Capital Structure Determinants among Construction Companies in South Korea: A Quantile Regression Approach

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Abstract
The present study empirically analyzed the capital structure determinants of 43 listed construction companies in Korea from 2000 to 2010 using multiple regression analysis. Specifically, the empirical analysis focused on changes in the coefficients of the determinants according to the leverage ratio quantiles of the examined construction companies. The empirical analysis found company and non-debt tax shield size to be positively related with leverage among construction companies, whereas profitability, growth, asset tangibility, and liquidity were found to be negatively related with leverage. The major results of the study are: 1) construction companies followed the static tradeoff theory in relation to size; 2) non-debt tax shields had quite limited effects on the capital-structure-related decisions of construction companies; 3) construction companies were found to follow the pecking order theory in relation to profitability; and 4) asset tangibility was estimated to have the opposite sign to that found in previous studies. These results were attributed to the characteristics of the construction business.

Keywords: capital structure; construction company; quantile regression; South Korea

1. Introduction
The international financial crisis began with the bankruptcy of Lehman Brothers Holdings, Inc., in the United States (US) in September 2008. This event not only caused a credit crunch in the US but also had a negative effect on various countries (and industries) worldwide. Moreover, the European sovereign debt crisis of 2009 led to the expectation of long-term macroeconomic downturns worldwide. Korea was also affected by these unpredictable financial crises. Rapid downturns in domestic businesses and decreasing consumer sentiment spread to related industries and greatly jeopardized individual businesses. In particular, because it is very sensitive to domestic and foreign market fluctuations (Kangari, 1988), the construction industry faced decreases in investments in equipment and construction, lowering real asset values, and a slump in the housing construction market. These consequently led to poor housing sales, decreased profitability, exhausted working capital, and financial liquidity crises (Jang et al., 2010). The liquidity crises did not end after the short-term effects of the crisis had been felt but led to company bankruptcies as well as the subsequent bankruptcies of their cooperative firms. A total of 403 construction companies (130 general contractors and 273 specialty contractors) went bankrupt in 2008 alone.

In light of these unpredictable changes in the macroeconomic environment, corporate-level coping methods are limited. In particular, construction companies may not always be financially sound because of their tendency to rely on borrowed capital, which can be regarded as a direct cause of corporate-level financial difficulties (Severson et al., 1993). In the case of Korea, a major cause of excessive borrowing is thought to be the dependence of construction companies on housing/real estate development projects. It is believed that these companies were unable to respond to liquidity crises during the macroeconomic downturns because of the types of projects they undertake, which require large amounts of capital from banks/financial institutions based on salability and the repayment of capital after a grace period. In addition, the uncertainty of production systems and the long project timelines resulting from the characteristics of the construction industry are...
known to cause many difficulties in the management of these types of companies (Abidali and Harris, 1995, Lee et al., 2013).

The structural problems mentioned above are causes of discriminative treatment (loans at high interest rates, requests for excessive collateral) against construction companies by credit/financial institutions compared to other industries. Accordingly, construction companies are reducing their financial risks through management strategies such as reinforcing their capabilities to receive orders and developing overseas construction markets. However, it is thought that construction companies are likely to repeatedly become insolvent in crisis situations unless their financial strategies are fundamentally changed.

The decision-making process on capital structures determines the use of borrowed capital. Therefore, the justification for the use of borrowed capital begins with questions such as, "What types of decision-making processes do construction companies use to determine their capital structures?" and "What elements are involved in capital-structure-related decisions?"

Many studies have been conducted in the fields of business management/finance in order to theoretically explain how businesses select their capital structures. However, although the construction industry has very large effects on the national economy, there are few theoretical/empirical studies on how these companies determine their capital structures. Furthermore, understanding the determinants of excessively low or high leverage among construction companies is considered to provide important information in identifying these companies' financial strategies.

Therefore, the present study aimed to conduct an empirical analysis of the capital structure determinants among listed Korean construction companies and identify the determinants according to capital structure quantile. The study's results are considered to provide basic information to construction companies, banks/financial institutions, credit rating agencies, and individual investors and help construction companies make decisions on the formation of their capital structures.

2. Literature Review
2.1 Capital Structure Theories
Theories regarding the determination of capital structures at the corporate level include the static tradeoff and pecking order theories. The static tradeoff theory of Modigliani and Miller (1958) assumes that businesses will borrow capital until the tax savings effect from borrowing additional capital equals the borrowing costs because the probability of financial difficulties increases with increased debt.

