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THE EFFECTS OF PROFITABILITY AND DEBT-TO-EQUITY RATIO ON OPERATING LEVERAGE

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Abstract

The aim of this study was to analyze the effects of profitability and debt-to-equity ratio on operating leverage in the case of companies listed on the Korea Exchange from 2000 to 2021. The analysis showed that the profitability and debt-to-equity ratio of companies in Korea rose with increasing operating leverage (fixed costs), and it is worth noting that a company's cost structure affects its capital structure. There was a positive correlation between profitability and debt-to-equity ratio for Korean firms, which means that their capital structure can be explained by the pecking order theory. That is, the more profitable a company is, the more it prefers to raise funds through debt issuance rather than equity issuance. In the case of Korean companies with a relatively high dependence on debt, the increase in operating leverage for facility investment among other business activities mostly expands debt, and the higher the profitability, the higher the debt-to-equity ratio is.

Keywords

Profitability, Debt-To-Equity Ratio, Operating Leverage, Trade-Off Theory, Pecking Order Theory

I. Introduction and Literature Review

Since the outbreak of COVID-19, Korean companies have been managing their businesses more conservatively by, for instance, expanding non-face-to-face services, practicing emergency management due to the growing deficit range, and reducing investment and securing cash. Amid such drastic changes in the business environment, companies experienced a decline in profitability and an inevitable increase in debt, which led to a growing number of marginal firms and deterioration of financial conditions. However, as the world began to transition to living with COVID-19 and expectations for an economic recovery rose, companies experienced a further increase in debt as they made advanced investments to gain a greater market share and improve profitability. As they aimed to boost sales, their operating leverage naturally increased, and this triggered the motivation to analyze the effects of profitability and debt-to-equity ratio on operating leverage. As such, grasping the post-pandemic situation of companies has major social and economic implications.

Companies adjust their investments and debts according to their financial situation, judgment, and strategic decisions, and the capital structure of these companies can be mainly explained by the trade-off theory and the pecking order theory, as shown in a number of previous studies. In brief, the trade-off theory is a theory that there is an optimal target capital structure, or debt-to-equity ratio, because there is a conflict between the tax-saving benefits and the costs of bankruptcy when a company uses debt, while the pecking order theory is a theory that when a company's investment activity is determined, it must raise funds in an external capital market such as the financial market, but considering the adverse selection cost arising from information asymmetry, it first uses the internal reserves it holds and then turns to debt financing before finally raising funds through equity financing. Many studies have validated these two theories, and recently, it has been argued that both theories should be considered at the same time to explain capital structure (Fama and French, 2005).

Past studies have reported different, or partially consistent, findings regarding the relationship of-operating leverage, financial leverage, and capital structure. Early studies on the relationship between operating leverage and debt-to-equity ratio were conducted by Lev (1974) and Mandelker and Rhee (1984). Chen et al. (2019), for example, reported a negative correlation between operating leverage and debt-to-equity ratio and between profitability and debt-to-equity ratio. They stated that companies with high operating leverage see an increase in

profitability when there is an uptick in sales and reduce their debt-to-equity ratio when sales drop due to the increased risk of bankruptcy, and that this negative correlation between operating leverage and debt-to-equity ratio can be explained by the trade-off theory. Most of the studies on capital structure have been regarding the determinants of the impact on capital structure based on the trade-off theory and the pecking order theory, and since about 15 years ago, there has been active research on the rate of capital structure adjustment, as studies have begun to focus more on companies adjusting their debt. Donaldson (1961) was the first to propose the pecking order theory, through which the motivation and sequence of capital raising by firms were presented. Myer and Majluf (1984) then proposed a modified pecking order theory under the premise of information asymmetry, explaining that when there is an investment opportunity, companies prefer external funds in the short term, and those with high growth potential in the long term will be reluctant to use debt due to the burden of higher capital cost compared to the use of internal reserves. The pecking order theory suggests that the lower the profitability, the lower the cash inflow, and the greater the information asymmetry, the higher the preference for debt and the higher the actual debt level.

