Dynamics Of Capital Structure: The Case Of Korean Listed Manufacturing Companies

By: **Hye-Sung Kim**, Almas Heshmati, and Dany Aoun

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Hyesung Kim, Heshmati A, Aoun D. Dynamics of Capital Structure: The Case of Korean Listed Manufacturing Companies. Asian Economic Journal. 2006;20(3):275-302. Publisher version of record available at: https://onlinelibrary.wiley.com/doi/abs/10.1111/j.1467-8381.2006.00236.x

Dynamics of Capital Structure: The Case of Korean Listed Manufacturing Companies*

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In this paper, we develop a model of dynamic capital structure choice based on a sample of Korean manufacturing firms and estimate the unobservable optimal capital structure using a wide range of observable determinants. Unbalanced panel data of Korean listed firms for the period 1985–2002 is used. In addition to identifying and estimating the effects of the determinants of capital structure, we take into consideration some Korea-specific features, such as the structural break before and after the financial crisis and firms' affiliation to chaebol business groups. Our results indicate that the optimal capital structure has been affected by the financial crisis. Although the results suggest that chaebol-affiliated firms have higher optimal level of leverage and adjust their capital structure faster than non-chaebol firms, firms' leverage might be associated with factors other than chaebol-affiliation, such as size, profitability and growth opportunity.

Keywords: capital structure, debt, firm, panel data, adjustment, Korea.

JEL classification codes: C33, D21, G32.

I. Introduction

The Asian financial crisis of 1997 seriously affected the Korean economy, causing bankruptcies of several highly leveraged Korean firms, particularly those belonging to large business groups or chaebols. The bankruptcies adversely affected financial institutions that were intricately linked to such firms. The dramatic capital outflow from several Asian economies was one of the major causes of the financial crisis. Highly leveraged firms were not only affected during the crisis, but they also had to endure vast restructuring in the post-crisis period. Following the outbreak of the crisis, the issue of highly leveraged Korean firms became important. The crisis, initially triggered by the sudden

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outflow of foreign capital that caused a liquidity crisis in the banking sector, exposed other structural weaknesses in the economy, including in its corporate sector. Another critical factor was the excessive investment by firms, which was induced by inefficient lending by financial institutions to firms with low profitability.

On 21 November 1997, the Korean Minister of Finance and Economy resigned and the succeeding minister had little choice but to ask for IMF assistance. The Korean media declared the country bankrupt as thousands of companies went out of business. Foreign investors fled the country and major banks became insolvent. These were only some of the effects of the crisis. In the aftermath of the crisis, Korean firms were asked to restructure their corporate finance mainly through reducing their dependence on debt (Fattouh et al., 2005). There is now a large published literature on the analysis of the causes and consequences of the Asian financial crisis that attributes the economy's vulnerability to high leverage (e.g. Choi, 2000).

In the present study, we adopt the optimal capital structure theory to explain the determinants of capital structure and the speed of adjustment for Korean firms. Capital structuring and particularly establishment of the optimal capital structure have been important areas of debate among academics and practitioners. The problem is appealing because it is fairly open-ended and subject to controversies and criticisms. In particular, the present study examines how Korean firms might choose their capital structure considering Korea-specific corporate features and the importance of leverage. It provides a comprehensive analysis of how a set of observable variables might affect capital structure choices in Korea. In addition, we estimate possible shifts in the impacts of individual factors and the overall adjustment in the capital structure with respect to the financial crisis.

Although the analysis is based on a dynamic model, we also include the typical static model to contrast the results between the static and dynamic models. We later show that the dynamic model is the preferred model. The contributions of the present paper to the published literature are as follows. First, the study provides a distinction between the observed and the estimated optimal debt ratio. Second, it empirically identifies factors determining the optimal debt level. Third, it captures the dynamics of capital structure adjustments by modeling movements towards optimal debt ratios. Fourth, it specifies an adjustment model where firm-specific and time-specific factors determining the speed of adjustment are identified and their impacts are quantified. Finally, it investigates the capital structure of listed non-financial companies in Korea using a very large sample (617 firms between 1985 and 2002).

The remainder of this paper is organized as follows. Section II provides the theory of capital structure and a brief literature review of published empirical studies. Section III contains the background of financial markets in Korea. Section IV provides the methodology and presents the empirical model. Section V explains the data, followed by the description of the determinants of capital structure and speed of adjustment in Section VI. Section VII summarizes the results of the empirical study, and Section VIII concludes the paper.

II. Theories of Capital Structure of Firms

The modern theory of capital structure is said to have begun with a seminal paper by Modigliani and Miller (1958). Since then, several theories have been proposed to explain the variation in debt ratios across firms. The capital structure theory suggests that firms determine what is often referred to as a target debt ratio, which is based on various trade-offs between the costs and benefits of debt versus equity. Assuming perfect and complete capital market structure, Modigliani and Miller (1958) postulate that the leverage of a firm is independent to, and, therefore, uncorrelated with, its market value. In the real world, however, bankruptcy costs, agency costs, costs derived from asymmetric information and incompleteness in markets are common, and there is a growing published literature that tries to incorporate such issues in the determinants of capital structure. In this section, some theoretical factors that determine the capital structure and speed of adjustment of firms are discussed. There are three important and common theories developed to explain the capital structure's relevancy to firm value, which are based on bankruptcy costs, agency costs, and the costs derived from asymmetric information.

II.1 Bankruptcy costs

Bankruptcy costs refer to costs that occur when a firm fails to pay back its principal of debt in the event that they over-borrow. As debt increases, the possibility of default also rises. In such a case, firms might begin to face financial distress. For example, firms might not be able to distribute dividends on preferred stocks and, consequently, their providers and/or banks might not extend credit for such firms. Such restrictions or limitations can affect a firm's value and its performance, as they eventually might have to forgo attractive investment opportunities, which could adversely affect profitability opportunities. In turn, the firm's bankruptcy probability could increase in extreme situations. Because an increase in firm value caused by a reduction in income tax might be offset by an increase in expected bankruptcy costs, worsening the firm's value, the existence of such a trade-off implies that an optimal capital structure exists and can be found.

II.2 Agency costs

Agency costs arise because of differences in the interests of principal and agents, both of who maximize their own objectives. Hence, the principal usually imposes some set of restrictions on agents' behavior to align their actions with the principal's objectives. This usually involves monitoring the behavior of agents as well. Jensen and Meckling (1976) identify agency costs, which might be monetary or non-monetary, as consisting of monitoring cost, bonding cost and residual loss. Accordingly, there can be two types of agency costs: agency costs of equity associated with the issuance of stocks (equity) and agency costs of debt associated with the issuance of debt.

The agency cost of debt occurs when a conflict of interest between shareholders and debtors exists. Such a conflict might interrupt further investment or financing activities, thereby adding extra costs in managing difficulties. Shareholders might be strongly tempted to maximize their own interests rather than to maximize the entire value of firms, which becomes a cost for debtors. This occurs particularly when they are faced with an extremely vulnerable situation, such as bankruptcy, and the CEO might behave in such a way to maximize the wealth or interests of shareholders. This type of game can be caused by 'risk incentives', 'under-investment incentives', and/or 'cash in run'.

Because the debt of firms increases the bankruptcy costs and agency costs of firms, agency costs can be incorporated into the capital structure decision. That is, the use of debt is associated with a rise in the value of a firm for the reduced income tax effect (a positive effect) and the increase in costs of financial distress (a negative effect) simultaneously.

II.3 Pecking order theory

It has often been observed in corporate financing decisions that firms tends to draw on internal financing first and seek external financing later by issuing shares or corporate bonds when there are insufficient funds for internal financing. According to Myers (1984), such a pattern of corporate financing is largely motivated by information asymmetry between managers and external investors. This is what is known as the pecking order theory.

