

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

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ABSTRACT

A model of dynamic capital structure choice based on a sample of Korean manufacturing firms is developed in this paper and results compared with the classical static model. This paper specifies and estimates the unobservable optimal capital structure using a wide range of observable determinants. Unbalanced panel data of Korean listed firms for the period 1985 to 2002 is used in this study. In addition to identification and estimation of the effects of the determinants of capital structure and capital structure optimality, some Korea-specific features such as the structural break before and after the financial crisis, as well as affiliation to a chaebol business groups, are taken into account to verify whether the optimal capital structure was affected by the financial crisis or whether belonging to a chaebol has any effect, and if so, to what extent.

Keywords: Capital structure, debt, firm, panel data, adjustment, Korea

JEL Classification Numbers: C33, D21, G32

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1. INTRODUCTION

The Asian financial crisis of 1997 seriously affected the Korean economy causing a number of highly leveraged Korean firms, especially those belonging to large business groups or chaebols, to become bankrupt. The bankruptcies, in turn, adversely affected financial institutions that had been intricately linked to such firms. The dramatic capital outflow as foreign investors lost confidence in Asian economies, including Korea, has been identified as a main cause of the financial crisis. Highly leveraged firms were not only affected during the crisis, but also had to endure heavy restructuring in the post-crisis period. Following the outbreak of the Asian financial crisis in late-1997, the issue of highly leveraged Korean firms has become an important one. The crisis, initially triggered by the sudden outflow of foreign capital that caused a liquidity crisis in the banking sector, exposed other structural weaknesses in the economy including its corporate sector. Another critical factor behind the crisis was the excessive investment by firms, which is connected to inefficient lending by financial institutions to low profitability firms.

In November 21, 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 Asian financial crisis that had begun in July 1997 with the devaluation of the Thai bath, to be followed by Indonesia, Malaysia, and other neighboring Asian countries. In the aftermath of the crisis, Korean firms have been asked to restructure their corporate finance, i.e. mainly to reduce their dependence on debt (Fattouh, Scaramozzino and Harris, 2004). There is growing literature analyzing the causes and consequences of the Asian financial crisis that attributes the economy's vulnerability to high leverage (Choi, 2000).

This study adopts the optimal capital structure theory to explain the determinants of capital structure and the speed of adjustment of Korean firms. Capital structuring and, in particular, establishing the optimal capital structure, has for a long time been important areas of debate among academicians and practitioners alike. Academically, the problem is appealing because it is a fairly open-ended question subject to controversies and criticisms. Particularly, this study pays attention to Korean firms in examining how firms might choose their capital structures considering Korea-specific corporate features and the importance of leverage. This paper provides a comprehensive analysis of how a set of observable variables might affect capital structure choices in Korea. In addition, possible shifts in the impacts of individual factors and the overall adjustment in capital structure in relation with the financial crisis is estimated.

Although the analysis is based on a dynamic model, for the purpose of comparison, this study also includes the typical static model whose results are contrasted to that of the dynamic model. Looking ahead, it is found that the dynamic model is the preferred model. The following differentiate this paper from other existing literature; the study 1) provides a distinction between the observed and the estimated optimal debt ratio, 2) empirically identifies factors determining the optimal debt level, 3) captures the dynamics of capital

structure adjustments by modeling movements towards optimal debt ratios, 4) specifies an adjustment model where firm-specific and time-specific factors determining the speed of adjustment are identified and their impacts are quantified, and 5) studies the capital structure of a sample of 617 Korean listed non-financial companies between 1985 and 2002.

This study identifies the key determinants of capital structure among the listed Korean firms. It is found that some variables are insignificant such as income variability, uniqueness, and trend, while other variables including growth, tangibility, and the crisis were found to be highly significant. Moreover, the 1997 crisis, and firm size, measured by the volume of sales, had a clear influence on the speed of adjustment in the observed capital structure towards the optimal level.

The remainder of this paper is organized as follows. Section 2 provides the theory of capital structure and a brief literature review of empirical studies. Section 3 contains the background of financial markets in Korea. Section 4 describes the data and methodology and presents the empirical model. Section 5 reports the data, which is followed by a listing of the determinants of capital structure and speed of adjustment in Section 6. Section 7 summarizes the results of the empirical study. Section 8 concludes and an Appendix provides statistical tables.

2. THEORIES OF CAPITAL STRUCTURE OF FIRMS

The modern theory of capital structure is said to have begun with Modigliani and Miller's seminal paper in 1958 entitled "The Cost of Capital, Corporation Finance and the Theory of Investment" (MM thereafter). Since then a number of theories have been put forward in order 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 tradeoffs between the costs and benefits of debt versus equity. Although the MM hypothesis, assuming perfectly and complete capital market structures, argues that the leverage of a firm is independent to, and thus uncorrelated with, its market value, in the real world, bankruptcy costs, agency costs, costs derived from asymmetric information and incompleteness in markets are common, and there is a growing literature that tries to incorporate such issues in their analysis of 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 deriving from asymmetric information (what is known as the Pecking Order Theory).

A. Bankruptcy Cost

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 as well, and in such a case, firms may 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 eventually they might have to give up on attractive investment opportunities, which could adversely affect profitability opportunities. In turn, the firm's bankruptcy probability could increase in extreme situations. Since an increase in firm value caused by a reduction in income tax may be offset by an increase in expected bankruptcy costs, which worsens the firm's value, the existence of such tradeoffs implies that an optimal capital structure exists and can be found.

B. Agency Cost

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' behaviour to align their actions with the principal's objectives. This usually involves monitoring the behaviour of agents as well. Jensen and Meckling (1976) identify agency costs, which may be monetary or non-monetary, as consisting of monitoring cost, bonding cost, and residual loss. Accordingly, there can be two types of agency costs, namely, agency costs of equity associated with the issuance of stocks (equity), and agency cost of debt associated with the issuance of debt.