Scott (1977), Kim (1978), and Chen (1979) stated that if a company's debt exceeds a certain level, its value might decrease because its bankruptcy costs would rapidly increase. They argued that the optimal capital structure could be determined by comprehensively considering the effects of increasing company values that would occur as debt increases and the effects of reducing company values as a result of increased bankruptcy costs. Jensen and Meckling (1976) argued that the optimal capital structure would be formed at the point where the sum of the agency costs of shares and the agency costs of debts is the lowest possible value. DeAngelo and Masulis (1980) argued that the optimal capital structures of individual companies could exist because businesses would have the incentive to use less debt if non-debt tax shields such as depreciation and investment tax credits were considered simultaneously in addition to tax saving effects from corporate and individual income taxes.

The pecking order theory assumes that when businesses have practical investment opportunities, they will first use internal funds and if they still need external funds, they will first issue liabilities followed by securities such as convertible bonds and shares to procure necessary funds (Myers and Majluf, 1984). The pecking order theory was first suggested by Donaldson (1961). In his paper, he argued that "management strongly prefers internal funds to external funds as sources of new funds necessary except for cases of capital requirement expansions occurring sometimes." However, he lacked theoretical grounds to support this argument.

Myers (1977) supplemented Donaldson's (1961) findings and named the resultant theory the pecking order theory. In his paper, he argued that there might be an order in which businesses procure necessary funds. According to the pecking order theory, since there are two types of funding sources, internal and external, no clearly defined optimal debt ratio exists.

A major issue on which the two theories differ is whether the optimum debt ratio exists. Whereas the static tradeoff theory concluded that the optimal debt ratio exists, the pecking order theory denied this and argued that financing methods vary according to the situations faced by companies. From the two previously mentioned capital structure theories, diverse studies began emerging in certain countries or industries. Recently, studies on individual industries have been conducted and arguments indicating that the capital structures of companies in individual industries are similar to each other have been raised (Antoniou et al., 2002, Feidakis and Rovolis, 2007).

Unfortunately, the two theories presented above have thus far failed to clearly explain the capital structures of companies; however, these theories have been partially adopted depending on changes in macroeconomic environments and the internal conditions of companies (Titman and Wessels, 1988). Recently, arguments have been raised that the static tradeoff and pecking order theories should be utilized complementarily to explain the capital structures of companies (Barclay and Smith, 2005).

2.2 Capital Structure in the Construction Sector
Capital structures in the construction sector began to be studied directly in the middle of the 2000s; the
following studies are related to the present study.

Samiran (2010) empirically analyzed capital structure determinants among Malaysian construction companies. In this study, a capital structure determination model was established using a total of 37 construction companies from 2003 to 2008. Independent variables used in the analyses included business scale, profitability, tangibility, non-debt tax shields, liquidity, growth opportunities, and tax changes; dependent variables included market and book value leverage ratios. Since the results of the study indicated highly negative relationships between liquidity/growth opportunities and leverage ratio, Malaysian construction companies argued that the study results strongly supported the pecking order theory.

Feidakis and Rovolis (2007) conducted an empirical study of the capital structure determinants of 66 large construction companies in nine European Union countries from 1996 to 2004. Their study examined relationships among variables such as business scale, profitability, liquidity, tangibility, asset utilization, growth opportunities, risk, share price performance, GDP growth rates, and leverage (long- or short-term debt). According to the results, they argued that the variables that explain capital structures showed robust effects in all nine countries. Behaviors that consistently supported certain theories, as argued in previous studies, were not identified.

Baharuddin et al. (2011) studied capital structure determinants among construction companies listed on the Bursa Malaysian stock market from 2001 to 2007. A total of 42 construction companies were examined and the employed explanatory variables were profitability, size, growth, and asset tangibility. According to the results, Baharuddin argued that profitability was negatively related to debt and positively related to size, growth, and asset tangibility. In conclusion, he argued that growing construction companies relied more on debt than equity.

Most studies on the construction sector, except for some of the previously mentioned studies, employ elementary approaches to capital structure determinants. One common factor between the present study and the existing literature is that it identifies and analyzes the capital structure determinants of construction companies. However, as previously mentioned, an advantage of the present study is that it allows for relative comparisons among capital structure determinants according to quantiles representing excessively low or high debt since it has identified determinants according to capital structure quantile.