For example, regarding firm size, recent studies emphasize differences between the optimal financial structure of small and large firms (e.g. Chittenden et al., 1996), although the original theory gives no reference to size. Significant differences in firm size are related to agency and asymmetric information, control aversion, preferences and other factors with implications for potential agency costs (Pettit and Singer, 1985; Cressy and Olofsson, 1997; Jordan et al., 1998).

II.4 Empirical studies on the determinants of capital structure

Capital structure theories suggest that the optimal debt ratio can be found given the trade-off between benefits and costs of debt financing. They do not, however, explain why debt ratios observed across countries are different. That is, although capital structure theories provide some explanations for the variations of debt ratios across firms, this does not necessarily constitute an explanation for the optimal debt–equity ratio or the extent of inoptimality. Therefore, many existing published studies have borrowed observed leverage as proxies for the optimal leverage ratio (Titman and Wessels, 1988; Wedig et al., 1988, Harris and Raviv, 1991; Rajan and Zingales, 1995). However, even if firms are aware of the inoptimality, they might not be able to adjust the debt ratio to an optimal level if the costs of adjustment are significantly high, making the adjustment too costly.

Dynamic modeling has been recognized in a number of studies. Fischer et al. (1989), for example, examine the features that determine the scope of deviations in firms' capital structures over time. Jalilvand and Harris (1984) characterize a firm's financial behavior as partial adjustments to long-run targets. The emphasis is on the interaction between different financial decisions of a firm and the long-run financial targets, and they allow for variations in the speed of adjustment by firm and over time. The long-term targets toward which firms adjust are specified exogenously. Rajbhandary (unpubl. data, 1997) uses a similar dynamic adjustment model in the context of Indian firm data but with constant speed of adjustment, whereas Vilasuso and Minkler (2001) study a dynamic model incorporating agency costs and asset specificity. Heshmati (2002) analyzes the dynamics of capital structure of Swedish micro and small firms, whereas Banerjee et al. (2004) examine the dynamics of capital structure of US and UK firms with a flexible adjustment parameter. Based on Korean non-financial listed companies for the period 1985–2002, the present study estimates their optimal capital structure, simultaneously treating the dynamics and flexible adjustment of capital structure.[1]

III. The Korean Financial Market

Korean firms have been criticized for their high leverage. Moreover, large conglomerates or chaebol[2] have commonly exhibited higher leverage than non-chaebol firms.[3] For example, during the period between 1985 and 2002, the debt ratio measured by total liability divided by the sum of total liability and equity for chaebol firms was 0.71, compared with 0.63 for non-chaebol firms (standard deviations were 0.154 and 0.191, respectively). Such a difference in the debt ratios between chaebol and non-chaebol firms has been consistent over the different subperiods that we studied (1985–1989, 1990–1996, 1997–2002, and before and after the financial crisis).[4] Such firm-specific features of Korean

1. A review of empirical studies of capital structure and its determinants related to the Korean financial market are provided in Section III.

2. According to the definition by the Korean Fair Trade Commission (KFTC), a chaebol or business group refers to a group of companies that holds more than 30 percent of its shares owned by some particular individual or by companies governed by those individuals. Since 1987, the KFTC has identified and listed business groups each year.

3. The average debt–equity ratio of firms exceeded 300 percent, approximately 4 times higher than that of Taiwan (IMF, 1998). For the 30 largest conglomerates, the ratio was over 500 percent and there were some large firms that recorded debt/equity ratios of 3000 percent (Lee et al., 2000). At the end of 1997, the total debt owed by Korean firms was approximately US$675 bn. This was almost 1.9 times the GDP in the same year (Nam et al., 1999).

4. Results not reported here are available from the authors upon request.

companies have not been treated in corporate finance theory as important determinants of a firm's capital structure. Hence, corporate finance theory alone seems insufficient in explaining the capital structure of Korean firms. Korea-specific features, both institutional and structural ones, should be considered to better understand Korean financial markets, as well as to better model and interpret the results of empirical study more comprehensively. In the rest of this section, we discuss background information of the Korean financial market and the way it functions, focusing on the reasons of high leverage of Korean firms.

A major reason for the high leverage of Korean firms is attributed to the government's interventionist development strategy, which has left a deep footprint on the development of financial markets and corporate governance in the economy. In the 1960s, the Korean Government directly intervened in securing the necessary industrial capital for firms and this direct intervention has been instrumental in Korea's economic development in the 1960s and 1970s. The government's export promotion policy during 1962–1972, followed by industrial promotion during 1973–1979 and the adjustment and deregulation during 1980–1993 are examples of the government-managed economy (World Bank, 1993). However, owing to strong government intervention and protectionism since the 1960s, Korean firms in general and the chaebols in particular have transferred risks associated with their business to the public (Chang, 2003). Therefore, firms had little incentive to lower their debt, thereby explaining their high debt to equity ratios particularly before the Asian crisis. Borensztein and Lee (1999) provide further discussion of Korea's high-leverage economic structure, which they attribute largely to government intervention and its favoritism toward certain industries.

Indeed, mainly domestic banks provide debt financing to firms, which was the case for Korea's financial markets before the financial crisis of 1997. Korean firms had the highest leverage and the highest growth of leverage ratios amongst East Asian firms in terms of the mean of the leverage ratios of listed firms during 1988–1996 (Claessens et al., 1998). Other studies treating the issue of corporate debt in Korea that confirm this trend include Borensztein and Lee (1999), Lee (1998), Nam and Kim (1994) and Park (1997).

Such high dependence on debt among Korean corporations was significantly reduced in the post-crisis period largely through the banking sector's restructuring. Before the financial crisis, the Korean capital market was far short of global standards in terms of its efficiency, both operational and informational (Choi, 2000). To enhance the efficiency of the capital market, the Korean Government has actively implemented comprehensive reforms addressing the rules and regulations of the capital market, including the regulatory system itself and corporate governance, which combined has contributed to the reduction in the debt to equity ratios of Korean firms after the crisis.

Lee et al. (2000) analyze changes in the leverage and debt structure of Korean firms using an unbalanced panel from 1981 to 1997. They consider the financing decisions of Korean firms and find that there are major differences in the capital structure choices between chaebol and non-chaebol firms after controlling for standard determinants proposed by corporate finance theory, such as firm size, growth rates, tangible fixed assets and profitability. Lee et al. divide their sample into three groups, the 1st to 5th largest chaebol firms, the 6th to 30th largest chaebol firms and non-chaebol firms, and find that the 5 largest chaebol firms significantly increased leverage in terms of foreign financing. Other studies that treat the determinants of capital structure choices of Korean firms, but with cross-sectional data or short-period panels, are Sunwoo (1990), Demirguc-Kunt and Maksimovic (1994), Kim et al. (1997), Hahm et al. (1998) and Wi (1998).

Using industry-level panel data of 32 Korean manufacturing sectors and applying the random effects GLS method, Borensztein and Lee (1999) examine whether credit allocation was efficient in Korean manufacturing industries for the 1969–1996 period. They investigate whether financial resources were directed to more efficient sectors and show that the profitability of investment did not play an important role in credit allocation. Instead, given industrial characteristics and year dummies, the previous year's profit rate turned out to have a negative effect on the current year's flow of credit. This suggests the possibility that credit was allocated preferentially to sectors exhibiting worse economic performance.[5]

In sum, the published literature has led us to believe that the capital structure of Korean firms, which is characterized by high leverage, is a reflection of Korean-specific factors, such as government's growth-oriented policy and government favoritism toward the chaebol. Inefficient management systems for credit analysis of commercial banks and firms' lacking transparency in corporate governance structures might also be specific factors of Korean firms, which, in turn, affect the leverage ratio of firms. That is, the high leverage structure of Korean firms, which was a critical factor behind the financial crisis, cannot be explained solely by internal factors of firms or factors suggested by corporate finance theory. In addition to such factors, the government's industrial and financial policy over Korea's economic development history, Korea's financial structure and firm characteristics should be taken into account to better understand the capital structure of Korean firms.

