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Changes in corporates' capital structure and the Covid-19: Public Korean corporates

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1. Abstract

This paper aims to investigate changes in the capital structure of listed corporates in Korea during the Covid-19. The influence of the Covid-19 on corporates is analysed, GLS fixed effects model is chosen through the Huasman test to observe the correlation between the capital structure (leverage ratio) and other selected explanatory variables including the Covid-19 (a dummy variable). Sample companies are selected if they are publicly traded from 2016 to 2021, approximately 1,600 companies in each year are taken for sample on average. The result indicates that the Covid-19 has statistically significant impact on the leverage ratio negatively. In addition, every explanatory variable (MTB, size, profitability, tangibility and interest rate) except growth opportunities are found to be significance to determine the leverage ratio. Furthermore, as sub-topic of the paper, the long-term debt-to-total-asset ratio is examined to further investigate the influence of the Covid-19 on the capital structure. The paper concludes that the Covid-19 doesn't have significance impact on the long-term debt-to-total-asset ratio at any statistical significance level. On the other hand, liquidity, growth opportunities, size, profitability of the corporate, and interest rate are found to be statistically influential in determining the long-term debt-to-total-asset ratio.

2. Introduction

In 1958, Modigliani and Miller addressed their theory about the capital structure of corporates for the very first time, and their paper provided a foothold for the capital structure to be discussed further. They argued that under the perfect capital market, corporates are indifferent to choosing between the cost of equity and debt. However, their main assumption, which is the perfect capital market; rational behaviour, absence of flotation costs, tax-free; no transaction costs, infinitely divisible securities; given investment policy; and perfect certainty (Modigliani & Miller, 1958), is too strong to apply in practice. In fact, the capital market is far away from perfection in practice. Since their paper was released, many pieces of literature review and studies were done to argue for and against their main ideas. This paper is written under the assumption that due to several micro and macro factors, companies are different in choosing the cost of equity and debt.

On the 11th of March 2020, WHO (the world health organization) announced the Covid-19 pandemic. As the Covid-19 restrained the global economy, most central banks announced monetary policies to expect supply liquidity to the market to protect the economy and support corporates. In February 2020, Fed announced that they were lowering the interest rate range to 0% - 0.25% from 1% - 1.25% (100 basis points), including a 700 billion quantitative easing

program to protect the economy and more monetary policies if it is necessary (CNBC, 2020). Fed expected that their dropping of interest rates and lowering of cash reserve ratio would lead to triggering corporates to invest by letting local banks to supplying more liquidity to the market with lower interest (cost of debt). The choice of Korean central banks (BoK) wasn't much different from Feds. On the 17th of March 2020, BoK decreased its interest rate from 1.5% to 0.75% (75 basis points) and lowered it again on the 28th of May to 0.5% (25 basis points) with the financial support policy for SMEs of the Size of 3.8 billion US dollar (Source: Bank of Korea). Since the level of the interest rate is defined to be the cost of debt, lowering the interest rate must influence corporates' decisions on capital structure significantly. Therefore, this paper investigates under the assumption that during the Covid-19, with having a low-interest rate and all the QE programs that are provided, changes in capital structure determinants are significant, and the Covid-19 influence the capital structure positively.

Hence, the main research question to be examined in the paper is whether corporates' leverage ratio is significantly changed during the Covid-19. Thus, the aim of the paper is to investigate the correlation between the changes in the capital structure and its determinants (MTB, Size, growth opportunity, profitability, tangibility, interest rate) from 2016 to 2021. Corporates that are taken as samples were publicly traded from 2016 to 2021, which means they are considered to be big in size and generate positive cash flow continuously; over 30 billion KRW of net asset, at least three years of operating history, 700 million KRW of 3 years average revenue, and more than 1 million outstanding public shares (PwC Asset and Wealth Management Korea Stock Exchange Highlights of Listing Requirements, 2019). According to the Korea CXO Institute (research institution), the revenue of the 71 largest public corporates in Korea had a share of approximately 84% of the nominal GDP of Korea in 2020. Samsung electronics solely takes a share of 37% of the total retained earnings of 71 companies. Furthermore, it is known that Korea's economy is highly dependent on imports and export. In 2020, 59.83% of Korea's nominal GDP was from imports and export, which implies these large companies play a crucial role in the Korean economy (National statical office of Korea), and their growth can represent the growth of South Korea. Considering the importance of these companies, the paper selects all publicly traded Korean companies to investigate the impact of the Covid-19 on their capital structure. Hence, the null hypothesis of the paper is as follows:

H_0: the Covid-19 has a significant impact on changes in corporates' leverage ratio

H_a: the Covid-19 doesn't have a significant impact on changes in corporates' leverage ratio

The paper is structured as follows: Firstly, the research question is introduced in the introduction. Secondly, related literature that provides the background knowledge of the paper are reviewed. In the third section, data and methodology are presented to explain how the result is derived by using Stata and present the empirical findings, including interpretation of the result of the data. Moreover, in the implication section, the sub-topic (impact of the Covid-19 on the long-term debt-to-total-asset ratio) of the paper is analyzed, including providing data and its description. In the last section, the paper summarizes the findings and concludes with possible limitations.