This study was carried out to empirically analyze the relationship of profitability and debt-to-equity ratio with operating leverage in the case of companies listed in Korea and how the former affects the latter. This paper is organized as follows: Section 1 provides an introduction and examines previous studies, Section 2 describes the model and variables, and Section 3 explains the data. Section 4 presents the empirical study that was conducted and an analysis of the results, while Section 5 presents the conclusions and implications obtained from the empirical analysis.

II. Sample and Research Methodology

2.1 Sample

In this study, sample companies were selected in accordance with the following criteria from among the companies listed on the Korea Exchange from January 1, 2000 to December 31, 2021. First, companies whose financial and stock price data from January 1, 2000 to December 31, 2021 were not available in the KIS Value Library, FnGuide, or TS2000 were excluded. Financial institutions engaging in banking, securities, or insurance business were excluded because they differ from general manufacturing businesses in terms of capital structure, business operation methods, and government regulation and supervision. Companies that were delisted during the analysis period and those who underwent a merger or designated as issues for administration during the analysis period were also excluded from the sample pool due to issues with continuity of financial data. In addition, companies with total assets of less than KRW 1 billion or no sales were excluded because they may lead to outliers for the variables, and each variable was winsorized at the 1st and 99th percentile to control the impact of outliers on the analysis results. The number of firm-year observations for the firms that fulfilled the above conditions was 29,486.

2.2 Research Model and Variables

In this study, a regression model, as shown in Eq. (1), was established to analyze the effects of profitability and debt-to-equity ratio on operating leverage according to the methodologies of Novy-Marx (2011), Rajan and Zingales (1995), Welch (2004), Kayhan and Titman (2007), and Lemmon et al. (2008).

$$\mathbf{Y_t = \beta_0 + \beta_1 OPERATINGleverage_t + \gamma X_t + \varepsilon_t} \qquad \mathbf{(1)}$$

In Eq. (1), Y_t denotes profitability ratio, book value leverage ratio, and market value leverage ratio, which are dependent variables, ($OPERATINGleverage_t$) denotes operating leverage ratio, which is an explanatory variable, and X_t denotes six control variables. In the case of the dependent variables, profitability ratio in year t ($PROFITability_t$) is measured by dividing operating income by total assets, book value leverage ratio in year t ($BOOKleverage_t$) is measured by dividing total debt by total assets, and market value leverage ratio in year t ($MARKETleverage_t$) is measured by dividing total debt by the market value of assets (total debt - market capitalization). The explanatory variable, operating leverage ratio in year t ($OPERATINGleverage_t$), is measured by dividing selling, general, and administrative expenses (SG&A) expenses by total assets in the previous year, and it was adjusted to total assets rather than sales because SG&A expenses are quasi-fixed costs and cannot be reduced immediately even if there are no sales. Novy-Marx (2011) used SG&A expenses as a substitute for operating leverage, arguing that time series data of companies are not necessary to calculate operating leverage and operating leverage is not a function of profitability. As for the six control variables, the market-to-book ratio in year t ($MKTbook_t$) is measured by dividing the company's market value (total debt + market capitalization) by total assets; the firm size in year t ($Logsale_t$) is measured by the logarithm of sales; the tangible asset ratio in year t ($Tangibility_t$) is measured by dividing tangible assets by total assets; the research and development (R&D) expense ratio in year t ($RDexpense_t$) is measured by dividing ordinary development expenses by sales; the dividend ratio in year t ($Dividend_t$) is measured by dividing the amount of cash dividends by total assets; and the cash reserve ratio in year t ($Cash_t$) is measured by dividing the amount of cash by total assets.