IV. The Dynamic Model of Capital Structure

Different approaches and different models have been used to study the capital structure of firms. For instance, Titman and Wessels (1988) uses the LISREL

5. Borensztein and Lee did not find any evidence to support the proposition that credit was directed to relatively more profitable activities either before or after financial reforms. They were also not able to find evidence to support the proposition that the flow of credit contributed positively to improve the performance of favored industries over time.

system to model the capital structure of US manufacturing firms specified as: $y = \Gamma\xi + \varepsilon$, where y is a $p \times 1$ vector of debt ratios, Γ is a $p \times m$ matrix of factor loadings and ε is a $p \times 1$ vector of disturbance terms. Fischer et al. (1989) derive the dynamic valuation equations of firm's debt and equity securities for any given recapitalization policy, simultaneously solving for the firm's optimal recapitalization policy and the equilibrium rate of return on the unleveraged assets.

The present study uses traditional models of dynamics of capital structure studies. The main aim is to distinguish between observed and optimal leverage, with the latter allowed to vary across firms and over time. Let us first begin with the optimal leverage denoted by L^*_{it} for firm i at time t, which will be a function of different variables:

$$L^*_{it} = F(X_{it}, X_i, X_t), \tag{1}$$

where X_{it} represents the determinants of optimal leverage that are firm and time variant, X_i is a vector of observable, but constant over time, firm-specific variables, and X_t is a vector of time variant determinants that are constant across firms. In addition, dummy variables are included to capture the unobservable firm-specific and time-specific heterogeneity effects.

Assuming ideal conditions, we safely state that at the equilibrium or at the long run, the observed leverage should be equal to the optimal leverage; that is, $L_{it} = L^*_{it}$. If we try to expand this idea, we note the equality in changes in leverage from a previous period to the current as follows:

$$L_{it} - L_{it-1} = L^*_{it} - L_{it-1}. \tag{2}$$

However, because adjusting from one state to another is costly, in many cases firms might find it easier and less expensive to adjust in the short run. Therefore, by introducing δ_{it}, an adjustment factor representing the magnitude of desired adjustment between two subsequent periods or the rate of convergence of L_{it} to its optimal value L^*_{it}, we allow the firm to adjust partially for the different reasons stated in the previous section. Accordingly, Equation (2) can be stated as follows:

$$L_{it} - L_{it-1} = \delta_{it}(L^*_{it} - L_{it-1}). \tag{3}$$

Three cases are possible here. First, if $\delta_{it} = 1$, the entire adjustment is made within one period and the firm's observed leverage equals its optimal leverage. Second, if $\delta_{it} < 1$, the adjustment is insufficient and the new observed leverage will be below the optimal level. Third, if $\delta_{it} > 1$, the firm is over-adjusting, and the observed leverage will be higher than the optimal level, which is possible when firms borrow based on future investment projects but renounce them afterward. Meanwhile, economic conditions change, leading to the need to downsize investment and demand for debt.

We include a measure of the speed of adjustment, which can be interpreted as the degree of adjustment per period, δ_{it}. Therefore, δ_{it} is a function of some variables affecting the adjustment cost. By setting Z_{it} as a vector of the determinants of speed of adjustment variables that are changing both over time and across firms, and including Z_i and Z_t, which are vectors of observable variables in one dimension but constants in another, we obtain

$$\delta_{it} = G(Z_{it}, Z_i, Z_t). \tag{4}$$

Dummy variables are included to capture the unobservable firm-specific, time-specific and other adjustment heterogeneity effects.

Finally, by rearranging Equation (3) and appending an error term ε_{it} to it, we use the following equation for observed leverage:

$$L_{it} = (1 - \delta_{it})L_{it-1} + \delta_{it}L^*_{it} + \varepsilon_{it}, \tag{5}$$

where the optimal leverage is specified in terms of observables as

$$L^*_{it} = \alpha_0 + \sum_j \alpha_j X_{jit} + \sum_s \alpha_s X_{si} + \sum_m \alpha_m X_{mt}. \tag{6}$$

The speed of adjustment is also specified in terms of observables as

$$\delta_{it} = \beta_0 + \sum_j \beta_j Z_{jit} + \sum_s \beta_s Z_{si} + \sum_m \beta_m Z_{mt}. \tag{7}$$

A general feature of this type of adjustment model is that it does not take into account the target leverage beyond time *t*. It is assumed that future shifts in exogenous variables affecting future optimal leverage are unforeseeable. That is, changes in factors affecting the target leverage are unanticipated. In the absence of or in anticipation of major structural change, the current and past level of optimal leverage and estimated adjustment parameters contain useful information that can be used to predict the future behavior of leverage.

As mentioned in Section I, for the purpose of comparison, the standard static model based on the following equation is included:

$$L_{it} = \alpha_0 + \sum_j \alpha_j X_{jit} + \sum_s \alpha_s X_{si} + \sum_m \alpha_m X_{mt}. \tag{8}$$

By using estimated optimal leverage and observed leverage, a measure of the degree of optimality of leverage is obtained from

$$L^*_{it}/L_{it}. \tag{9}$$

The optimality ratio takes on a value of 1 if the firm is at its optimal leverage at time *t*. Because optimal leverage cannot be negative, the optimality ratio is restricted to being non-negative. However, because the optimal leverage might shift over time, at any time a value of 1 for this ratio does not have any implications for its future optimality unless the optimal leverage is firm-specific but time-invariant.

The dynamics in Equation (5) and its associated components consisting of Equations (6) and (7) are jointly estimated. The model is non-linear in its parameters and an iterative non-linear estimation method is used,[6] whereas the static model (Equation 8), serving as a benchmark, is linear and least squares is used. In both models, unobservable firm-specific and time-specific effects are controlled.

V. The Data

The data used in the present paper is from KIS2003 (a corporate information database provided by the Korea Information Service). The database is based on the firms' own financial accounts. After selecting listed non-financial companies for the period from 1985 to 2002,[7] our sample totaled 617 companies. In addition, the information on the 30th largest business groups and their affiliated firms (or chaebol) is based on the information released by Korea's Fair Trade Commission (KFTC).[8] Note that these firms vary year by year. In particular, after the crisis there was a significant change in this affiliation. In addition, the definition of chaebol has changed since 2001. Hence, following the definition of the large business group by KFTC, firms having a total assets base larger than 2 trillion won for observations of 2001 and 2002 are classified as chaebol.

Combining the KIS2003 database and information from KFTC, we have constructed an unbalanced panel with 9604 observations. Table 1 presents summary statistics. All monetary variables are expressed in constant 2000 prices using the manufacturing producer price index as the deflator.[9]

The sample's descriptive statistics show that the debt ratio for Korean firms, measured by total liability divided by sum of total liability and equity, has remained very high. For the entire period, 1985–2002, the average debt ratio was 64.8 percent. It was 69 percent during 1985–1989, 66 percent during 1990–1996 and 60 percent during 1997–2002. Comparing the debt ratio before and after the crisis, owing to corporate restructuring it significantly fell in the post-crisis period. Over time, the variability in the debt ratios across firms differs depending on the period, and after the crisis the variability as a result of differences in the impact of structural adjustment increased.[10]

VI. Measures of Capital Structure and its Determinants

A typical concern in capital structure studies involves the question of whether to use the book value of debt and equity, or the market value (or a combination of

6. The procedure SYSNLIN in SAS is used to estimate the dynamic model.
7. For a study of dynamics of capital structure of a large sample of Swedish micro and small firms, see Heshmati (2002).
8. Each year, KFTC reports the 30th largest business groups and firms that are affiliated with such groups.
9. Because we use the ratio of variables, transformation of the variables to constant prices is not necessary. For variables that are in levels or non-ratio form, we transform them to constant 2000 prices.
10. Results not reported here are available from the authors upon request.