3. Literature review

Before investigating the significant impact of the Covid-19 on capital structure, determinants of the capital structure must be defined. In the efficient and integrated market, corporates are indifferent between financing through equity and debt because the cost is the same (Modigliani and Miller, 1958). However, the real market isn't at its most efficient and perfectly integrated. Hence, there are many factors that could influence corporates' decisions on the capital structure. Titman and Wessels (1988) proposed the determinants of the capital structure are tangibility, non-debt tax shields, growth, uniqueness, industry classification, size, volatility, and profitability. However, Frank and Goyal (2009) built up further and argued that industry median leverage, expected inflation, market capitalization, the tangibility of assets, market-to-book ratio, and profitability determine the capital structure.

Furthermore, Modigliani and Miller (1958) suggested that the leverage ratio of the corporate doesn't influence the corporate value; they believed capital structure is a matter of how to distribute the pie (the size of corporates), not making the pie bigger. However, due to strong assumptions (perfect capital market), several studies have been investigated further and built from MM. Under the capital structure model, most studies fall into three major theories. The first is Static theory (trade-off theory) which argues for maintaining an optimal balance of capital structure that maximizes corporates' value while minimizing the cost of financing via debt or equity. The second is the Pecking order model, which argues corporates are incentivized to finance through internal financing then external financing (debt and equity) due to its cost. The last is models that argue otherwise.

Thus, Static theory (trade-off theory) and pecking order theory are two major models that have a solid explanation behind their theory on why corporates are different in choosing between debt and equity to finance due to various reasons (corporate tax, agency cost, stability of economics situation) and stand against MM by assuming corporates are different from

choosing from the cost of debt and equity to optimize its leverage ratio to enhance its value. Several studies found a positive correlation between size of corporates, tangibility, and leverage ratio in common, which supports the trade-off theory (Graham, J. R., & Leary, M. T. 2011). On the other hand, the trade-off theory is found to fail in explaining the negative correlation between leverage and profitability (Titman, S., & Wessels, R. 1988). Fama and French (2002) stated that each theory fails to explain the nature of capital structure; the pecking-order theory fails to explain why young, small, and growth companies finance through external channels (mainly via equity), and the trade-off theory fails to explain why high leverage ratio firms tend to have relatively low profitability. Lastly, Market timing theories suggest that corporates' decision on the capital structure is highly dependent on equity market timing. In practice, firms issue equity then debt when the market value is relatively high to book value (Book-to-market ratio) and the cost of equity is low (Baker and Wurgler, 2002). During the Covid-19, the cost of equity capital increased by 172 basis-points average in the US (Y.Ke, 2021), which implies that corporates are more incentivized to finance through debt since the cost of debt (interest rate) decreased. In other words, according to market timing theory, the leverage ratio is expected to be high during the Covid-19 with statistical significance.

Moving on from determinants of capital structure and related theories from MM's capital structure theory, Pinegar and Wilbricht (1989) conducted a survey on 176 managers in the US on their preferences on selected six financing sources (Internal equity, straight debt, convertible debt, external common equity, straight preferred stock, and convertible preferred stock). The result of the survey shows that 69.8% of managers preferred internal sources the most. Within internal sources, financing through internal equity is chosen to be the first option by 84.3 % of the respondents, and straight debt (14.9%), convertible debt, external common equity, straight preferred stock, and convertible preferred stock follows. Furthermore, throughout the survey, it is found that managers value-generating projected cash flow as the most important input for the capital structure which is affected by the Covid-19 negatively to most companies.