The agency cost of debt occurs when there exists some conflict of interest between shareholders and debtors since such conflicts may interrupt further investment or financing activities, thereby adding extra costs in managing such difficulties. Shareholders may be strongly tempted to maximize their own interests rather than maximize the entire value of firms, which becomes a cost for debtors, especially when they are faced with an extremely vulnerable situation, such as bankruptcy, and the CEO, the agent, who represents the interests of shareholders may 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'.

As the debt of firms increases the bankruptcy cost and agency cost of firm rises, and it is through this argument that 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. Thus, due to such tradeoffs, the optimal capital structure may exist and can be found

C. Pecking Order Theory

Often in corporate financing decision, however, it has been observed that a firm tends to draw on firstly internal financing, and then look to external financing later by issuing shares or corporate bonds in the financial market when there is insufficient funds for internal financing. According to Myers (1984), such a pattern of corporate financing is largely motivated by information asymmetry between the insiders, which is the managers, and the external investors. This is what is known as the Pecking Order theory.

For example, regarding firm size, although there was no reference to size in the original theory, recent studies emphasize differences between the optimal financial structure of small and large firms (e.g., Chittenden et al., 1996). Interestingly, it has been shown that

significant differences of firm size are related to agency and asymmetric information, control aversion, preferences and other factors having implications for potential agency costs. (Pettit and Singer (1985), Cressy and Olofsson (1997a) and Jordan et al. (1998)).

Empirical Studies on the Determinants of Capital Structure

Capital structure theories suggest that the optimal debt ratio can be found given the tradeoff 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, which are observed, this does not necessarily constitute an explanation for the optimal debt-equity ratio or the extent of inoptimality. Many existing literature, therefore, have borrowed observed leverage as proxies for the optimal leverage ratio (Rajan et al. 1995; Titman et al. 1988; Wedig et al. 1988, Harris and Raviv 1991). However, even if firms are aware of the inoptimality, they may 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, Heinkel, and Zechner (1989), for example, examine the features that determine the scope of deviations in a firms' capital structures over time. Another example, 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 speeds of adjustment by company and over time. The long-term targets toward which firms adjust are specified exogenously in their paper. Rajbhandary (1997) uses a similar dynamic adjustment model in the context of Indian firm data but with constant speed of adjustment, while Vilasuso and Minkler (2001) studied a dynamic model incorporating agency costs and asset specificity. Heshmati (2002) analyzed the dynamics of capital structure of Swedish micro and small firms, while Banerjee et al. (2004) analyzed 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 to 2002, this study estimates their optimal capital structure simultaneously treating the dynamics and flexible adjustment of capital structure.

A review of empirical studies of capital structure and its determinants related to the Korean financial market is provided in the next section.

3. THE KOREAN FINANCIAL MARKET

Korean firms have been criticized for their high leverage. Moreover, large conglomerates or the chaebol¹ have commonly exhibited higher leverage than non-chaebol firms.² For

¹ 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% 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.

² The average debt/equity ratio of firms exceeded 300%, approximately four times higher than that of Taiwan (IMF, 1998). For the 30 largest conglomerates, the ratio was over 500% and there were some large firms that

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 to 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 sub-periods that we studied (1985-1989, 1990-1996, 1997-2002, and before and after the financial crisis. See Appendix A). Such firm-specific features of Korean companies have not been treated in corporate financing theory as important determinants of a firm's capital structure, and, therefore, corporate finance theory alone seems insufficient in explaining the capital structure of Korean firms. Arguably, Korea-specific features, both institutional and structural ones, should be considered to better understand Korean financial markets, and to better model and interpret the results of empirical study more comprehensively. Thus, in this section, background information of the Korean financial market and the way it functions focusing on the reasons of high leverage of Korean firms is discussed.

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 70s. The government's export promotion policy between 1962 and 1972, for example, followed by industrial promotion between 1973 and 1979, as well as the adjustment and deregulation between 1980 and 1993 are examples of the government-managed economy (World Bank 1993). However, due 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). Thus, firms had little incentive to lower their debt, thereby explaining their high debt to equity ratios especially before the infamous Asian crisis. Borensztein and Lee (1998) provide further discussion for 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 of Korea's financial markets. 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 the period 1988 to 1996 (Claessens et al., 1998). Other studies treating the issue of corporate debt in Korea confirming this trend are Borensztein and Lee (1998), 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 et al. 2000). In order to enhance the

in fact recorded debt/equity ratios of 3,000 percent (Lee et al., 2000). At the end of 1997, the total debt owed by Korean firms was approximately US\$675 billion. This was almost 1.9 times the GDP in the same year (Nam et al., 1999).

efficiency of the capital market, the Korean government has actively implemented comprehensive reforms addressing the rules and regulations, including the regulatory system itself and corporate governance, which combined together has contributed to the reduction in the debt to equity ratios of Korean firms after the crisis.

Lee et al. (2000) has studied changes in the leverage and debt structure of Korean firms using an unbalanced panel from 1981 to 1997. They studied the financing decision of Korean firms and found that there were 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. In their study, they divided their sample into three groups, the 1st-5th largest chaebol firms, the 6-30th largest chaebol firms and non-chaebol firms, and found that the five 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, Ferri and Bongini (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) examined whether credit allocation was efficient in Korean manufacturing industries for the period 1969 to 1996. They investigated whether financial resources have been directed to more efficient sectors over this period. Their study shows that the profitability of investment did not play an important role in credit allocation but rather, 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. They 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 also were not able to find evidence to support the proposition that the flow of credit, over time, contributed positively to improve the performance of favored industries.

In sum, the 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 system for credit analysis of commercial banks, and firms' lacking transparency in corporate governance structures also might belong to 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, the financial structure and firm characteristics also should be taken into account to better understand the capital structure of Korean firms.

4. 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) used the LISREL system to model the capital structure of US manufacturing firms specified as: $y = \Gamma\xi + \varepsilon$, where y is $p \times 1$ vector of debt ratios, Γ is $p \times m$ matrix of factor loadings, ε is $p \times 1$ vector of disturbance terms. Fischer, Heinkel and Zechner (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.

