경영학석사학위논문

The Impact of Operating Leverage on Profitability and Financial Leverage in Korean Market

한국 시장에서 영업레버리지가 수익성과 재무레버리지에 미치는 영향에 대한 연구

2020년 2월

서울대학교 대학원

경영학과 재무금융 전공

진 알 렉 스

The Impact of Operating Leverage on Profitability and Financial Leverage in Korean Market

한국 시장에서 영업레버리지가
수익성과 재무레버리지에 미치는 영향에 대한 연구

지도교수 조성욱

이 논문을 경영학 석사 학위논문으로 제출함

2019 년 6 월

서울대학교 대학원
경영학과 재무금융전공
진 알 렉 스 (Tin Aleksey)

진알렉스의 경영학 석사 학위논문을 인준함

2019 년 6 월

위 원 장 김 우 진 (인)

부 위 원 장 이 종 섭 (인)

위 원 조 성 욱 (인)

Abstract

The Impact of Operating Leverage on Profitability and Financial Leverage in Korean Market

Aleksey Tin (Alex Jin)

College of Business Administration

The Graduate School

Seoul National University

In the present research I investigate the impact of operating leverage on profitability and financial leverage in Korean Market. I find that for firms, with a positive profitability, operating leverage increases profitability and reduces financial leverage in good times. Hence, operating leverage is an explanatory variable of the negative correlation between financial leverage and profitability of a firm, which is inconsistent with trade-off theory. Operating leverage is assumed as the fixed-cost, and in good times it increases profitability, however in recession it may increase a bankruptcy risk and lead company to a financial distress earlier than managers predict. Using three different natural events, China's entry into the World Trade Organization in 2001, Asian Financial Crisis in 1997 and The World Financial Crisis 2008, as exogenous shocks on capital structure, I check how managers adjust operating leverage and how these adjustments impact on profitability and financial

leverage. I believe that when managers decide to increase operating leverage, they choose to lower financial leverage, to reduce firm's risk of default. Book leverage of the post period of China's entry to WTO strongly support prediction, that financial leverage reduced under influence of operating leverage. However, there is no significant evidence for market leverage. To find more evidence I chose Asian Financial Crisis 1997 as another exogenous shock event. The data shows significant positive relations between operating and book leverage. As Yun (2003) reports, Asian Financial Crisis influenced firms to reduce operating and financial leverage at the same time, causing positive correlation between them. On the assumption of results, I conclude that data supports prediction that there is a positive relation between operating leverage, and that profitability, and negative relation between operating and financial leverage is the explanatory variables of negative relation between profitability and financial leverage.

Keywords: Financial leverage, operating leverage, profitability, China's WTO, IMF, World financial crisis, Asia financial crisis, selling, general, and administrative cost

Student Number: 2017-21294

Table of Contents

Tables

1. Introduction

The present study is done to investigate the impact of operating leverage (OL) on profitability and financial leverage (FL). I believe that operating leverage is an important factor, that explains the negative relationship between financial leverage and profitability, and can lead firm to financial distress in recession.

During economy growth, operating cost increases with sales revenue, but not by the same rate. Thus, increasing in operating cost (or leverage) have an influence on increasing profitability. However, when economy faces recession higher fixed costs may lead firm to default. From this can be concluded that operating leverage is positively related with profitability and has first priority effect on the capital structure.

Operating leverage is expenses which firms have to pay to keep operating, also considered to be a fixed cost. It has one of the first priorities in capital structure and associated with positive profitability, in good times. Thus, when firm has a positive dynamic of growth its sales increase its' operating cost to meet demand. FL is defined as firms' total debt to total assets. If firm uses FL it has to pay an interest rate, which is fixed cost firm has to pay independently of sales revenue. A Company with less ratio of operating cost has more option of FL, and vice versa. Hence, OL and FL can substitute each other. Earlier research on operating and FL relations made by Yang (1986), Goo (1994) and Lim (2011) show the evidence of negative relation between OL and FL.

According to the trade-off theory, a firm borrows to the margin where the present value of interest tax shield is just offset by the loss value due to agency costs of debt and the financial distress costs. Hence, borrowing helps to reduce taxes, but too much debt can lead to a costly trouble. However, Myers (1984) shows that trade-off theory works for some extent, but does not seem to be effective in explaining wide variety

of debt ratios across firms in the same industry, and firms with positive high profitability do not have as much leverage as it should have according to the trade-off. Also Graham (2000) proves that the trade-off theory does not explain the reason of firms using the debt conservatively. Shin (2006) represents the same evidence for Korean firms.

Empirical studies in Korea show different results of relationship between OL and FL. The first research about OL and FL, produced by Yang (1986), shows that in general there is negative relation between FL and OL. Goo (1994) find the same results for the same sample period, but extension of the period shows opposite relations, which is confirmed again by Yun (2003). Lim (2011) and Jeoung (2011) show the negative association between OL and FL. Lim (2017) check the flexibility of operating leverage within Korean firms, and find that firms with a high OL flexibility have more option of using financial leverage (FL).

Profitability increases with OL in good times, but since OL is a fixed cost, the increased OL cannot be easily reduced, and during the economy recession it may cause firms to go bankruptcy faster than predicted. Therefore, when firm increases OL, it chooses to decrease FL in order to reduce the risk of firm to go bankrupt.

For instance, consider a startup with an idea of producing an electric car. To start a business plan CEO must calculate operating cost to run a business, and his first step will be analyzing the car manufacturing industry: innovation of the industry, production technology, labor cost, land cost etc. Hence, generally in the operating cost will be defined exogenously, by technology and innovations in relevant industry. In the present study, to prove the causality that the high OL is positively associated with profitability and negatively associated with FL, I use three natural exogenous experiments and industry-level tests. The first event is China’s Entry to World Trade Organization in 2001, the second is Asian Financial Crisis in 1997, and the third one

is World Financial Crisis 2008. The difference between first and second event. There is a three years' interval between first and second events, making an opportunity to see a dynamic change in capital structure of Korean firms. Then, I use 2008 financial crisis used to show the default probability of firms with high OL, and check how firms adjust FL to decrease the risk of default. Lastly, I do a robustness test at industry level for both positive and negative profitability firms to confirm the effect of OL. The main contribution of the present research is to investigate the role of OL in capital structure, and confirm that it is positively associated with profitability and generate negative relation between profitability and FL.

The present article consists of follow contents: the next section, two, describes hypothesis development. The third and fourth sections describes the main data set and methodology of the study. In the fifth section I show the empirical results of the test. Section six represent the robustness test. And the last section, sixth, summarize and conclude.

2. Hypothesis

Empirical hypotheses are the same as Chen et al. (2018), but for Korean firms. I also use firms with positive profitability, which include about 83% of the data. I also analyze firms with negative profitability at robustness test, which is about 17% of the whole observation data.

Hypothesis 1: Operating leverage rises profitability.

When economy is positive, sales revenue increases, making higher profitability. Therefore, OL increases profitability in good time, leading to hypothesis that profitability is positively associated with OL.

Hypothesis 2: Operating leverage increase causes financial leverage decrease. Thus, there is a negative relation between operating and financial leverage.

OL is a quasi-fixed expenses, which firm cannot easily reduce and has to pay even in distress. This leads firm to a high probability of default and costly trouble. Managers of firms with a high OL ratio reduce their FL to decrease the risk of default. Therefore, there is a substitution effect between operating and FL.

Hypothesis 3: Since operating leverage increase causes increase in profitability and decrease in financial leverage, OL explains negative relationship between profitability and financial leverage.

Considering hypothesis 1 and 2, intuition leads to the hypothesis 3, that profitability and FL are negatively correlated, and OL is an important channel to explain negative relations between them.

