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Financial Distress Costs and the Pandemic

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Abstract:

The macroeconomic shock in March 2020 and the Covid-19 pandemic have increased the risk levels of companies around the world. The amount of leverage held is no longer associated with a positive tax-shield benefit. Therefore, this paper analyzes the effect of holding higher amounts of leverage with respect to financial distress costs for companies. Through an OLS panel data regression, the effect of higher leverage on the financial and operational performance of firms is estimated. Given the findings, the increase in leverage negatively influences sales growth and the operating performance of firms.

Keywords: Corporate Finance, Financial Distress Cost, Pandemic, Leverage, Debt

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Introduction:

The macroeconomic shock on March 21st, 2020 and the Covid-19 pandemic have hit the worldwide economy as hard as almost no other crisis in history. When considering the consequences this had on the world's markets, it is evident that some sectors and companies have been able to sustain their activity better than others. In this paper, we investigate why some companies were especially prone to financial distress by analyzing leverage ratios, as a measure of the amount of risk associated with a company. Given past research, leverage is additionally associated with a tax shield, which increases revenues and hence the overall well-being of the companies. However, a lot of companies have filed for bankruptcy during this pandemic even though they seemed healthy before the market crash. We analyze the effect higher leverage has on the probability of financial distress. As a proxy for financial distress and operational performance, we use the growth of sales and the growth of earnings before interest, taxes, depreciation, and amortization (EBITDA). This is used as an increase in sales generates more revenue, and hence a company is more financially stable compared to a situation of sales decline. The operational performance of a company is most directly measured by the cash in and outflow of everyday activities and hence the EBITDA of a company. Given prior research and the theoretical background of leverage influencing the financial well-being of a company, as it increases the risk a company holds, the change in leverage from the time before the pandemic is used to see its influence on the sales growth during the pandemic. The data is grouped according to industries and countries, to control for differences across the worldwide market.

Given the recent nature of the data set used, we research the negative effect the pandemic has brought on the worldwide economy and the companies in it. From this research, companies will then be able to infer whether leverage had a negative or positive effect on company performance during the pandemic and can adjust their risk management accordingly.

Ordinary least squares cross-sectional analysis is utilized to see if there is a significant effect on the financial profitability of companies due to holding higher leverage during the pandemic compared to before the pandemic. We differentiate between companies, sectors, and countries to have a clearer macroeconomic view on industry and country specializations and outliers, as taking the worldwide economy as a whole would lead to unification mistakes in estimating the correct high-leverage dummy. Hence, in this paper we use the leverage ratio and financial variables to measure financial distress.

The leverage ratio is calculated by the amount of leverage held over the total assets held per company. This controls for firm size, as larger firms automatically hold more leverage (Opler and Titman 1994). This leverage ratio will then be used to compare the top three deciles of leverage being held to the remaining companies. Hence, the significant effect of high leverage being held during the pandemic indicates a negative influence on firm performance as sales and EBITDA growth declines.

The macroeconomic shock can be used as a cut-off point indicating the negative effect higher amounts of leverage had on the financial performance of companies. As for the causes of decrease in financial performance, statistically significant results are found for different deciles when splitting the dataset up according to either country, industries, or a combination of both. When considering the split per industry, the top two deciles proved a significant influence on a sales decline, and a significant decrease of the EBITDA growth is found for the top three deciles. For the split per country, significant declines in sales growth were found for the top two deciles and the top two deciles on EBITDA growth decrease. For the combinatory split of industry and country, a significant decline is found only for the top three deciles of sales growth and no significant result is found for EBITDA growth.

After considering past research to summarize the underlying economic theories that are being tested, this paper will go into detail about the data and the methodology used to

distinguish the best model and describe the model selection procedure devised from machine learning techniques to find the adequate variables to regress the panel data on, whilst keeping the model robust with the highest R-squared value. After the methodology and data description, the results and the discussion of the findings will be presented before concluding all the results and findings of this paper.