3. Empirical Methodology
3.1 Data and Models

The samples used in the present study were limited to construction companies listed on the Korean stock market over the 11-year period from 2000 to 2010 (T = 11) because listed companies have large effects on the national economy in terms of their size or economic activities; their financial data can be more easily collected compared to that of non-listed companies, companies subject to external audits, and companies not subject to external audits; and the reliability of their financial data can be ensured. Financial data necessary for the study were collected from TS2000, of the Korea Listed Companies’ Association, and the data analysis, retrieval, and transfer system of the Financial Supervisory Service.

The samples used in the study were selected from companies that did not meet criteria for impaired capital, suspension of current account transactions, bankruptcy, or delisting during the data collection period during which financial data necessary for the capital structure calculations could be secured. The final number of selected construction companies was 43 (N = 43) and there were a total of 473 observed values (Observations : N×T).

To explain the capital structures of construction companies, the present study employed multiple regression models that were established and used in previous studies. In addition, to identify determinants according to their capital structure quantiles, multiple quantile regression models were introduced. The present study employed balanced panel data combining cross-sectional and time series data. First, a capital structure determination model was established as per equation 1 below.

\[
Y_{it} = a_1 + \sum_{k=2}^{K} a_k X_{ikt} + \epsilon_{it}, i = 1, 2, ..., N, t = 1, 2, ..., T, \tag{1}
\]

where, \( Y_{it} \) represents dependent variables combining \( N \) pieces of cross-sectional data and \( T \) pieces of time series data; \( X_{ikt} \) represents explanatory variables combining \( N \) pieces of cross-sectional data and \( T \) pieces of time series data; \( a_k \) is a constant term; \( \epsilon_{it} \) is a random error with a mean of 0 and variance of \( \sigma^2 \); and \( K \) is the number of explanatory variables.

Multiple regression models using the Ordinary Least Squares (OLS) assumption (Gujarati, 1995) generally do so as shown above. However, to use OLS, the behavior of average groups should be analyzed based on conditional average values. If the distribution of dependent variables is uneven or is spread to both ends, the effects of certain variables on dependent variables may be under- or over-estimated. This may lead to different capital structure determinants for low, average, and excessively high leverage quantiles.

Recently, studies that use the quantile regression analysis proposed by Koenker and Bassett (1978), Buchinsky (1998), and Koenker and Hallock (2001) to overcome this limitation are being increasingly conducted. Whereas classical OLS models use linear models centered on the conditional mean of the dependent variables, the quantile regression analysis uses linear models centered on the conditional \( \tau \) - quantile of the dependent variables. Therefore, the
quantile regression analysis can be said to be more general. Of course, groups may be arbitrarily selected to conduct regression analysis. Because exogenous sample-selection criteria are arbitrarily imposed in this case, sample selection bias will be a problem. In contrast, sample selection bias does not occur in the quantile regression analysis since all observed values are assigned different weighted values and used without the arbitrary division of samples.

Quantile regression estimators provide detailed information on the conditional distribution of dependent variables and indicate how robust non-sensitive responses to ideal point or error term distributions are. Consequently, determinant models were established by capital structure quantiles as per equation 2 below. The present study set a total of nine \( \tau \) -quantiles ranging from 0.1 to 0.9.

\[
y_{\tau} = \alpha_{\tau} + \sum_{i=1}^{K} \alpha_{\tau}x_{\tau i} + \epsilon_{\tau}, \quad i = 1, 2, ..., N, \quad \tau = 1, 2, ..., T
\]

where, \( y_{\tau} \) is represents dependent variables combining N pieces of cross-sectional data in quantile \( \tau \) quantile and T pieces of time series data; \( x_{\tau i} \) represents explanatory variables combining N pieces of cross-sectional data in quantile \( \tau \) quantile and T pieces of time series data; \( \alpha_{\tau} \) is a constant term in quantile \( \tau \) quantile; \( \epsilon_{\tau} \) is a random error with a mean of 0 and variance of \( \sigma^2 \); and K is the number of explanatory variables.