Table 1 Summary statistics of the data, 9604 observations

Variable	*Definition*	*Mean*	*Standard deviation*	*Minimum*	*Maximum*
Determinants of capital structure:					
Crisis	1997 financial crisis	0.299	0.458	0.000	1.000
Size	log(total assets)	18.506	1.515	13.615	24.890
Deratio	Leverage	0.648	0.187	0.043	1.000
Grow	Growth opportunity	9.459	24.657	−541.523	97.518
Tang	Tangibility	0.350	0.175	0.003	0.973
Prof	Profitability	0.014	0.350	−6.273	28.531
Ndts	Non-debt tax shield	0.196	0.169	0.000	3.141
Uniq	Uniqueness	0.810	0.194	0.000	9.303
Vari	Income variability	14.899	138.220	0.000	2415.791
Chaebol	Chaebol affiliation	0.187	0.390	0.000	1.000
Determinants of the speed of adjustment:					
Lintan	Log(Intangible assets)	8.501	5.371	0.000	21.941
Linve	Log(Investment)	16.323	1.819	7.212	22.857
Scurliabil	Current Liabilities	0.637	0.183	0.025	1.000
Shgovern	Shareholder, government	0.218	3.081	0.000	77.800
Shallcorp	Shareholder, corporation	25.465	22.655	0.000	122.800
Shforeig	Shareholder, foreigner	3.700	9.002	0.000	100.000
Shindivi	Shareholder, individual	51.310	32.890	0.000	100.000
Shminor	Shareholder, minor	42.410	26.791	0.000	100.000
Shmajor	Shareholder, major	22.853	18.420	0.000	100.000
Shtotal	Shareholder, total	80.716	39.455	0.000	100.000

both). A firm's choice concerning the optimal level of leverage is directly determined by the relative level of costs incurred vis-à-vis the level of benefits accruing from borrowing. By borrowing, the firm should benefit from tax savings because expenses are tax deductible, which will eventually have some positive effect on the firm's value. However, changes in the market value of debt have no direct effect on cash savings from the interest tax shield.

On the one hand, proponents favoring the use of book value argue that the main cost of borrowing is the expected cost of financial distress in the event of bankruptcy, and the relevant measure of debt holders' liability is the book value of debt rather than the market value. On the other hand, those arguing in favor of market value to book value contend that the market value ultimately determines the real value of a firm. It should be noted that it is possible for a firm to have a negative book value of equity while simultaneously enjoying a positive market value, as a negative book value reflects previous losses, whereas a positive market value denotes the expected future cash flows of the firm.

Because of data availability, we use only the book value of leverage, measured as the ratio of total liabilities to the sum of equity and total liabilities. In certain cases, when data availability allows, it is desirable that the total liability be divided into short-term and long-term liabilities. In the present study, making such a distinction is limited, however. This can be considered in future studies.

VI.1 Determinants of optimal leverage

We now turn to describe explanatory variables recognized in the published literature as possible determinants of firms' capital structure, which are also used in the present study to explain variations in leverage. The expected effect of each factor on leverage based on the theory of capital structure is indicated in parenthesis.[11]

Income variability (–)
Variability of income is expected to be negatively related to leverage because the more volatile the income, the higher the probability of default on interest payment. For our purpose, the variance of operating income is used as a measure of income variability as operating income is subject to interest payment. The simple correlation matrix over the total sample period 1985–2002 shows that income variability was positively correlated with the debt ratio for Korean listed firms, and this positive correlation was consistent over the all subperiods (1985–1989, 1990–1996 and 1997–2002).

Growth opportunity (–)
Firms with future growth prospects tend to rely more on equity finance (Rajan and Zingales, 1995). This can be explained by agency costs. If a firm is highly leveraged, then shareholders of firms tend not to invest much in a firm's project because returns to their investment will benefit mostly creditors rather than shareholders (Myers, 1984). Such agency costs might be significant, and if this is so, fast growing firms with highly profitable projects are likely to depend more on equity rather than debt.[12] Therefore, we might expect a negative relation between growth opportunity and leverage. The annual percentage change in total assets is used as a measure of growth. The simple correlation over the total sample period as well as the subperiods shows that growth opportunity was negatively correlated with debt.

Tangibility (+/–)
Tangibility is measured as the ratio of tangible assets to total assets, and should be positively related to leverage, because firms with a high level of tangible assets have more collateral available to raise debt. However, Grossman and Hart (1982) show that firm's tangible (fixed) assets could be negatively correlated with firm's leverage because of information asymmetry in firms with limited tangible assets and, hence, less collateralized debt would indicate more difficulty in monitoring employees. By increasing leverage, firms with limited tangible

11. For a summary of the expected effects by various theories of capital structure, including agency costs, bankruptcy costs and asymmetric information, see Heshmati (2002).
12. However, such a negative relationship is expected for long-term debts. According to Titman and Wessels (1988), it might be possible that short-term debt ratios that are positively related to growth rates for the growing firms might substitute their short-term liabilities for long-term liabilities to reduce agency costs.

assets might receive help from creditors, including financial intermediaries to monitor employees, and, therefore, reduce the costs of information asymmetry.[13] The simple correlation matrix shows that that tangibility over the total sample period 1985–2002 did not show a significant correlation with the debt ratio. This was also the case for the period 1990–1996. However, a negative correlation between tangibility and debt ratio is found for the period 1985–1989, whereas a positive correlation is found for the period 1997–2002.

Size (+/–)

Titman and Wessels (1988) suggest that firm size and leverage are likely to be positively related, particularly in larger firms because they typically have less direct bankruptcy costs and tend to diversify more, allowing a higher optimal debt capacity. According to Chittenden et al. (1996) larger firms use more leverage than small firms because of the relatively smaller costs of monitoring the firm, as well as reduced moral hazard and adverse selection problems. By contrast, Rajan and Zingales (1995) indicate that less asymmetric information within larger firms leads to less incentive to raise debt, suggesting a negative relationship. The log of total assets is used as a measure of the firm's size. The simple correlation matrix over the total sample period 1985–2002 shows that size was positively correlated with the debt ratio for Korean listed firms, and this positive correlation is consistent over all three separate subperiods.

Profitability (+/–)

Previous studies show different results regarding the relationship between leverage and profitability. For instance, Myers and Majluf (1984) state that because profitability is positively related to equity, it should be negatively related to leverage. Jensen (1986) states that profitable firms might signal quality by leveraging up, resulting in a positive relation between leverage and profitability. The measure used in the present study is net income to total assets. The simple correlation matrix shows that, over the total sample period 1985–2002, profitability was negatively correlated with the debt ratio for Korean listed firms, and the results were consistent over all three separate subperiods.

Non-debt tax shield (–)

Heshmati (2002) suggests that firms face incentives for borrowing, and take advantage of interest tax shields when they have enough taxable income to justify a debt issue. Therefore, the presence of other non-debt tax shields is likely to reduce the optimal leverage. By using the ratio of depreciation to total assets, the firm's use of tax shields other than interest tax shields can be accounted for. The simple correlation matrix shows a negative correlation between the non-debt tax

13. Using tangible fixed assets to total asset, Lee et al. (2000) find a negative relationship between tangible fixed assets and a firm's leverage, and their results are robust throughout different model specifications.

shields and the debt ratio over the total sample period 1985–2002, and this was consistent with the two subperiods before the crisis. In the subperiod in the post-crisis era, no correlation is found between non-debt tax shield and the debt ratio.

Uniqueness (–)

Uniqueness of a firm's assets is measured by the cost of sales to net sales. Firms with unique products are expected to exhibit a lower leverage level because in the case of bankruptcy, a competitive secondary market for their inventory and production equipment does not exist. However, the simple correlation matrix shows a positive correlation of uniqueness with the debt ratio over the total and this is consistent for all three separate sample subperiods.

