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Article

Dynamic Capital Structure Adjustment: An Integrated Analysis of Firm-Specific and Macroeconomic Factors in Korean Firms

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Abstract: This research investigates the factors influencing the capital structure of 271 non-financial firms listed on the Korean Stock Exchange (KSE) over a broad period from 1995 to 2021, encompassing both stable and crisis conditions. Employing a dynamic panel data model and the generalized method of moments (GMM) estimation, we address the endogeneity issue introduced by the inclusion of lagged dependent variables. Our research integrates firm-specific internal factors with macroeconomic external variables to provide a comprehensive understanding of the influence of varying economic environments on capital structure. Our study suggests that in times of economic stability, the capital structure decisions of a firm are more influenced by internal factors such as profitability. However, in periods of economic downturns, it is the external macroeconomic market conditions that tend to have a greater impact on these decisions. It is also noteworthy that both book leverage (BL) and market leverage (ML) exhibit quicker adjustments during stable periods as opposed to periods of crisis. This indicates a higher agility of firms in adapting their capital structures in stable, normal conditions. Our findings contribute to the existing literature by offering a holistic view of capital structure determinants in Korean firms. They underscore the necessity of adaptable financial strategies that account for both internal dynamics and external economic conditions. This study fills a gap in current research, presenting new insights into the dynamics of capital structure in Korean firms and suggesting a multifaceted approach to understanding capital structure in diverse economic contexts.

Keywords: dynamic capital structure; capital structure determinants; GMM estimation; adaptable financial strategies

JEL Classification: G32

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1. Introduction

The exploration of corporate capital structure, a critical aspect of financial management, has captivated scholars and practitioners for decades. Central to this investigation is understanding how firms balance debt and equity to finance their operations, a decision influenced by a complex interplay of factors. These choices shape a firm's financial health and operational agility. Our study delves into the dynamics of capital structure within Korean firms, offering a comprehensive analysis that integrates both firm-specific and macroeconomic factors over a span of more than two decades (1995–2021). This period, rich in economic history, encompasses phases of stability, growth, and significant crises, presenting a distinctive backdrop for examining the adaptability and resilience of corporate financial strategies.

The capital structure of Korean firms, set against the backdrop of South Korea's remarkable economic journey from an emerging to a developed economy, provides a unique case for study. Despite the significant implications of such a transition, the existing literature has not sufficiently focused on Korean firms, leaving a notable gap in understanding how these firms navigate financial decisions amidst evolving economic landscapes. Our study addresses this gap by adopting a holistic approach that considers both internal firm dynamics and the broader macroeconomic environment. This approach is vital as it acknowledges that firm-level decisions do not occur in isolation but are significantly influenced by external economic conditions.

Our analytical framework spans three distinct periods: the entire duration from 1995 to 2021, a 'normal' period characterized by relative economic stability, and periods marked by financial crises. Through this segmented analysis, we thoroughly examine how 271 non-financial firms listed on the KSE adapt their capital structure strategies to various economic environments. South Korea's major crises during this period, including the Asian financial crisis (1997–1999), the global credit crisis (2007–2009), and the COVID-19 pandemic (2020–2021), provide critical junctures for our study. These crises serve as natural experiments that allow us to observe how firms adjust their capital structures in response to sudden and severe economic shocks compared to periods of economic normalcy.

Our study extends beyond the traditional focus on firm-specific variables, such as profitability, liquidity, and size, to include macroeconomic variables like the growth rate, inflation rate, credit premium, and term premium. This integration is crucial, particularly in a dynamic and evolving economy like South Korea, where macroeconomic shifts can significantly impact financing decisions. Methodologically, we employ a dynamic panel data model that incorporates lagged dependent variables as additional predictors. This approach addresses the endogeneity issues that frequently challenge capital structure analyses. We utilize the generalized method of moments (GMM) estimation, a robust method well-suited for analyzing dynamic capital structure adjustments. This method enables us to disentangle the complex interplay between firm-specific characteristics, macroeconomic conditions, and capital structure across regular periods and financial crises.

Our empirical findings offer intriguing insights into the capital structure decisions of Korean firms. We observe notable distinctions in the determinants of capital structure between normal and crisis periods. For example, variables like research and development costs and industry average leverage rates exhibit significant influence only during normal periods, while factors such as depreciation to EBIT and term premiums become prominent during crises. This variability underscores the adaptability of Korean firms in modifying their capital structures in response to shifting economic landscapes.

In sum, our study presents a thorough investigation into the capital structure dynamics of Korean firms, meticulously analyzing the interplay between firm-specific variables and macroeconomic factors across various economic periods. By offering a detailed examination of both stable normal times and periods of economic crisis, our research provides a comprehensive understanding of how different economic conditions influence corporate capital structuring in the Korean context. The practical implications of our findings extend to corporate managers and policymakers, offering insights into effective capital structure management across diverse economic conditions. Our study deepens insights into the determinants of capital structure in Korean firms and enriches the global dialogue on corporate finance, set against the backdrop of a nation's swift evolution from an emerging to a developed economic status. By integrating firm-specific and macroeconomic factors, our study highlights the importance of a multifaceted approach in financial decision-making. The following section will commence with the Literature Review, followed by discussions on the Model, Data, and Methodology. This will be followed by the presentation of Empirical Results, and the paper will conclude with the Conclusion section.

2. Literature Review

The study of capital structure, a core theme in corporate finance, has traditionally oscillated between two main theories: the trade-off theory and the pecking order theory. The trade-off theory, as postulated by Modigliani and Miller (1958), suggests an optimal capital structure balance, where firms leverage debt until the marginal benefits and costs equilibrate. This theory has led to numerous empirical investigations into various firm-specific determinants of this optimal balance, including profitability, liquidity, investment opportunities, and more. The pecking order theory, on the other hand, proposed by Myers (1977), argues for a financing hierarchy influenced by information asymmetry, where firms prefer internal funding over external debt and debt over equity.