3. DATA

The present study based on the historical annual accounting data of all listed firms in Republic of Korea. The main data set of accounting reports and market capital is obtained from the FN-DataGuide database. Since the data for all firms is available from 1980 year, I set the sample period from 1980 to 2018 years, and exclude all financial firms, due to difference of capital structure, government regulations and supervisory. The main data sample include nonfinancial firms with positive total assets and sales revenue, which is about 83% of the whole observation number. To solve the problem of survivorship bias all delisted firms are included in sample. All missing, not reliable data, and data disclosed before IPO are removed from the main sample. Firms' industry defined and classified into sixteen industries, according to

standard industry classification provided by FnGuide. The whole analysis process is performed at SAS software.

4. Methodology and Empirical Results

This part describes research methodology and empirical results. I start with variable constructions, using same methods presented in previous literature[1]. Then, I present summary statistics of all constructed variables of the full sample data from 1980 to 2018. The summary statistics (Table 1) includes observation number, mean, standard deviation and distribution of all variables. A next step shows results of firms sorting into deciles (Table 2) based on OL and profitability. I start the test with confirming that selling, general and administrative cost is less volatile and good proxy of OL. The main test run, using Fama-MacBeth regression, and adjust with the Newey-West (1987) method with 4 lags, to solve the problem of downward bias. To check the default probability of firms with high OL, I construct the *O-score*, following Ohlon's (1980) method.

Variable Construction

All variables are constructed following the previous literature of Chen et al. (2018).

Book Leverage (*BKLEV*) is the ratio of total debt to total assets at *t*.

$$BKLEV = \frac{Total\ Debt_t}{Total\ Assets_t} \quad (1)$$

[1] Rajan et al. (1995), Kayhan et al. (2007), Welch (2004), Lemmon et al. (2008)

Market Leverage (*MKLEV*) is the ratio of total debt to total debt plus market capital at time *t*.

$$MKLEV = \frac{Total\ Debt_t}{Total\ Debt_t + Market\ Capital_t} \quad (2)$$

Operating leverage is constructed as selling, general and administrative cost (*SGA*) to total assets at time *t*.

$$OL = \frac{Selling,general\ \&\ administrative\ cost_t}{Total\ Assets_t} \quad (3)$$

Profitability (*PROF*) is calculated as sales minus SGA and cost of goods sold (*COGS*) at time *t*, divided to total assets at time *t-1*.

$$PROF = \frac{Sales_t - SGA_t - COGS_t}{Total\ Assets_{t-1}} \quad (4)$$

Market to book ratio (*MB*) is the ratio of total market capital plus preferred stock and minus deferred taxes at time *t*, divided to total assets at time *t*.

$$MB = \frac{Market\ Capital_t + Preferred\ Capital\ Stock_t - Deferred\ Taxes_t}{Total\ Assets_t} \quad (5)$$

Proxies for size is log of sales(LOG_SAL): $LOG\_SAL = \sqrt{Sales_t}$; tangibility (TAN) is the ratio of property, plant and equipment to total assets at time *t*.

$$TAN = \frac{Property,plang\ and\ equipment_t}{Total\ Assets_t} \quad (6)$$

R&D (RD) is the ratio of research and development expense to sales at time *t*.

$$RD = \frac{R\&D_t}{Sales_t} \quad (7)$$

Industry median book leverage (LEVMED) is the median value of the book leverage of the relevant industry using Korean industry classification standard.

Dividend (DIVID) is the ratio of cash dividend at time *t* to total assets at time *t*.

$$DIVID = \frac{Cash\ \ Dividend_t}{Total\ \ Assets_t} \tag{8}$$

Summary Statistics

Table 1 show summary statistics of the whole sample data of all variables, used in the study. The table includes firms with only positive profitability for the period from 1980 to 2018. I had a challenge with clearing the data due to a lot of missing values. Negative profitability firms are not included in the present table, however I separately run robustness test for negative profitability firms. To eliminate outliers in the data, all variables, excluding R&D and dividend, are winsorized at the top and bottom one percentile. For not reported values of dividend I set dividend dummy, which takes value 0, when data is not reported, and 1 otherwise.

TABLE 1

Summary Statistics

Variable	*N*	Mean	SD	Min.	P5	P25	Med	P75	P95	Max.
BKLEV	30957	0.455	0.245	0.009	0.093	0.265	0.447	0.628	0.827	2.632
MKLEV	30957	0.476	0.261	0.009	0.072	0.252	0.476	0.690	0.898	1.000
OL	30957	0.165	0.163	0.008	0.033	0.069	0.116	0.198	0.457	2.390
PROF	30957	0.085	0.076	0.000	0.008	0.035	0.066	0.111	0.225	0.780
MB	30957	1.128	0.754	0.136	0.499	0.764	0.950	1.222	2.363	14.089
LOG_SAL	30957	25.61	1.50	21.11	23.53	24.55	25.42	26.43	28.50	30.69
TAN	30957	0.313	0.181	0.001	0.030	0.178	0.302	0.435	0.630	0.859
RD	30955	0.013	0.057	0.000	0.000	0.000	0.000	0.003	0.066	4.788
LEVMED	30957	0.482	0.153	0.104	0.263	0.371	0.450	0.607	0.747	0.905
DIVID	30957	0.007	0.012	0.000	0.000	0.000	0.003	0.011	0.027	0.294

Table 1 represent summary statistics, which include information about number of observations(*N*), mean, standard deviation (SD), distribution of variables from minimum to maximum values for all variables, which are book leverage (BKLEV), market leverage (MKTELV), operating leverage (OL), profitability (PROF), market to book ratio (MB), log sales (LOG_SAL), tangibility (TAN), R&D (RD), leverage median (LEVMED), and dividend (DIVID). The data sample is set for positive profitability firms from 1980 to 2018.

Total observation number of positive profitable firms is 30,957, which is around 83% of the whole sample. The mean of book leverage (BKLEV) (0.455) and market leverage (MKLEV) (0.476) shows that around half of Korean firms have no or very low debt. OL mean and median are 0.165 and 0.116. Profitability mean and median are 0.085 and 0.066 respectively. The proxy of the size is a logarithm of sales, which is the same when I use total assets.

Sorting procedure

At this stage all firms sorted into deciles by OL and profitability, respectively. Table 2, part A show the results of sorting by OL. Each decile includes around 3,000 observations. For firms with low OL, profitability is lower than the OL, and when OL increases profitability increases by different rate, as predicted by a hypothesis 1, the profitability increases with OL. The opposite move can be seen in a book (BKLEV) and market leverage (MKLEV). When OL increases book and market leverage decreases monotonically, supporting hypothesis 2. The differences between top and bottom deciles are statistically significant for all variables.

The results of sorting by profitability is reported in Table 2, part B. The results show similar patterns: profitability and OL move up in the same direction, while a book and market leverage move down across the profitability deciles. Same as in part A, the differences between top and bottom deciles are statistically significant for all variables.

Empirical Test on Stickiness of Operating and Production Cost

Following Chen et al. (2018) I start the study with confirming that selling, general and administrative cost (SGA) is actually quasi-fixed cost comparing to cost of

TABLE 2
Sorting Firm Characteristics by Operating Leverage and Profitability

PART A. Sorted on Operating Leverage

Rank	No. of Obs.	OL	PROF	BKLEV	MKLEV
Low	3080	0.056	0.032	0.480	0.553
2	3096	0.062	0.053	0.484	0.546
3	3103	0.069	0.070	0.474	0.523
4	3097	0.073	0.087	0.467	0.503
5	3092	0.080	0.106	0.457	0.483
6	3106	0.084	0.128	0.442	0.459
7	3100	0.089	0.156	0.452	0.455
8	3100	0.094	0.199	0.435	0.435
9	3099	0.109	0.277	0.433	0.408
High	3084	0.136	0.541	0.425	0.394
High -Low	0.079 (8.413)	0.509 (4.625)	-0.055 (-11.531)	-0.160 (-31.951)	

PART B. Sorted on Profitability

Rank	No. of Obs.	PROF	OL	BKLEV	MKLEV
Low	3080	0.010	0.125	0.495	0.540
2	3096	0.025	0.128	0.483	0.546
3	3103	0.037	0.131	0.486	0.551
4	3097	0.048	0.133	0.488	0.543
5	3092	0.060	0.147	0.477	0.523
6	3106	0.073	0.155	0.467	0.498
7	3100	0.089	0.161	0.454	0.470
8	3100	0.111	0.181	0.430	0.424
9	3099	0.146	0.210	0.409	0.377
High	3084	0.253	0.279	0.360	0.286
High -Low	0.244 (6.039)	0.154 (5.160)	-0.136 (-5.905)	-0.254 (-5.902)	

Table 2 shows the results of sorting firm characteristics by operating leverage (Part A) and profitability (Part B), respectively. Firms are sorted into deciles by two main firm characteristics: operating leverage (OL) and profitability (PROF). The table includes four firm characteristics, such as operating leverage (OL), profitability (PROF), book leverage (BKLEV), and market leverage (MKLEV). High-Low show the difference between top and bottom decile, with *t*-statistics for each variable. The table includes the whole sample period from 1980 to 2018.

goods sold (COGS).