This study uses tradition 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.

$$(1) \quad L_{it}^* = F(X_{it}, X_i, X_t)$$

where X_{it} , represent 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, while 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, i.e. $L_{it} = L_{it}^*$. If we try to expand this idea, we note the equality in changes in leverage from a previous period to the current as follows:

$$(2) \quad L_{it} - L_{it-1} = L_{it}^* - L_{it-1}$$

But since adjusting from one state to another is costly, in many cases, firms may find it easier and less expensive to adjust in the short-run. Thus, 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, (2) can be stated as follows:

$$(3) \quad L_{it} - L_{it-1} = \delta_{it}(L_{it}^* - L_{it-1})$$

Three cases are possible: If (i) $\delta_{it} = 1$, then the entire adjustment is made within one period and the firm's observed leverage equals its optimal leverage, (ii) $\delta_{it} < 1$, then the adjustment is insufficient and the new observed leverage will still be below the optimal, and (iii) $\delta_{it} > 1$, then the firm is over adjusting, and the observed will be higher than the optimal, which is possible when firms borrow based on future investment projects but

renounce them later on, meanwhile economic conditions change leading to the need to downsize investment and demand for debt.

We also intend to include a measure of the speed of adjustment, which could also be interpreted as the degree of adjustment per period, i.e. δ_{it} . Thus δ_{it} is also a function of some variables affecting the adjustment cost, therefore 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 variable in one dimension but constant in another, we obtain the following:

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

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

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

$$(5) \quad L_{it} = (1 - \delta_{it})L_{it-1} + \delta_{it}L_{it}^* + \varepsilon_{it}$$

where, the optimal leverage is specified in terms of observables as:

$$(6) \quad L_{it}^* = \alpha_0 + \sum_j \alpha_j X_{jit} + \sum_s \alpha_s X_{sit} + \sum_m \alpha_m X_{mit}$$

and the speed of adjustment is also specified in terms of observables as:

$$(7) \quad \delta_{it} = \beta_0 + \sum_j \beta_j Z_{jit} + \sum_s \beta_s Z_{sit} + \sum_m \beta_m Z_{mit}$$

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 contains useful information that can be used to predict the future behavior of leverage.

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

$$(8) \quad L_{it} = \alpha_0 + \sum_j \alpha_j X_{jit} + \sum_s \alpha_s X_{sit} + \sum_m \alpha_m X_{mit}$$

and by using estimated optimal leverage and observed leverage a measure of the degree of optimality of leverage is obtained from:

$$(9) \quad L_{it}^* / L_{it}$$

The optimality ratio takes on a value of 1 if at time t the firm is at its optimal leverage. Since optimal leverage cannot be negative, the optimality ratio is restricted to being non-negative. However, since the optimal leverage may 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 (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,³ while the static model (8) serving as a benchmark is linear and least squares is used. In both models unobservable firm-specific and time-specific effects are controlled for.

5. THE DATA

The data used in this 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 2002,⁴ our sample totaled 617 companies. An unbalanced panel with 9,604 observations was constructed. Table 1 presents summary statistics, while Table 2 shows the frequency distribution of firms by various characteristics. All monetary variables are expressed in fixed 2000 prices by dividing by manufacturing producer price index with the 2000 as the base year.⁵

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 debt ratio was on average 64.8%. During the period between 1985 and 1989, the earlier period of our sample, the average debt ratio was 69%. It was 66% between 1990 and 1996 and 60% for the after crisis period, 1997 to 2002. Comparing the debt ratio before and after the crisis, the debt ratio due to corporate restructuring has significantly lowered 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 due to differences in the impact of structural adjustment increased (see Appendix B for further details).

6. MEASURES OF CAPITAL STRUCTURE AND ITS DETERMINANTS

A typical concern in capital structure studies involves the question of whether to employ the book value of debt and equity, or the market value (or a combination of both). On the one hand, 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 since expenses are tax deductible, which will eventually have some positive effect on the firm's value. However,

³ The procedure SYSNLIN in SAS is used to estimate the dynamic model.

⁴ For a study of dynamics of capital structure of a large sample of Swedish micro and small firms see Heshmati (2002).

⁵ Since we use ratio of variables, transformation of the variables to fixed prices is not necessary. For variables that are in levels or non-ratio form, we transform them to fixed 2000 prices.

changes in the market value of debt have no direct effect on the interest tax shield cash savings.

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 argue 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, while a positive market value denotes the expected future cash flows of the firm.

Due to 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 and long-term liabilities. In this study, making such a distinction has been limited however, but this can be considered in future studies.

A. Determinants of Optimal Leverage

We now turn to describe explanatory variables recognized in the literature as possible determinants of firms' capital structure that is also used in this study to explain variations in leverage. The expected effect of each factor on leverage based on the theory of capital structure⁶ is also indicated in parenthesis:

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 purposes, 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 showed that income variability was positively correlated with the debt ratio for Korean listed firms, and this positive correlation was consistent over the all sub-periods, namely, 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 invest much in a firm's project in the sense that returns to their investment will benefit mostly creditors rather than shareholders (Myers, 1997). Such agency costs may be significant, and if this is so, fast growing firms with highly profitable projects are more likely to depend more on equity rather than debt.⁷ Thus we may expect a negative relation between growth opportunity and leverage. As a measure of growth, the annual percentage change in total assets is used. The simple

⁶ For a summary of the expected effects by various theories of capital structure including agency costs, bankruptcy costs and asymmetric information see Heshmati (2002).

⁷ However, such negative relationship is especially for long-term debts. According to Titman and Wessels (1998), it might be possible that short-term debt ratios are positively related to growth rates for the growing firms may substitute their short-term liabilities for long-term liabilities to reduce the agency cost.

correlation over the total sample period 1985-2002, and sub-periods as noted above, shows that growth opportunity was negatively correlated with debt.

Tangibility (+/-): This 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 would mean higher availability of collateral to raise debt. However, in Grossman and Hart (1982), it was shown that firm's tangible (fixed) assets could be negatively correlated with firm's leverage due to 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 assets may receive help from creditors including financial intermediaries to monitor employees and therefore reduce the costs of information asymmetry. Using tangible fixed assets to total asset, Lee et al. (2000) found a negative relationship between tangible fixed assets and a firm's leverage, and their results were robust throughout different model specifications. 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, interestingly, for the period 1985-1989, negative correlation between tangibility and debt-ratio was found, followed by a positive correlation for the period 1997-2002.