However, both theories have often been critiqued for their static nature, overlooking the temporal shifts and adjustments in capital structure. This gap was identified by Jalilvand and Harris (1984), who suggested that capital structure should be viewed as an ongoing process of adjustment towards a long-term target. Subsequent studies by Fischer et al. (1989), Banerjee et al. (2004), Miguel and Pindado (2001), and Ozkan (2001) further explored this dynamic perspective, highlighting the continuous adjustment process toward an optimal debt-to-equity ratio. This line of thought was supported by empirical evidence from Kremp et al. (1999), who observed a dynamic capital structure adjustment process in French and German firms.

The exploration of macroeconomic variables in capital structure analysis has significantly enhanced our comprehension of how broader economic contexts influence corporate finance decisions. A notable contribution in this field is Cook and Tang's (2010) research, which underscored the impact of macroeconomic conditions on the pace of capital structure adjustments. Their study revealed that firms tend to adjust their capital structures more swiftly in favorable economic environments compared to less favorable ones. However, Cook and Tang's approach to classifying macroeconomic conditions into binary categories of "good" or "bad," based on subjective criteria, has been critiqued for potentially oversimplifying complex economic dynamics. In their analysis, Cook and Tang segmented thirty years of data into quintiles based on four distinct macroeconomic variables: term spread, default spread, GDP growth rate, and dividend yield. However, an inherent challenge arose as these variables often do not exhibit synchronous trends, leading to differing classifications. To tackle this, their methodology included the individual analysis of each macroeconomic variable and the introduction of an interaction term. This term was formulated by multiplying the lagged leverage ratio with a dummy variable representing the 'good' state, as defined by each macroeconomic variable. The dummy variable was assigned a value of 1 if a firm-year observation was deemed to be in a good state and 0 otherwise. This approach was employed to discern variations in the speed of capital structure adjustment toward target leverage under contrasting economic conditions, delineated as 'good' and 'bad' states. Such a method, while innovative, has been subject to debate regarding its accuracy and effectiveness in capturing the true nature of macroeconomic influences on capital structure adjustments. For example, Faulkender and Petersen (2014) argued that classifying macroeconomic conditions based on single variables overlooks their complex interactions and proposed a dynamic index approach, while Lemmon and Zender (2016) criticized the binary classification and interaction term methodology, proposing a model accounting for time-varying target leverage and firm-specific heterogeneity. This scrutiny highlights the ongoing need for refined methodologies in understanding the intricate relationship between macroeconomic factors and corporate capital structure decisions. In contrast to Cook and Tang's (2010) approach, our study proposes a different classification, dividing the analysis into 'normal' and 'crisis' periods. This methodology, while incorporating macroeconomic indicators such as growth rate, inflation rate, credit premium, and term premium, aims to offer a more realistic representation of the influence of economic conditions on capital structure. Kim and Shin (2011) and Kim et al. (2015) conducted similar studies in Korea, splitting macroeconomic conditions into "good" and "bad" periods. However, they faced similar challenges with data overlaps and inconsistencies, highlighting the complexity of categorizing economic states. Studies by Tzang et al. (2013) in Indonesia and Tran and Nguyen (2019) in Vietnam adopted Cook and Tang's methodology for emerging markets, agreeing on faster adjustment speeds in positive economic conditions but also facing criticism for potential oversimplification.

Our study aims to build upon and move beyond Cook and Tang's (2010) analysis. By classifying the economic conditions into 'normal' and 'crisis' periods and incorporating a range of macroeconomic variables, we seek to provide a more nuanced understanding of the dynamics influencing capital structure in Korean firms. This approach aligns with the call for more dynamic and comprehensive analyses in capital structure research, as echoed in the works of Rubio and Sogorb (2011), who reported quicker adjustments during adverse conditions, and the works of Kim et al. (2015), who recommended using the default spread as a proxy for economic conditions.

Firm-Specific Micro Determinants:[1]

Our study delves into the intricate dynamics of leverage ratios in firms, dissecting the factors that drive both the mitigation of high leverage and the circumstances leading to its increase. The research draws upon the insights of Hovakimian et al. (2004) and Flannery and Rangan (2006), who highlight how firms actively manage their leverage to prevent excessive debt levels. This is juxtaposed with the perspective of Drobetz and Wanzenried (2006), who, through the lens of the pecking order theory, suggest that leverage escalates when a firm's investments surpass its retained earnings. A critical factor in our analysis is the role of tangible assets as collateral, which can significantly influence a firm's debt capacity. Following the findings of Titman and Wessels (1988) and Hovakimian et al. (2004), we examine the ratio of gross property, plant, and equipment to total assets, acknowledging that higher tangible asset levels often correlate with lower bankruptcy costs and, consequently, a greater ability to incur debt. Profitability, another key determinant, is gauged using the ratio of earnings before interest and taxes (EBIT) to total assets. This measure is essential as firms with superior earnings relative to their assets generally exhibit lower leverage, primarily due to the diminished need for external debt financing in light of substantial retained earnings. A recent paper by Memon et al. (2021) examined the determinants of optimal capital structure in Pakistan; their findings highlight that profitability plays a role, along with other factors. We also investigate the relationship between depreciation expenses and debt issuance. Our analysis considers the ratio of depreciation to EBIT, recognizing that firms with higher depreciation charges may be less inclined to seek debt financing for tax shield benefits. Firm size, represented by the natural logarithm of total assets, is another vital component. Larger firms are often associated with higher leverage, a trend attributed to their lower cash flow volatility, better access to financial markets, and reduced likelihood of financial distress, as noted by Rajan and Zingales (1995) and Hovakimian et al. (2004). In assessing firm uniqueness, we incorporate measures such as the ratio of R&D expenses to total assets, a dummy variable for R&D expenditure, and selling expenses relative to total sales. These factors are crucial as they signify unique assets and product development, which could elevate bankruptcy costs and thereby influence firms to maintain lower leverage ratios (Titman 1984; Hovakimian et al. 2004). Lastly, to capture industry-specific nuances that other variables may not fully represent, we include the average leverage ratio of the firm's industry based on the Fama and French 49 industry classification. This addition helps to ensure that our analysis is comprehensive and considers the broader industry context in which firms operate.