The profitability is calculated according to equation (1). When changes in $Sales_t$ is more than in $SGA_t + COGS_t$ profitability changes, and the main purpose of the

test is to compare reaction of SGA and COGS when sales revenue decrease versus increase, and confirm a prediction that SGA changes more conservatively, and is good proxy for operating cost.

To test the above prediction, I use the same regression as Anderson et al. (2003) and Chen et al. (2018):

$$Y_t = \gamma_0 + \gamma_1 REVRATE_t + \gamma_2 (REVRATE_t \times DECREASE\_DUMMY_t) + e_t \quad (9)$$

where dependent variable Y_t is the logarithmic change in SGA or COGS and independent variables *REVRATE* is the logarithmic change in sales revenue. When sales revenue at *t* decreases, comparing to sales revenue at *t-1*, $DECREASE\_DUMMY$ takes value 1, and 0 otherwise. The coefficient γ_1 indicates the rate of change in cost for 1% of increase in sales. The sum of coefficients γ_1 and γ_2 indicates the rate of change in cost for 1% of decrease in sales. I expect γ_1 to be positive, and γ_2 to be negative, confirming that firms are not able easily reduce the cost, therefore cost is quasi-fixed.

The results of regression are shown in Table 3 When independent variable is SGA the γ_1 = 0.544 and $\gamma_2 = -0.213$. Comparing to regression results when independent variable is COSG $\gamma_1 = 0.948$ and γ_2= -0.041, SGA coefficient is smaller. The sum of coefficients γ_1 and γ_2, when sales revenue decrease by 1%, for SGA is 0.331% (0.544-0.213), which is 60.8% (0.331/0.544) of the percentage change when revenues increase, and for COGS 0.907% (0.948-0.041), which is 95.7% (0.907/0.948) of the percentage change when revenues increase. From these results can be concluded that COGS commoves with the sale revenue, and SGA move more conservatively. Hence, SGA can be defined as quasi-fixed cost in capital structure, which cannot be easily adjusted when sales revenue decreases.

Fama-MacBeth Regressions

Unlike other studies, in the present study I use cross-sectional Fama-MacBeth (1973) regression to test hypothesis of the study. The test consists of firm-specific control variables, that generally used in the previous literature: market to book asset ratio, firm size (logarithm of sales), asset tangibility, R&D, industry median book leverage and dividend ratio. For not reported cash dividend I use a dummy, which takes value 1 if data reported, and 0 otherwise.

TABLE 3
Empirical Test on Stickiness of Operating and Production Costs

Variable	γ_0	γ_1	γ_2	$\gamma_1 + \gamma_2$	Adj. R^2
SGA	0.045 (26.296)	0.544 (119.681)	-0.213 (-28.354)	0.331	0.301
COGS	0.005 (3.930)	0.948 (269.349)	-0.041 (-6.975)	0.907	0.746

Table 3 shows the results of panel regression on operating cost (SGA) or production cost (COGS) in response to decrease in sales revenue, following Anderson et al. (2003):

$$Y_t = \gamma_0 + \gamma_1 REVRATE_t + \gamma_2 (REVRATE_t \times DECREASE\_DUMMY_t) + e_t$$

Where dependent variable Y_t is the logarithmic change in SGA or COGS and independent variables *REVRATE* is the logarithmic change in sales revenue. When sales revenue at *t* decreases, comparing to sales revenue at *t-1*, $DECREASE\_DUMMY$ takes value 1, and 0 otherwise.

The results of Fama-MacBeth (1973) regression, made year-by year, are reported in Table 4. The first Part A, represent results of regression of profitability on OL alone (Model 1), and with control variables (Model 2). Firm-specific control variables are firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. Following Petersen (2009), the *t*-statistics are adjusted with Newey-West (1987) method with 4 lags, to solve downward biased standard errors.

Part A of the Table 4 shows results of Fama-MacBeth(1973) regression, made

year-by-year, for all firms with positive profitability. For Model 1 I regress profitability on OL alone, and for Model 2 all firm-specific control variables are included. According to Hypothesis 1: "Profitability increases with operating

TABLE 4
Fama-MacBeth regression of Operating Leverage on Profitability and Financial Leverage

	Part A Profitability		*Part B Book Leverage*		*Part C Market Leverage*	
Variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
OL	0.162	0.111	-0.106	0.026	-0.211	-0.002
	(12.15)	(9.23)	(-6.02)	(2.87)	(-6.95)	(-1.01)
LOG_SAL		-0.002		0.034		0.036
		(3.57)		(8.71)		(9.87)
TAN		-0.029		0.076		0.096
		(-7.86)		(6.88)		(8.02)
MB		0.024		0.210		-0.141
		(8.33)		(5.36)		(-10.49)
RD		0.132		-0.285		-0.367
		(-0.73)		(-3.39)		(-3.25)
LEVMED		-0.038		0.575		0.580
		(0.40)		(9.73)		(10.45)
DIVID		1.037		-3.030		-3.321
		(11.95)		(-8.83)		(-10.38)
DIV_DUMMY		-0.022		-0.136		0.105
		(-5.40)		(10.75)		(-9.16)
Intercept	0.067	0.120	0.553	-0.866	0.596	-0.526
	(13.59)	(2.81)	(14.87)	(-11.94)	(13.87)	(-10.37)
Adj. R^2	0.106	0.272	0.008	0.391	0.036	0.430
Number of Obs.	30881	30624	30881	30624	30881	30624

Table 4 represents results of Fama-MacBeth regression, made year-by-year, with adjusted *t*-statistics, using Newey-West (1987) method with 4 lags. Part A shows results, when OL regress on profitability alone (Model 1), and with firm specific control variables (Model 2). Part B include results of regressing OL on book leverage alone and with control variables, and the Part C consist of regression results of operating leverage on market leverage. The control variables are firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. At the bottom of the table reported adjusted R square and total number of observations in each regression.

leverage.". The results of the regression prove the hypothesis 1. When profitability is regressed on OL (Part A, Model 1), the coefficient is significantly positive 0.162,

with *t*-statistics = 12.15, and 0.111 with *t*-statistics = 9.23, when regression includes firm-specific control variables. The results strongly confirm the hypothesis 1.

Part B and C of the Table 4 reports results when OL is regressed on a book and market leverage, respectively. When the dependent variable is book leverage, the results are significantly negative with a coefficient -0.106 and *t*-statistics = -6.02, supporting hypothesis 2: "There is a negative relation between operating and financial leverage.". However, when firm-specific control variables are added in regression, the results changes to significantly positive with a coefficient 0.026 and *t*-statistics = 2.87.

When the explanatory variable is market leverage alone the coefficient is -0.211 and *t*-statistics = -6.95, but with firm-specific control variables the significance decreases to *t*-statistics = -1.01 with a coefficient = -0.002. Thus, hypothesis 2 is supported when the explanatory variable is book leverage alone and in both models when explanatory variables is market leverage.