Theoretical Framework:

Past research into the indicators of financial distress and how to measure the effect of a macroeconomic shock on the well-being of companies and the market as a whole has led to different theories being established. Financial distress is defined when companies are no longer capable of fulfilling their financial obligations and eventually must file for bankruptcy (John 1993). Overall financial distress has been measured in different ways, often resulting in different capital structures of companies being evaluated and how this change gains the best tax advantage and credit rating.

Previous research by Opler and Titman (1994) suggests that highly financially levered firms present a larger market downturn than competitors that are less levered, hence being a good indicator of financial distress. They categorize the downturn being manager, customer or competitor driven but never specifying which one is the main force leading to the downturn. To differentiate between the loss in sales, which can be due to higher leverage, they also considered the loss in operating income. Nevertheless, they also found that during an industry downturn, operating income decreases significantly more for companies with higher leverage compared to companies that hold less debt.

Considering research on the usage of debt as a financing tool, F. Modigliani and M. Miller's (1958) (1963) research and propositions found early on that leverage affects the cost

of equity (1963). The amount of leverage changes the risk of bankruptcy, which in turn increases the cost of equity in the asymmetrical real world. With the introduction of taxes into their proposition, the extra tax shield is taken to be comparably less risky in the view of investors, and hence, the increase in leverage and thus increase in overall equity favored the valuation of companies with extra leverage over unlevered companies. Therefore, the extra debt that companies hold is predicted to increase their valuation and financial stability to a larger extent than the extra risk that the debt imposes on the credibility of the company and the additional increase in bankruptcy costs. This has in turn led companies to utilize their tax shields effectively and an increase in debt has also been used as a signaling factor to investors that the company is doing well, which furthermore increases their valuation strength (Opler and Titman (1994).

The usage of debt as a financing tool has been further researched by V. Maksimovic and J. Zechner (1991). They conclude that as soon as taxes are included in the decision-making of investments, the capital structure of firms matters. According to their research, it matters up to the point that firms do not have any preference between keeping debt at a critical level, and thus investing in projects that maximize pre-tax profits, or using a high debt level to invest in projects that are less efficient in generating pre-tax profits. Hence, according to their findings, an increase in the corporate tax rate increases the number of inefficient investments, wherefore firms sometimes limit their debt issuance to commit to projects with lower risk.

Taking a more detailed look at the bankruptcy costs that likewise influence the financial stability and its valuation perception, initially Warner (1977) and later Altman (1984) conclude that the amount of debt has a significant influence on bankruptcy costs. Bankruptcy costs increase to a larger extent after a specific debt level has been surpassed. This in turn equalizes the initial tax benefits of taking on the given debt. Both Warner (1977) and Altman (1984) further differentiate between direct costs, which are measurable and easily visible, and indirect

costs, which Warner (1977) did not measure, but concludes that they have potential substantial effects. Direct costs are concluded to be explicit costs that the debtor pays in the liquidation process of the firm and are documented in official records of the firm.

Indirect bankruptcy costs as Altman (1984) further analyses are made up of lost opportunities due to managerial occupation on the liquidation of the firm. More specifically, these include a loss of sales and profits, a higher cost of credit due to missing opportunities to obtain beneficial credit, or the issuance of new securities to finance profitable opportunities for the company. Thus, indirect costs also include the loss of sales and paybacks of buyers in the case of the company being expected to go into bankruptcy. Following these indirect bankruptcy costs, Altman (1984) concludes that the agency costs can lead to an optimal choice on the capital structure of the cost. This is furthermore measured by Altman (1984) by a loss in sales and profits of expected sales compared to actual sales and profits after the bankruptcy was declared. Given the non-physical nature of indirect costs, these can occur at any point in time, even if companies do not end up defaulting.

Following Altman's findings (1984) T. Hoshi, A. Kashyap and D. Scharfstein (1990) conclude that large financial distress costs come from real costs in the product market, hence macroeconomic shocks. Hence, there is the possibility of a causation issue through a firm's performance depending on its financial situation, while its financial situation simultaneously depends on its performance. Therefore, their concluding argument states that the financial structure is the final factor on the accessibility to renegotiating the firm's liabilities, which essentially allows or does not allow the firm to survive in a financially distressed situation.