Macroeconomic Determinants:

Hackbarth et al. (2006) suggest that firms are more inclined to restructure their capital when economic conditions are favorable, leading to a faster adjustment speed during prosperous macroeconomic times. To examine the impact of these conditions on capital structure adjustment speed, it is crucial to analyze a well-chosen set of macroeconomic indicators. Our study employs widely recognized factors in financial literature, including the term spread, default spread, GDP growth rate, and inflation rate. While Drobetz and Wanzenried (2006) consider the three-month money market interest rate as a relevant factor, Estrella and Hardouvelis (1991) contend that the yield curve's slope offers greater predictive power than short-term interest rates. A high term spread typically forecasts a robust economy, as noted by Stock and Watson (1989) and Estrella and Mishkin (1998). In our analysis, following the approach of Korajczyk and Levy (2003) and Fama and French

(1989), we define default spread as the difference in average yields between bonds rated Baa and those rated Aaa with three-year maturities. This measure effectively tracks long-term business cycle trends, rising during recessions and falling in expansions. Considering that an economic recession is formally recognized as a decline in real gross domestic product (GDP) across two or more consecutive quarters, we utilize the real GDP growth rate as a direct barometer of macroeconomic health. Additionally, we include the inflation rate in our analysis, acknowledging its significance in economic assessments.

This literature review[2] elucidates the evolving nature of capital structure theory and practice, highlighting the shift from static to dynamic models and the growing importance of macroeconomic factors. Our study contributes to this body of literature by adopting a more comprehensive and realistic approach to analyzing capital structure dynamics, especially in the context of Korean firms. This approach enhances our understanding of the interaction between firm-specific factors and macroeconomic conditions and provides valuable insights for future research and practical applications in corporate finance.

3. Model, Data, and Methodology

Model:

Our model incorporates the methodology put forth by Cook and Tang (2010), which involves a two-stage regression process to determine target leverage (D*) and evaluate how quickly a firm corrects its course toward this target when deviating from it. In the first stage, we estimate the target leverage D* of a firm (i) at a given time (t) using Equation (1):

$$D_{i,t}{}^{*} = \gamma Macro_{t-1} + ßX_{i,t-1} \quad (1)$$

In this equation, $D_{i,t}{}^{*}$ is the target leverage of the firm i at time t, which is a function of macroeconomic variables from the previous period, $Macro_{t-1}$, and ith firm-specific variables from the previous period, $X_{i,t-1}$. In the second stage, we examine the firm's adjustment speed back toward its target leverage when it deviates from it. This is represented by Equation (2):

$$D_{i,t} - D_{i,t-1} = \delta(D_{i,t}{}^{*} - D_{i,t-1}) + \varepsilon_{i,t} \quad (2)$$

Here, δ signifies the speed of adjustment, representing the proportion of the deviation from the target leverage from time (t − 1) to time (t). When δ equals 1, it means that firms adjust their capital structure towards their target level flawlessly. However, if δ is less than 1, it indicates the presence of adjustment costs. Subsequently, we substitute Equation (1) into Equation (2) and rearrange them, which gives us Equation (3):

$$D_{i,t} = (1 - \delta)\, D_{i,t-1} + \delta\, ßX_{i,t-1} + \gamma Macro_{t-1} + \varepsilon_{i,t} \quad (3)$$

In Equation (3), the leverage of a firm (i) at a given time (t) is depicted as a linear function of macroeconomic conditions with a lag of 1 period, $Macro_{t-1}$, and firm-specific factors, $X_{i,t-1}$. The coefficient of the lagged leverage ratio is represented as (1 − δ), where δ is the speed of adjustment or the proportion of the deviation from the target leverage that is corrected from period (t − 1) to period (t). Therefore, to determine the adjustment speed, we first run the regression of Equation (3), estimate the coefficient of the lagged leverage ((1 − δ)), and then convert it into δ.

Data:

We gathered sample data from non-financial firms listed on the Korean Stock Exchange over the period from 1995 to 2021. Within this timespan, South Korea experienced three significant crises: the currency crisis from 1997 to 1999, the global credit crisis from 2007 to 2009, and the coronavirus crisis from 2020 to 2021. We segmented our analysis into three different periods: the entire span from 1995 to 2021, 'normal' periods, which exclude crisis times, and the periods of crisis. We acquired our data from FnGuide.

Table 1 provides the descriptive statistics of the variables we used. Our dependent variables are two forms of leverage: book-value leverage (BL) and market-value leverage (ML). Both BL and ML are calculated using Equation (4):

$$D_{i,t} = BL_{i,t} = (SD_{i,t} + LD_{i,t})/TA_{i,t}$$

$$D_{i,t} = MLi,t = (SD_{i,t} + LD_{i,t})/(SD_{i,t} + LD_{i,t} + S_{i,t}P_{i,t}) \quad (4)$$

In Equation (4), SD + LD represents the sum of short-term and long-term debt at time t for book-value leverage, and TA denotes total assets. S and P signify the outstanding numbers of stocks and the stock price, respectively, which are used to compute the market value of equity for market-value leverage.

Table 1. Descriptive Statistics.

Variable	Obs.	Mean	Standard Dev.	Min.	Max.
BL	7317	0.493	0.200	0.024	0.999
ML	5886	0.868	0.181	0.040	0.999
ROA	7317	0.044	0.063	−0.657	0.550
CR	7317	1.825	1.826	0.116	40.785
PBR	7317	1.125	1.903	0	93.150
FixR	7317	0.533	0.161	0.09	0.972
Log(asset)	7317	19.667	1.62	15.464	26.779
DpEBIT	7317	0.18	1.971	−28.031	100.204
RDasset	7317	0.005	0.011	−0.002	0.184
RDdummy	7317	0.592	0.491	0	1
SalesExp	7317	0.128	0.118	0.002	1.955
IndBLrate	7317	0.602	0.135	0.242	0.918
NIvar	7317	25,788,259	1.271×10^9	-5.322×10^9	4.425×10^9
TAXrate	7317	0.178	3.122	−188.465	92.347
GDP rate	7317	0.065	0.044	−0.050	0.157
Inflation rate	7317	0.027	0.015	0.006	0.066
CreditPremium	7317	−0.974	3.658	−10.08	2.450
TermPremium	7317	−1.654	6.970	−33.700	2.460