Moreover, to anticipate the finding of the paper, the financial crisis in 2008 is reviewed since it is the most comparable crisis to the Covid-19 although the two crises are different in nature: the financial crisis was caused by banks giving excessive loans to the market, and the Covid-19 was caused by a biological disease called "Coronavirus" However, how they both impacted the economy and corporates and the way central banks handled the two crises are similar; lowering interest rate sharply and introducing massive QE programs to protect the economy; the only difference in terms of the CBs' response between the two crises is they supported the economy with much larger and more monetary-oriented policies in shorter

periods. The empirical findings of Harrison and Widjaja's paper (2013) provide more power to the pecking order theory in explaining changes in capital structure during the financial crisis. Tangibility and Market to Book ratio were found to influence capital structure choices more significantly than prior to the crisis. On the other hand, the influence of profitability decreased significantly for the decision process. Moreover, the size of corporates was negatively correlated during the crisis, while it was positively correlated before 2008.

4. Research Methodology

4.1 Data

For the matter of credibility of the data, an annual financial data of variables is retrieved from Wharton Research Database System (WRDS). The research paper involves the use of a panel data regression model to determine the impact of the Covid-19 on changes in corporates' capital structure. The determinants of capital structure are expected inflation, size of the firm, tangibility, market-to-book ratio, tangibility, and profits (Frank, M. Z., & Goyal, V. K. 2009). However, the industry is noted to be insignificant in determining the capital structure (Remmers et al., 1974). Therefore, the model is built based on Frank and Goyal's model but excludes industry median leverage and takes interest rate instead of expected inflation. For cross-section data, a dependent variable (leverage ratio) and five independent variables (MTB, Size, profitability, tangibility, growth, and the Covid-19) are taken under the model for each chosen year (2016-2021). When it comes to analyzing panel data, there are two major models, which are REM (random-effects model) and FEM (fixed-effects model). The Hausman test is used to identify whether differences between REM and FEM are statistically significant or not. Hence, if there are significant differences between the two models, FEM is chosen to examine the significance of explanatory variables on the dependent variable.

The model consists of two parts: six independent variables and one dependent variable. Independent variables are the size of companies, growth, profitability, MTB (market to book ratio), tangibility, and interest rate. The presence of the Covid-19 will be treated as a dummy variable. Hence, the period from 2020 to 2021 is represented by 1, and 2019 and the years before 2019 are represented by 0. The dependent variable is the leverage ratio of the corporate. Therefore, our regression model is in the form of the following for each chosen year:

$$Lev_t = \beta_0 + \beta_1 * MTB_t + \beta_2 * Size_t + \beta_3 * Growth_t + \beta_4 * Profitability_t + \beta_5 * Tangbility_t + \beta_6 * Interest_t + \beta_7 * \boldsymbol{Covid_t} + \varepsilon_t$$

Table 1. Description of variables in the regression model

Variables description	Notation	Definition
The leverage ratio of the corporate	Lev	$\frac{Total\ debt}{Total\ assets}$
Market to Book value ratio	MTB	$\frac{Market\ Capitalization}{Total\ book\ value}$
The size of the corporate	Size	$ln(Total\ asset)$
The estimated growth of the corporate	Growth	$\frac{Total\ asset_t - Total\ asset_{t-1}}{Total\ asset_{t-1}}$
The profitability of the corporate	Profitability	$\frac{Net\ income}{Total\ assets} * 100\%$
The tangibility of the corporate	Tangibility	$\frac{Net\ Tangible\ Assets *}{Total\ Assets}$
Interest rate of South Korea	Interest	Interest at the end of each year*
Dummy variable	Covid	The presence of the Covid-19

*Net Tangible Assets = Total assets – Intangible assets – Total liabilities
*Source: Bank of Korea

Table 2. Overall summary of regression variables

	Mean	Std.Dev	Min	Max
Leverage	0.2198	0.1718	0	2.8626
MTB	2.0076	6.4115	-592.72	250.42
Size	12.553	1.5176	8.0122	19.871
Growth	0.1188	0.4305	-0.8810	10.318
Profitability	-0.0061	0.1888	-5.1663	4.0759
Tangibility	0.5257	0.2258	-2.6492	0.9876
Interest rate	0.01238	0.0049	0.005	0.0175

Source: The leverage ratio analysis.dta

Table 2 summarizes the independent variables (MTB, Size, growth, profitability, tangibility, and interest rate) and the dependent variable (leverage ratio) during the selected periods. The average leverage ratio is 21.9% during the research period, and the deviation of the leverage ratio is 17.2% which indicates the leverage ratio deviates much among corporates. The lowest leverage ratio is 0, which tells the corporate runs by only its equity, and the highest leverage ratio in given years is 286.1%, which informs that the corporate's total debt is almost three times its asset.

The average MTB is 2, which implies the average market value is relatively valued at its book value. As the standard deviation points out the considerable variation (6.4), the variation is significantly large among corporates, even if the average MTB is at the level of 1. However, this is due to a few extreme outliers. There are only 758 observations that are under -5 and above 5 MTB out of 9,410 observations.