Overall, the question remains to what extent this is all purely caused by financial distress or economic distress, or a combination of both (Andrade and Kaplan 1998). Given that the economic distress is universal and impacted all industries and companies, the difference between companies can be purely considered to be financial distress. The universal

macroeconomic shock, however, can be arguably the reason for lower financial performance across all companies (Opler and Titman 1994). Given that only financial factors are analyzed, the impact of leverage filters out the financial distress from the economic distress causing this decline in performance. Nevertheless, the correlation between both factors must be taken into account (Andrade and Kaplan 1998).

Financial Distress Indicators

To analyze the effect that the higher levered capital structure of companies had on the financial well-being of the companies, past research by Opler and Titman (1994) considers the decline in sales. They based their usage of sales growth on previous findings of Altman (1984) and Warner (1977). Sales are directly related to direct financial distress, as a reduction in sales leads to a reduction in revenue. There may be a reversed causality issue in different previous experiments, as this was the case for Opler and Titman (1994), Altman (1984), Warner (1977), and Pindado and Rodrigues (2005). However, as this event study has impacted the entire economy randomly and without leaving any industry untouched, the question of whether or not a reduction in sales led to the financial distress or the other way around is redundant, also due to taking a two-year lag for all contemporaneous variables and normalizing all variables according to firm size. Hence, the reversed causality issue, which has been significant for all previous studies no longer applies to this specific event taken.

The question which remains is to what extent the decline in sales influences the increase in financial distress. The logarithm of sales was taken by Opler and Titman (1994), and Pindado and Rodrigues (2005) as a baseline in their models. Besides the dependent variable being identified as the sales growth rate in past research, the independent variable of interest is the change in the leverage ratio pre-pandemic to during the pandemic. The leverage ratio used by previous research includes the long-term debt and the debt in current liabilities (Pindado and

Rodrigues 2005) over the total share capital of stockholders or, as Opler and Titman (1994) computed this by dividing by the total assets. The same ratio as utilized by Opler and Titman (1994) is used in this paper. The ratio is then further split into two categories, the leverage amount considered as ‘higher’ leverage than other companies in the same industry compared to companies with otherwise considered ‘normal’ leverage amounts. Opler and Titman (1994) make this split by using the top 8-10 deciles. Given their previous analysis, we consider the top two deciles of leverage held per company split by industry sector.

Furthermore, economic and financial theory has shown that the amount and costs of liquid asset holdings, earnings before taxes, amortization and depreciation, the market value of equity, Tobins’ Q, asset sale ratio, and the current leverage ratio influence the capital structure of companies and hence their financial performance. The costs of holding assets, as described by Pindado and Rodrigues (2005), with emphasis on the short-term influence may have a positive effect on the financial performance as more liquid assets allow the company to stay away from fire sales for longer (Schleifer and Vishny 1992). On the other hand, previous research by Mikkelson and Partch (2003) has shown that financially distressed firms use their liquid assets to pay off their debts instead of investing them into profitable investment opportunities. Thus, variables indicating the change in asset holdings, specifically liquid assets, indicate the financial performance of companies.

Besides assets, the EBITDA is a measure of the operating performance of companies. Thus, it indicates the financial well-being of companies. However, this measure is most likely to be influenced by companies (Opler and Titman 1994). Given that it can be influenced by accounting measures, it most likely underestimates the true effect it has on financial performance (Pindado and Rodrigues 2005). The market value of equity of a company before the distressing situation further influences the probability of bankruptcy (Altman 1984). This is evidenced by larger companies who hold a larger market value of equity and hence have a

larger base to pull funds and investment opportunities to survive from. Opler and Titman (1994) furthermore use the growth in EBITDA to measure the effect of leverage on the operating performance of their companies.