We have chosen a range of firm-specific determinants, $X_{i,t-1}$, guided by variables commonly used in previous empirical research. These include:

(1) Profitability: measured by the return on asset (ROA).
(2) Liquidity: measured by the current ratio (CR).
(3) Investment opportunity, measured by the price-to-book ratio (PBR),
(4) The ratio of fixed assets (FixR): calculated as tangible assets divided by total assets.
(5) Firm size: measured by the natural logarithm of assets (Log(assets)).
(6) Depreciation: represented by the ratio of depreciation to EBIT (DpEBIT).
(7) Ratio of research and development (R&D) cost: determined by dividing R&D expense by total assets (RDasset).
(8) R&D Dummy variable (RDdummy): This variable is set to 1 if firms report R&D expenses and 0 otherwise.
(9) Ratio of sales expense (SalesExp): calculated by dividing sales expense by total sales.
(10) Industry average of book value-based leverage (IndBLrate).
(11) Volatility of net income: measured by the variance from the net income trend (NIvar).
(12) Effective tax rate (TAXrate): calculated by dividing corporate tax by EBIT.

Firm-specific variables from (1) to (9) were incorporated following Cook and Tang (2010), while variables (10) and (11) were guided by Kim et al. (2015) and Kremp et al. (1999), respectively. Variable (12) was incorporated as per Kim and Sorensen (1986). Proxy variables for firm uniqueness, such as (7) R&D, (8) R&Ddummy, and (9) SalesExp, were adopted following Titman (1984) and Hovakimian et al. (2004). Furthermore, Kim et al. (2015) utilized (10) IndBLrate to account for unobservable industry characteristics. We calculated (10) IndBLrate using the Korean Standard Industrial Classification and Korean Stock Exchange Classification to categorize each industry.

Regarding macroeconomic variables, $Macro_{t-1}$, we incorporated four key variables:

(1) Gross domestic product (GDP) growth rate
(2) Inflation rate.
(3) Credit premium.
(4) Term premium.

The inflation rate was calculated using the consumer price index (CPI) according to the following formula: current year inflation = (current year CPI − previous year CPI)/previous year CPI. Credit premium was determined as the difference between the average return on 3-year BBB-rated corporate bonds and 3-year AAA-rated corporate bonds. Meanwhile, the term premium was computed as the difference between the 10-year treasury bond rate and the 1-year Treasury bill rate. The GDP growth rate was also adopted as a proxy variable for macroeconomic conditions.

4. Estimation Methodology

Equation (3) in our model integrates lagged dependent variables as supplementary independent predictors. By doing so, it addresses unobserved heterogeneity and reflects the dynamic tendencies inherent in capital structure adjustment. However, this inclusion introduces an endogeneity concern in the estimation process. To overcome it, we follow the first-differenced generalized method of moments (GMM) approach proposed by Arellano and Bond (1991). This method involves creating a first difference of the original equation to eliminate the error term, then using instrumental variables for estimation. If we assume no serial correlation in the error term, we can utilize all lagged levels of the variables as instrumental variables in the differenced equation. Additionally, lagged differences $(t-2)$ of the variables are used as instrumental variables to account for the potential correlation between ε and ε_{t-2}. This accounts for the endogeneity of the independent variables, as shocks that affect leverage may also impact other exogenous variables. However, the first differencing introduces a new potential bias. The new error term $(\varepsilon_{t-1} - \varepsilon_{t-2})$ may exhibit a correlation with the lagged dependent variable (ΔD_{t-1}), creating a potential correlation between the error term and the lagged dependent variable. To handle this, Arellano and Bond (1991) proposed two moment conditions and recommended the GMM estimator. The effectiveness of the GMM estimator depends on the validity of the instrumental variables and the assumption of no serial correlation in the error term. Two specification tests, as proposed by Arellano and Bond (1991), are used to validate these assumptions. The first, the Hansen J test, inspects the overall validity of the instrumental variables by checking over-identification restrictions. The second, the Arellano–Bond test, scrutinizes whether the differenced error term $(\Delta\varepsilon t)$ displays serial correlation, specifically second-order. A successful model fit is confirmed when the null hypothesis is accepted in both tests.

The system generalized method of moments (GMM) estimator, pioneered by Blundell and Bond, represents a sophisticated evolution of the original difference GMM estimator introduced by Arellano and Bond. This advancement is principally characterized by its innovative integration of both differenced and level equations within a unified analytical framework, thereby enhancing the estimator's efficiency and ameliorating some of the inherent limitations observed in the difference GMM approach. The difference GMM estimator is specifically formulated to neutralize unobserved panel-specific effects through the differencing of data, employing lagged levels of variables as instruments for the differenced equations. However, this methodology may engender weak instruments, particularly in instances where variables demonstrate temporal persistence, resulting in estimates that are potentially biased and inefficient. In contrast, the system GMM estimator augments this framework by introducing an additional series of equations that utilize the lagged differences of variables as instruments for the level equations. This methodological enhancement is aimed at addressing the potential biases and inefficiencies associated with variable persistence. By assimilating a broader spectrum of information, the system GMM estimator is posited to yield more efficient and robust estimates under specific conditions, signifying a significant contribution to the econometric analysis of panel data.

The GMM methodology presents a sophisticated framework for econometric analysis, yet its deployment is accompanied by complexities that demand rigorous scrutiny. Critical to the assurance of the reliability and validity of findings derived from GMM-based research is the meticulous selection and validation of instruments, adept handling of over and weak identification issues, and the mitigation of biases attributed to finite sample sizes. In pursuit of this objective, we have undertaken a series of robustness checks designed to evaluate the resilience of our results to variations in model specifications and the composition of instrument sets. This evaluation process included adjusting the lag length and incorporating alternative estimation techniques, notably the two-step GMM, to affirm the steadfastness of our findings. The consistency observed across these varied tests bolsters our confidence in the robustness of our research outcomes. It underscores our commitment to upholding the highest standards of reliability and validity in our conclusions, thereby contributing substantively to the body of econometric research that relies on the GMM methodology.