III. Empirical Results

3.1 Descriptive Statistics

This section presents an empirical analysis of the effects of profitability and debt-to-equity ratio on operating leverage. First, Table 1 shows the basic statistics and correlations of the variables used in this study.[1] The mean (median) values of the dependent variables, profitability ratio in year t (PROFITability), book value leverage ratio in year t (BOOKleverage), and market value leverage ratio in year t (MARKETleverage), were found to be 0.0895 (0.0615), 0.4351 (0.4267), and 0.4294 (0.3940), respectively, indicating that the debt-to-equity ratios of Korean companies are higher than those of American companies (mean book value leverage ratio of 0.252 and mean market value leverage ratio of 0.279) (Chen et al., 2019). The mean (median) operating leverage ratio in year t, the explanatory variable, was determined to be 0.1724 (0.1225), and the mean (median) values of the control variables, market-to-book ratio in year t (MKTbook), firm size in year t (Logsale), tangible asset ratio in year t (Tangibility), R&D expense ratio in year t (RDexpense), dividend ratio in year t (Dividend), and cash reserve ratio in year t (Cash) were found to be 1.0305 (0.8642), 8.2550 (7.8941), 0.3058 (0.2804), 0.0106 (0.0005), 0.0075 (0.0040), and 0.0796 (0.0512), respectively.

Variables	Average	Median	Standard deviation	Minimum	maximum
PROFITability	0.0895	0.0615	0.1008	0.0006	0.4952
BOOKleverage	0.4351	0.4267	0.2016	0.0587	0.9183
MARKETleverage	0.4294	0.3940	0.2453	0.0005	1.0167
OPERATINGleverage	0.1724	0.1225	0.1509	0.0199	0.8742
MKTbook	1.0305	0.8642	0.6978	0.1526	4.5276
Logsale	8.2550	7.8941	0.6570	6.9564	10.0052
Tangibility	0.3058	0.2804	0.1905	0.0001	1.046
RDexpense	0.0106	0.0005	0.0288	0.0001	0.1349
Dividend	0.0075	0.0040	0.0104	0.0001	0.0524
Cash	0.0796	0.0512	0.0867	0.0005	0.4564

Note) All variables are presented by winsorizing 1% extreme values from top and bottom

Table 1: Descriptive statistics analysis

3.2 Ranking Test

In Table 2, the sample companies were categorized into deciles according to operating leverage and profitability for analysis. The entire sample pool was used, and the same results were obtained even when analyzed by year. Panel A presents profitability, book value leverage ratio, and market value leverage ratio in order according to the operating leverage deciles, and it shows that profitability increases as operating leverage increases. Both book value and market value leverage ratios tend to increase slightly with increasing operating leverage but the relationship between the two variables is not clear. Panel B presents operating leverage, book value leverage ratio, and market value leverage ratio in order according to the profitability deciles, and it shows that profitability and operating leverage have the same direction, and as profitability increases, operating leverage also increases. However, as profitability rises, the debt-to-equity ratio either increases or decreases across the deciles and does not show any distinct characteristics. Also, the difference between the maximum and minimum values is statistically significant with a positive value in Panel A only.

Panel A Sorted on operating leverage				
Rank	**OPERATING leverage**	**PROFIT ability**	**BOOK leverage**	**MARKET leverage**
1 Low	0.0339	0.0534	0.4007	0.5114
2	0.0556	0.0644	0.4368	0.5299
3	0.0738	0.0722	0.4262	0.5351
4	0.0905	0.0768	0.4263	0.5238
5	0.1092	0.0858	0.4190	0.5114
6	0.1322	0.0942	0.4142	0.5180
7	0.1579	0.0961	0.4123	0.5209

[1] In the process of analyzing the results, the subscript (t) indicating time with respect to the variables were omitted for simplicity.