The financial data used in the analysis include extreme values because of their nature. Therefore, to remove the extreme values, winsorization, derived from Charles P. Winsor’s technique, was utilized (Barnett and Lewis, 1984; Tukey, 1962). In addition, the dependent and independent variables in each model (pooled-OLS, Quantile Regression) were transformed through the natural logarithm (double-log form). This transformation method can easily interpret estimated regression coefficients and also reduce the variance and heteroskedasticity of explanatory variables (Gujarati, 1995). To collect and process variables and establish empirical models, programs such as EXCEL, PASW STATISTICS 18, and STATA 11 were utilized. The present study employed variables that have been representatively used in the previously mentioned theories. These variables are explained in detail in the next chapter.

3.2 Variables

(1) Leverage Ratio (LEVR)

Although financial leverage ratios may be measured using various proxy variables, depending on the purposes of the study, the present study selected the ratio of total liabilities to total assets as a proxy for the employed capital structure. Total liabilities include both short- and long-term liabilities. These two types of liabilities were not separated because the present study focuses on borrowing behavior for outside capital rather than the maturity structures of liabilities.

(2) Company Size (SIZE)

As businesses grow, management is more diversified and the possibility of bankruptcy gradually decreases. In addition, approaches to capital markets become easier (Gruber and Warner, 2012). Consequently, large businesses will increase their use of debt because they can do so at a relatively low cost. Titman and Wessel (1988) argued that as business size increased, companies would benefit from economies of scale in liability issuing costs. Based on this argument, the present study expected construction company size to be positively related with leverage. The natural logarithm value of the total assets was used as a proxy variable for company size.

(3) Profitability (PROF)

Profitability is one of the most frequently discussed proxy variables in the static tradeoff and pecking order theories. According to the static tradeoff theory, as business profits increase, tax burdens also increase. Therefore, managers tend to procure borrowed capital to some extent to benefit from the non-debt tax shield of interest costs. Therefore, in the static tradeoff theory, profitability is thought to be positively related with leverage. In contrast, the pecking order theory argues that when profitability increases, there will be more internally held funds with low issuing costs and thus the procurement of borrowed capital will be avoided (Myers, 1984; Titman and Wessels, 1988). The present study employed the ratio of operating profits to sales as a proxy for profitability. The profitability of construction companies is expected to follow the pecking order theory and to be negatively related with leverage.

(4) Growth Opportunities (GROWTH)

In general, businesses with high growth rates can be considered to have more diverse investment opportunities than other businesses. According to Jensen and Meckling (1976), businesses with many growth opportunities tend to maintain a low level of debt to avoid conflicts of interest with creditors because they have many financing options for future investments (Jensen and Meckling, 1976; Kim and Sorensen, 1986). Since increased debt costs due to business growth opportunities are perceived as agency costs that reduce business value, managers should prefer equity to debts to avoid incurring such costs.

Therefore, the present study selected the market to book ratio as a proxy for growth opportunities.

(5) Non-debt Tax Shield (NDTS)

DeAngelo and Masulis (1980) proposed not only the tax-reduction effects of interest costs but also non-debt tax shields resulting from the expenditures of non-cash expenses such as depreciation costs and investment tax credits. This argument states that if a tax reduction effects investment tax credits and non-cash expenses will offset the tax-reduction effects of debt; businesses with large non-debt tax shields thus have relatively fewer incentives to use debt (extension of the static tradeoff theory). Accordingly, among construction
companies, non-debt tax shields and leverage can be negatively related. As in Fama and French (2002), the present study used the ratio of depreciation costs to total assets as a proxy for non-debt tax shields.

(6) Assets Tangibility (TANG)

Myers and Majuluf argued that if businesses established collateral as grounds for liability issues, they could reduce costs related to information asymmetry. They argued that the possession of tangible fixed assets would consequently improve solvency security and reduce information asymmetry; thus, those businesses would use debt rather than equity. In some cases, businesses will establish collateral as grounds for liability issues, thereby reducing the costs associated with information asymmetry. They argued that assets such as tangible fixed assets would improve solvency security and reduce information asymmetry. They argued that the possession of tangible fixed assets would consequently improve solvency security and reduce information asymmetry; thus, those businesses would use debt rather than equity. In some cases, businesses will establish collateral as grounds for liability issues, thereby reducing the costs associated with information asymmetry.

(7) Liquidity (LQDT)

Liquidity refers to the ability to cash-in assets at firm prices in a short time and liquidity ratios indicate the ability of companies to repay short-term debts. Short-term liquidity is measured by the current and quick ratios. In the present study, current ratios were used. Quick ratios were measured by the ratio of current assets to current liabilities.

