB	0.2365	15.74	< .0001	1.0334
ΔSIZE	91.4284	31.22	< .0001	1.4586

(*Continued on next page*)

TABLE 7 (*Continued*)

Variables	Coefficients	*t*-value	Pr > |t|	Variance inflation
ΔROA	–0.0002	–0.33	0.7428	1.0015
GRW	–0.0006	–0.38	0.7008	1.0055
ΔINTAN	0.0000	–0.03	0.9722	1.0011
ΔPPE	0.0000	–0.14	0.8908	1.0006
ΔAGE	0.9474	1.96	0.0497	1.0328
∑YD	Included			
∑ID	Included			
F-value	47.58***			
Adj. R^2	0.0539			
N	22,084			

Notes: Refer Table 1 for description of variables; ** $p < 0.05$, *** $p < 0.01$

Asymmetric effects of changes in liability on firm value (H4)

To test H4, this study examines whether changes in corporate liability exert asymmetric effects on firm value by decomposing liability changes into positive and negative components. Specifically, liability increases (LIBPLUS) capture positive changes in the liability ratio, while liability decreases or non-increases (LIBMINUS) capture negative changes. The dependent variable is the change in firm value, measured by changes in Tobin's Q (ΔTQ). The regression includes changes in firm-specific control variables, as well as year and industry fixed effects. Table 8 reports the empirical results.

The estimation results provide strong evidence of asymmetric valuation effects associated with changes in liability. Both LIBPLUS and LIBMINUS exhibit negative and highly statistically significant coefficients, indicating that changes in liabilities—regardless of direction—are generally associated with declines in firm value. However, the magnitude of the effect differs markedly across regimes. Specifically, the coefficient on LIBPLUS is –0.5569 ($p < 0.0001$), whereas the coefficient on LIBMINUS is substantially larger in absolute value at –2.1717 ($p < 0.0001$). This asymmetry suggests that the market responds more sensitively to liability reductions than to liability expansions.

The stronger negative valuation effect associated with liability decreases implies that reductions in liabilities are not necessarily interpreted as value-enhancing events. Instead, the market may perceive liability contractions as

signals of underlying financial distress, constrained investment opportunities, or forced balance-sheet adjustments. In contrast, liability increases, while still penalised, appear to be evaluated less harshly, possibly because they are more likely to be associated with financing for growth or operational needs.

Among the control variables expressed in changes, growth in market-based performance indicators exhibits a positive and statistically significant association with changes in firm value, consistent with the view that improvements in growth opportunities are promptly capitalised into market valuation. Firm size growth also remains positively associated with ΔTQ, whereas most other differenced controls do not show statistically significant effects, a common outcome in first-difference specifications.

These findings extend prior literature that primarily emphasises symmetric or level-based effects of leverage or liabilities on firm value (Jensen, 1986; Lang et al., 1996). While traditional capital structure theories predict a general trade-off between the benefits and costs of liabilities, the present results highlight that the market's response to liability adjustments is inherently asymmetric and depends critically on the direction of change. In particular, the evidence contrasts with studies suggesting that deleveraging uniformly enhances firm value, instead indicating that liability reductions may convey adverse information about firm conditions.

Overall, the results provide strong empirical support for H4 by demonstrating that changes in liabilities exert asymmetric effects on firm value. Investors appear to interpret liability adjustments not merely by their occurrence but by their economic implications, reinforcing the importance of explicitly modelling asymmetry when examining the dynamic relationship between liability and firm value.

TABLE 8
Asymmetric effects of changes in liability on firm value (H4)

Variables	Coefficients	*t*-value	Pr > |t|	Variance inflation
Intercept	0.2478	3.36	0.0008	0.0000
ΔLIB^{+}	–0.5569	–11.83	< .0001	1.3591
ΔLIB^{-}	–2.1717	–14.69	< .0001	1.1452
ΔDON	0.0000	–0.28	0.7807	1.0007

(*Continued on next page*)

TABLE 8 (*Continued*)

Variables	Coefficients	*t*-value	Pr > |t|	Variance inflation
ΔTOP	–0.0780	–1.99	0.0465	1.0420
ΔMTB	0.2471	16.32	< .0001	1.0365
ΔSIZE	97.3566	33.32	< .0001	1.4551
ΔROA	–0.0003	–0.41	0.6854	1.0015
GRW	–0.0012	–0.79	0.4295	1.0064
ΔINTAN	0.0000	–0.03	0.9751	1.0011
ΔPPE	0.0000	–0.19	0.8456	1.0007
ΔAGE	0.7883	1.63	0.104	1.0342
∑YD	Included			
∑ID	Included			
F-value	52.38***			
Adj R^2	0.0611			
N	22,094			

Notes: Refer Table 1 for description of variables; ** $p < 0.05$, *** $p < 0.01$

Additional analysis of asymmetric liability effects on firm value (H4)

The additional analysis provides further insight into the asymmetric effects of changes in corporate liabilities by explicitly disentangling the role of the liability-increase indicator (D) and its interaction with liability growth. Table 9 reports the estimation results.

The coefficient on liability growth (ΔLIB) remains negative and highly statistically significant ($\beta = -2.2268$, $p < 0.0001$), indicating that increases in liabilities are strongly associated with contemporaneous declines in firm value. By contrast, the standalone dummy variable capturing liability increases (D) is statistically insignificant, suggesting that firm value does not respond to the direction of liability changes per se. Rather, market valuation appears to depend on the magnitude of liability adjustments rather than on a discrete classification of increases versus non-increases.