Since the unit of size is too large relative to other variables, a natural logarithm is used to solve the problem and increase the accuracy by reducing skewness and kurtosis. The size of the firm is in the range from 8 at the lowest to 19.8 at the highest with the standard deviation of 1.518. Extreme outliers within samples could have caused a large standard deviation in size. Moreover, the average size of the sample companies is 12.552.

The average growth rate from 2016 to 2021 is 11.9%. Like other variables, the variation in growth is extreme as well. The standard deviation is 43%, and the median is 5.2%; the large gap between the mean and median tells extreme positive skewness in the distribution in growth.

The average profitability from all sample corporates during the given years is surprisingly below 0 (-0.6%), which means average corporates struggled to generate positive net income from the usage of total assets. The median is 1.5% which indicates a large variation in the mean again. Thus, the positive skewness of the distribution implies discriminatory profitability among corporates during the research period.

Lastly, the average tangibility of the samples is 52.6% which indicates the average of sample firms holds 52.6% of tangible assets. The median is 52.4% which informs the normal distribution (average and mean are approximately at the same level). However, 22.6% of the standard deviation still points out big variation among samples. The corporate with the lowest tangibility is -264.9%, which indicates its total liability exceeds its total assets more than two times.

Table 3. Descriptive summary of regression variables from 2016 to 2021

Mean Std.Dev	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
Leverage	0.2147	0.2104	0.2164	0.2333	0.2243	0.2184
	0.1718	0.1651	0.1687	0.1771	0.1817	0.1641
MTB	2.1234	1.9712	2.2150	2.0878	2.0089	1.6639
	4.0238	3.0472	8.6992	10.554	4.6987	3.0668
Size	12.452	12.471	12.521	12.547	12.573	12.736
	1.5142	1.5121	1.5038	1.5162	1.5214	1.5251
Growth	0.0638	0.1048	0.1123	0.0955	0.0794	0.1977
	0.1246	0.4926	0.3655	0.3593	0.4115	0.4958
Profitability	-0.0024	0.0074	-0.0059	-0.0204	-0.0184	0.0043

	0.2036	0.1954	0.1323	0.2099	0.1729	0.2069
Tangibility	0.5235	0.5277	0.5242	0.5172	0.5307	0.5305
	0.2244	0.2170	0.2246	0.2325	0.2360	0.2190
Interest rate	0.0125	0.015	0.0175	0.0125	0.005	0.0125
	0	0	0	0	0	0
Num of Obs	1,420	1,423	1,563	1,622	1,671	1,623

Source: The leverage ratio analysis.dta

Table 3 shows the trend of the average and standard deviation of each determinant from 2016 to 2021. Hence, movements of each determinant prior to the Covid and during the Covid-19 can be observed. Overall, the most significant change in both average and variations occurred in 2019, which is quite surprising knowing that the Covid-19 only started to paralyze in early 2020. In fact, the Korean economy was already in worry about deflation in 2019 due to suppressed economic growth from the influence of the China-US tariff war, deferred recovery of the semiconductor market, and minus CPI for two consecutive quarters. With its deflationary pressures, global investment banks adjusted their prospection to 1.6%. In response to hindered economic growth, BoK lowered the interest rate to 1.25% from 1.75% (Tank, 2019).

The leverage ratio shows an unclear trend over the research period. The average leverage ratio increased the most from 21.6% in 2018 to 23.3% in 2019 and has remained at around 22% level since then. An increase in leverage ratio in 2019 can be explained by Korea's central bank lowering its interest rate by 25bp on the 18th of July 2019, from 1.75%. Low-interest rates and the market knowing that the central bank would lower the interest rate further could incentivize corporate managers to adjust their capital structure.

Furthermore, by injecting liquidity into the market, the size of the market has gotten bigger in nature. In fact, the Size of KOSPI in 2021 has grown by 66% compared to 2016 (1.03 trillion to 1.71 trillion US dollars). As a result, the average size of corporates shows a clear increasing trend with its standard deviation.

The average growth sharply decreased to 9.5% from 11.2% in 2019, and it even further collapsed to 8% in 2020. Even so, the average growth recovered quickly from the crisis and reached 19.8% in 2021. In addition, the average profitability recorded negative in every year but 2017 and 2021.