Tobin's Q is used by Pindado and Rodrigues (2005), as it is the ratio of the market value of a company over the asset replacement costs. Hence, it indicates how much financial stability a company has, and how often it would be able to save itself by the assets it owns. Given that the assets, as discussed before, clearly indicate financial well-being, the total market value of a company at a given time, additionally indicates the financial distress it can experience before bankruptcy (de Miguel, Pindado und de la Torre 2003). Furthermore, it has been found by de Miguel, Pindado, and de la Torre (2003) that Tobin's Q is a good proxy to estimate the investment opportunities that companies have. This is important, as investment opportunities can be used as an indicator for future growth.

Previous research also considers the probability of financial distress and economic and legal changes, as well as stock returns. We will not consider these variables and indicators, as the event utilized as the cut-off point used to differentiate between the pandemic and pre-pandemic time is random. The legal changes were furthermore not considered, as the pre-pandemic period is taken as the normal scenario, and no differences between these are made, while almost all companies had a large change in economic regulations during the pandemic. Due to spatial limitations, stock returns will not be considered here. The two major regressions that are run are on the growth of sales to indicate the financial performance of companies and on the growth of the EBITDA to show the influence of leverage on operating performance.

Methodology:

OLS- Model

To analyze the previously described direct and indirect costs of bankruptcy, we will regress the debt explanatory variables on financial profitability. A standard ordinary least squares (OLS) model will be used on a cross-sectional basis as the data is in panel data format. The time variable will be across the timespan from January 2016 until the most recent quarter, June 2021, and the panel variable will be all companies, grouped per industry, country, and a combination of both in the Compustat Global Quarterly Fundamentals and the Compustat Global Daily Security Prices. The financial and operational performance of companies is calculated by taking the first difference of the sales turnover from the first quarter in 2016 until the most recent quarter, June 2021, with the same done for the EBITDA growth.

A machine learning algorithm is used to find the best explanatory variables for the change in sales growth due to a change in the amount of leverage held per company before and during the pandemic.

The OLS-Model is purely used in the machine learning algorithm to minimize the mean squared error (MSE) and hence obtain the most explanatory independent variables for an OLS regression. This is because the machine learning method makes it possible to run a wider variety of models whilst comparing all variables and combinations to one another.

Machine Learning Method

The choice of which financial variables is determined by running a machine learning algorithm (Scikit 2020) over the different variables available (Appendix A: Independent Variables). A model selection procedure is devised from machine learning techniques, a description of which follows.

The only mandatory variable to be included in the model is the dummy variable indicating the highest leverage held during the pandemic. The final independent variables that

were chosen, are based on minimizing the mean squared error (MSE) which increase the in-sample predictor accuracy. Thus, the smaller the MSE, the better the explanatory variables explain the dependent variable. Therefore, a code is run on minimizing the MSE for each dependent variable given List 1 (Appendix 1) variables. The resulting variables are then utilized to create the most statistically significant models (Appendix 1: Model 1 and 2). The minimum MSE is chosen, as this leads to smaller variances and eliminates more measurement error compared to the cohort approach as discussed by Verbeek and Nijman (1993). All variables that were included in the data set from which the machine learning code could choose are based on economic reasoning, the model-specific variables are explained below. Explanations of all variables given for selection can be seen in Appendix 1: Data Selection.

Variables Selected

The panel data model and regression are the final models of interest, as these use the independent variables chosen by minimizing the MSE and hence give the most accurate result of explaining the growth in sales due to the change in the capital structure induced by higher leverage being held by companies during the pandemic. The model is run three times for each specification and clustering per group; firstly, considering the different industries' fixed effects, secondly, the different country fixed effects, and thirdly, a combination of both. These were all run for the top one to three deciles of leverage held per company. Lastly, this is all done for the sales growth and the EBITDA growth. In total there were twelve regressions including the variable of interest run. Next to this also the counter-regressions, which included the opposite to the variable of interest, hence the highest leverage influence before the start of the pandemic, were run. The comparison is being used to see whether the higher leverage held is already significant to determine company performance before the pandemic. The following variables are used as independent variables:

Log of Sales: The natural logarithm of the sales turnover.