(8) Time Dummy (DUM2001-2010)

In the present study, to control for exogenous effects that affect all sample companies at a certain point, a time dummy variable was added to the model. These exogenous effects refer to diverse factors such as international financial crises and macroeconomic variables. Through the time dummy variable, the effects of the 2008 international financial crisis can be understood as indirectly affecting and structural changing capital structures.

4. Results of Empirical Analysis

The descriptive statistics for the dependent and independent variables used in this study are shown in Table 1. The descriptive statistics were calculated using the values of the relevant variables before they were natural logarithm-transformed. Table 2. shows the results of the analysis of the correlations between the dependent and independent variables. The results indicate that variables other than liquidity had weak correlations at the 5% significance level. Liquidity was negatively correlated with leverage at the 1% significance level.

The results of the verification of multicollinearity shown in Table 1. demonstrated that the mean variance inflation factor was 1.27 (maximum value: 1.67), indicating that multicollinearity was not a problem.

Table 3. shows the results of the Pooled-OLS multiple regression and quantile regression analyses. In the case of the quantile regression analysis, as mentioned in the theoretical discussion on the model, τ was set to 0.1~0.9 and regression coefficients were estimated for each of a total of nine quantiles.

(1) Company Size (SIZE)

The results of the POLS regression analysis indicated that when SIZE increased by 1%, LEVR increased by 6.9%.

The results of the quantile regression analysis indicated that SIZE had a positive relationship to some extent at all τ quantiles. Therefore, in the case of listed Korean construction companies, SIZE can be considered to have a positive effect on decisions related to leverage ratios regardless of whether borrowed capital levels are excessively low or high. Consequently, with regard to SIZE, construction companies are considered to follow the static tradeoff theory because larger construction companies can more easily obtain loans from credit/financial institutions. This result is consistent with the empirical studies conducted by Feidakis and Rovolis (2007), and Baharuddin et al. (2011).

(2) Profitability (PROF)

In the Pooled-OLS regression analysis, PROF was identified as being negatively related with leverage at

Table 1. Descriptive Statistics

<table>
<thead>
<tr>
<th>Category</th>
<th>N</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Mean</th>
<th>Standard Error</th>
<th>Standard Deviation</th>
<th>VIF*</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEVR (%)</td>
<td>427</td>
<td>19.810</td>
<td>97.050</td>
<td>60.829</td>
<td>0.760</td>
<td>15.696</td>
<td>-</td>
</tr>
<tr>
<td>SIZE (Thousand Won)</td>
<td>429</td>
<td>33,7940</td>
<td>8,144,000</td>
<td>1,274,432</td>
<td>87,464</td>
<td>1,811,597</td>
<td>1.67</td>
</tr>
<tr>
<td>GROWTH (%)</td>
<td>429</td>
<td>24.499</td>
<td>1132.761</td>
<td>259.585</td>
<td>11.624</td>
<td>240.758</td>
<td>1.40</td>
</tr>
<tr>
<td>N DTS (%)</td>
<td>429</td>
<td>0.002</td>
<td>0.552</td>
<td>0.145</td>
<td>0.006</td>
<td>0.129</td>
<td>1.31</td>
</tr>
<tr>
<td>TANG (%)</td>
<td>429</td>
<td>1.217</td>
<td>38.980</td>
<td>14.341</td>
<td>0.454</td>
<td>9.413</td>
<td>1.11</td>
</tr>
<tr>
<td>PROF (%)</td>
<td>427</td>
<td>-14.510</td>
<td>15.270</td>
<td>5.586</td>
<td>0.228</td>
<td>4.704</td>
<td>1.07</td>
</tr>
<tr>
<td>LQDT (%)</td>
<td>427</td>
<td>63.810</td>
<td>569.440</td>
<td>173.795</td>
<td>4.347</td>
<td>89.817</td>
<td>1.06</td>
</tr>
</tbody>
</table>

Note: *Variance Inflation Factor.