4.2 Methodology

The Durbin-Watson and VIF (Variance Inflation Factor) tests are done to detect autocorrelation and multicollinearity within the explanatory variables. Firstly, The Hausman

test is done to identify which GLS regression model to choose. The p-value of the test is 0, which implies the difference between fixed effects and random effects models is significant. Thus, the null hypothesis, which states that have is no correlation between the two models, is rejected. Hence, GLS fixed effects model is done in the paper. Durbin-Watson test is taken to detect autocorrelation instead of the Portmanteau test, and there isn't enough evidence to reject the presence of autocorrelation in residuals. Furthermore, the result of VIF suggests there is no correlation between variables. Hence, no multicollinearity is satisfied.

Table 4. GLS regression fixed effects model result

	Coefficient	**Std.Err**	**P-value**
Constant	-0.3806	0.0499	0.000***
MTB	0.0012	0.0005	0.024**
Size	0.1619	0.0043	0.000***
Growth	0.0027	0.0024	0.261
Profitability	-0.0006	0.0000	0.000***
Tangibility	-0.1199	0.0031	0.000***
Interest rate	-1.4049	0.2504	0.000***
Covid-19	-0.0122	0.0023	0.000***

Source: Source: The leverage ratio analysis.dta
Standard errors are in parentheses. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 4 presents the result of explanatory variables' statistical significance on leverage ratio under the fixed effects model. It summarizes the impact of MTB, Size, growth, profitability, and tangibility on corporates' capital structure (leverage) from 2016 to 2021 (before and during the Covid-19). Moreover, the adjusted R squared is 0.3117, which indicates the determinant variables explain the variance of leverage at 31.17% (Moore, D. S., Notz, W. I, & Flinger, M. A, 2013). Lastly, the F-test of the regression (result: 0.000) shows that the result is statistically significant.

According to Table 4, all selected determinants but growth are found to be statistically significant, which implies that all explanatory variables except growth have a significant influence on leverage ratio. Moreover, besides the size variable, all determinants negatively correlate with the leverage ratio, which informs one additional increase in those variables, decreases the leverage ratio.

Firstly, MTB is positively correlated with the leverage ratio with the coefficient of 0.001, which informs 1% increase in MTB increases the leverage ratio by 0.001% at less than a 5% significance level. High MTB tells the market values the corporate's equity highly compared to its book value. Since the corporate is valued high in the market, it could find a leverage opportunity to keep the value which would lead to a high leverage ratio. Secondly, size forms a positive correlation with the leverage ratio at a 1% significance level. An increase in size leads to an increase in leverage ratio by 0.162%. This trend can be explained by the following logic: the larger the size of an entity, the more likely it is to have higher credibility, so the larger entities have more options or easier access to debt. Moreover, the profitability is found to be negatively associated with the leverage by the coefficient of 0.0005 averagely at a 1% significance level. It implies that an additional 1% increase in profitability decreases the leverage ratio almost by 0%. This result supports the pecking order theory, which argues corporates prefer to fiancé through the internal source (positive NPV projects) than external source (equity or debt). The tangibility is negatively correlated to the leverage ratio at a 1% significance level: a 1% increase in tangibility lowers leverage by 0.12% on average. Furthermore, interest rate, a macroeconomic factor, has the most significant impact on the leverage ratio, a 1% significance level, among other factors. The interest rate is negatively correlated to the leverage ratio with the coefficient of 1.4049, which implies that a 1% increase in the interest rate decreases the leverage ratio by 1.4% on average. This finding supports one of the early assumptions that changes in the interest rate influence corporates' decision-making process on their changes in the capital structure directly.