The 38 year sample data from 1980 to 2018, in Korean market support the hypothesis 1 and 2, and consistent with findings in US market. For all firms with positive profitability OL has influence on profitability and FL. OL increases profitability in good times, and have negative relations with FL. It is assumed, that firms' OL depends on production technology of relevant industry, thus can be concluded that OL is mostly relying on exogenous factors. Therefore, when OL influenced by exogenous shock, firm managers adjust capital structure, and since OL is quasi-fixed cost, managers are most likely to adjust FL. The next section confirms this hypothesis and I further a run test to show the evidence.

Impact of Operating Leverage on Default Probability

According to hypothesis 2 OL is negatively related with FL, and firms with high OL have higher probability to default earlier than it can be the case. To confirm this, I use Ohlson's (1980) *O*-score default probability and check the influence of OL on default probability. To calculate the *O*-score I follow Ohlson (1980):

$$O-\text{score} = -1.32 - 0.407\ln(\text{TA}) + 6.03\frac{TL}{TA} - 1.43\frac{WC}{TA} + 0.076\frac{CL}{CA} - 2.37\frac{NI}{TA} - 1.83\frac{FFO}{TA} + 0.285I_{(NI_{t-1}<0<\ and\ \ NI_t<0)} - 1.72I_{(TL>TA)} - 0.521\frac{NI_t - NI_{t-1}}{|NI_t| - |NI_{t-1}|} \quad (10)$$

where $\ln(\text{TA})$ is a logarithm of the firm's total assets (TA); $\frac{TL}{TA}$ is the ratio of total liability (TL) to total assets (TA); $\frac{WC}{TA}$ is the ratio of working capital (WC=current asset-current liability) to total assets (TA); $\frac{CL}{CA}$ is the ratio of current liability to current assets; $\frac{NI}{TA}$ is the ratio of net income (NI) to total assets (TA); $\frac{FFO}{TA}$ is the ratio of funds from operation (FFO) to total assets; *I* takes value 1 if condition is satisfied, and 0 otherwise; $|NI_t| - |NI_{t-1}|$ are absolute values of net income at *t* and *t-1*. The greater the value of *O*-score, the greater the probability of distress.

The next Table 5 represent the results of Fama-MacBeth regression to check the influence of OL on default probability of positive profitability firms[2]. Model 1 includes results of regressing *O*-score in operating and market leverage. The coefficient of the OL is positive 0.474 with *t*-statistics=2.03, which are significantly support prediction that firms with high OL have higher probability of financial

[2] I also run Fama-MacBeth regression for firms with negative profitability, and find same results. However, for Model 2 with firm-specific control variables operating leverage coefficient stays significantly positive, making support for of the prediction.

distress. However, when regression run with firm-specific control variables OL lose its' significance *t*-statistics = -0.21. Thus, only Model 1 supports the prediction that OL increases the expected cost of financial distress by increasing the probability that the firm will default earlier than it can be a case.

Considering, both results for positive and negative profitability firms, in general, I carefully conclude that OL and profitability are associated only when there are no controlled variables, and OL can generate higher probability of default risk. However, there should be stronger support of the hypothesis.

China's Membership in The World Trade Organization (WTO) in 2001

To compare the impact of OL to profitability and FL, I use an exogenous event, China's Entry to WTO in 2001. Following Chen et al (2018), I choose only manufacturing firms listed in Korean market, for test sample. The sample includes firms with only positive profitability. After exogenous shock firms need a time for proper reaction and adaptation to a new environment, I choose 2 years forward from 2001 to see the difference. Pierce and Schott (2016) find that China' WTO entry caused US manufacturing firms to change labor-intensive to capital-intensive production technologies. The same findings for Korean manufacturing firms are find by Namsuk (2017), firms decrease the labor intensive level and increase technology-intensive level.

The average sample mean of the OL increases from mean=0.137 in 2001 to mean=0.153 in 2003. And profitability increases from 0.087 to 0.096. In contrast, the book leverage decreases from 0.754 to 0.563, and market leverage decreases from 0.699 to 0.556.

TABLE 5
Probability of Default for Operating Leverage

	O-Score	
Variable	Model 1	Model 2
OL	0.474 (2.03)	-0.399 (-0.21)
MKTLEV	6.753 (6.58)	8.019 (5.28)
LOG_SALES		-0.095 (-0.57)
TAN		-0.108 (-0.18)
MTOB		1.135 (3.68)
RD		-6.854 (-1.95)
LEVMED		-0.455 (-0.36)
DIVID		2.106 (0.18)
DIV_DUMMY		1.067 (1.51)
INTERCEPT	-14.052 (-7.85)	-13.355 (-3.19)
Adj. R^2	0.002	0.003
Number of Obs.	24041	24031

Table 5 represent results of Fama-MacBeth regression of default probability variable O-score (1980) on operating leverage (OL) and market leverage (MKLEV) in Model 1, and with all firm control variables in Model 2. The control variables are firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. The regression run for all firms with positive profitability from 1980 to 2018. *T*-statistics are adjusted with the Newey-West (1987) method with 4 lags. At the bottom of the table reported adjusted R square and total number of observations in each regression.

To check the impact of OL on profitability and FL under exogenous event I estimate the regression:

$$Y_{2003-2001} = \gamma_0 + \gamma_1 OLCH_{2003-2001} + \mathrm{c}\Delta X_{2003-2001} + e_t \qquad (11)$$

where dependent variable $Y_{2003-2001}$ is the profitability or FL change between 2001 and 2003, $OLCH_{2003-2001}$ is an OL change during that period, and $\Delta X_{2001-2003}$ is the changes in firm-specific control variables during 2001-2003.

TABLE 6
The 2001 China's Entry in WTO as Exogenous Event 1

Variable	PROF	BL	ML
$OLCH_{2003-2001}$	-0.479 (-0.70)	-0.058 (-1.69)	-0.131 (-2.20)
LOG_SAL	61.982 (2.67)	5.834 (4.33)	11.621 (2.36)
TAN	0.080 (0.26)	0.010 (0.42)	0.021 (0.21)
MB	-0.210 (-0.13)	0.051 (0.63)	-1.368 (-5.08)
RD	-0.0001 (-0.61)	0.001 (9.38)	0.001 (10.92)
DIV	4.972 (3.47)	-0.008 (-0.51)	-0.032 (-1.33)
INTERCEPT	0.197 (0.66)	-0.050 (-2.67)	0.013 (0.32)
Adj.R^2	0.564	0.057	0.246
Number of Obs.	493	493	493

Table 6 represents results of Fama-MacBeth regression for all positive profitability firms, after China's entry to WTO, from 2001 to 2003. The regression equation is:

$$Y_{2003-2001} = \gamma_0 + \gamma_1 OLCH_{2003-2001} + c\Delta X_{2003-2001} + e_t$$

where dependent variable $Y_{2003-2001}$ is the profitability or financial leverage change between 2001 and 2003, $OLCH_{2003-2001}$ is an operating leverage change during that period, and $\Delta X_{2003-2001}$ is the changes in firm-specific control variables during 2001-2003. The firm specific control variables include firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. *T*-statistics are adjusted with the Newey-West (1987) method with 4 lags. At the bottom of the table reported adjusted R square and total number of observations in each regression.

Table 6 represents results of the Fama-MacBeth analysis for period after China's entry to WTO. Hypothesis 2 predicts there is negative association between OL and FL. OL increase from 2001 to 2003, cause significant decrease in a book and market

leverage with coefficient -0.058 and -0.131, and *t*-statistics = -1.69, and *t*-statistics=-2.20, respectively. Therefore, I conclude that China's entry to WTO as exogenous shock, force Korean manufacture firms with positive profitability and high OL decrease FL, confirming prediction, that there is a substitution effect between OL and FL.