Total Liabilities growth rate: The growth rate of total liabilities gives the general underlying trend of whether liabilities have increased or decreased. Thus, it controls for a market-wide change compared to a company-specific change in growth. This variable is calculated by taking the first difference between the following quarter to the prior quarter.

Change in Current Leverage Ratio: This variable is the first difference of the current leverage per company, divided by the total assets. The division by total assets filters out the firm size effect. The difference is then taken at a two-year lag to estimate its effect on the leverage during the pandemic, without considering the changes in current leverage due to the influence of the pandemic but controlling for the current leverage ratio at assumed normal times.

Change in Investments over Assets: This variable is the two-year lag of total investments divided by total assets for each company. The two-year lag is taken to filter out the effect on the change in assets and investments during the pandemic. This variable is also included as it limits the biases of firms with better prospects (which have lower leverage ratios) being able to survive the financial downturn better.

Change in Long-Term Debt: This variable gives the change in long-term debt, as the first difference for each long-term debt value, over the total assets held per company. Dividing by total assets controls the variable for firm size. This variable is taken at a two-year lag to assure that short-term changes and adjustments due to the pandemic do not change the results.

Dummy for Highest Leverage: This variable indicates whether the company is in the top decile of leverage per industry segment for a given time period represented by a 1 in the positive case and 0 otherwise. This indicates directly whether or not higher leverage also explains the change in sales growth in general, not necessarily only during the pandemic. For the third and fourth regression, this includes the top two deciles (the top twenty percent) of the highest leverage being held for each company per industry.

Tobin's Q: This financial ratio is calculated by taking the market value of a company over the total asset replacement value. Given the Compustat Data set, it is created by adding the total assets with the market value of equity minus the ordinary equity and dividing all of this by the total assets. Given that Tobin's Q explains the number of assets available to repurchase the entire market value a company holds, it is a good indicator of the liquidity of a company and hence its financial performance.

Current Leverage Ratio: The current leverage ratio is an indicator of the momentary amount of debt a company holds; hence, also how much availability of cash it holds for further investments at a given point in time.

Liquid Asset Holding Rate: This is the ratio of liquid assets, hence cash and cash equivalents over the total amounts of assets held per company. This is taken at a two-year lag to account for the short-term influences and fluctuations the pandemic has.

Change in Short-Term Investments: This is calculated by taking the ratio of the change in short-term assets over the total amount of assets. Thus, controlling for firm size. Due to the same reasoning as the variables above, the two-year lag is taken.

Highest Leverage Ratio Decile: This is an indicator variable for the top decile of leverage being held by a company. No lag is taken for this variable, as it is taken as a dummy, with 1 representing the company being in the top decile and 0 otherwise.

Change in Total Equity: This is the ratio of total equity over the total amount of assets held per company. Again this is taken at a two-year lag to filter out noise from the effect of leverage on financial and operating performance.

Equation 1: OLS Model

Financial Performance_{it}

$$= \alpha_{it} + \beta_i * \text{independent variable}_{sit} + \beta_{n-1} * \text{High - Leverage Dummy}_{it} \\ * \text{Pandemic Dummy}_{it} + \epsilon$$

i: being the panel data identifier

t: being the time variable identifier

Data:

Due to firm, country, and yearly fixed effects, the panel data regressions are clustering the time variable and firm fixed effects in combinatory fixed effects filtering out industry and time fixed effects, country and time fixed effects, and lastly country, industry and time fixed effects. Given that different clustering of the error terms influences the significance of the results, different robustness tests are considered. For further information see Appendix B: Regression Diagnostics.

Specific data points had to be dropped before constructing the models due to the unavailability of some data, as a result the total market value of debt for the firms could not be analyzed. Therefore, the change in operating income is used to consider the operating performance indicator of firms. Additionally, all data points for firms in the financial sector were taken out of the data set due to using different accounting standards, which could not be compared to the other market sectors. All companies listed in more than one industry were dropped as it led to adjustment problems of the data set, this also included dropping firms where the data required for each analysis, or regression was unavailable.