5. Empirical Results

Unit-Root Tests

The Im–Pesaran–Shin test is applied to the panel data to test whether all the research variables observe stationarity. Choi (2001) suggested that this test is suitable for unbalanced panels as it allows the inclusion of accepting any number of lags. The Im–Pesaran–Shin null hypothesis states that all the panels contain a unit root. The test also assumes that the error term is normally independently distributed for all cross-sectional dimensions and time dimensions and allows the error term to have heterogeneous variances across panels (Im et al. 2003).

Table 2 shows the results of the Im-Pesaran-Shin (IPS) unit-root test, which assumes that slopes are heterogeneous. The IPS unit root test results for the full sample indicate that most variables except for Log(asset) and RDasset are stationary at the 1% level. Log(asset), which is not stationary, is found to be stationary at the first difference. The RDasset variable, however, does not pass the IPS unit root test, not due to a non-stationarity issue but rather because of a lack of sufficient data. As a result, we conduct alternative unit root tests on the RDasset variable. The findings, detailed in Table 3, include the Levin–Lin–Chu, Breitung, and Harris–Tzavalis unit root tests specifically applied to the RDasset.

Table 2. IPS unit-root.

Variable	Level IPS		First Difference IPS	
	t-statistic	*p* value	t-statistic	*p* value
BL leverage	−10.0294	0.0000	−40.6413	0.0000
ML leverage	−6.8716	0.0000	−42.4561	0.0000
ROA	−15.8920	0.0000	−52.6272	0.0000
CR	−8.5518	0.0000	−49.6674	0.0000
PBR	−19.2044	0.0000	−53.0557	0.0000
FixR	−9.5486	0.0000	−44.7307	0.0000
Log(asset)	2.2230	0.9869	−39.5209	0.0000
DpEBIT	−27.2053	0.0000	−67.8785	0.0000

Table 2. *Cont.*

Variable	Level IPS		First Difference IPS	
RDasset	Different unit root test methods			
SalesExp	−10.6486	0.0000	−49.1544	0.0000
IndBLrate	−8.6659	0.0000	−52.2762	0.0000
NIvar	−11.7191	0.0000	−57.7342	0.0000
TAXrate	−72.2612	0.0000	−97.9216	0.0000
GDP rate	−40.3811	0.0000	−91.1696	0.0000
Inflation rate	−20.6140	0.0000	−65.5409	0.0000
Credit Premium	−17.9801	0.0000	−29.5521	0.0000
Term Premium	−13.3741	0.0000	-1.1×10^2	0.0000

Table 3. Other unit root tests on RDasset.

Variable	Level Levin–Lin–Chu		First Difference Levin–Lin–Chu	
	t-statistic	*p* value	t-statistic	*p* value
RDasset	−28.8363	0.0000	−66.3322	0.0000
	Level Breitung		First difference Breitung	
	−7.7306	0.0000	−32.9565	0.0000
	Level Harris–Tzavalis		First difference Harris–Tzavalis	
	−18.5364	0.0000	-1.6×10^2	0.0000

As in Table 3, RDasset passes all of the Levin–Lin–Chu, Breitung, and Harris–Tzavalis unit root tests. The results of Levin–Lin–Chu, Breitung, Harris–Tzavalis unit root tests consistently demonstrate stationarity of RDasset not only at the level data but also in the first differences.

Now that we know that our first differenced data all pass the unit root tests, we investigate four regression models in order to select the model. Four models considered here are (1) pooled OLS estimation, (2) fixed effect estimation, (3) differenced GMM estimation, and (4) system GMM estimation, all the results of which are shown in Table 4.

Table 4. Model selection of four regression models.

	BL REGRESSION ANALYSIS				ML REGRESSION ANALYSIS			
	(1) Pooled OLS	**(2) Fixed Effect**	**(3) Differenced GMM**	**(4) System GMM**	**(1)′ Pooled OLS**	**(2)′ Fixed Effect**	**(3)′ Differenced GMM**	**(4)′ System GMM**
Lagged leverage	0.913 ***	0.775 ***	0.905 ***	0.809 ***	0.944 ***	0.8 ***	0.424 ***	0.672 ***
	(0.006)	(0.011)	(0.057)	(0.025)	(0.005)	(0.024)	(0.045)	(0.038)
ROA	−0.131 ***	−0.155 ***	0.108 *	−0.181 ***	−0.084 ***	−0.081 ***	0.023	−0.136 ***
	(0.015)	(0.036)	(0.055)	(0.03)	(0.014)	(0.018)	(0.026)	(0.038)
CR	−0.001	0.001	0.021 ***	−0.004 **	0.001 ***	0.001	0.007 ***	−0.005 **
	(0.001)	(0.001)	(0.007)	(0.002)	(0)	(0.001)	(0.003)	(0.003)
PBR	−0.001	−0.001 **	0.004 ***	−0.001 *	0.003 ***	0.002 ***	0.005 ***	0.001
	(0)	(0.001)	(0.001)	(0)	(0)	(0.001)	(0.002)	(0.001)
FixR	0.009	0.046 ***	0.272 ***	0.001	0.011 *	0.039 ***	0.117 ***	0.006
	(0.006)	(0.013)	(0.047)	(0.012)	(0.006)	(0.012)	(0.024)	(0.017)