Table 2. Result of Pearson’s Correlation Analysis

<table>
<thead>
<tr>
<th>Category</th>
<th>LEVR</th>
<th>SIZE</th>
<th>GROWTH</th>
<th>N DTS</th>
<th>TANG</th>
<th>PROF</th>
<th>LQDT</th>
</tr>
</thead>
<tbody>
<tr>
<td>LEVR</td>
<td>1</td>
<td>.485**</td>
<td>-.468**</td>
<td>-.107*</td>
<td>-.103*</td>
<td>-.170**</td>
<td>-.706**</td>
</tr>
<tr>
<td>SIZE</td>
<td>.485**</td>
<td>1</td>
<td>-.02</td>
<td>-.451**</td>
<td>-.017</td>
<td>0.088</td>
<td>-.454**</td>
</tr>
<tr>
<td>GROWTH</td>
<td>-.468**</td>
<td>-.02</td>
<td>1</td>
<td>-.039</td>
<td>-.119*</td>
<td>.234**</td>
<td>.214**</td>
</tr>
<tr>
<td>N DTS</td>
<td>-.107*</td>
<td>-.451**</td>
<td>-.039</td>
<td>1</td>
<td>.246**</td>
<td>-.05</td>
<td>.096*</td>
</tr>
<tr>
<td>TANG</td>
<td>-.103*</td>
<td>-.017</td>
<td>-.119*</td>
<td>.246**</td>
<td>1</td>
<td>0.004</td>
<td>-.089</td>
</tr>
<tr>
<td>PROF</td>
<td>-.170**</td>
<td>0.088</td>
<td>234**</td>
<td>-.05</td>
<td>.004</td>
<td>1</td>
<td>0.017</td>
</tr>
<tr>
<td>LQDT</td>
<td>-.706**</td>
<td>-.454**</td>
<td>214**</td>
<td>-.05</td>
<td>.004</td>
<td>1</td>
<td>0.17</td>
</tr>
</tbody>
</table>

Note: *Correlation is significant at the 0.05 level (2-tailed); **Correlation is significant at the 0.01 level (2-tailed).
the 5% significance level or lower. The results can be interpreted as indicating that when PROF increases by 1%, the leverage ratios decrease by 3.7%. In the quantile regression analysis, PROF was identified as negatively related with leverage at all quantiles except 0.1 and 0.3 (at the 5% significance level). However, since not all leverage ratio quantiles generated significant results, as in the case of the quantile regression analysis, the capital structures of construction companies are considered to partially accommodate the pecking order theory. Due to the static characteristics of the study methodology, the dynamic analyses present some difficulties, as mentioned above.

(3) Growth Opportunity (GROWTH)

The results of the Pooled-OLS regression analysis indicated that GROWTH was negatively related with leverage at the 5% significance level or lower. This result can be interpreted as indicating that when GROWTH increases by 1%, leverage ratios decrease by 11.7%. In the quantile regression analysis, GROWTH’s coefficient values also show negative relationships at a certain level. This means that GROWTH variables show robust effects at all quantiles. Consequently, construction companies can be considered to support the static tradeoff theory because businesses with high growth rates should prefer to invest only in investment projects that can maximize shareholder value rather than investing in optimal investment proposals by issuing liabilities because they have many investment opportunities. Since high agency costs may be incurred due to agency conflicts between shareholders and creditors as a result of such excessively low investments, companies with high growth rates are able to maintain low leverage ratios. The results of the present study are consistent with those of previous studies (Jensen and Meckling, 1976; Kim and Sorensen, 1986).

(4) Non-debt Tax Shield (NDTS)

The results of the Pooled-OLS regression analysis indicated that when NDTS increased by 1%, leverage ratios increased by 2.6% (significance level of 5% or lower). However, the results of the quantile regression