Size (+/-): According to Titman and Wesels (1988) firm size and the leverage are likely to be positively related especially in larger firms, as they typically have less direct bankruptcy costs and tend to diversify more, allowing themselves a higher optimal debt capacity. According to Chittenden (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. On the other hand, Rajan and Zingales (1995) state 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 show that size was positively correlated with the debt ratio for Korean listed firms, and this positive correlation was consistent over all three separate sub-periods.

Profitability (+/-): Previous studies show different results regarding the relationship between leverage and profitability. For instance, Myers and Majluf (1984) state that since profitability is positively related to equity, it should be negatively related to leverage. Jensen (1986) states that profitable firms may signal quality by leveraging up, resulting in a positive relation between leverage and profitability. The measure used in this 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 sub-periods.

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. Thus, 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 shields and the debt ratio over the total sample period 1985-2002, and this was consistent with the two

sub-periods before the crisis. In the sub-period in the post-crisis ear, no correlation was 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 sub-periods.

Time Trend (+/-): This is included to capture any variation in leverage across time. Under normal conditions, leverage could either increase or decrease over time, and so should be studied on a case-by-case basis. But for the data set in this study, and since the period considered includes the financial crisis in 1997, the expected effect is found to have a negative relationship, i.e., 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 sub-period, which showed a positive correlation although weakly significant at only the 9 % level.

Financial Crisis (-): We may 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 denoted 1 for years after 1997 and 0 to other years.

Industrial Sector (+/-): To capture any systematic but unobservable industry heterogeneity effect that might have been overlooked by the variables listed above, industrial sector dummies are also included. All 617 companies are categorized into 24 industries. For further details, see the Appendix C.

B. Determinants of the speed of adjustment.

Since 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 to long-term liabilities possess ability to adjust to a new level of leverage easier and faster than

firms with a lower level of short-term liabilities. Since 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. Since the speed of adjustment is positively related to tangible assets it should be negatively related to intangible assets. Thus, 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 seen as a sign of potential growth and strength after taking into consideration the risk related to each investment. Thus firms with a high degree of investment are expected to raise debt easier than their counterparts. The log of investment is used for estimation.

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, since we can expect 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 can expect a direct and clear effect on both, optimal leverage and the speed of adjustment. After the crisis, the 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. 6 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, respectively.

7. EMPIRICAL RESULTS

The dynamic and static capital structure models were estimated using non-linear and linear least square estimation, respectively. 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 not directly comparable, yet the static model can serve as a benchmark.

To compare the two models, the respective root mean squares error (RMSE) and coefficient of determination (R^2) values of the two models are examined (see Table 3 for results). The dynamic model had a RMSE of 0.0809 and R^2 of 0.8138 compared to a RMSE of 0.1684 and a R^2 of 0.1936 for the static model. Thus, without considering some

insignificant parameters, the lower RMSE and higher R^2 of the dynamic model with lag dependent variables is, as expected, a better fit for modelling the capital structure, which provides us 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, since it offers a more complete representation of leverage behaviour.

A closer examination of the restricted traditional dynamic model, where the speed of adjustment consists only of a constant term (Rajbhandary, 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 0.7811 compared to a RMSE of 0.1684 and a R^2 0.1936 for the static model) was due largely to 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 shows that Korean manufacturing companies have relatively high levels of leverage. The sample mean and standard deviations are 64.8% and 18.7%. It has been shown that listed U.S. firms are in the 25% to 33% range, while those in the U.K. range from 10% to 16% (Rajan & Zingales, 1995). Furthermore, Table 4 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 4 it is shown that the mean adjustment parameter δ before 1997 was 18%, while after 1997, it decreased to 14.9%; the mean optimal debt recorded was 65.2% before the crisis compared to 39.7% in the post-crisis period. The observed mean debt dropped from 67.6% to 58.3% and the mean distance declined from -2.4% to -18.6%, which is consistent with the mean optimality ratio that also dropped from 96.5% to 68.1%. The 1997 economic crisis had an enormous impact on Korea's financial markets, when macroeconomic fundamentals were good but the banking sector became a burdened over-ridden 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% of overall loans as at the end of 1996, equivalent of 68 trillion won, compared to the proportion of collateralized loans in 1990 and 1995 at 42.2 and 37.6%, respectively (Kataoka, 2000) and 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 on firms, especially for chaebols. However, as we have already mentioned, there was significant reduction in the firms' leverage and, correspondingly, bank lending since. The financial crisis forced banks to implement radical and painful changes in order to improve competitiveness and efficiency. The banking sector has also 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, die example (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 well the financing behavior of listed Korean companies. We empirically

estimated all three models, namely, the static, restricted and unrestricted dynamic models for the entire period, 1985-2002, and also for the sub-periods, 1985-1989, 1990-1996, and 1997-2002, to see whether results differed by different time periods.⁸

A. Determinants of Optimal Leverage.

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). Rajan and Zingales (1995) argued 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. On the one hand, the estimated parameter of the static model was not statistically significant, while 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% level of significance. The results from the static model by sub-periods 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. Thus, 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 due to the fact that larger firms have better ability to raise more debt than smaller firms and are less vulnerable to bankruptcy.

⁸ In order to conserve space, not all results from the sub-periods are reported here. However, these are available from the authors upon request.

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 Michaels et al., (1999). The coefficients were negative and highly significant at the 1% 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, due to sunk costs in production technology, are expected to exhibit lower leverage since, 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), while 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 insignificant relationship between uniqueness and the 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, since 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 found to be 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, due to the expansionist growth policy and the common within chaebol group cross-debt guarantees, most Korean business group affiliates were highly indebted.

B. Determinants of the Speed of Adjustment.

In reality, firms have different capital structure 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, i.e. there is no difference between the observed and the optimal leverage ratios.