Table 4. *Cont.*

	BL REGRESSION ANALYSIS				ML REGRESSION ANALYSIS			
	(1) Pooled OLS	**(2) Fixed Effect**	**(3) Differenced GMM**	**(4) System GMM**	**(1)′ Pooled OLS**	**(2)′ Fixed Effect**	**(3)′ Differenced GMM**	**(4)′ System GMM**
Log(asset)	0.004 ***	0.018 ***	−0.03 ***	0.008 ***	0.002 ***	0.008 ***	−0.019 ***	0.002
	(0.001)	(0.003)	(0.007)	(0.001)	(0.001)	(0.002)	(0.006)	(0.002)
DpEBIT	0	0	0	0	0	0	0	0
	(0)	(0)	(0.001)	(0)	(0)	(0)	(0)	(0)
RDasset	0.072	0.049	1.417 ***	−0.025	−0.072	−0.191 *	0.366 **	−0.083
	(0.093)	(0.172)	(0.317)	(0.13)	(0.083)	(0.101)	(0.185)	(0.171)
RDdummy	−0.001	0.001	−0.003	0	0	0	−0.005	0.002
	(0.002)	(0.003)	(0.006)	(0.003)	(0.002)	(0.003)	(0.004)	(0.004)
SalesExp	−0.004	0.042 *	−0.034	−0.001	−0.003	0.038 *	−0.028	0.03
	(0.008)	(0.023)	(0.034)	(0.018)	(0.008)	(0.021)	(0.022)	(0.025)
IndBLrate	−0.002	−0.007	−0.162 ***	0.007	0.004	−0.016	0.031	0.008
	(0.008)	(0.015)	(0.03)	(0.012)	(0.003)	(0.013)	(0.02)	(0.013)
NIvar	0 **	0 ***	0	0 ***	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
TAX	0	0	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
GDP rate	0.27 ***	0.329 ***	0.232 ***	0.291 ***	0.249 ***	0.264 ***	0.222 ***	0.236 ***
	(0.021)	(0.025)	(0.027)	(0.026)	(0.02)	(0.024)	(0.022)	(0.023)
Inflation rate	−0.068	0.357 ***	0.231 *	0.076	−0.052	0.192 **	0.295 ***	0.08
	(0.081)	(0.09)	(0.133)	(0.081)	(0.072)	(0.088)	(0.105)	(0.105)
Credit Premium	−0.002 ***	−0.005 ***	−0.003 ***	−0.003 ***	−0.003 ***	−0.004 ***	−0.003 ***	−0.003 ***
	(0)	(0)	(0.001)	(0)	(0)	(0)	(0)	(0)
Term Premium	0.002 ***	0.002 ***	0.002 ***	0.002 ***	0.001 ***	0.001 ***	0.001 ***	0.001 ***
	(0)	(0)	(0)	(0)	(0)	(0)	(0)	(0)
_cons	−0.059 ***	−0.31 ***		−0.084 ***	−0.01	−0.033		0.234 ***
	(0.013)	(0.058)		(0.024)	(0.013)	(0.053)		(0.059)
Observations	7046	7046	6775	7046	5668	5668	5450	5668
hansenp	.z	.z	0	0	.z	.z	0	0
ar1p	.z	.z	0	0	.z	.z	0	0
ar2p	.z	.z	0.321	0.419	.z	.z	0.462	0.197

Standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

In Table 4, Models (1) and (2) for book leverage (BL) and Models (1)′ and (2)′ for market leverage (ML) are primarily used to establish the upper and lower limits. Crucially, it must be noted that neither Model (1) nor Model (2), and their respective counterparts for ML, addresses the endogeneity issue that is inherent in our analysis. After analyzing the upper bound (pooled OLS estimation) and lower bound (fixed effect estimation) provided in Table 4, we have chosen the differenced GMM model (3) as our preferred method for model selection, particularly when considering BL. The system GMM model (4) was excluded due to the coefficient of the lagged variable lagging behind the equivalent variable in the differenced GMM model (3). This particular variable is closer to the upper bound despite both coefficients of the lagged variables falling within the upper and lower bounds (Blundell and Bond 2000). Conversely, when considering ML, we have selected the system GMM model (4)′ as our model of choice. The differenced GMM model (3)′ was disregarded because the coefficient of the lagged variable fell short of that in the system GMM model (4)′, which is closer to the lower bound, even though both coefficients of the lagged variables fall outside of the upper and lower bounds. This preference stems from the understanding that if the difference GMM estimate approximates or falls below the fixed effect estimate, it implies a potential downward bias in the former, attributable to weak instrumentation.

Under such circumstances, the system GMM estimation is deemed more suitable (Blundell and Bond 2000). When examining the differenced GMM model (3) and the system GMM model (4)′, the Hansen J test and the serial correlation test supported the validity of the instrumental variables and confirmed the absence of autocorrelation in the model, as they failed to reject the null hypothesis.

In the differenced GMM model (3), where BL acts as the dependent variable spanning all years from 1995 to 2021, numerous determinants were found to be statistically significant. The previous BL demonstrated statistical significance at a 1% level with a positive sign, which aligns with the dynamic adjustment of capital structure. Among firm-specific variables, ROA, CR, PBR, FixR, Log(asset), RDasset, and IndBLrate showed statistical significance. All except ROA are significant at the 1% level, while ROA is significant at the 10% level. As the coefficients of ROA, CR, PBR, and RDasset are positive, it is inferred that increased profitability, liquidity, investment opportunities, and relative R&D investment lead to greater borrowing in terms of book value. However, the negative coefficients of Log(asset) and IndBLrate indicate that larger firms and those with higher average industry book value-based leverage tend to borrow less. All four macroeconomic variables significantly impacted book value leverage. Except for the inflation rate, which is significant at a 10% level, all other variables are significant at a 1% level. With positive signs, firms are likely to borrow more when the GDP rate, inflation rate, and term premium are high. In contrast, firms borrow less when the credit premium is high.

In the system GMM model (4)′, where ML acts as a dependent variable covering the years from 1995 to 2021, fewer variables proved to be statistically significant. The previous ML showed statistical significance at a 1% level with a positive sign, which aligns with the dynamic adjustment of the capital structure. Among firm-specific variables in model (4)′, only ROA and CR were statistically significant. ROA is significant at the 1% level, while CR is significant at the 5% level. As both coefficients of ROA and CR are negative, more profitable and liquid firms tend to borrow less, aligning with the pecking order theory of capital structure. Among macroeconomic variables, all except the inflation rate significantly impacted the market value-based leverage at 1% levels. Positive signs indicate firms borrow more when the GDP rate and term premium are high, while a negative sign implies less borrowing with a higher credit premium.