1997 Asia Financial Crisis as Exogenous Event

To find more empirical evidence of the hypothesis I choose another big event, which had a great impact on Korean market. In November 1997 Asian Financial Crisis reached Korean economy, making negative impact on all local firms and capital structure, to be specific the shock made firms to lower OL and FL (Yun 2003). Therefore, the intuition predicts that OL is positively associated with FL right after Asian financial crisis. In section, I use the Asia financial crisis 1997 as an exogenous event to check the impact of OL on profitability and FL. Using the same method, I choose only manufacturing firms listed in Korean market for the event period 1997-1999. The sample includes firms with only positive profitability. After exogenous shock firms need a time for proper reaction and adaptation to a changed environment, I choose 2 years forward from 1997 to see the difference. To check the impact of OL on profitability and FL under exogenous event I estimate the regression:

$$Y_{1999-1997} = \gamma_0 + \gamma_1 OLCH_{1999-1997} + \mathrm{c}\Delta X_{1999-1997} + e_t \qquad (11)$$

where dependent variable $Y_{1999-1997}$ is the profitability or FL change between 1997 and 1999, $OLCH_{1999-1997}$ is an OL change during that period, and $\Delta X_{1999-1997}$ is the changes in firm-specific control variables during 1997-1999.

The results of regression in Table 7 represents that after the Asia Financial Crisis

TABLE 7
The 1997 Asia Financial Crisis as Exogenous Event 2

Variable	PROF	BL	ML
$OLCH_{1999-1997}$	0.366 (1.62)	0.085 (2.23)	0.026 (1.04)
LOG_SAL	27.339 (3.65)	-3.511 (-2.90)	-0.569 (-0.70)
TAN	-0.292 (-2.08)	0.020 (0.64)	0.009 (0.41)
MB	-0.195 (-1.59)	0.036 (1.47)	-0.268 (-12.07)
RD	-0.011 (-3.41)	0.001 (0.78)	0.001 (0.44)
DIVID	-0.003 (-0.17)	-0.005 (-3.66)	-0.007 (-4.33)
INTERCEPT	0.493 (3.52)	-0.180 (-14.27)	-0.152 (12.97)
Adj.R^2	0.024	0.047	0.466
Number of Obs.	410	410	410

Table 7 represents results of Fama-MacBeth regression for all positive profitability firms, after 1997 Asia Financial Crisis, from 1997 to 1999. The regression equation is:

$$Y_{1999-1997} = \gamma_0 + \gamma_1 OLCH_{1999-1997} + \mathrm{c}\Delta X_{1999-1997} + e_t$$

where dependent variable $Y_{1999-1997}$ is the profitability or financial leverage change between 1997 and 1999, $OLCH_{1999-1997}$ is an operating leverage change during that period, and $\Delta X_{1999-1997}$ is the changes in firm-specific control variables during 1997-1999. The firm specific control variables include firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. *T*-statistics are adjusted with the Newey-West (1987) method with 4 lags. At the bottom of the table reported adjusted R square and total number of observations in each regression.

in 1997, OL significantly cause decrease in profitability, with estimated coefficient 0.366, *t*-statistics = 1.62. As predicted, OL significantly positively associate with FL. The coefficient of book leverage is 0.085 with *t*-statistics=2.23, and the market leverage is 0.026 with *t*-statistics=1.04. From the results can be concluded that Asian financial crisis, as an exogenous shock, had a large influence on Korean firms, causing taking a high risk and borrow capital to keep operating.

Operating Leverage has an impact on Relation between Profitability and Financial Leverage

Since both exogenous events increase the OL, it gives an opportunity to check

TABLE 8
Impact of Operating Leverage on Profitability and Financial Leverage after the Asia Financial Crisis 1997

Variable	BL_{1997}	ML_{1997}	BL_{1999}	ML_{1999}
$\widehat{PROF_{1997}}$	-0.390 (-0.97)	-0.434 (-1.37)		
$\widehat{PROF_{1999}}$			-0.760 (-3.36)	-0.880 (-3.95)
LOG_SALES	0.042 (12.36)	0.046 (15.23)	0.029 (5.32)	0.037 (6.75)
TAN	0.044 (0.91)	0.029 (0.77)	0.013 (0.27)	0.207 (4.98)
MTOB	0.192 (3.17)	-0.257 (-7.25)	-0.016 (-3.53)	-0.072 (-10.54)
RD	-0.379 (-2.65)	-0.330 (-2.39)	-0.386 (-2.14)	0.158 (0.92)
DIV	-11.395 (-7.90)	-11.169 (-8.88)	-3.751 (-4.91)	-7.296 (-7.99)
DIV_DUMMY	0.084 (6.11)	0.060 (5.13)	0.217 (8.89)	0.088 (4.59)
INTERCEPT	-0.553 (-5.07)	-0.143 (-1.55)	-0.189 (-1.32)	-0.304 (-2.03)
Adj. R^2	0.361	0.562	0.251	0.546
Number of Obs.	722	722	777	777

Table 8 represents results of 2 stage least squares regression for all positive profitability manufacture firms, after Asia Financial Crisis, from 1997 to 1999. At the first stage regression:

$$PROF_t = b_0 + b_1 OL_t + b_2 X_{1997} + e_t$$

The estimated profitability is used at the second stage regression:

$$Y_t = \gamma_0 + \gamma_1 \widehat{PROF_t} + cX_{1997} + e_t$$

where dependent variable Y_t is the book or market leverage in 1997 and 1999, $PROF_t$ is the profitability in 1997 or 1999, and X_{1997} is the control variables. The firm specific control variables include firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. *T*-statistics are adjusted with the Newey-West (1987) method with 4 lags. At the bottom of the table reported adjusted R square and total number of observations in each regression.

whether the OL has an impact on profitability and financial leverage, and whether it helps explain negative relation between profitability and FL. The sample mean of OL during the Asian financial crisis increases from 0.137 in 1997 to 0.153 in 1999, with profitability increase from 0.087 to 0.096. For the same period FL decreases for book leverage from 0.754 to 0.563, and for market leverage from 0.699 to 0.556. The influence of China's Entry from 2001 to 2003, increase OL from 0.148 to 0.163, and decreases market leverage from 0.479 to 0.429.

To figure out the direct connection of OL with profitability and FL, I run 2 stage least squares regression. The first regression is run to regress profitability on OL, with firm-specific control variables. The second stage regression is run to regress FL on estimated profitability for both periods: Asian financial crisis 1997-1999, and China's Entry to WTO 2001-2003. Regression for each year is run separately.Table 8 shows results of 2 least stage regression for all firms with positive profitability. The coefficient of estimated profitability on book leverage in 1997 is not significant, however for market leverage coefficient is -0.434 with *t*-statistics= -1.37. And significantly negative for book and market leverage, as expected, and consistent with previous literature. Therefore, an exogenous event impacts firms to increase OL, and decrease FL, generating a substitution effect between them. For the estimated period, there is a positive correlation between OL and profitability, causing negative correlation between OL and FL, and generating stronger negative relation between FL and profitability.

Table 9 reports result of the same 2 least stage regression Using the second exogenous event, China's Entry to WTO in 2001. I get results, implying a conclusion, that exogenous shock causes firms to increase OL, and having substitution effect, increase the FL.

TABLE 9

Impact of Operating Leverage on Profitability and Financial Leverage after China's WTO in 2001

Variable	BL_{2001}	ML_{2001}	BL_{2003}	ML_{2003}
$\widehat{PROF_{2001}}$	-1.372 (-2.75)	-1.433 (-3.65)		
$\widehat{PROF_{2003}}$			-0.413 (-0.67)	-1.345 (-1.99)
LOG_SALES	0.062 (11.35)	0.065 (15.45)	0.051 (14.12)	0.047 (11.73)
TAN	0.097 (2.06)	0.112 (3.42)	0.098 (3.41)	0.121 (3.90)
MTOB	0.079 (2.61)	-0.158 (-13.01)	0.01 (0.80)	-0.168 (-15.79)
RD	-0.522 (-2.65)	-0.403 (-3.17)	-0.227 (-1.49)	-0.545 (-3.58)
DIV	-3.906 (-5.80)	-4.238 (-4.64)	-4.388 (-8.40)	-6.342 (-11.62)
DIV_DUMMY	0.167 (8.97)	0.114 (6.52)	0.104 (6.83)	0.049 (3.22)
INTERCEPT	-1.192 (-8.02)	-0.966 (-8.27)	-0.869 (-9.68)	-0.465 (-4.53)
Adj. R^2	0.335	0.608	0.330	0.489
Number of Obs.	935	935	1039	1039

Table 9 represents results of 2 stage least squares regression for all positive profitability manufacture firms, after China's entry to WTO, from 2001 to 2003. At the first stage regression:

$$PROF_t = b_0 + b_1 OL_t + b_2 X_{2001} + e_t$$

The estimated profitability is used at the second stage regression:

$$Y_t = \gamma_0 + \gamma_1 \widehat{PROF_t} + cX_{2001} + e_t$$

where dependent variable Y_t is the book or market leverage in 2001 and 2003, $PROF_t$ is the profitability in 2001 or 2003, and X_{2001} is the control variables. The firm specific control variables include firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. *T*-statistics are adjusted with the Newey-West (1987) method with 4 lags. At the bottom of the table reported adjusted R square and total number of observations in each regression.