Table 3 panel B shows that some of the measured variables are significant while 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). Moreover, 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 are therefore willing to lend more to high investment firms than low investment ones.

The *crisis and trend* variables were both found to be 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 earlier, in Section 6, 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 was found to be statistically insignificant.

C. Variations in the Results

Table 4 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, δ , after the mean which dropped from about 18.0% before the crisis to a 14.9% in the post-crisis period, indicating that raising debt in the post-1997 period became more difficult and may have become more costly. This is backed up by the fact that the optimal and observed ratios decreased comparing both 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%.

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% and a minimum of 17.2%, while after 1997, the mean

dropped never exceeding a maximum of 15.2%. For the year 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%), more or less constantly in the post-crisis period.

Restructuring in the banking sector in the aftermath of the Asian crisis pushed for more efficient and transparent credit analysis systems, and has been judged to be an effective measure. Interestingly, the distance between optimal and observed leverage, which was negative until 1993 (with the gap becoming narrower) turned positive in 1994 and increase 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 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 while the observed leverage, overall, decreased for a while and remained quite constant after the crisis. The observed pattern of firms' actual financing behaviour, therefore, is not necessarily consistent with the change in optimal level of leverage mainly due to adjustment costs that a firm could be facing. The optimality, the ratio between optimal and observed leverage, provides us similar interpretation as 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 4 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 that recorded 0.163, indicating the possibility that chaebol firms had better access to debt financing as a result of cross-subsidiary loan guarantees and/or mutual investments. Chaebol firms were also associated with higher optimal level of leverage as well as observed leverage compared to non-chaebol firms, and also the optimality ratio was higher (the distance was smaller) for chaebol firms compared to their non-chaebol counterparts.

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, and the strong and homogeneous impact of the crisis on the capital market and bank-firm relationship.

Table 5 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 negative correlated with time, while the distance and firm size are positively related to time.

The correlation coefficient between optimal and observed leverages is somewhat low at 0.55. The distance or gap from optimality was found to be 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.

8. SUMMARY AND CONCLUSIONS

This paper examined factors that influence the capital structure decision for Korean listed manufacturing companies. The aim of this paper was to provide deeper insight regarding the Korean firms' leverage behavior, which has attracted considerable interest, as the high debt ratios were singled out as a major cause of the 1997 financial crisis. To trace capital structure adjustments over time, a dynamic model has been adopted in this study. The results from the dynamic model are compared to the conventional static model, which is 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 estimate models in this study. Results include the fact that the speed of adjustment decreased and the optimal leverage also decreased by a larger degree compared to the observed leverage in the post-crisis period, which led to an increase in the distance between both measures and a fall in the optimality ratio. It also 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, especially 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.

The restructuring agreement between the IMF and the Korean government, under Articles 32 and 37 stipulated that (i) firms should increase the ceiling on individual foreign ownership from 7 to 50% by the end of 1997, (ii) government should not interfere with banks' business operations and lending decisions, (iii) bankruptcy procedures should be improved and any subsidies to bail out individual companies eliminated, and (iv) debt levels of Korean companies reduced and changes made regarding the system of mutual guarantees within conglomerates to reduce the risks that these guarantees entail. All these measures are basically aimed at lowering the debt ratio and to encourage firms' reliance on external sources of capital. The improved financial stability and recovery of the economy together with improved domestic financial sources will hopefully help Korea on its path towards becoming an advanced industrialized nation; a nation strong enough to avoid exposure to future undesirable external shocks in the domestic financial market.

This study has examined whether Korean unique factors such as chaebol-affiliation influenced the optimal level of leverage, as well as the speed of adjustment, to better understand specific characteristics of the Korean financial market that might help explain

Korean firms' higher leverage structure. The result of this study shows that chaebol-affiliated firms adjust more likely to the optimal leverage once they have drifted away from the optimal levels, but being a chaebol-affiliated firm is not a causal factor determining the optimal level of leverage. This finding differs from several other studies. Regarding the chaebol effect, one may make judgment that chaebol firms are more likely to have high debt ratio than non-chaebol firms. For example, Lee et al. (2000) argued 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 asserted 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 this paper, however, indicates that such a gap is not caused by a pure chaebol effect. Rather, chaebol firms's leverage associated with other factors such as size, profitability and growth opportunity, which influence the optimal leverage positively. Our empirical findings showed that the coefficient for chaebol in the static model when significant was negative and insignificant in the dynamic unrestricted model. Chaebol-affiliated firms are positively associated with higher debt not because they are chaebol affiliated, but because they are larger in size, more profitable, and/or have more unique products. In general, it is rather difficult to isolate the chaebol effect effectively, as it might appear in other characteristics, as well as the industrial sector and time effects. In earlier studies such as Lee et al. (2000), the positive coefficient was not always statistically significant and was dependent on the model specification or period through which the study was conducted, indicating that such positive and significant coefficient (mostly 5% level in the case the coefficient showed significance) may appear as a result of omissions of variable determining the optimal leverage such as uniqueness and non-debt tax shields.

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Table 1. Summary Statistics of the Data, 9604 observation.

Variable	Definition	Mean	Std. Dev	Minimum	Maximum
<u>A. Determinants of Capital Structure:</u>					
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
<u>B. Determinants of the Speed of Adjustment:</u>					
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

Table 2. The frequency distribution of firms, observations..