Time trend (+/–)

Time trend is included to capture any variation in leverage across time. Under normal conditions, leverage could either increase or decrease over time. However, for the dataset in the present study, and because the period considered includes the financial crisis in 1997, the expected effect is found to have a negative relationship; that is, leverage is expected to decrease especially after 1997. According to the simple correlation matrix, a negative correlation between trend and the debt ratio over the total sample period was found, with the exception of the 1990–1996 subperiod, which showed a positive correlation although weakly significant at only the 9-percent level.

Chaebol affiliation (+)

Following the definition of the large business group by KFTC, the value 1 is given to those firms that belong to the 30th largest business groups, and 0 to those that do not. In years 2001 and 2002 the value of 1 is assigned to the firms with more than 2 trillion won of total assets and 0 otherwise. Chaebol firms are expected to have a higher leverage on average than non-chaebol firms. Traditionally, the government encouraged banks to allocate loans to chaebols at favorable rates. Moreover, affiliated firms could guarantee loans on behalf of each other through cross-debt guarantees across affiliated firms. The system encouraged banks to lend to them, therefore increasing their leverage. In addition, chaebols owned several merchant banks in the 1990s, which helped them to acquire more loans. Therefore, considering chaebols' easier access to bank loans than non-chaebols as a result of government help and their own guarantees, chaebol-affiliated firms are expected, on average, to have higher leverage (+) compared with non-chaebol firms.

Financial crisis (–)

We expect a negative relation between the 1997 financial crisis and firms' leverage. In the post-crisis period, credit companies shifted towards tighter credit policy, making it more difficult and more costly for firms to raise debt. The crisis dummy was assigned 1 for years after 1997 and 0 for other years.

Industrial sector (+/–)
To capture any systematic but unobservable industry heterogeneity effect that might have been overlooked in the variables listed above, industrial sector dummies are also included. All 617 companies are categorized into 24 industries (see Table 2).

VI.2 Determinants of the speed of adjustment

Because the speed of adjustment (δ_{it}) is also a function of observable factors affecting the adjustment cost, what follows is a listing of these factors, some of which are partially overlapping with the factors determining the optimal debt level, and a specification of the expected relation between them and the speed of adjustment. It should be noted that the costs of shifting from the observed to the optimal leverage is the focus here, rather than the direct costs associated with leverage levels.

Distance (+)
If fixed costs are an important segment of the total costs of adjusting the capital structure, firms with lower than optimal leverage would change their capital structure only if they are sufficiently far away from the optimal capital structure. The likelihood of adjustment is a positive function of the difference between optimal and observed leverage. In this model, the absolute value of the gap $| L^*_{it} - L_{it-1} |$ is incorporated as a determinant.

Current liabilities (+)
Firms with a high level of short-term liabilities compared with long-term liabilities possess the ability to adjust to a new level of leverage more easily and faster than firms with a lower level of short-term liabilities, because short-term liabilities, relative to the long term, can be easily raised or paid-off, depending on whether the firm is below the optimal leverage or above it. The ratio of current liabilities to total liabilities is used as a measure of current liabilities.

Intangible assets (–)
Credit companies are more willing to lend money if they can secure collateral against it, and collateral is measured by the degree of tangible assets that a firm owns. Because the speed of adjustment is positively related to tangible assets, it should be negatively related to intangible assets. Therefore, the higher the degree of intangible assets the slower is the speed of adjustment. The log of intangible assets is used as a measure for this variable.

Investment (+)
Investment is a sign of potential growth and strength after taking into consideration the risk related to each investment. Therefore, firms with a high degree of investment are expected to raise debt more easily than their counterparts. The log of investment is used for estimation.

Table 2 Static and dynamic model parameter estimates, 9604 observations

Model		*Static model*		*Restricted Dynamic*		*Unrestricted Dynamic*	
Variable	*Definition*	*Estimate*	*Standard error*	*Estimate*	*Standard error*	*Estimate*	*Standard error*
Determinants of capital structure							
Intercept	Intercept	0.3970***	0.0326	–0.0814	0.1224	0.0864	0.0894
Variability	Inc. variability	–0.0000**	0.0000	–0.0001	0.00005	–0.00005	0.00003
Growth	Growth	–0.0013***	0.0001	–0.0024***	0.0003	0.0022***	0.0003
Tangibility	Tangibility	0.0002	0.0112	–0.0775*	0.0415	–0.2150***	0.0320
Size	Size	0.0171***	0.0016	0.0359***	0.0059	0.0366***	0.0043
Profitability	Profitability	–0.0465***	0.0051	–0.3395***	0.0230	–2.2197***	0.0805
Non-debt tax shield	Non-debt tax shield	–0.0329***	0.0116	–0.0479	0.0428	0.0902***	0.0320
Uniqueness	Uniqueness	0.0529***	0.0010	0.1655***	0.0372	–0.0369	0.0348
Trend	Trend	–0.0081***	0.0006	0.0066***	0.0024	–0.0004	0.0017
Crisis	Crisis	–0.0654***	0.0063	–0.4233***	0.0282	–0.3019***	0.0193
Chaebol	Chaebol	0.0351***	0.0053	0.0263	0.0196	0.0343***	0.0132
Ind2-Ind24	Industry dummies	included		included		included	
Determinants of speed of adjustment							
Intercept	Intercept	—	—	0.1409***	0.0054	–0.0470**	0.0216
Distance	Distance	—	—	—	—	0.0000	0.0060
Current Liabilities	Current liabilities	—	—	—	—	0.0677***	0.0067
Intangible Assets	Intangible assets	—	—	—	—	0.0029***	0.0004
Government Sh.	Shareholder, government	—	—	—	—	–0.0029**	0.0013
Foreigner Sh.	Shareholder, foreigner	—	—	—	—	0.0022***	0.0003
Individual Sh.	Shareholder, individual	—	—	—	—	–0.0001	0.0001
Minor Sh.	Shareholder, minor	—	—	—	—	–0.0011***	0.0001
Major Sh.	Shareholder, major	—	—	—	—	0.0020***	0.0002
Total Sh.	Shareholder, total	—	—	—	—	0.0001	0.0001
Crisis	Crisis	—	—	—	—	–0.0233***	0.0090
Trend	Trend	—	—	—	—	–0.0050***	0.0011
Investment	Investment	—	—	—	—	0.0123***	0.0014
Adjusted R^2	Adjusted R^2	0.1908		0.7803		0.8129	
RMSE	Root mean square error	0.1684		0.0878		0.0809	

Notes: Dependent variable is the ratio: total liability/[equity + (total liability)]. *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.

Time trend (–)
Whether the speed of adjustment varies over time can be an interesting issue, considering especially the impact of the Asian financial crisis. A negative relation between trend and the speed of adjustment is expected, because we anticipate that credit firms have preferred tighter credit policy after the crisis, which is reflected in the trend variable.

Financial crisis (–)
The crisis variable is included because we expect a direct and clear effect on both optimal leverage and speed of adjustment. After the crisis, speed of adjustment is expected to slow down somewhat, because raising debt is expected to become more difficult.

Shareholding (+/–)
Shareholder dummies are also included to capture the effect of different shareholders (ownership structure) on decisions on capital structure and, hence, the speed of adjustment. Six dummy variables are included regarding the corporate governance structure, indicating shares held by government, by corporation, by foreign shareholders, by individuals, by minor shareholders and by major shareholders.

VII. Empirical Results

The dynamic and static capital structure models were estimated using non-linear and linear least square estimation. The reason for including a standard static model in addition to the dynamic one is to make comparisons between both, and to verify whether the dynamic model offers a better explanation than the traditional static one. The two models are not nested and, as such, are not directly comparable, yet the static model can serve as a benchmark.