**Table 3. Regression Results for Leverage Ratio, 2000-2010 (with time dummies)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Pooled-OLS</th>
<th>Quantile Regression</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>r = 0.1</td>
<td>r = 0.2</td>
</tr>
<tr>
<td>CONSTANT</td>
<td>5.211</td>
<td>(0.214)</td>
</tr>
<tr>
<td>SIZE</td>
<td>0.869</td>
<td>(0.008)</td>
</tr>
<tr>
<td>PROF</td>
<td>-0.085</td>
<td>(0.011)</td>
</tr>
<tr>
<td>GROWTH</td>
<td>-0.017</td>
<td>(0.012)</td>
</tr>
<tr>
<td>NDTES</td>
<td>0.026</td>
<td>(0.008)</td>
</tr>
<tr>
<td>TANG</td>
<td>-0.093</td>
<td>(0.009)</td>
</tr>
<tr>
<td>LQDT</td>
<td>-0.363</td>
<td>(0.032)</td>
</tr>
<tr>
<td>DUM2001</td>
<td>0.045</td>
<td>(0.042)</td>
</tr>
<tr>
<td>DUM2002</td>
<td>-0.095</td>
<td>(0.038)</td>
</tr>
<tr>
<td>DUM2003</td>
<td>-0.039</td>
<td>(0.041)</td>
</tr>
<tr>
<td>DUM2004</td>
<td>-0.071</td>
<td>(0.039)</td>
</tr>
<tr>
<td>DUM2005</td>
<td>-0.022</td>
<td>(0.042)</td>
</tr>
<tr>
<td>DUM2006</td>
<td>-0.025</td>
<td>(0.042)</td>
</tr>
<tr>
<td>DUM2007</td>
<td>0.028</td>
<td>(0.041)</td>
</tr>
<tr>
<td>DUM2008</td>
<td>-0.096</td>
<td>(0.041)</td>
</tr>
<tr>
<td>DUM2009</td>
<td>-0.111</td>
<td>(0.041)</td>
</tr>
<tr>
<td>DUM2010</td>
<td>-0.115</td>
<td>(0.044)</td>
</tr>
<tr>
<td>DUM2011</td>
<td>0.014</td>
<td>(0.041)</td>
</tr>
</tbody>
</table>

Notes: The bold regression coefficients are significant at the 5% level. The values in parentheses are Bootstrap standard errors extracted using 1000 bootstrap replications. **Indicates significance at the 5% level; ***indicates significance at the 1% level. SIZE: total assets; PROF: the ratio of operating profits to sales; GROWTH: market to book ratio; NDTES: the ratio of depreciation costs to total assets; TANG: the ratio of tangible fixed assets to total assets; LQDT: the ratio of current assets to current liabilities. Dependent and independent variables were natural logarithm-transformed (except time dummy variables).
analysis indicated that NDTS had no significant value at the 0.5 or lower quantiles. NDTS was identified as being positively related with leverage ratios at the 0.6 or higher quantiles. This result is in contrast to the results of a previous study indicating that, from the perspective of the static tradeoff theory, businesses with many non-debt tax shield measures such as investment tax credits would procure smaller debts. The previous study on non-debt tax shields is evaluated as not logically interpretable. Therefore, it can be concluded that non-debt tax shields are not appropriate for the determination of capital structures among construction companies.

(5) Asset Tangibility (TANG)

According to the results of the Pooled-OLS regression analysis, when TANG increased by 1%, leverage ratios decreased by 9.3% (significance level of 5% or lower). As with the results of the Pooled-OLS regression analysis, the results of the quantile regression analysis indicated that TANG was negatively related with leverage ratios at all quantiles (significance level of 5% or lower). Given these results, the asset tangibility of the construction industry operates through a different mechanism than that found by previous empirical analyses. Whereas the manufacturing industry continuously generates sales through factories, machines, equipment, and land, construction companies do not generate revenues through tangible fixed assets. This is considered to be why its coefficient showed a different sign. Of particular interest in the results for TANG is that the effects of coefficients decreased at higher leverage ratio quantiles. Additional studies are required to further investigate this matter.

(6) Liquidity (LQDT)

According to the results of the Pooled-OLS regression analysis, when LQDT increased by 1%, leverage ratios decreased by 36.3%. The results of the quantile regression analysis showed that the effects of coefficients decreased at higher leverage ratio quantiles. This result proves that if the OLS estimation method has a centralizing tendency, regression coefficients may be under- or over-estimated. In conclusion, this means that construction companies with high liquidity should have low leverage ratios.

(7) Time Dummy (DUM2001~2010)

The results of the Pooled-OLS regression analysis indicated that the time dummy variables for 2002, 2003, 2008, 2009, and 2010 were significant (significance level of 5% or lower). This indicates that the leverage ratios of construction companies changed due to the 2008 international financial crisis and the 2009 European sovereign debt crisis mentioned in the introduction. The results of the quantile regression analysis indicated that the time dummy variables for 2008, 2009, and 2010 were significant within the excessively high leverage ratio quantiles. Given this finding, exogenous factors such as the macroeconomic crisis can be considered to have changed the capital structures of companies that fall within excessively high leverage ratio quantiles.