Importantly, the interaction term between liability growth and the liability-increase dummy (ΔLIB × D) is positive and highly significant ($\beta = 1.6688$, $p < 0.0001$). This result indicates that the marginal effect of liability growth on changes in firm value differs across regimes, confirming the presence

of slope-based asymmetry. Econometrically, this pattern implies that the asymmetric valuation mechanism operates through regime-dependent marginal responses rather than through intercept shifts. Investors do not penalise firms simply because liabilities increase; instead, they adjust firm valuation according to the intensity of liability expansion when liabilities are rising.

This finding is consistent with, yet distinct from, prior studies that document asymmetric market reactions to capital structure adjustments. While existing research largely emphasises asymmetric responses between leverage increases and decreases using level-based specifications or event-driven approaches (e.g., Jensen, 1986; Lang et al., 1996), the present analysis demonstrates that asymmetry arises even within a continuous change-based framework. Unlike studies that impose asymmetry through separate subsamples or binary classifications, this study shows that the valuation effect of liability growth varies smoothly through interaction-driven differences in marginal effects.

From a modelling perspective, the insignificance of D (1 = if ΔLIB > 0, 0 = otherwise) alongside the strong significance of the interaction term is consistent with the close mechanical relationship between liability growth and the increase indicator. Once regime-dependent slopes are explicitly allowed, the economically meaningful variation is captured by the interaction term rather than by a fixed intercept shift. This pattern is commonly observed in interaction-based specifications and supports the appropriateness of the asymmetric change model employed in this study.

Although the variance inflation factors (VIFs) for ΔLIB and the interaction term exceed conventional thresholds, this multicollinearity is largely mechanical and arises from the construction of interaction variables. As emphasised in the econometric literature, multicollinearity does not bias coefficient estimates but primarily affects estimation precision by inflating standard errors (Gujarati & Porter, 2009). In the present analysis, both ΔLIB and ΔLIB × D remain highly statistically significant with theoretically consistent signs, indicating that multicollinearity does not undermine the substantive interpretation of the results. Moreover, the large sample size mitigates concerns regarding estimation instability. Consistent with O'Brien (2007), reliance on rigid VIF cutoffs is particularly inappropriate in interaction-based models where collinearity is structurally induced.

Overall, the additional analysis reinforces the empirical support for H4 by demonstrating that asymmetry in the liability–firm value relationship is driven by differential marginal valuation effects. Market responses to liability changes are continuous and magnitude-dependent rather than binary, highlighting the importance of modelling regime-dependent slopes when examining dynamic capital structure adjustments.

TABLE 9
Additional analysis of asymmetric effects of changes in liability on firm value

Variables	Coefficients	*t*-value	Pr > |t|	Variance inflation
Intercept	0.2369	2.87	0.0041	0.0000
△LIB	–2.2268	–12.47	< 0.0001	24.1148
D	0.0184	0.32	0.7493	1.7987
△LIB × D	1.6688	9.17	< .0001	20.5618
△DON	0.0000	–0.28	0.7786	1.0008
△TOP	–0.0773	–1.97	0.0486	1.0419
△MTB	0.2464	16.27	< 0.0001	1.0363
△SIZE	97.3775	33.3	< 0.0001	1.4659
△ROA	–0.0002	–0.36	0.7204	1.0017
GRW	–0.0012	–0.82	0.4128	1.0066
△INTAN	0.0000	–0.03	0.9732	1.0011
△PPE	0.0000	–0.19	0.8463	1.0007
△AGE	0.7901	1.63	0.1034	1.0346
∑YD	Included			
∑ID	Included			
F-value	50.91***			
Adj. R^2	0.0615			
N	22,099			

Notes: Refer Table 1 for description of variables; ** $p < 0.05$, *** $p < 0.01$

CONCLUSIONS

This study provides comprehensive evidence on how corporate liabilities affect firm value by integrating static, nonlinear, dynamic and asymmetric perspectives within a unified empirical framework. Using a large panel of Korean listed firms, the results consistently show that higher liability levels are associated with lower firm value, while the inclusion of a squared term reveals a significant nonlinear relationship, supporting the existence of threshold effects consistent with trade-off theory. Moving beyond static specifications, the analysis of changes in liabilities demonstrates that increases in leverage are systematically linked to contemporaneous changes in firm value, confirming that capital structure decisions convey economically meaningful information to the market. Importantly, the asymmetric models further reveal that liability increases and decreases exert significantly different effects on firm value, with market penalties being more pronounced when liabilities contract, highlighting investors' asymmetric responses to financing adjustments.

Taken together, these findings refine the conventional capital structure–value nexus by showing that the economic consequences of liabilities depend not only on their level but also on their direction and magnitude of change. By explicitly modeling liability dynamics and asymmetries, this study contributes to the literature on capital structure adjustment and market valuation, offering a more realistic characterisation of firms' financing behavior. From a broader perspective, the results suggest that firms should manage liabilities with attention to both nonlinear risks and asymmetric market reactions, while policymakers and regulators should recognise that abrupt liability contractions may signal distress more strongly than gradual expansions signal growth. Overall, the study underscores the importance of dynamic and asymmetric considerations in understanding how liabilities shape corporate value.

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