To compare the two models, the root mean squares error (RMSE) and the coefficient of determination (R^2) values of the two models are examined (see Table 2 for results). The dynamic model had an RMSE of 0.0809 and an R^2 of 0.8129 compared with an RMSE of 0.1684 and a R^2 of 0.1908 for the static model. Therefore, without considering some insignificant parameters, the lower RMSE and higher R^2 of the dynamic model with lag dependent variables is a better fit for modeling the capital structure, which provides us with a better understanding of the variation in the capital structures of Korean firms. By including the flexible speed of adjustment parameter, we allow the dynamic model to contain more explanatory power than the traditional static one, because it offers a more complete representation of leverage behavior.

Closer examination of the restricted traditional dynamic model, where the speed of adjustment consists of only a constant term (Rajbhandary, unpubl. data, 1997; Vilasuso and Minkler, 2001), shows that the increase in explanatory power of the model (RMSE of 0.0878 and a lower R^2 of 0.7803 compared with an

RMSE of 0.1684 and R^2 of 0.1908 for the static model) is a result, largely, of the introduction of a lagged-dependent variable, whose coefficient is the constant in the adjustment equation (namely, β_0.)

The summary statistics reported in Table 1 show that Korean manufacturing companies have relatively high levels of leverage. The sample mean and standard deviations are 64.8 and 18.7 percent, respectively. Listed US firms are in the 25 to 33-percent range, whereas those in the UK range from 10 to 16 percent (Rajan and Zingales, 1995). Table 3 shows the mean values by crisis period, by which we can easily confirm the difference in indebtedness of Korean manufacturing firms for the periods before and after the 1997 financial crisis.

For instance, in Table 3 it is shown that the mean adjustment parameter δ before 1997 was 18 percent, and after 1997 it decreased to 14.9 percent; the mean optimal debt recorded was 65.2 percent before the crisis compared with 39.7 percent in the post-crisis period. The observed mean debt dropped from 67.6 to 58.3 percent and the mean distance declined from –2.4 to −18.6 percent, which is consistent with the mean optimality ratio that also dropped from 96.5 to 68.1 percent. The 1997 economic crisis had an enormous impact on Korea's financial markets, when macroeconomic fundamentals were good but the banking sector became burdened with non-performing short-term loans. The proportion of collateralized loans of Korean banks was very low before the crisis. For example, the collateralized loans of 25 commercial banks were only 32 percent of overall loans at the end of 1996, equivalent to 68 trillion won, compared with the proportion of collateralized loans in 1990 and 1995 at 42.2 and 37.6 percent, respectively (Kataoka, 2000; Takahashi, 1998). Evidently, bank-lending practices were not based on proper credit risk analysis, and such a trend was more significant, especially right before the crisis. Korean banks expanded non-collateral based loans to firms, especially for chaebols. However, there was significant reduction in firms' leverage and, correspondingly, bank lending since. The financial crisis forced banks to implement radical and painful changes to improve competitiveness and efficiency. The banking sector has undergone restructuring and has been forced to abandon practices that encourage moral hazard. Banks have had to adopt an advanced management system including proper credit analysis (Kataoka, 2000).

We now turn to a detailed analysis of the empirical results from the dynamic flexible adjustment model and investigate whether the conventional corporate finance theory describes the financing behavior of listed Korean companies well. We empirically estimated all three models; namely, the static, restricted and unrestricted dynamic models for the entire period, 1985–2002, as well as for the subperiods, 1985–1989, 1990–1996 and 1997–2002, to see whether results differed by different time periods.[14]

14. To conserve space, not all results from the subperiods are reported here. However, they are available from the authors upon request.

Table 3 Mean values from unrestricted dynamic model, 9604 observations

Year	*Definition*	*Delta*	*Optimal*	*Observed*	*Distance*	*Optimal ratio*
Panel A. Mean by year of observation:						
1986		0.188	0.601	0.736	–0.135	0.817
1987		0.183	0.589	0.722	–0.133	0.816
1988		0.184	0.591	0.680	–0.089	0.869
1989		0.183	0.625	0.639	–0.014	0.979
1990		0.187	0.642	0.647	–0.006	0.991
1991		0.181	0.649	0.664	–0.015	0.977
1992		0.179	0.656	0.668	–0.012	0.982
1993		0.174	0.661	0.665	–0.004	0.995
1994		0.172	0.674	0.668	0.006	1.010
1995		0.174	0.677	0.666	0.011	1.017
1996		0.175	0.704	0.666	0.038	1.056
1997		0.177	0.740	0.692	0.048	1.070
1998		0.148	0.457	0.653	–0.196	0.700
1999		0.148	0.404	0.600	–0.195	0.674
2000		0.148	0.391	0.589	–0.197	0.665
2001		0.151	0.383	0.555	–0.172	0.690
2002		0.152	0.351	0.522	–0.171	0.672
Panel B. Mean by crisis period:						
1985–1997	Pre-crisis	0.180	0.652	0.676	–0.024	0.965
1998–2002	Post-crisis	0.149	0.397	0.583	–0.186	0.681
Panel C. Sample mean and standard deviations by industrial sector:						
Industry 1	Fishing and mining	0.189	0.597	0.645	–0.048	0.925
Industry 2	Food products and beverage	0.188	0.655	0.706	–0.051	0.928
Industry 3	Tobacco products	0.212	0.403	0.262	0.140	1.535
Industry 4	Textiles, except sewn wearing	0.164	0.511	0.624	–0.113	0.819
Industry 5	Sewn wearing apparel	0.176	0.530	0.613	–0.083	0.864
Industry 6	Luggage and footwear	0.144	0.592	0.685	–0.093	0.864
Industry 7	Wood	0.188	0.514	0.630	–0.116	0.816

Table 3 (*continued*)

Year	*Definition*	*Delta*	*Optimal*	*Observed*	*Distance*	*Optimal ratio*
Industry 8	Paper and paper products	0.159	0.586	0.672	–0.087	0.871
Industry 9	Publishing and printing recorded media	0.183	0.446	0.626	–0.180	0.712
Industry 10	Coke, refined petroleum products	0.221	0.525	0.583	–0.058	0.901
Industry 11	Chemicals and chemical products	0.169	0.531	0.601	–0.070	0.884
Industry 12	Rubber and plastic production	0.186	0.500	0.583	–0.084	0.857
Industry 13	Other non-metallic mineral products	0.188	0.556	0.645	–0.088	0.863
Industry 14	Basic metals	0.178	0.579	0.613	–0.035	0.943
Industry 15	Fabricated metal products	0.148	0.577	0.689	–0.113	0.837
Industry 16	Other machinery and equipment	0.160	0.523	0.619	–0.096	0.844
Industry 17	Computers and office machinery	0.163	0.498	0.580	–0.082	0.859
Industry 18	Electrical machinery and furniture	0.170	0.512	0.604	–0.092	0.847
Industry 19	Electronics, radio, television	0.156	0.527	0.611	–0.084	0.862
Industry 20	Medical instruments	0.149	0.517	0.583	–0.065	0.888
Industry 21	Motor vehicles and trailers	0.173	0.595	0.664	–0.069	0.895
Industry 22	Other transport equipment	0.200	0.692	0.736	–0.044	0.940
Industry 23	Furniture	0.175	0.581	0.710	–0.130	0.818
Industry 24	Other sectors	0.169	0.658	0.715	–0.058	0.919
Panel D. Sample mean and standard deviations by size of firm:						
1	Very small (total sales <27 million won)	0.155	0.538	0.653	–0.116	0.823
2	Small (27–60 million won)	0.156	0.560	0.623	–0.062	0.900
3	Medium (60–125 million won)	0.164	0.557	0.621	–0.065	0.896
4	Large (125–300 million won)	0.174	0.575	0.647	–0.072	0.888
5	Very large (300+ million won)	0.198	0.637	0.693	–0.055	0.920
Panel E. Sample mean and standard deviations by chaebol affiliation:						
0	Non-chaebol	0.163	0.553	0.634	–0.081	0.873
1	Chaebol	0.202	0.673	0.710	–0.037	0.948
Panel F. Sample mean and standard deviations:						
Mean	Mean	0.170	0.576	0.648	0.175	0.832
Std dev	Standard deviation	0.057	0.209	0.187	0.163	0.213

Dispersion in revenue measured as income variability was found to be statistically insignificant. The variability of income was expected to be negatively related to leverage, according to the theory, implying that the more volatile the income, the higher the probability of default. However, the insignificance of the coefficient was robust over all three models. Income variability did not appear to be a significant factor determining the level of leverage of Korean firms. This suggests that, for credit providers in the Korean financial market, income-based criterion was not a major rationing criterion.