5. Conclusion

This study empirically analyzed the capital structure determinants of listed Korean construction companies from 2000 to 2010. In particular, the empirical analyses focused on changes in the coefficients of the determinants according to the leverage ratio quantiles of the construction companies. The results of the empirical analyses can be summarized as follows.

Construction company size was positively related with leverage. Construction company size had a certain positive effect on all leverage quantiles and there were no extreme differences between the excessively low and high leverage ratio quantiles. This result supports the static tradeoff theory with regard to business size.

Construction company profitability was negatively related with leverage. The profitability of construction companies had a stronger negative effect on the high leverage quantiles. In contrast, the coefficient values became less significant in the lower quantiles. Therefore, the tendency of construction companies to partially accommodate the pecking order theory could be identified.

Growth was identified as being negatively related with leverage. The influence of growth gradually increased in the higher leverage quantiles.

Although non-debt tax shields were identified as being positively related with leverage, in the results of the quantile regression analysis, the relationships were significant for the 0.6 or higher quantiles. Although the effects of non-debt tax shields were larger for the excessively high leverage quantiles, the sign of the coefficient was different from that found in previous studies, making analysis impossible. In conclusion, the effects of non-debt tax shields on the capital-structure-related decisions of construction companies are considered to be quite limited.

Asset tangibility was found to be negatively related with leverage. This result differed from those of previous studies because the asset portfolios of construction companies differ from those of companies in other industrial fields. In addition, asset tangibility effects gradually decreased as leverage quantiles increased. This is considered different from the results obtained when the acts of average groups were explained based on the conditional mean value of OLS. That is, the OLS estimation coefficient at excessively low leverage under-estimated actual quantities and that at excessively high leverage over-estimated actual quantities. The foregoing asset tangibility behavior should be further empirically analyzed.

Liquidity was found to be strongly negatively related with leverage, because the financing behavior of construction companies is focused on the management of operating capital. Moreover, as with asset tangibility, large differences were identified in both extreme quantiles. Liquidity was more sensitive in the excessively low leverage quantiles than in the excessively high leverage quantiles. Additional studies are required to further analyze this issue.
According to the results of both empirical analysis models, liquidity had the strongest negative effect on the capital structures of listed construction companies. However, the effect of liquidity was lower in excessively high leverage quantiles than the excessively low leverage quantiles. This is because most construction companies utilized the leverage effect to maximize profits regardless of their financial (debt-repayment) capabilities. The risky behavior of the analyzed Korean construction companies could lead to repeated financial liquidity crises whenever macroeconomic recessions occur.

To resolve this problem, construction companies need to set a target leverage ratio based on their debt-repayment capabilities and future growth potential and profitability. This target then needs to be continuously managed and modified. Moreover, the reason construction companies in Korea repeatedly face liquidity crises is their excessive concentration on private housing construction. Despite the riskiness of this business sector, they employ no risk-hedging strategies. Therefore, if construction companies utilize excessively high leverage, they will have to reduce their financial risks through diversification (such as taking on public construction projects and securing cash-flows).

As shown in the conclusion, the capital structure determinants of construction companies exhibit different patterns from those described in traditional theories and previous studies, perhaps because the characteristics of the construction industry. Moreover, the patterns vary according to the market environments and cultures of different countries. Currently, studies in business management and finance utilize various quantitative analysis methods to theorize about the decision-making behaviors of companies and aim to help actual businesses make decisions. The construction industry should also accept/apply related methodologies and theories to derive new research fields.

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Notes
1 Capital structure can be defined differently depending on the purpose of the study. In the present study, capital structure was defined as a combination of equity and borrowed capital, and leverage ratios (total debt and bonds payable to total assets) were utilized.
2 As for agency costs, gaps exist between the interests of creditors or shareholders and those of managers in limited company systems, where ownership and management are separated from each other. Depending on their interests, agency problems can occur. The costs from conflicts of interests between external shareholders and managers are called agency costs of equity. The agency costs between shareholders and creditors are called agency costs of debt. For example, the simple double-log form is as follows: ln Y = a + b ln X + ε. a means that when X increased by one percent, Y changed by a%. It is called the elasticity coefficient in economics. where, ln Y is logged Y, a, is constant term; b, is coefficient; ln X is logged X; ε is error term.

References