8	0.2019	0.1905	0.3919	0.5162
9	0.2734	0.1226	0.3872	0.5018
10 High	0.4848	0.1518	0.4082	0.5605
High-Low	0.4509	0.0984	0.0075	0.0491
t-value	146.8546	40.8468	2.8563	6.2860
Panel B Sorted on profitability				
Rank	**PROFITability**	**OPERATINGleverage**	**BOOKleverage**	**MARKETleverage**
1 Low	0.0366	0.1192	0.4316	0.5231
2	0.0415	0.1185	0.4405	0.5490
3	-0.0489	0.1305	0.4490	0.5469
4	0.0566	0.1354	0.4492	0.5411
5	0.0692	0.1513	0.4317	0.5416
6	0.0804	0.1575	0.4218	0.5222
7	0.0964	0.1666	0.4140	0.5179
8	0.1197	0.1925	0.3809	0.5182
9	0.1511	0.2063	0.3559	0.4732
10 High	0.2306	0.2374	0.3155	0.4919
High-Low	0.1940	0.1182	-0.1161	-0.0312
t-value	87.9683	36.1658	-16.7644	-3.0753

Table 2: Measurement of variables according to operating leverage and profitability ranking

3.3 Effect of Profitability on Operating Leverage

Table 3 shows the results of analyzing the effect of profitability on operating leverage using the Fama-MacBeth regression approach, with the t-values adjusted using the methodology of Newey-West (1986). The results show that in <Model 1>, the operating leverage ratio had a significant positive effect on the profitability ratio at a significance level of 0.01, suggesting that profitable companies see an increase in profitability when their operating leverage increases. Also, in the analysis with the control variables included using <Model 2>, the operating leverage ratio was observed to have a significant positive effect on the profitability ratio at a significance level of 0.01, indicating that in the case of companies with high operating leverage, profitability increases when sales increase because profits increase to a greater degree than fixed costs. In addition, the analysis showed that the control variables, market-to-book ratio, dividend ratio, and cash retention ratio all had a significant positive effect on the profitability ratio at a significance level of 0.01 and that the firm size had a significant negative effect on the profitability ratio at a significance level of 0.01.

Variables	PROFITability	
	Model 1	Model 2
Constant term	0.065*** (11.42)	0.067** (2.06)
OPERATINGleverage	0.212*** (8.95)	0.193*** (9.86)
MKTbook		0.005*** (4.43)
Logsale		-0.009*** (-3.80)
Tangibility		0.006 (1.32)
RDexpense		0.026 (0.87)
Dividend		1.824*** (36.08)
Cash		0.213*** (17.20)

Firm effect	Included	Included
Year effect	Included	Included
Industry effect	Included	Included
Number of observations	29,486	29,486
Adjusted $-$ R^2	0.1352	0.2649
F $-$ value	359.43***	627.86***

Note) t-values were adjusted according to the methodology of Newey-West (1987), and ***, **, and * indicate a significance level of 0.01, 0.05, and 0.10, respectively.

Table 3: Effect of profitability on operating leverage

3.4 Effect of Debt-to-Equity Ratio on Operating Leverage

Table 4 shows the results of analyzing of the effect of book value leverage ratio on operating leverage using the Fama-MacBeth regression approach, with the t-values adjusted using the methodology of Newey-West (1986).. The results show that in <Model 1>, the operating leverage ratio did not have a significant effect on the book value leverage ratio, and in the analysis with the control variables included using <Model 2>, the operating leverage ratio has a significant positive effect on the book debt ratio at a significance level of 0.01. This suggests that in the case of Korean companies, there is a positive correlation between operating leverage and book value leverage ratio, and that even when their operating leverage is high, companies make the decision to increase debt rather than reduce it. It can also be seen that the higher the operating leverage, the higher the debt-to-equity ratio–is for profitable companies.