Operating Cost Flexibility

All presented tests of regression are done under consumption that operating

TABLE 10
Flexibility and Financial Leverage

	Book Leverage		Market Leverage	
Variable	MODEL 1	MODEL 2	MODEL 1	MODEL 2
OLFL	-0.0002 (-0.77)	0.0001 (0.55)	0.0007 (2.81)	0.0004 (2.21)
OL		-0.003 (-0.44)		-0.039 (-6.11)
LOG_SAL		0.034 (47.78)		0.037 (54.52)
TAN		0.126 (22.05)		0.166 (30.64)
MB		0.024 (16.14)		-0.097 (-69.01)
RD		-0.095 (-5.25)		-0.079 (-4.63)
LEVMED		0.744 (42.47)		0.797 (48.09)
DIV		-2.342 (-24.00)		-3.269 (-35.43)
DIV_DUMMY		0.131 (50.42)		0.087 (35.20)
INTERCEPT	0.298 (54.97)	-0.912 (-45.70)	0.332 (57.30)	-0.813 (-43.06)
Adj. R^2	0.332	0.500	0.324	0.605
Number of Obs.	30740	30740	30740	30740

Table 10 represents results of Fama-MacBeth regression, estimated year-by-year. The dependent variables are book leverage or market leverage, and independent variable is operating leverage alone and firm-specific control variables. The sample data period includes all firms with positive profitability from 1980 to 2018. The firm specific control variables include firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. *T*-statistics are adjusted with the Newey-West (1987) method with 4 lags. At the bottom of the table reported adjusted R square and total number of observations in each regression.

expenses are fixed, but in a real world, firms have heterogeneous flexibility to reduce operating leverage during economy recession. This flexibility can impact on the trade-off between operating and financial leverage, because flexibility of operating expenses decreases effective OL. Therefore, this section analyses the impact of

operating expense flexibility on FL.

I start with an estimation of operating expense flexibility (OLFL), which defined as total sum of coefficients β_1 and β_2 for each firm, estimated using equation (2). Therefore, estimated coefficient OLFL, is a rate of operating expense decrease, when sales revenues decrease for 1%. The higher the estimated value the greater the flexibility adjustment.

Table 10 represents results of Fama-MacBeth regression results, estimated year-by-year. Model 1 shows result of regression of book and market leverage on operating expense flexibility (OLFL) alone, and model 2 represents regression results with firm-specific control variables. Estimated coefficients are significantly positive only for market leverage with value 0.0007 and *t*-statistics = 2.81 alone, and 0.0004, *t*-statistics = 2.21 with firm-specific control variables. From obtained results, I conclude that flexibility is correlated with higher market leverage, but not with a book leverage, when OL is control variable.

6. Robustness Test

In this section I describe method and results of robustness test for the main hypothesis. Since there is a possibility of variety existing on an individual firm level, I attend to form portfolios at industry level, using standard industry classification provided by FnGuide. Thus, industry sample mean helps to exclude possibility of the endogenous deviation of firms. I also use world financial crisis in 2008 as another natural experiment to recheck an important channel of causality of negative association between operating and FL. In addition, I represent panel regression results for Table 4, to show similarity and difference between two regressions.

TABLE 11
Industry Level Test

Variable	PROF	BL	ML
OL	0.305	-0.261	-0.427
	(2.834)	(-1.807)	(-3.774)
LOG_SAL	0.182	0.933	0.801
	(1.678)	(5.048)	(5.467)
TAN	-0.036	-0.221	-0.220
	(-0.385)	(-2.530)	(-2.714)
MB	0.801	0.665	-0.728
	(3.751)	(2.947)	(-3.945)
RD	0.991	-1.442	-0.760
	(1.938)	(-2.094)	(-0.882)
DIVID	1.037	-0.782	-1.081
	(3.737)	(-0.308)	(-0.519)
INTERCEPT	-0.188	-0.785	-0.236
	(-1.719)	(-5.065)	(-1.636)
Adj.R^2	0.563	0.423	0.572
Number of Obs.	494	494	494

Table 11 represents results of Fama-MacBeth regression, estimated year-by-year, for the main hypothesis with control variables at industry level, according to standard industry classification. The sample data period includes all firms with positive profitability from 1980 to 2018. The firm specific control variables include firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD) and dividend (DIVID). *T*-statistics are adjusted with the Newey-West (1987) method with 4 lags. At the bottom of the table reported adjusted R square and total number of observations in each regression.

For industry level test I calculate equal-weighted averages in each industry, using standard industry classification provided by FnGuide, remove industry median book leverage (LEVMED), and delete the dividend dummy variable. Table 11 shows results of Fama-MacBeth[3] regression, run year-by-year. Regressing profitability, book leverage and market leverage, respectively, with OL and firm-specific variables

[3] I repeat the test with using panel regression. Panel regression test gives similar results with Table 11, showing higher *t*-statistics. For book leverage variable the coefficient is insignificantly negative.

at industry level for firm with positive profitability, results support hypothesis 1 and 2.

Comparing to Table 4, industry level test shows significant positive association between OL and profitability with a coefficient 0.305, *t*-statistics = 2.834. Book and

TABLE 12
Panel regression of Operating Leverage on Profitability and Financial Leverage

	Part A Profitability		*Part B Book Leverage*		*Part C Market Leverage*	
Variable	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
OL	0.138	0.090	-0.092	-0.003	-0.278	-0.039
	(52.56)	(35.91)	(-12.51)	(-0.44)	(-35.71)	(-6.12)
LOG_SAL		-0.0001		0.034		0.037
		(-0.51)		(47.77)		(54.48)
TAN		-0.027		0.126		0.166
		(-12.91)		(22.05)		(30.63)
MB		0.027		0.024		-0.097
		(48.84)		(16.13)		(-69.04)
RD		-0.042		-0.095		-0.081
		(-6.35)		(-5.28)		(-4.72)
LEVMED		-0.021		0.744		0.797
		(-3.30)		(-24.01)		(48.10)
DIVID		1.492		-2.342		-3.271
		(41.24)		(50.42)		(-35.46)
DIV_DUMMY		-0.014		0.131		0.087
		(-14.98)		(42.47)		(35.15)
Intercept	0.042	0.031	0.313	-0.912	0.380	-0.812
	(21.27)	(4.14)	(56.51)	(-45.69)	(65.06)	(-43.03)
Adj. R^2	0.114	0.277	0.336	0.5003	0.3503	0.6052
Number of Obs.	30740	30740	30740	30740	30740	30740

Table 12 represents results of panel regression of all firms with positive data, for period from 1980 to 2018. Part A shows results, when operating leverage regress on profitability alone (Model 1), and with firm specific control variables (Model 2). Part B include results of regressing operating leverage on book leverage alone and with control variables, and the Part C consist of regression results of operating leverage on market leverage. The control variables are firm size (LOG_SAL), asset tangibility (TAN), market to book asset ratio (MB), R&D (RD), industry median book leverage (LEVMED), dividend (DIVID), and dividend dummy (DIV_DUMMY) of the missing values of dividend. At the bottom of the table reported adjusted R square and total number of observations in each regression.

market leverage are also significantly negative, when firm-specific control variables are included in regression, proving prediction that there is negative association between operating and FL.