Characteristics	Definition	Frequency	Percent	Cumulative Frequency	Cumulative Percentage
<u>A. Frequency by year of observation:</u>					
1986		515	5.36	515	5.36
1987		537	5.59	1052	10.95
1988		551	5.74	1603	16.69
1989		558	5.81	2161	22.50
1990		563	5.86	2724	28.36
1991		568	5.91	3292	34.28
1992		571	5.95	3863	40.22
1993		569	5.92	4432	46.15
1994		573	5.97	5005	52.11
1995		575	5.99	5580	58.10
1996		575	5.99	6155	64.09
1997		575	5.99	6730	70.07
1998		574	5.98	7304	76.05
1999		575	5.99	7879	82.04
2000		575	5.99	8454	88.03
2001		575	5.99	9029	94.01
2002		575	5.99	9604	100.00
<u>B. Frequency by Industry Sector: (based on International Code Standardization):</u>					
Ind.1	Fishing and Mining	119	1.24	119	1.24
Ind.2	Manufacture of Food Products and Beverage	644	6.71	763	7.94
Ind.3	Man. of Tobacco Products	9	0.09	772	8.04
Ind.4	Man. of Textiles, Except Sewn Wearing	355	3.70	1127	11.73
Ind.5	Man. of Sewn Wearing Apparel	315	3.28	1442	15.01
Ind.6	Man. of Luggage and Footwear	98	1.02	1540	16.03
Ind. 7	Man. of Wood	51	0.53	1591	16.57
Ind.8	Man. of Paper and Paper Products	355	3.70	1946	20.26
Ind.9	Publishing and Printing Recorded Media	33	0.34	1979	20.61
Ind.10	Man. of Coke, Refined Petroleum Products	84	0.87	2063	21.48
Ind.11	Man. of Chemicals and Chemical Products	1584	16.49	3647	37.97
Ind.12	Man. of Rubber and Plastic Production	230	2.39	3877	40.37
Ind.13	Man. of Other Non-metallic Mineral Products	390	4.06	4267	44.43
Ind.14	Man. of Basic Metals	626	6.52	4893	50.95
Ind.15	Man. of Fabricated Metal Products	183	1.91	5076	52.85
Ind.16	Man. of Other Machinery and Equipment	449	4.68	5525	57.53
Ind.17	Man. of Computers and Office Machinery	100	1.04	5625	58.57
Ind.18	Man. of Electrical Machinery and Furniture	336	3.50	5961	62.07
Ind.19	Man. of Electronics, Radio, Television	810	8.43	6771	70.50
Ind.20	Man. of Medical Instruments	114	1.19	6885	71.69
Ind.21	Man. of Motor Vehicles and Trailers	545	5.67	7430	77.36
Ind.22	Man. of Other Transport Equipment	85	0.89	7515	78.25
Ind.23	Man. of Furniture	102	1.06	7617	79.31
Ind.24	Refer to Appendix C	1987	20.69	9604	100.00
<u>C. Frequency by size of sales:</u>					
Very small	(tot assets <27.000000 won)	1596	16.62	1596	16.62
Small	(27.000000-60.000000 won)	1962	20.43	3558	37.05
Medium	(60.000000-125.000000 won)	1966	20.47	5524	57.52
Large	(125.000000-300.000000 won)	1968	20.49	7492	78.01
Very large	(tot assets >300.000000 won)	2112	21.99	9604	100.00

Table 3. Static and dynamic model parameter estimates, NT=9604 observations. Dependent variable is the ratio: total liability/(equity+total liability).

Model		Static Model		Restricted Dynamic		Unrestricted Dynamic	
Variable	Definition	Estimate	Std Err	Estimate	Std Err	Estimate	Std Err
<u>A. Determinants of capital structure:</u>							
Intercept	Intercept	0.3970a	0.0326	-0.0814	0.1224	0.0864	0.0894
Variability	Inc. variability	-0.0000b	0.0000	-0.0001	0.00005	-0.00005	0.00003
Growth	Growth	-0.0013a	0.0001	-0.0024a	0.0003	0.0022a	0.0003
Tangibility	Tangibility	0.0002	0.0112	-0.0775c	0.0415	-0.2150a	0.0320
Size	Size	0.0171a	0.0016	0.0359a	0.0059	0.0366a	0.0043
Profitability	Profitability	-0.0465a	0.0051	-0.3395a	0.0230	-2.2197a	0.0805
Non-debt tax shield	Non-debt tax shield	-0.0329a	0.0116	-0.0479	0.0428	0.0902a	0.0320
Uniqueness	Uniqueness	0.0529a	0.0010	0.1655a	0.0372	-0.0369	0.0348
Trend	Trend	-0.0081a	0.0006	0.0066a	0.0024	-0.0004	0.0017
Crisis	Crisis	-0.0654a	0.0063	-0.4233a	0.0282	-0.3019a	0.0193
Chaebol	Chaebol	0.0351a	0.0053	0.0263	0.0196	0.0343a	0.0132
Ind.2	Man. Food Products and Beverage	0.0614a	0.0170	0.0306	0.0628	0.0700c	0.0423
Ind.3	Manufactor of Tobacco Products	-0.3951a	0.0585	-0.1341	0.2165	-0.0890	0.1340
Ind.4	Man. of Textiles, Except Sewn Wearing	-0.0170	0.0179	-0.0492	0.0663	-0.0600	0.0459
Ind.5	Man. of Sewn Wearing Apparel	-0.0128	0.0185	-0.0370	0.0683	0.0021	0.0469
Ind.6	Man. of Luggage and Footwear	0.0471a	0.0232	-0.0131	0.0859	0.0217	0.0671
Ind.7	Man. of Wood	-0.0169	0.0283	-0.0874	0.1048	-0.0486	0.0700
Ind.8	Man. of Paper and Paper Products	0.0373b	0.0184	-0.0147	0.0667	0.0413	0.0466
Ind.9	Publishing and Printing Recorded Media	0.0171	0.0337	0.0249	0.1245	-0.1006	0.0859
Ind.10	Man. of Coke, Refined Petroleum Products	-0.0746a	0.0242	-0.1365	0.0895	-0.0046	0.0547
Ind.11	Man. of Chemicals and Chemical Products	-0.0337b	0.0163	-0.0493	0.0602	-0.0189	0.0410
Ind.12	Man. of Rubber and Plastic Production	-0.0546a	0.0191	-0.1158	0.0708	-0.0260	0.0479
Ind.13	Man. of Other Non-metallic Mineral Products	-0.0013	0.0178	-0.0351	0.0658	0.0275	0.0442
Ind.14	Man. of Basic Metals	-0.0367b	0.0170	-0.0977	0.0629	-0.0482	0.0426
Ind.15	Man. of Fabricated Metal Products	0.0513b	0.0200	0.0162	0.0740	-0.0146	0.0542
Ind.16	Man. of Other Machinery and Equipment	-0.0101	0.0176	-0.0603	0.0651	-0.0284	0.0455
Ind.17	Man. of Computers and Office Machinery	-0.0549b	0.0230	-0.0799	0.0851	-0.0822	0.0616
Ind.18	Man. of Electrical Machinery and Furniture	-0.0317c	0.0182	-0.0981	0.0673	-0.0378	0.0462
Ind.19	Man. of Electronics, Radio, Television	-0.0166	0.0167	-0.0313	0.0616	-0.0438	0.0423
Ind.20	Man. of Medical Instruments	-0.0446b	0.0223	-0.0221	0.0824	-0.0813	0.0621
Ind.21	Man. of Motor Vehicles and Trailers	0.0310c	0.0172	0.0375	0.0635	0.0471	0.0433
Ind.22	Man. of Other Transport Equipment	0.0296	0.0243	0.0131	0.0898	-0.0087	0.0588
Ind.23	Man. of Furniture	0.0743a	0.0229	0.0331	0.0847	0.0162	0.0582
Ind.24	Refer to Appendix C	0.0538a	0.0162	0.0203	0.0599	0.0403	0.0408