Variables	BOOKleverage	
	Model 1	Model 2
Constant term	0.431*** (25.08)	-0.306*** (-9.86)
OPERATINGleverage	-0.028 (-1.20)	0.139*** (5.64)
MKTbook		0.038 (1.55)
Logsale		0.070*** (20.97)
Tangibility		0.128*** (11.72)
RDexpense		-0.846*** (-9.36)
Dividend		-5.905*** (-46.63)
Cash		-0.283*** (-14.98)
Firm effect	Included	Included
Year effect	Included	Included
Industry effect	Included	Included
Number of observations	29,486	29,486
Adjusted $-$ R^2	0.0508	0.2943
F $-$ value	53.86***	638.42***

Note) t-values were adjusted according to the methodology of Newey-West (1987), and ***, **, and * indicate a significance level of 0.01, 0.05, and 0.10, respectively.

Table 4: Effect of book value leverage ratio on operating leverage

Table 5 shows the results of analyzing the effect of the market value leverage ratio on operating leverage using the Fama-MacBeth regression approach, with the t-values adjusted using the methodology of Newey-West (1986). The results show that in <Model 1>, the operating leverage ratio had a significant positive effect on the market value leverage ratio at a significance level of 0.01, and in the analysis with the control variables included using <Model 2>, the operating leverage ratio was found to have a significant positive effect on the market value leverage ratio at

a significance level of 0.01. This shows that in the case of companies in Korea, there is a positive correlation between operating leverage and market value leverage ratio, as is the case with book value leverage ratio, and that even when their operating leverage is high, companies make the decision to increase debt rather than reduce it. It can also be seen that the higher the operating leverage, the higher the debt-to-equity ratio is for profitable companies.

Variables	MARKETleverage	
	Model 1	Model 2
Constant term	0.538*** (9.85)	0.387*** (3.76)
OPERATINGleverage	0.092*** (4.53)	0.319*** (8.24)
MKTbook		-0.260*** (-10.55)
Logsale		0.024*** (2.76)
Tangibility		0.154*** (8.87)
RDexpense		-0.392*** (-6.12)
Dividend		-5.838*** (-16.80)
Cash		-0.103*** (-3.95)
Firm effect	Included	Included
Year effect	Included	Included
Industry effect	Included	Included
Number of observations	29,486	29,486
Adjusted $-$ R^2	0.0896	0.4317
F $-$ value	72.59***	1159.62***

Note) t-values were adjusted according to the methodology of Newey-West (1987), and ***, **, and * indicate a significance level of 0.01, 0.05, and 0.10, respectively.

Table 5: Effect of market value leverage ratio on operating leverage

IV. Conclusions

This study was conducted with the aim of analyzing the impact of profitability and debt-to-equity ratio on operating leverage in the case of companies listed on the Korea Exchange from 2000 to 2021. The results of the analysis were as follows: First, in the case of companies with high operating leverage, profitability increases when sales increase because profits increase to a greater degree than fixed costs. Second, there is a positive correlation between operating leverage and book value leverage ratio in the case of Korean companies, and that even when their operating leverage is high, companies tend to make the decision to increase debt rather than reduce it. Also, as for profitable companies, the higher the operating leverage, the higher the debt-to-equity ratio is. In sum, Korean companies' profitability and debt ratio increase as operating leverage (fixed costs) rises, and it is worth noting that the cost structure of a company affects its capital structure. There is a positive correlation between profitability and debt-to-equity ratio for companies in Korea, which means that their capital structure can be explained by the pecking order theory. That is, the more profitable a company is, the more it prefers to raise funds through debt issuance rather than equity issuance. In the case of Korean companies with a relatively high dependence on debt, the increase in operating leverage for facility investment among other business activities mostly expands debt, and the higher the profitability, the higher the debt-to-equity ratio is. The results of the empirical analysis carried out in this study can be used to examine the impact of operating leverage and managerial decision-making depending on whether the business is in the red or in the black and whether its debt ratio is high or low. Further systematic analysis will be needed in the future with a larger number of samples that are categorized more specifically, and comparative analysis of pre- and post-COVID-19 situations should also be conducted. In Korea, there is a lack of research on the effects of profitability and debt-to-equity ratio on operating leverage, and various follow-up studies should be conducted on this particular topic.

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