For reported Table 4, which include results of Fama-MacBeth regression, estimated year-by-year, I reconfirm the results by running Panel regression. The results of Panel regression with time fixed effect are reported in Table 12. The results strongly support hypothesis that OL increases with profitability and negatively associate with FL, with firm-specific control variables.

The World Financial Crisis 2008

Following Chen et al. (2018), I use financial crisis 2008 as another exogenous shock event. Consideration, that the crisis decreases demand and increase systematic volatility exogenously within all listed firms, leads to conclude that given operating leverage level will most likely to cause default, and affects FL decision as predicted by a hypothesis of the present study.

Simply considering before and after crisis effect, I check the changes made by crisis. To do so, I set a sample period to the pre-crisis 2005-2007 and post-crisis 2008-2010. Then, I calculate an average mean of OL by the end of 2007, and by the estimated value, I divide firms into a high and low-OL groups. After estimation is done and all variables are calculated I run regression:

$$Y_t = \gamma_0 + \gamma_1 CRIS_t + \gamma_2 HOL + \gamma_3 (HOL \times CRIS_t) + cX_{t-1} + e_t \qquad (12)$$

where dependent variable Y_t is a book or market leverage; $CRIS_t$ is an indicator of crisis period, which takes value 1 for post-crisis period and 0 for pre-crisis; HOL is an indicator of operating variable, which takes value 1 for firms with high OL

groups, and 0 for low OL groups; X_{t-1} is firm-specific control variables.

The coefficient γ_2 estimate book and market leverage differences in high and low OL groups for pre and post-crisis period, and γ_3 estimates changes in FL differences of high and low OL groups for pre and post-crisis periods.

Table 13 represents results of the regression during World Financial Crisis 2008. The prediction that γ_2 and γ_3 estimations will be negative are inconsistent, and results shows insignificant results of variables HOL and $HOL \times CRIS_t$, in Model 1 and Model 2 of book and market leverages.

As previous literature (Elkamhi et al. (2014)) suggests, firms with higher tangibility have higher rates of recovery, and the same evidence can be seen at Table 4 and Table 12: book and market leverage have highly significant positive relations with tangibility, when OL is control variable. Chen et al.(2018) investigate empirical question of positive effect of the higher recovery rate and the negative effect of higher OL on default probability, by dividing firms into high and low tangibility (*HITAN*) groups, by estimated tangibility average mean by the end of 2007. Then, I run regression:

$$Y_t = \gamma_0 + \gamma_1 CRIS_t + \gamma_2 HOPLEV + \gamma_3(HOL \times CRIS_t) + \gamma_4 HITAN + \gamma_5(HITAN \times CRIS_t) + \gamma_6(HOL \times HITAN) + \gamma_7(HOL \times HITAN \times CRIS_t) + cX_{t-1} + e_t \quad (13)$$

where dependent variable Y_t is the book or market leverage; $CRIS_t$ and HOL are indicators of crisis period and OL level, respectively (as described above); *HITAN* is an indicator of high and low tangibility, which takes value 1 if tangibility is in high group and 0 otherwise; $(HITAN \times CRIS_t)$, $(HOL \times HITAN)$ and $(HOL \times HITAN \times CRIS_t)$ are indicator variables for high tangibility groups.

TABLE 13
The World Financial Crisis 2008

	Book Leverage				Market Leverage			
Variable	M 1	M 2	M 3	M 4	M 1	M 2	M 3	M 4
CRIS	0.005	-0.014	0.000	-0.020	0.064	0.013	0.072	0.024
	(0.70)	(-2.51)	(-0.03)	(-2.69)	(2.05)	(2.24)	(6.72)	(3.10)
HOL	0.027	-0.002	0.024	0.012	0.083	0.005	0.076	0.031
	(3.90)	(-0.25)	(2.69)	(1.57)	(2.06)	(0.92)	(8.13)	(4.28)
HOL X CRIS	0.008	0.001	0.027	0.017	-0.004	0.006	-0.005	0.005
	(0.82)	(0.14)	(2.16)	(1.62)	(0.88)	(0.82)	(-0.38)	(0.45)
HITAN			-0.047	-0.020			-0.079	-0.008
			(-5.13)	(-2.38)			(-8.49)	(-1.07)
HITAN X CRIS			0.008	0.010			-0.017	-0.023
			(0.64)	(0.88)			(-1.20)	(-2.16)
HOL X HITAN			-0.006	-0.025			-0.005	-0.049
			(-0.44)	(-2.14)			(-0.35)	(-4.45)
HOL X HITAN X CRIS			-0.037	-0.034			0.006	0.000
			(-2.01)	(-2.14)			(0.30)	(-0.01)
LOG_SAL		0.048		0.049		0.039		0.040
		(29.40)		(30.36)		(24.1)		(24.98)
TAN		0.133				0.158		
		(11.57)				(14.16)		
MB		0.006		0.004		-0.131		-0.133
		(1.64)		(1.07)		(-31.95)		(-32.45)
RD		-0.002		-0.011		-0.015		-0.024
		(-0.06)		(-0.26)		(-0.30)		(-0.43)
LEVMED		0.481		0.496		0.612		0.627
		(11.93)		(12.25)		(14.32)		(14.54)
DIVID		-2.710		-2.795		-2.951		-3.049
		(-9.63)		(-9.87)		(-9.51)		(-9.76)
DIVID_DUMMY		0.108		0.105		0.076		0.073
		(16.34)		(15.91)		(11.37)		(10.87)
INTERCEPT	0.385	-1.068	0.410	-1.050	0.323	-0.748	0.365	-0.735
	(80.64)	(-24.92)	(65.00)	(-24.27)	(2.03)	(-17.25)	(50.13)	(-16.74)
Adj. R^2	0.007	0.285	0.029	0.283	0.055	0.457	0.095	0.455
Number of Obs.	6924	6924	6924	6924	6924	6924	6924	6924

Table 13 represents results of regression of sample data during world financial crisis 2008. The total estimated period is from 2005 to 2010, pre and post-crisis period. There is two regressions for the test: the first one is run for Model 1 and Model 2 of book and market leverages:

$$Y_t = \gamma_0 + \gamma_1 CRIS_t + \gamma_2 HOL + \gamma_3 (HOL \times CRIS_t) + cX_{t-1} + e_t$$

where dependent variable Y_t is book or market leverage; $CRIS_t$ is an indicator, which takes value 1 for post-crisis period and 0 for pre-crisis; HOL is and indicator, which takes value 1 for firms with high operating leverage groups, and 0 for low operating leverage groups; X_{t-1} is firm-specific control variables, which are the same as in Table 4.

And the second regression is run for Model 3 and Model 4:

$$Y_t = \gamma_0 + \gamma_1 CRIS_t + \gamma_2 HOL + \gamma_3 (HOL \times CRIS_t) + \gamma_4 HITAN + \gamma_5 (HITAN \times CRIS_t) + \gamma_6 (HOL \times HITAN) + \gamma_7 (HOL \times HITAN \times CRIS_t) + cX_{t-1} + e_t$$

Where *HITAN* is indicator of high tangibility group at the end of 2007.

Table 13, Model 3 and Model 4, represent results of the regression with inclusion of high tangibility groups. Results suggest that the difference change of a book and market leverage with high OL firms for post-crisis period change to significantly positive ($HOL \times CRIS_t$) for book leverage, but stays insignificant for a market leverage. For *HITAN*, results are significantly negative for both book and market leverage, leading to conclusion that even though tangibility has a relation with higher leverage, within higher OL it does not. *HOL X HITAN* coefficients are significantly negative, with firm-specific control variables, suggesting that OL have first priority, making the net effect negative. The coefficient of the rest indicator variables shows different results, for instance, with interaction of all three variables coefficients are only negatively significant for book leverage, showing no significance for a market leverage. Therefore, leading to conclusion that in Korean market relations between variables have dynamic change after crisis.