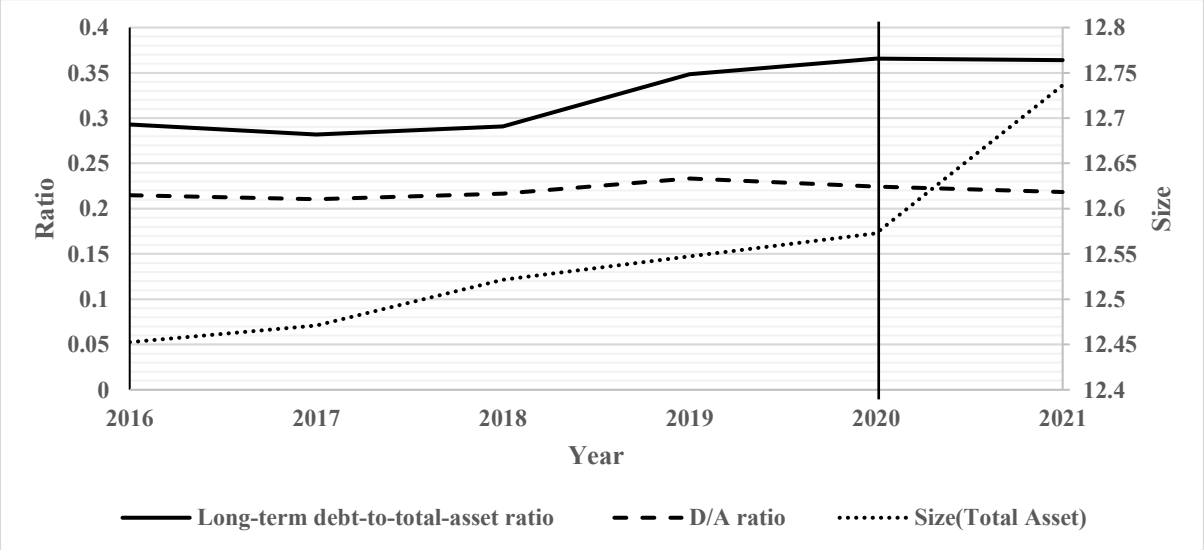
Lastly, with the presence of the Covid-19, sample corporates' leverage ratio decreased by 1.22% at a 1% significance level. Therefore, there is no evidence found to reject the null hypothesis: *the Covid-19 has a significant impact on changes in corporates' leverage ratio.* The empirical finding shows that the Covid-19 influenced the leverage ratio with statistical significance. The Covid-19 negatively correlated with the leverage ratio, unlike the expectation: the interest rate was low during the Covid-19, which would trigger corporates to finance through more debt since the cost of debt decreased. Thus, one possible explanation for the negative correlation between the Covid-19 and the leverage ratio is that the cost of equity decreases more than the cost of debt.

In order to investigate further changes in corporates' capital structure during the Covid-19, in the next part, changes in longer-term and the short-term debt ratio are investigated to examine their statistical significance during the same research period as a subtopic of the research paper.

5. Implications

In this paper, the significant impact of the Covid-19 on the capital structure of Public Korean companies is dealt, and the conclusion is drawn to be the Covid-19 influenced the leverage ratio to decrease. To further develop and investigate the empirical finding, this section examines changes in the long-term debt-to-total-asset ratio from 2016 to 2021. Figure 1 shows that the long-term debt-to-total-asset ratio increased during the research period, especially from 2018 to 2019, while the Debt-to-Asset ratio (leverage ratio) showed a very steady increasing trend from 2016 to 2019 and a slightly decreasing trend during the Covid-19 periods. Thus, it can be said that changes in total debt are almost the same as changes in the total asset each year. In addition, total assets kept increasing from 2016 to 2019 and dramatically increased from 12.57 to 12.73 in 2020 due to the influence of monetary policies possibly. From observing an increasing trend in total assets and a barely change in the Debt-to-Asset ratio, it informs that while total assets increased sharply, total debt increased at the same speed of growth in assets or decreased imperceptibly. Furthermore, the long-term debt-to-total-asset ratio shows a very clear increasing trend which indicates that corporates financed through long-term debt more than in the past. The long-term debt-to-total-asset ratio was at 6.75% in 2016 and increased by 1.3% until 2021 (8.07%).

Figure1. changes in Debt ratio, Debt-to-Asset ratio, and Size



Source: the long-term debt-to-total-asset ratio analysis.dta

Eldomiaty selected corporate tax rate, debt/equity ratio, bankruptcy risk, growth, and profitability as determinants of long-term corporate debt (2008). Some papers might argue that firm quality, earning volatility, and asset maturity must be added as they play a crucial role in the decision process (Antoniou et al., 2003). The most recent study suggests that the long-term corporate debt is not only a matter of corporates but also a supply of long-term treasury bonds (Badoer & James, 2016). In this paper, corporate tax rate, debt/equity ratio, liquidity, growth, profitability, size of the corporate, and interest rate at the end of each year are chosen to be examined as determinants of long-term corporate debt. Once again, the Covid-19, as a dummy variable, is added to the regression to measure its significance on the corporate debt structure. Hence, the regression of the long-term debt-to-total-asset ratio is built like the following:

$$L.Debt_t = \beta_0 + \beta_1 * Tax_t + \beta_2 * \frac{D}{E}_t + \beta_3 * Li_t + \beta_4 * Growth_t + \beta_5 * Profitability_t + \beta_6 * Size_t + \beta_7 * Interest_t + \beta_8 * Covid + \varepsilon_t$$