Based on the theory of corporate finance growth measured as growth opportunity, a negative relationship with leverage is expected (Stulz, 1990). Ranjan and Zingales (1995) argue that the under-investment problem might cause firms with high-expected future growth to mainly use equity financing. Growth opportunity showed a negative sign in the static model (−0.0013) and in the restricted dynamic model (−0.0024), but a positive relationship in the unrestricted dynamic capital structure model (0.0022), with all cases having highly statistically significant results. Even for the static model, the negative sign seemed to be associated with the period after the crisis, as it was positive 0.0007 and 0.0004 for the first two periods, 1985–1989 and 1990–1996, respectively.

The results for tangibility show a difference in signs as well as magnitudes between the static and dynamic models. The estimated parameter of the static model was not statistically significant, whereas the unrestricted dynamic model showed a negative effect (−0.2150), which is consistent with Grossman and Hart (1982). The same applies to the restricted dynamic model, which showed a negative relationship, but at a lower 10-percent level of significance. The results from the static model by subperiods were also examined, and results suggest that the relationship between tangibility and the debt ratio was negative and highly significant during the periods 1985–1989 and 1990–1996. A positive sign appeared only in the period after the crisis, 1997–2002. Therefore, the positive sign in the static model over the entire sample period 1985–2002 must be a result of the significant and positive effect in the post-crisis period, which would have dominated the negative effect in the pre-crisis period. Specifically, for the period after the crisis, the empirical result suggests that banks or credit providers became more careful in lending, often requiring sufficient collateral.

Our empirical estimation showed a positive and statistically significant relation between size, measured by log of total assets, and leverage in all of the three models (static, restricted and unrestricted dynamic models). This can be interpreted as a result of larger firms having better ability to raise debt and being less vulnerable to bankruptcy than smaller firms.

In all three models (static, restricted and non-restricted dynamic models), profitability showed a negative relationship with leverage, and is consistent with Myers (1984) and Michaelas et al. (1999). The coefficients were negative and highly significant at the 1-percent level of significance with values –0.0465,

−0.3395 and −2.2197 for the static, restricted and unrestricted dynamic models, respectively. As already mentioned, for a profitable firm, the target debt to equity ratio is typically low, because such firms would prefer to rely on internal financing before seeking external loans (i.e. the pecking order theory (Myers, 1984)).

The coefficient of non-debt tax shields is negative and significant for the static model (−0.0329) and positive for the unrestricted dynamic model (0.0902). If the positive sign for the dynamic model is in fact correct, then Korean listed firms do not make much use of other tax shields that do not involve the issuance of debt, for instance depreciation. That is, the main tax shield seems to be generated from deducting interest expense.

Firms with product uniqueness, as a result of sunk costs in production technology, are expected to exhibit lower leverage because, in the case of bankruptcy, a competitive secondary market for their inventory and production equipment would not exist. The static and the restricted models showed positive and significant coefficients (0.0529 and 0.1655), whereas the dynamic model showed a negative sign, but was statistically insignificant. Even the positive sign in the static model can be interpreted as being a result of the dominant crisis effect compared with the period before the crisis, which showed an insignificant relationship between uniqueness and debt ratio.

The time trend variable, which is expected to be negatively correlated with the leverage mainly because of the adverse effects of the financial crisis on the credit market, was found to be highly significant and negatively correlated with leverage (−0.0081) in the static model, whereas in the unrestricted dynamic model the negative association was statistically insignificant.

For both static and dynamic models, the coefficient for financial crisis turned out to be highly significant and negatively related to leverage, which was expected, because the financial crisis had a debt tightening effect on financial markets in Korea. Before the crisis, it was easier to raise debt than after the crisis when banks adopted tighter credit policy.

Most of the industrial sector dummy coefficients were statistically insignificant, especially in the unrestricted dynamic model. The lack of industry heterogeneity is evidence of the homogenous impact of the crisis on firms across different sectors of the economy. Before the financial crisis, because of the expansionist growth policy and the common within-chaebol group cross-debt guarantees, most chaebol-affiliated firms were highly indebted. The positive and highly significant effect of chaebol affiliation on the level of leverage is confirmed in both the static and the dynamic flexible adjustment models.

VII.2 Determinants of the speed of adjustment

In reality, firms have different capital structures and face different capital market conditions. This leads to different speeds of adjustment towards their firm-specific optimal capital structures. Differences in adjustment speeds are accounted for by including the determinants of the speed of adjustment, which are captured by the dynamic model. In the static model, the assumption of instantaneous adjustment implies that the speed adjustment coefficient is equal to 1; that is, there is no difference between the observed and the optimal leverage ratios.

Table 2 shows that some of the measured variables are significant whereas others are not. For instance the share of current liabilities variable is positively significant (0.0677) showing that firms with a high level of short-term debt adjust faster than their counterparts, which is an obvious result as current liabilities are highly liquid and could be relieved easily. Our empirical findings also show that firms with a higher degree of foreign investment adjust rapidly towards their optimal level of capital structure, suggesting that foreign investors could have access to a broader set of credit sources, (the parameter estimated was 0.0022). The investment variable was also found to be positive and significant (0.0123), illustrating the fact that firms with a high level of investment could adjust more easily than firms with lower levels. This implies that investment is seen by creditors as a sign of strength, profitability and growth, and, therefore, are willing to lend more to high investment firms than low investment ones.

The crisis and trend variables are both negatively related to the speed of adjustment, which asserts our expectations that with time, and especially after the crisis, the financial environment in Korea became tighter, making the act of borrowing more demanding, thereby leading to a wider gap between the observed and the optimal leverage, and, consequently, slowing down the speed of adjustment. As suggested in Section VI, a distance variable representing the absolute difference between optimal and observed leverages was included. If the coefficient is positive, this indicates a positive association between the gap of optimal and observed leverage as well as the speed at which a firm might fill the gap in optimality. This suggests the presence of fixed adjustment costs and an inverted U-shaped overall adjustment cost. However, the coefficient is statistically insignificant.

VII.3 Variations in the results

Table 3 shows the mean values of the speed of adjustment, optimal leverage, observed leverage, distance between the observed and the optimal leverage, and the ratio of optimality, by year of observation, crisis period, industry aggregate, size of companies and membership to the chaebol affiliation. The variable total asset is used to classify firms by group size.

It is clearly noticeable from panel B that the effect of the crisis on the speed of adjustment was significant. The mean speed of adjustment dropped from approximately 18.0 percent before the crisis to 14.9 percent in the post-crisis period. This indicates that raising debt in the post-1997 period became more difficult and might have become more costly. This is backed up by the fact that the optimal and observed ratios decreased when comparing the two periods.

Moreover, one of the effects of the crisis has been to increase the distance between the observed and the optimal, with the mean dropping from −2.4 to −18.6 percent.