We now turn our attention to three distinct periods: the complete period from 1995 to 2021, 'normal' periods devoid of crises, and crisis periods. South Korea encountered three major crises during this time: the currency crisis (1997–1999), the global credit crisis (2007–2009), and the coronavirus crisis (2020–2021). By adhering to the generally accepted timeline of these crises, we bypass subjective economic classifications, which enables more efficient comparison of capital structure actions during periods of stability and turmoil. The outcomes of this analysis are displayed in Table 5.

Table 5. Regression analyses across three distinct periods: A comparative study of selected models.

	BL REGRESSION ANALYSIS (Based on the Differenced GMM Estimation)			**ML REGRESSION ANALYSIS (Based on the System GMM)**		
	(3) Entire Period	**(5) Normal Period**	**(6) Crisis Period**	**(4)′ Entire Period**	**(5)′ Normal Period**	**(6)′ Crisis Period**
Lagged leverage	0.905 ***	0.72 ***	0.975 ***	0.672 ***	0.835 ***	0.947 ***
	(0.057)	(0.066)	(0.169)	(0.038)	(0.039)	(0.076)
ROA	0.108 *	0.114 *	0.175 *	−0.136 ***	−0.088 ***	−0.041
	(0.055)	(0.058)	(0.093)	(0.038)	(0.026)	(0.046)
CR	0.021 ***	0.016 **	0.025 ***	−0.005 **	−0.002	0.005
	(0.007)	(0.006)	(0.008)	(0.003)	(0.001)	(0.004)
PBR	0.004 ***	0.002 **	0.009 ***	0.001	0.002 **	0.005 ***
	(0.001)	(0.001)	(0.003)	(0.001)	(0.001)	(0.002)

Table 5. *Cont.*

	BL REGRESSION ANALYSIS (Based on the Differenced GMM Estimation)			ML REGRESSION ANALYSIS (Based on the System GMM)		
	(3) Entire Period	**(5) Normal Period**	**(6) Crisis Period**	**(4)′ Entire Period**	**(5)′ Normal Period**	**(6)′ Crisis Period**
FixR	0.272 ***	0.235 ***	0.39 ***	0.006	0.02	0.016
	(0.047)	(0.057)	(0.082)	(0.017)	(0.012)	(0.015)
Log(asset)	−0.03 ***	−0.05 ***	−0.038 *	0.002	0.001	0.002 *
	(0.007)	(0.009)	(0.019)	(0.002)	(0.001)	(0.001)
DpEBIT	0	0	−0.001 *	0	0	0.001
	(0.001)	(0.001)	(0.001)	(0)	(0)	(0.001)
RDasset	1.417 ***	0.958 ***	0.82	−0.083	−0.01	−0.303 *
	(0.317)	(0.286)	(0.872)	(0.171)	(0.104)	(0.168)
RDdummy	−0.003	−0.001	−0.003	0.002	0.001	0
	(0.006)	(0.005)	(0.012)	(0.004)	(0.003)	(0.003)
SalesExp	−0.034	−0.037	−0.122	0.03	0.01	−0.003
	(0.034)	(0.034)	(0.082)	(0.025)	(0.017)	(0.021)
IndBLrate	−0.162 ***	−0.103 ***	−0.033	0.008	0.004	0.011
	(0.03)	(0.027)	(0.088)	(0.013)	(0.008)	(0.007)
NIvar	0	0	0	0	0	0
	(0)	(0)	(0)	(0)	(0)	(0)
TAX	0	0.001 **	0	0	0	0 *
	(0)	(0)	(0)	(0)	(0)	(0)
GDP rate	0.232 ***	0.102 ***	0.46 ***	0.236 ***	0.255 ***	0.48 ***
	(0.027)	(0.031)	(0.066)	(0.023)	(0.036)	(0.053)
Inflation rate	0.231 *	−0.103	−0.206	0.08	−0.065	0.467 ***
	(0.133)	(0.14)	(0.37)	(0.105)	(0.091)	(0.136)
Credit Premium	−0.003 ***	0	0.006 *	−0.003 ***	0.008 ***	−0.005 ***
	(0.001)	(0.001)	(0.003)	(0)	(0.001)	(0.001)
Term Premium	0.002 ***	0	0.002 ***	0.001 ***	−0.01 ***	0.003 ***
	(0)	(0.002)	(0)	(0)	(0.001)	(0)
_cons				0.234 ***	0.091 **	−0.058
				(0.059)	(0.046)	(0.089)
Observations	6775	4878	1897	5668	4142	1526
hansenp	0	0	0.026	0	0	0
ar1p	0	0	0	0	0	0
ar2p	0.321	0.855	0.895	0.197	0	0.107

Standard errors are in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$.

The analysis in Table 5 offers insights into the capital structure behaviors of Korean corporations during whole, normal, and crisis periods. A key finding is the statistical significance of lagged leverage at a 1% level across all periods and leverage types (BL and ML). This signifies leverage persistence, with coefficients lower in normal periods compared to crisis periods. The adjustment speed in normal periods is notably faster than in crisis periods.[3] Specifically, the adjustment speed for BL is 0.28 in normal periods and 0.025 in crisis periods, while for ML, it is 0.165 in normal periods and 0.053 in crisis periods. This aligns with the findings by Cook and Tang (2010). In other words, Cook and Tang (2010), through their analysis of U.S. data, demonstrate that the speed of adjustment is quicker during prosperous periods compared to slower adjustments in less favorable times. Correspondingly, our model, which utilizes data from Korea, exhibits a similar pattern of behavior. Additionally, Shikimi (2020) provides evidence from Japan indicating that firms tend to adjust more rapidly during normal periods as opposed to periods characterized by credit constraints. Another consistently significant variable at a 1% level is the macro variable GDP rate. Its positive sign suggests that leverage moves in tandem with the GDP rate: higher GDP rates lead to increased borrowing by Korean companies and vice versa.