Table 5. Description of variables in the regression model

Variables description	Notation	Definition
Long-term debt ratio of the corporate	L.Debt	$\frac{Longterm\ Debt}{Total\ Asset}$
Corporate Tax rate	Tax	$\frac{Total\ Tax\ Expense}{PreTax\ Income}$
Debt-to-Equity ratio	D/E	$\frac{Total\ Debt}{Total\ Equity}$
Liquidity ratio of the corporate	Li	$\frac{Current\ Assets}{Current\ Liabilities}$
Estimated growth of the corporate	Growth	$\frac{Total\ asset_t - Total\ asset_{t-1}}{Total\ asset_{t-1}}$
Profitability of the corporate	Profitability	$\frac{Net\ income}{Total\ assets} * 100\%$
Size of the Corporate	Size	ln $(Total\ Assets)$
Interest rate	Interest	Interest at the end of each year*
Dummy variable	Covid	The presence of the Covid-19

*Source: Bank of Korea

The data is retrieved from WRDS once again for its credibility. The data is in the form of panel data and consists of two primary time periods: pre-Covid (2016 - 2019) and during the

Covid-19 (2020 - 2021). Since the panel data regression is required for the analysis, the same methodology is applied again, which means the Durbin-Watson and VIF tests are done to detect multicollinearity and autocorrelation between explanatory variables. Furthermore, the Hausman test is done, and the result indicates a significant difference exists between the random effects and fixed effects model. Thus, GLS fixed effects model is chosen again to measure the significance of its impact on the long-term debt-to-total-asset ratio during the selected period.

Table 6. Descriptive summary of regression variables from 2016 to 2021

Mean Std.Dev	**2016**	**2017**	**2018**	**2019**	**2020**	**2021**
L.Debt	0.0675	0.0628	0.0662	0.0768	0.0798	0.0807
	0.0895	0.0878	0.0878	0.0934	0.0948	0.0961
Tax	-0.8148	-0.1119	-0.0449	0.1850	0.3101	0.1064
	34.663	7.5412	4.5880	3.7905	6.9423	2.4504
D/E	0.5987	0.5710	0.7820	0.6636	0.6323	0.5824
	1.0278	0.8313	6.9260	1.4300	1.2104	1.0600
Li	2.6246	2.5373	2.6726	2.5867	2.7223	2.5834
	4.4661	3.2864	5.2255	3.9380	4.0578	3.6313
Growth	0.0638	0.1048	0.1123	0.0955	0.0794	0.1977
	0.1246	0.4926	0.3655	0.3593	0.4115	0.4958
Profitability	-0.0024	0.0074	-0.0059	-0.0204	-0.0184	0.0043
	0.2036	0.1954	0.1323	0.2099	0.1729	0.2069
Size	12.452	12.471	12.521	12.547	12.573	12.736
	1.5142	1.5121	1.5038	1.5162	1.5214	1.5251
Interest	0.0125	0.015	0.0175	0.0125	0.005	0.0125
	0	0	0	0	0	0
Num of Obs	1,420	1,423	1,563	1,622	1,671	1,623

Source: Source: the long-term debt-to-total-asset ratio analysis.dta
Standard errors are in parentheses. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

Table 6 provides the mean of each determinant and the long-term debt-to-total-asset ratio from 2016 to 2021. To add more details, the long-term debt-to-total-asset ratio, which was shortly mentioned in the introduction, shows a clear increasing trend over the research period with its standard deviation besides 2016 and 2017. Its biggest growth was from 2018 to 2019. The standard deviation is bigger than the mean, which implies that the range of ratio between corporates is very wide.

Tax shows the fastest growing trend among other independent variables. However, the average Tax rate from 2016 to 2018 was recorded as negative, which is impossible if the

variable represents actual corporate tax in each year. The variable represents how much tax has been taken from corporates' pretax income. Thus, negative tax implies that corporates with a below certain level of sales or revenue get a tax refund. Therefore, from 2016 to 2018, average sample corporates struggled to generate enough revenue to pay corporate taxes. However, from 2019 to 2021, the actual paid tax rate increased significantly, especially in 2020.

D/E ratio increased from 2016 to 2018 by almost 10%, but since 2019 the ratio started to decrease, which means total debt decreased relative to the equity. Moreover, the trend of the variation is very unclear but certainly larger compared to the mean. Thus, the D/E ratio is very varied from corporate to corporate.

The current ratio is taken to measure the liquidity of corporates which is current assets divided by current liabilities. The liquidity shows an unclear trend over the period, but current assets are two times bigger than current liabilities consistently. Furthermore, like the mean, the variation also shows an unclear trend. Once again, the standard deviation is larger than the mean, which informs the presence of big disparities between sample corporates.