The results shown in Panel A, by year of observation, also lead to the same conclusion as those in the post-crisis period. Before 1997, the mean of the speed of adjustment fluctuated between a maximum of 18.8 percent and a minimum of 17.2 percent, whereas after 1997 the mean dropped, never exceeding a maximum of 15.2 percent. For 1986–1994, the mean speed of adjustment decreased over time, although there were some fluctuations during this period, but increased after 1994 until 1997. After the crisis, there was a significant decrease in the mean speed of adjustment, indicating that firms had faced financial difficulties. The mean of adjustment speed remained low (approximately 14.9 percent), more or less constantly in the post-crisis period.

Restructuring in the banking sector in the aftermath of the Asian crisis focused on more efficient and transparent credit analysis systems. Interestingly, the distance between optimal and observed leverage, which was negative until 1993 (with the gap becoming narrower) became positive in 1994 and increased up until 1997. The shift from a negative to positive distance implies that since 1994, firms' optimal leverage exceeded observed leverage, meaning that firms were less dependent on debt financing. After the crisis, the distance became negative again in 1998. Since 1998, the distance increased but remained negative until 2002. This is mainly because, although the observed leverage declined after the crisis, implying that the firms tend to depend less on debt-financing or that it became more difficult to borrow, the optimal level of leverage dropped more significantly than the observed level.

Regarding the change in the observed and optimal leverage, before the crisis, the optimal leverage, overall, increased over time, whereas the observed leverage, overall, decreased after 1997 and remained quite constant after the crisis. The observed pattern of firms' actual financing behavior, therefore, is not necessarily consistent with the change in optimal level of leverage, mainly because of adjustment costs that a firm could be facing. The optimality, the ratio between optimal and observed leverage, provides a similar interpretation of the distance between them.

Panel D, which shows the mean by firm size, reflects the fact that the speed of adjustment increases as firm size increases, mainly because larger firms find it easier and relatively cheaper to adjust than smaller firms.

Panel E of Table 3 shows that the mean speed of adjustment for chaebol firms was 0.202 over the sample period, which was higher than that for non-chaebol firms, which recorded 0.163, indicating the possibility that chaebol firms had better access to debt financing because of cross-subsidiary loan guarantees and/or mutual investments. Chaebol firms were also associated with higher optimal level of leverage and observed leverage compared with non-chaebol firms, and the optimality ratio was higher (the distance was smaller) for chaebol firms compared with their non-chaebol counterparts.

Table 4 Pearson correlation coefficients, based on unrestricted dynamic model, 9604 observations

	Year	*Size*	*Optimal*	*Observed*	*Optimal ratio*	*Distance*	*Delta*	*Chaebol*
Year	1.0000							
Size	0.3974	1.0000						
	0.0001							
Optimal	−0.3566	0.1562	1.0000					
	0.0001	0.0001						
Observed	−0.2248	0.0763	0.5467	1.0000				
	0.0001	0.0001	0.0001					
Optimal ratio	−0.3099	0.0940	0.7338	−0.0585	1.0000			
	0.0001	0.0001	0.0001	0.0001				
Distance	0.2538	−0.0717	−0.4691	0.0491	−0.7512	1.0000		
	0.0001	0.0001	0.0001	0.0001	0.0001			
Delta	−0.2274	0.2876	0.0987	−0.0718	0.1867	−0.2017	1.0000	
	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001		
Chaebol	−0.0022	0.4787	0.2234	0.1580	0.1292	−0.1031	0.2623	1.0000
	0.8334	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	

Note: p-values are shown below the coefficients.

The industry aggregate panel does not show any significant difference between the different industries, because the level of debt financing and the speed of adjustment do not differ by industry type. This indicates similarities in the financial market and in credit policy conditions that firms face, as well as the strong and homogeneous impact of the crisis on the capital market and bank–firm relationship.

Table 4 reports the correlation coefficients between optimal, observed, and their distance and optimality ratio of leverage, size, speed of adjustment and time. The optimal, observed, and their ratios and speed of adjustment are negatively correlated with time, whereas the distance and firm size are positively correlated with time.

The correlation coefficient between optimal and observed leverages is somewhat low at 0.55. The distance or gap from optimality was negatively related to size and group membership, indicating that external sources of investment was to a higher degree accessible to larger firms, in particular those with chaebol affiliation. Chaebol firms are closer to their optimal level and tend to adjust their capital structure much faster.

VIII. Summary and Conclusions

In this paper, we have examined factors that influence the capital structure decision for Korean listed manufacturing companies. A major objective of this paper was to provide deeper insight regarding Korean firms' leverage behavior, which has attracted considerable interest, as high debt ratios were singled out as a major cause of the 1997 financial crisis. A dynamic model was adopted to trace capital structure adjustments over time. The results from the dynamic model were compared with those from the conventional static model, which was used to identify systematic differences.

The Asian financial crisis had very clear effects on the Asian financial markets in general, and the Korean market in particular, which was confirmed in all estimated models in this study. The speed of adjustment fell and the optimal leverage also decreased by a larger degree compared to the observed leverage in the post-crisis period, leading to an increase in the distance between both measures and a fall in the optimality ratio. It is likely that Korean non-financial firms after the outbreak of crisis have become more risk averse and have begun to favor internal financing over debt financing, particularly for growing and profitable firms. This is confirmed by the negative relation between growth opportunity and profitability on the one hand, and leverage on the other.

We have also examined whether chaebol-affiliation influenced the optimal level of leverage, as well as the speed of adjustment. The results showed that chaebol affiliations were positively related to optimal leverage and chaebol-affiliated firms were more likely to adjust to the optimal leverage once they drifted away from the optimal levels, but in our view being a chaebol-affiliated firm is not necessarily a causal factor determining the optimal level of leverage. This finding does not differ from other studies. Regarding the chaebol effect, one might consider that chaebol firms are more likely to have higher debt ratios than non-chaebol firms. For example, Lee et al. (2000) argue that the chaebol-affiliation dummies, which are designed to test whether chaebol firms have significantly higher leverage than non-chaebol firms, appear significantly positive, and that this empirical finding is supported by the observation that the chaebol-affiliated firms have higher debt–asset ratios than non-chaebol firms. Based on their finding, they assert that chaebol firms have more leverage than their non-chaebol competitors, even after controlling for other determinants of the firms' capital structure.

The empirical finding of the present paper, however, suggests that such a gap between the two groups of firms was not necessarily caused by the pure chaebol effect. Rather, firms' leverage could be associated with other factors, such as size, profitability and growth opportunity, which would influence the optimal leverage positively. Our results show that the coefficients for chaebol in both the static model and dynamic unrestricted models were positive and statistically significant. Chaebol-affiliated firms were positively associated with higher debt not only because they were chaebol affiliated, but also because they were larger in size, more profitable, and/or have more unique products. In general, it would be rather difficult to isolate the chaebol effect effectively, as the effect might be confounded with other characteristics, as well as the industrial sector and time effects.[15]

15. In earlier studies, such as Lee et al. (2000), the positive coefficient was not always statistically significant and was dependent on the model specification and the period under consideration. This suggests that a positive and significant coefficient (mostly at the 5-percent level) might appear, resulting from omissions of variables that determine the optimal leverage, such as uniqueness and non-debt tax shields.

What then is the economic rationality between leverage level and being a chaebol or non-chaebol? As our data shows, chaebol firms have higher leverage on average than non-chaebol firms. This is a well-known fact, and the logic is that chaebols were encouraged to have higher leverage because of government guarantees and cross-debt guarantees across affiliated firms. Traditionally, the government encouraged banks to allocate loans to chaebols at favorable rates, although this practice has reduced considerably since the late 1980s. The fact that chaebol-affiliated firms could guarantee loans on behalf of each other might have encouraged banks to lend to them, thereby increasing leverage.[16]

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16. Somewhat related to this is that chaebols owned several merchant banks in the 1990s, which helped them acquire more loans. Overall, they had easier access to bank loans than non-chaebol firms.

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