Table 3. Continued.

Model		Static Model		Restricted Dynamic		Unrestricted Dynamic	
Variable	Definition	Estimate	Std Err	Estimate	Std Err	Estimate	Std Err
B. Determinants of speed of adjustment:							
Intercept	Intercept	....	....	0.1409a	0.0054	-0.0470b	0.0216
Distance	Distance	....	....	....	....	0.0000	0.0060
Current Liabilities	Current Liabilities	....	....	....	....	0.0677a	0.0067
Intangible Assets	Intangible Assets	....	....	....	....	0.0029a	0.0004
Government Sh.	Shareholder, Government	....	....	....	....	-0.0029b	0.0013
Total Sh.	Shareholder, Total	....	....	....	....	0.0001	0.0001
Foreigner Sh.	Shareholder, Foreigner	....	....	....	....	0.0022a	0.0003
Individual Sh.	Shareholder, Individual	....	....	....	....	-0.0001	0.0001
Minor Sh.	Shareholder, Minor	....	....	....	....	-0.0011a	0.0001
Crisis	Crisis	....	....	....	....	-0.0233a	0.0090
Trend	Trend	....	....	....	....	-0.0050a	0.0011
Investment	Investment	....	....	....	....	0.0123a	0.0014
Major Sh.	Shareholder, Major	....	....	....	....	0.0020a	0.0002
Adj R ²	Adjusted R ²	0.1908		0.7803		0.8129	
RMSE	Root Mean Square Error	0.1684		0.0878		0.0809	

Note: Significant at the less than 1% (a), 1–5% (b) and 5–10% (c) levels of significance

Table 4. Mean values from unrestricted dynamic model, 9604 observations.

Year	Definition	delta	optimal	observed	distance	mills ratio
<u>Panel A. Mean by year of observation:</u>						
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
<u>Panel B. Mean by crisis period:</u>						
1985-1997		0.180	0.652	0.676	-0.024	0.965
1998-2002		0.149	0.397	0.583	-0.186	0.681
<u>Panel C. Sample mean and standard deviations by industrial sector:</u>						
Ind.1	Fishing and Mining	0.189	0.597	0.645	-0.048	0.925
Ind.2	Man. Food Products and Beverage	0.188	0.655	0.706	-0.051	0.928
Ind.3	Man. of Tobacco Products	0.212	0.403	0.262	0.140	1.535
Ind.4	Man. of Textiles, Except Sewn Wearing	0.164	0.511	0.624	-0.113	0.819
Ind.5	Man. of Sewn Wearing Apparel	0.176	0.530	0.613	-0.083	0.864
Ind.6	Man. of Luggage and Footwear	0.144	0.592	0.685	-0.093	0.864
Ind.7	Man. of Wood	0.188	0.514	0.630	-0.116	0.816
Ind.8	Man. of Paper and Paper Products	0.159	0.586	0.672	-0.087	0.871
Ind.9	Publishing and Printing Recorded Media	0.183	0.446	0.626	-0.180	0.712
Ind.10	Man. of Coke, Refined Petroleum Products	0.221	0.525	0.583	-0.058	0.901
Ind.11	Man. of Chemicals and Chemical Products	0.169	0.531	0.601	-0.070	0.884
Ind.12	Man. of Rubber and Plastic Production	0.186	0.500	0.583	-0.084	0.857
Ind.13	Man. of Other Non-metallic Mineral Products	0.188	0.556	0.645	-0.088	0.863
Ind.14	Man. of Basic Metals	0.178	0.579	0.613	-0.035	0.943
Ind.15	Man. of Fabricated Metal Products	0.148	0.577	0.689	-0.113	0.837
Ind.16	Man. of Other Machinery and Equipment	0.160	0.523	0.619	-0.096	0.844

Ind.17	Man. of Computers and Office Machinery	0.163	0.498	0.580	-0.082	0.859
Ind.18	Man. of Electrical Machinery and Furniture	0.170	0.512	0.604	-0.092	0.847
Ind.19	Man. of Electronics, Radio, Television	0.156	0.527	0.611	-0.084	0.862
Ind.20	Man. of Medical Instruments	0.149	0.517	0.583	-0.065	0.888
Ind.21	Man. of Motor Vehicles and Trailers	0.173	0.595	0.664	-0.069	0.895
Ind.22	Man. of Other Transport Equipment	0.200	0.692	0.736	-0.044	0.940
Ind.23	Man. of Furniture	0.175	0.581	0.710	-0.130	0.818
Ind.24	Refer to Appendix C	0.169	0.658	0.715	-0.058	0.919
<u>Panel D. Sample mean and standard deviations by size of firm:</u>						
1		0.155	0.538	0.653	-0.116	0.823
2		0.156	0.560	0.623	-0.062	0.900
3		0.164	0.557	0.621	-0.065	0.896
4		0.174	0.575	0.647	-0.072	0.888
5		0.198	0.637	0.693	-0.055	0.920
<u>Panel E. Sample mean and standard deviations by chaebol affiliation:</u>						
0		0.163	0.553	0.634	-0.081	0.873
1		0.202	0.673	0.710	-0.037	0.948
<u>Panel F. Sample mean and standard deviations:</u>						
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

Table 5. Pearson correlation coefficients, based on unrestricted dynamic model, 9604 observations.