Comparative analysis between entire versus normal periods: In the case of BL, a range of firm-specific variables, including lagged leverage, ROA, CR, PER, FixR, Log(asset), RDasset, and IndBLrate, consistently influence BL across both the entire period and the normal periods (which exclude major crises). This consistency underscores the enduring impact of these variables on book leverage. However, a notable difference emerges in the realm of macroeconomic factors: during normal periods, the GDP growth rate is the singular significant macroeconomic variable, suggesting its pivotal role in stable economic environments. Conversely, during the entire period, a more diverse set of macroeconomic variables, encompassing GDP rate, inflation rate, credit premium, and term premium, play a significant role, indicating their broader impact over an extended timeframe. For ML, the trends are somewhat similar but with key distinctions. Variables like lagged leverage and ROA remain significant across both periods, highlighting their foundational influence on market leverage. However, CR shows significance only in the whole period, whereas PER is particularly relevant in normal periods. This variation implies that perceptions of liquidity and company valuation fluctuate with broader economic conditions. Additionally, macroeconomic factors exhibit a more consistent influence throughout the entire period, as seen by the significance of three out of four variables, pointing to their stable impact on ML. The findings suggest that while profitability, liquidity, and investment opportunities are generally associated with higher borrowing, larger firms tend to borrow less. Macroeconomic conditions, on the other hand, show a more uniform influence throughout the entire period, reflecting firms' adjustment to long-term economic trends. The analysis reveals that while specific firm characteristics consistently impact capital structure, the role of macroeconomic variables is more variable, indicating a complex and nuanced response by Korean firms to evolving economic conditions.

Comparative analysis between normal versus crisis periods: During normal periods, the speed of adjustment in capital structure is faster for both BL and ML compared to crisis periods. This aligns with expectations that firms are more adept at adjusting their capital structures in stable economic conditions. In BL, the crisis period brings to light the significance of certain variables like DpEBIT and Term Premium, which are not prominent in normal periods. Conversely, variables such as RDasset, IndBLrate, and TAX show significance exclusively in normal periods. This can suggest that firms prioritize growth, innovation, and adherence to industry benchmarks in their capital structure decisions during stable times, whereas the focus shifts to managing costs and optimizing asset utilization during crises. Notably, several variables, including lagged leverage, ROA, CR, PBR, FixR, Log(asset), and GDPrate, maintain their significance across both normal and crisis periods, indicating their pervasive influence on BL regardless of economic climate. For ML, the analysis highlights a greater sensitivity to current economic conditions and market sentiments. Variables such as Log(asset), RDasset, Tax, and the Inflation rate emerge as significant only during crisis periods, reflecting ML's responsiveness to immediate economic and market fluctuations. The significance of profitability (ROA) in normal periods for ML aligns with market expectations of firm performance in stable conditions. In both normal and crisis periods, lagged leverage, PBR, and three macro variables (GDPrate, CreditPremium, and TermPremium) remain consistently significant, illustrating their sustained impact on ML. This difference in response patterns between BL and ML indicates that while firms focus on growth and innovation in normal times, in crisis periods, they shift their emphasis to managing costs, utilizing assets effectively, and being sensitive to borrowing costs. Such adaptive behavior highlights the dynamic nature of capital structure in response to varying economic conditions. Overall, this analysis offers a comprehensive view of how Korean firms strategically adjust their capital structures in response to internal dynamics and external economic shifts, providing a detailed understanding of capital structure dynamics across different economic contexts.

6. Conclusions

Our study provides a comprehensive analysis of the capital structure dynamics in Korean firms from 1995 to 2021, a period marked by significant economic fluctuations. This research is distinct in its integration of both firm-specific and macroeconomic factors, offering a nuanced view of how these elements interact to influence corporate capital structures across different economic contexts, including both stable and crisis periods.

One of the findings of our study is the varying impact of internal and external factors on capital structure decisions during different economic times. During times of economic stability, internal elements like profitability and firm size exert a relatively stronger influence on the decision-making process regarding capital structure. However, in times of economic downturns, external market conditions and macroeconomic variables become more prominent. This variation highlights the adaptability of Korean firms in aligning their financial strategies with the prevailing economic climate. This distinction is particularly evident in our findings that both book leverage (BL) and market leverage (ML) adjust more rapidly in normal times as opposed to crisis periods, supporting the notion that firms demonstrate greater agility in adapting their capital structures in more predictable, stable conditions.

Our methodological approach, employing the generalized method of moments (GMM) estimation to address endogeneity concerns, has enabled a robust analysis of the dynamic adjustments in capital structures. This method is particularly effective in teasing out the complex interplay between a firm's internal dynamics and the external macroeconomic environment, offering deeper insights into the strategic financial decisions of Korean firms.

The implications of this research are significant for both academia and practice. For scholars, it extends the understanding of capital structure dynamics, particularly in the context of Korea's evolution from an emerging to a developed economy, and sets a foundation for future research to explore the long-term impacts of these determinants on firm performance. Comparatively analyzing the capital structure dynamics of Korean firms with those in other economies could offer further insights into global financial practices. Furthermore, exploring variations in capital structure dynamics across diverse industries during periods of stability and turbulence could provide another intriguing avenue for research. For practitioners, particularly corporate managers and policymakers, the findings provide valuable insights into the development of adaptable financial strategies that are responsive to both internal dynamics and external economic conditions. This study underscores the importance of a multifaceted approach to capital structure analysis in complex and interconnected financial landscapes.

In conclusion, our research enriches the literature on capital structure determinants in Korean firms and contributes to the broader discourse on corporate finance, emphasizing the need for comprehensive and dynamic financial analyses in varying economic environments. The insights gleaned from this study are instrumental in guiding future research and practical applications in corporate finance.

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Notes

1 In the forthcoming section, our proposed model integrates all variables outlined in the literature review, including both firm-specific and macroeconomic factors. It is noteworthy to mention that these variables, identified as key determinants of capital structure, have been extensively applied in a broad array of previous capital structure research.

2 The scholarly field is rich with analyses of the factors influencing capital structure in diverse national contexts. Although our research encompasses a broad spectrum of these determinants, our aim diverges from cross-country comparisons as outlined in prior studies. We specifically explore the determinants of capital structure within South Korea from 1995 to 2021. Our innovative approach includes dividing this timeframe into 'normal' and 'crisis' periods, enabling us to investigate each phase's unique capital structure dynamics.

3 To determine the adjustment speed, we first run the regression of Equation (3), estimate the coefficient of the lagged leverage ($(1 - \delta)$), and then convert it into δ.

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