Growth, profitability, size, and interest rate were described in the primary analysis section. Thus, descriptions for those variables are skipped in this section since they share the same trend.

Table 7. GLS regression fixed effects model result

	Coefficient	**Std.Err**	**P-value**
Constant	-0.5829	0.1496	0.000***
Tax	-0.0007	0.0005	0.176
D/E	0.0012	0.0008	0.136
Liquidity	0.0253	0.0014	0.000***
Growth	0.0191	0.0074	0.010***
Profitability	-0.0002	0.0169	0.094*
Size	0.0709	0.0119	0.000***
Interest	-3.6966	0.7973	0.000***
Covid-19	-0.043	0.0072	0.544

Source: Source: the long-term debt-to-total-asset ratio analysis.dta
Standard errors are in parentheses. *, **, and *** indicate significance at the 10 percent, 5 percent, and 1 percent levels, respectively.

The result of the regression implies that the Covid-19 doesn't affect the long-term debt-to-total-asset ratio at any significant level, which means the Covid-19 didn't influence changes

in the long-term debt-to-total-asset ratio during the research period. In addition, liquidity, growth opportunities, size of corporates, and interest rate are found to be significant at a 1% level, implying that those variables' impact is statistically significant on the long-term debt-to-total-asset ratio. Primarily, the impact of the interest rate continues to influence not only the leverage ratio but also the long-term debt-to-total-asset ratio. During the research period, a 1% increase in interest rate correlates to a 3.69% decrease in the long-term debt-to-total-asset ratio. Although profitability is found to be a significant determinant for the leverage ratio at a 1% level, it is found to be significant at only a 5% level in the long-term debt-to-total-asset ratio analysis. Growth, size, and interest, shared determinants with the leverage ratio analysis, are found to be significant at a 1% level.

6. Conclusion

This paper investigated the impact of the Covid-19 on the capital structure (leverage ratio) for the listed companies in the KOSPI from 2016 to 2021 by analyzing its determinants (MTB, Size, growth, profitability, tangibility, interest rate, and the Covid-19). The research period is divided into two periods which are before and during the Covid-19 to observe changes in the capital structure: 2016-2019 as the pre-Covid and 2020-2021 as the Covid-19. Furthermore, the paper further investigated the impact of the Covid-19 on the long-term debt ratio to observe how the leverage ratio changed during the Covid in more detail.

The empirical finding of the paper proves that the Covid-19 has impacted the leverage ratio of sample firms negatively with statistical significance. This finding supports the null hypothesis of the paper that argues the Covid-19 has a significant impact on the leverage ratio. However, unlike the expectation: due to extensive monetary policies during the Covid-19 and the lower interest rate, firms are more incentivized to invest and finance through debt than before the Covid; the empirical finding implies otherwise: the Covid-19 negatively correlated to the leverage ratio. Moreover, as a sub-topic, the Covid-19 didn't have an influence on the long-term debt ratio from 2016 to 2021. Taking account of the two empirical findings, the covid-19 doesn't have a significant impact on changes in the long-term debt-to-total-asset ratio, while the total leverage ratio decreased with the presence of the Covid-19 with statistical significance. Furthermore, not only the Covid-19 variable but also most of the determinants are found to be statistically significant in determining the leverage ratio of sample firms during the given period (2016-2021). Most of the determinants suggest a negative correlation between the leverage ratio except size. Moreover, the negative correlation between profitability and the leverage ratio has been noted by several papers (Y.Qin & H. Kang, 2012). The empirical

finding of the paper is consistent with the prior research of Ke.Y (2021) but applies to US companies, while the sample of the paper is publicly traded Korean companies from 2016 to 2021.

The paper faces a few limitations. First, there could be more possible determinants than what is chosen for this research. Only interest rate is taken as a macroeconomic factor, while there could be more macro determinants that influence the decision-making process of capital structure. Furthermore, it only covers publicly listed Korean companies from 2016 to 2021. Hence, its application is only limited to South Korea. Lastly, the sampled companies are listed companies; other types of companies, such as SMEs and Startups might have been impacted more severely from the Covid-19 due to their limited capital and other reasons. Hence, it is advised for a future related research analysis to include all types of companies and compare their capital structure change during the Covid-19.

Even with its limitations, the paper did not only quantify the impact of the Covid-19 on the capital structure but also the influence of the Covid-19 on the debt structure of corporates. Therefore, the result of the paper contributes to deepening the knowledge of how corporates react when they face unexpected crises like the Covid-19.

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