	Year	size	optimal	observed	opt. 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					
opt. 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	

P value shown below coefficient.

Appendix A. Summary statistics by sub-periods.

Variable	Mean	Std Dev	Mean	Std Dev	Mean	Std Dev
	1985-1989		1990-1996		1997-2002	
	N=2161		N=3994		N=3449	
<u>A. Dependent variable:</u>						
Leverage ratio	0.693	0.155	0.664	0.159	0.602	0.222
<u>B. Independent variables:</u>						
growth	17.378	16.460	13.981	15.601	-0.739	32.781
tangibility	0.341	0.165	0.338	0.166	0.370	0.188
profitability	0.039	0.062	0.019	0.118	-0.007	0.566
non debt tax shield	0.189	0.146	0.201	0.168	0.195	0.182
uniqueness	0.794	0.129	0.802	0.13	0.829	0.272
variability	15.522	141.331	14.743	137.554	14.689	137.053
equity	48306558	312618933	115327976	580212499	314748804	1578814759
total liability	111155284	417200430	268859328	877160389	519678130	1759324403
tangible	82873342	589581290	181710900	1050569727	397504605	2149751774
intangible	674945	4482371	1110939	6754630	11280712	110695644
investment	17158648	53215289	52803185	166656762	153283414	574034072
<u>C. Characteristic variables:</u>						
scurliabil	0.645	0.175	0.631	0.159	0.638	0.211
shgovern	0.087	1.865	0.195	3.340	0.326	3.363
shallcorp	15.92	22.318	27.97	22.284	28.546	21.644
shforeign	1.327	6.037	3.657	7.827	5.236	11.225
shindivi	37.932	38.644	49.087	31.000	62.264	26.952
shtotal	55.252	49.735	80.896	39.317	96.463	18.475
shminor	30.813	31.337	45.719	27.228	45.844	20.408
shmajor	15.772	18.207	22.254	17.125	27.984	18.426
trend	3.533	1.115	9.013	1.999	15.500	1.708
chaebol	0.187	0.390	0.188	0.391	0.186	0.389
size (log assets)	17.557	1.387	18.478	1.384	19.134	1.420
size1 very small	0.406	0.491	0.147	0.354	0.038	0.191
size2 small	0.242	0.428	0.232	0.422	0.149	0.356
size3 medium	0.146	0.353	0.222	0.415	0.222	0.416
size4 large	0.115	0.319	0.193	0.395	0.275	0.447
size5 very large	0.091	0.288	0.206	0.405	0.316	0.465

Appendix B. Debt ratio by period and by Chaebol affiliation

Sample	Total	Period 1	Period 2	Period 3
Period	1985-2002	1985-1989	1990-1996	1997-2002
<u>A. Total Sample:</u>				
N	9604	2161	3994	3449
Debt Ratio (Mean)	0.648	0.690	0.660	0.600
Debt Ratio (Std.Dev)	0.187	0.160	0.160	0.220
<u>B. Chaebol Sample:</u>				
N	1796	404	751	641
Debt Ratio (Mean)	0.710	0.737	0.749	0.645
Debt Ratio (Std.Dev)	0.154	0.149	0.116	0.174
<u>C. Non-Chaebol Sample:</u>				
N	7808	1757	3243	2808
Debt Ratio (Mean)	0.634	0.683	0.644	0.592
Debt Ratio (Std.Dev)	0.191	0.155	0.161	0.231

Appendix C. Industry Classification

Industrial code	Code	Industry
05000	1	Fishing
10000	1	Mining of Coal, Crude Petroleum and Natural resources
11000	1	Mining of Metal Ores
15000	2	Manufacture of Food Products and Beverage
16000	3	Manufacture of Tobacco Products
17000	4	Manufacture of Textiles, Except Sewn Wearing
18000	5	Manufacture of Sewn Wearing Apparel and Fur Articles
19000	6	Tanning and Dressing of Leather , Manufacturing of Luggage and Footwear
20000	7	Manufacture of Wood and of Products of Wood and Cork, Except Furniture; and Manufacture of Articles of Straw and Plaiting Materials
21000	8	Manufacture of Pulp, Paper and Paper Products
22000	9	Publishing, Printing and Reproduction of Recorded Media
23000	10	Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel
24000	11	Manufacture of Chemicals and Chemical Products
25000	12	Manufacture of Rubber and Plastic Production
26000	13	Manufacture of Other Non-metallic Mineral Products
27000	14	Manufacture of Basic Metals
28000	15	Manufacture of Fabricated Metal Products
29000	16	Manufacture of Other Machinery and Equipment
30000	17	Manufacture of Computers and Office Machinery
31000	18	Manufacture of Electrical Machinery and Furniture
32000	19	Manufacture of Electronic Components, Radio, Television and Communication Equipment and Apparatuses
33000	20	Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks
34000	21	Manufacture of Motor Vehicles, Trailers and Semitrailers
35000	22	Manufacture of Other Transport Equipment
36000	23	Manufacture of Furniture; Manufacturing of Articles n.e.c.
40000	24	Electricity, Gas, Steam and Hot Water Supply
45000	24	General Construction
50000	24	Sale of Motor Vehicles and Motorcycles ;
51000	24	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
52000	24	Retail Trade, Except Motor Vehicles and Motorcycles
60000	24	Land Transport ; Transport Via Pipelines
61000	24	Water Transport
62000	24	Air Transport
63000	24	Supporting and Auxiliary Transport Activities of Travel Agencies
64000	24	Post and Telecommunications
72000	24	Computer and Related Activities
74000	24	Professional, Scientific and Technical Services
75000	24	Business Support Services
87000	24	Motion Picture, Broadcasting and Performing Arts Industries

Based on Korea Standard Industry Classification.