We use dummy variables to represent high leverage rather than a continuous variable, as we expect the relationship between leverage and financial and operating performance to be difficult to specify in advance. Additionally it may be nonlinear. Hence, the dummy variable for the high leverage during the pandemic is taken in three versions, once including the top decile, the top two deciles, and the top three deciles of leverage held per company and grouping. As the leverage ratio is also taken over the total amount of assets, this already controls for different firm sizes. Opler and Titman (1994) use the two-year prior ex-ante leverage ratio to decrease reverse causality probabilities. We do not only use the two-year ex-

ante leverage ratio but continuously lag the leverage ratio by two years to decrease the probability of reverse causality throughout the change occurring during the pandemic.

To analyze and distinguish the change of debt held by companies before the macroeconomic shock compared to after, this paper uses the Wharton Research Data Service - Compustat Global Quarterly Fundamentals. The period of the quarterly data that is being analyzed is from January 2016 until June 2021. Data is only taken from 2016 and after, as before 2016 the financials of companies, especially in the Euro Zone were still largely affected by the sovereign debt crisis and non-traditional methods to stimulate the economy, which include quantitative easing and the implementation of negative interest rates. The total amount of companies in the data set are 31,556 companies across 64 industries.

As a cutoff point for the data pre-pandemic to during the pandemic, the macroeconomic shock in March 2020 was utilized. Hence everything pre-March 2020, including March 2020 will be treated as a pre-treatment coefficient and everything after March 2020 will be treated as during the pandemic.

The coefficient of the high-Leverage dummy is the main variable of interest, as it is the dummy variable indicating whether the company is in the top quartile of their industry holding leverage during the pandemic. The pandemic dummy gives a value of 1 if it is during the pandemic, hence after March 2020, and 0 if it occurred before. The difference between both explains whether a higher amount of leverage, in general, has a significant effect on financial performance, or if this effect only occurs during an overall market-stressed situation.

Considering the descriptive statistics of the main variables below, it is evident that the data holds different amounts of observations for different variables. Table 1 includes all significant variables explaining the dependent variables of interest and the dependent variables being investigated. The panel data is thus not balanced.

Table 1: Descriptive Statistics

This table includes the descriptive statistics of the independent and dependent variables used in all six models. Their total number of observations given the panel data, their mean value, standard deviation, as well as minimum and maximum values are given.

Variable	Observations	Mean	Std. dev.	Min	Max
Logarithm of Sales	468.34	5.88803	2.982827	0	1.3998170
Sales Growth	427962	0.004443	0.1005528	-0.405639	0.509304
Leverage Ratio	186202	0.273755	0.1904654	0	1.0541
Total Liabilities growth rate	254618	-0.000003	0.0044631	-0.02857	0.026666
Total Equity growth rate	238391	0.000229	0.0031496	-0.01298	0.022727
Current Leverage Ratio	230658	0.312461	0.2334311	0.009118	1.416667
Liquid Asset Holding Rate	277819	-0.00050	0.0900692	-0.33333	0.384615
Change in Investments	86.49	-0.03296	0.0628833	-0.35733	0
Short-Term Investment Change	16116	-0.00193	0.0426438	-0.18077	0.153084
Long-Term Debt Change	190946	0.00946	0.0613309	-0.1875	0.259259

Results and Discussion:

The regression analysis investigates whether there is a significant effect of holding more leverage during the pandemic compared to before the pandemic. This should then furthermore lead to a conclusion leading to new knowledge on how important a good capital structure and debt level is for a company's well-being during an extreme and enduring macroeconomic shock such as this pandemic. Hence, the firm's profitability in all cases should be negatively correlated to the explanatory variable of higher amounts of leverage being held during the pandemic, the coefficient of interest (β_n) in all models.