6. Conclusion

Following Chen et al. (2018), I investigate the impact of OL on profitability and FL within Korean listed firms. I set hypothesis, that OL increases with profitability in good times, and negatively associated with FL, that is a manager of firms with high OL chose to lower FL, to reduce high risk probability of distress.

Using the full data of 38 years for Korean firms, I find the evidence that within firms with positive profitability, which is approximately 83% of the whole sample data, OL is positively associated with profitability, and have negative relations with FL. In addition, the data weakly support prediction that firms with high OL related with higher probability of default. However, significantly the evidence is weak. To check findings, I use natural events with different characteristics. China's Entry to WTO in 2001 shows significant support of hypothesis 2 and 3, that firms with high OL reduce FL, thus have a substitution effect between each other. Asian financial crisis 1997 shows positive correlation between OL and FL, leading to intuition that currency crisis impacts Korean firms to reduce both OL and FL at the same time, thus generating positive correlations between OL and FL.

In sum, I conclude that firms with high OL have positive relations with profitability, and negative relations with FL, which is the main channel to explain a negative correlation between FL and profitability. The results of the study indicate that OL is a quasi-fixed cost, which cannot be easily lowered during a recession. Therefore, when managers choose to increase OL, considering financial risk, they endogenously chose to decrease FL at the same time to prevent financial distress.

However, the present study is limited and there is an opportunity for the future researches of the presented topic. In the future studies in Korean market there should be added a firm fixed effect, due to a strong chaebol effect on a company policy and capital structure. Moreover, there should be stronger significant evidence of the relation between default probability and OL, book leverage and operating leverage with control variables. I leave these questions for the future research in the corporate finance.

References

Anderson M.C., Banker R.D., Janakiraman S.N. (2003), “Are Selling, General, and Administrative Costs “Sticky”?”, *Journal of Accounting Research*, Vol.41, No. 1, pp. 47-63.

Chen Z., Harford J., Kamara A. (2018), “Operating Leverage, Profitability, and Capital Structure”, *Journal of Financial and Quantitative Analysis*, Vol. 00, No.00, pp. 1-24.

Fama F.E., MacBeth J.D. (1973), “Risk, Return, and Equilibrium: Empirical Tests.”, *Journal of Political Economy*, Vol. 81, No. 3, pp. 607-636.

Jang H., Yoon Y. (2004), “An Empirical Test of Negative Correlations between Operating and Financial Leverages”, *The Korean Journal of Financial Management*, Vol. 21, No. 1, pp. 33-58.

Goo J. (1994), “Analysis of Business Risks and Financial Risks of Korean Companies and their Impact on Corporate Profits”, *The Korean Journal of Financial Management*, Vol. 11, No. 1, pp. 31-72.

Graham R.J. (2000), “How Big Are the Tax Benefits of Debt?”, *The Journal of Finance*, Vol. 55, No. 5, pp. 1901-1941.

Kayhan A., Titman S. (2007), “Firms’ histories and their capital structures”, *Journal of Finance Economics* 83, pp. 1-32.

Kim H. (2011), “Financial Leverage of Korean Business Conglomerates “Chaebols” in the Post-Asian Financial Crisis”, *Journal of academia-industrial technology*, Vol. 12, No. 2, pp. 699-711.

Ohlson J.A. (1980), “Financial Ratios and the Probabilities Prediction of Bankruptcy.” *Journal of Accounting Research*, 19, pp. 109-131.

Lee D., Cho J. (2016), “Cyclical Patterns of Debt and Equity Financing in Korean Firms.”, *Asian Review of Financial Research*, Vol. 29, No. 2, pp. 235-264.

Lee J. Shin M. (2017), “The Effects of Cost Structure on Corporate Capital Structure”, *Journal of Industrial Economics and Business* 30(5), 1683-1706.

Lim H., Baek S., Lee Y. (2011), “Investigation of the cause of the value effect in Korean Stock Market: Based on Operating Leverage Hypothesis”, *Korea Accounting Information Association*, Vol. 29, No. 1, pp. 133-157.

Mandelker N.G., Rhee G.S. (1984), ”The Impact of the Degrees of Operating and Financial Leverage on Systematic Risk of Common stock”, *The Journal of Financial and Quantitative Analysis*, Vol. 19, No. 1, pp. 45-57.

Rajan G.R., Zingales L. (1995), “What Do We Know about Capital Structure? Some Evidence from International Data”, *The Journal of Finance*, Vol. 50, No. 5, pp. 1421-1460.

Shin D. (2006), “The Financing Behavior and Financial Structure Determinants of Korean Manufacturing Firms”, *The Korean Journal of Financial Management*, Vol. 23, No.2, pp. 109-141.

Son S. (2005), “Information Contents of Changes in Financial Leverage”, *Korea Journal of Business Administration*, Vol. 53, pp. 2893-2915.

Yang D. (2006), “A Study on the Relationship between Leverage and Degree of Leverage”, *Korean Accounting Association*, pp. 269-290.

Yang H. (1986), “The Effect of Leverage on the Systematic Risk of Common Stock”,

Inha University graduate school.

Yoon B. (2005), “A long—run Analysis of the Determinants of Capital Structure.”, *Korean Management Review*, Vol. 34, No. 4, pp. 973-1000.

Yoon Y. (2003), “An Empirical Analysis of Correlation between Operating and Financial leverage for Manufacturing Companies Listed in the Korean Stock Exchange”, *Inha University graduate school*, p. 116-118.

Welch I. (2004), “Capital Structure and Stock Returns”, *Journal of Political Economy*, 112, pp.106-131.

국문초록

연구는 한국 시장에서 영업레버리지가 수익성과 재무레버리지에 미치는 영향에 대해서 조사하였다. 양의 수익성을 가진 기업에서 영업레버리지는 수익성을 증가시켰고 재무레버리지는 감소시켰다. 그러므로, 상충관계이론과는 일치하지 않게 영업레버리지는 회사의 재무레버리지와 수익성 사이의 음의 상관관계를 설명하는 변수이다. 영업레버리지는 고정비로 측정되었으며, 경제활황기에 수익성을 증가시킨다. 하지만, 경제침체기에서는 영업레버리지가 파산위험을 증가시킬지도 모를 뿐만 아니라 경영자가 예상하는 것보다 더 빠르게 회사가 재무적 곤경에 빠지도록 한다. 이 연구는 2001년 중국의 WTO 가입과 1997년 아시아금융위기, 그리고 2008년 세계금융위기와 같은 자본구조에 외생적인 충격을 주는 세개의 이벤트를 이용해서, 경영자가 영업레버리지를 어떻게 조정하는지, 그리고 이러한 조정이 수익성과 재무레버리지에는 어떻게 영향을 미치는지 확인했다. 예측하건데, 경영자가 영업레버리지를 증가시키기로 결정하였을 때, 회사의 부도위험을 줄이기 위해서 더 낮은 수준의 재무레버리지를 선택할 것이다. 중국의 WTO 가입 이후 기간의 장부 레버리지는 이 예측을 강력히 지지했다. 즉, 영업레버리지의 영향 하에서 재무레버리지가 감소했다. 그러나, 시장레버리지에 대해서는 유의한 증거를 발견할 수 없었다. 실증적인 증거를 더 찾기 위해서 1997년 금융위기를 또 다른 외생적 이벤트로 살펴보았다. 그 결과, 데이터는 영업레버리지와 장부레버리지 사이의 양의 관계를 보였다. 윤여준 (2003)이 보고하듯이 아시아금융위기는 회사들이 영업레버리지와 재무레버리지를 동시에 줄이도록 하였고, 이는 두 레버리지 사이에 양의 상관관계를 초래했다. 결론적으로, 데이터는 영업레버리지와 수익성 사이에 양의 관계가 있다는 예측을 지지했고, 영업레버리지와 재무레버리지 사이에 나타나는 음의 관계는 수익성과 재무레버리지 사이의 음의 관계를 설명하는 변수이다.