The following models (Model 1 and 2) in Table 2, show the influence of the independent variables on the growth of sales and EBITDA when grouped according to the company industries. For the top two deciles, leverage decreases sales growth at a 5% significance level. The companies that hold higher leverage with a lag of two years have a significant decrease of 0.27% in sales growth. When considering the impact that the highest three deciles of leverage grouped per industry have on EBITDA growth, then the growth declines at a 5% significance level as well by 0.00185%. This shows that there is less leverage

necessary to influence the EBITDA growth during the pandemic when grouping according to industries compared to the amount necessary for influencing the sales growth. For both models, the results of the regression analysis including the higher leverage before the pandemic started are statistically insignificant. This leads to a conclusion, similar to Opler and Titman (1994), that the simultaneous decrease in the financial performance indicators, shows that managerial decisions to optimize the organization for example, which may lead to a decline in total revenues but should not lead to a simultaneous decline in net income, is not the case. Also, it highlights the fact that before the pandemic, it did not matter for the outcome of the net income (EBITDA), as long as it is not in the top three deciles of their industry, as the coefficient for holding higher leverage before the pandemic is not significant. When comparing this to the coefficient for the effect of leverage for the pre-pandemic dummy variable, it is evident that in non-pandemic times, higher leverage positively influences financial performance at a 5% significance level. This clearly shows the increase in financial distress costs due to higher leverage during the pandemic, which is also found by Pindado and Rodrigues (2005) in a similar analysis.

Models 3 and 4 in Table 3, are grouped according to the country in which the headquarters are located, given that this is generally the location where the accounting standards are based. This gives a good representation of the company's location. Even though, it allows for some error, as it does not have to be the official companies' location. This grouping of data gives statistically significant results for the top two deciles of leverage at a 5% significance level. Thus, higher leverage held per company influenced the sales growth negatively by 0.23%. For the effect that higher leverage holds on the EBITDA growth during the pandemic, the top two deciles showed significant results. This showed a 5% statistically significant decline of 0.4% in EBITDA growth. As for the previous two models, the effect during the pandemic is negative, however, the effect prior to the pandemic is positive at a 5%

Table 2: Model 1 and 2 Regression Results

	Sales Growth	Sales Growth	Sales Growth	Sales Growth	Sales Growth	Sales Growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth
Logarithm of Sales	0.00283** (0.000335)	0.00283** (0.000335)	0.00284** (0.000328)	0.00284** (0.000328)	0.00284** (0.000333)	0.00284** (0.000333)	0.00311* (0.000785)	0.00311* (0.000785)	0.00313* (0.000778)	0.00313* (0.000778)	0.00313* (0.000784)	0.00313* (0.000784)
Total Equity growth	-154.7 (113.1)	-154.7 (113.1)	-155.9 (112.8)	-155.9 (112.8)	-156.5 (114.9)	-156.5 (114.9)	-125.6 (48.86)	-125.6 (48.86)	-126.4 (48.70)	-126.4 (48.70)	-128.7 (49.24)	-128.7 (49.24)
Total Liabilities growth	61.62 (67.17)	61.62 (67.17)	61.69 (67.11)	61.69 (67.11)	61.41 (67.19)	61.41 (67.19)	-84.99 (131.5)	-84.99 (131.5)	-86.70 (130.7)	-86.70 (130.7)	-86.84 (131.9)	-86.84 (131.9)
Change in Investments	-0.0254*** (0.00172)	-0.0254*** (0.00172)	-0.0252*** (0.00171)	-0.0252*** (0.00171)	-0.0252*** (0.00165)	-0.0252*** (0.00165)						
Short-Term Investment Change	-0.0125 (0.00600)	-0.0125 (0.00600)	-0.0127 (0.00574)	-0.0127 (0.00574)	-0.0128 (0.00573)	-0.0128 (0.00573)	-0.00887 (0.0110)	-0.00887 (0.0110)	-0.00893 (0.0108)	-0.00893 (0.0108)	-0.00913 (0.0108)	-0.00913 (0.0108)
Top Decile Pandemic Leverage Dummy	-0.00145 (0.00225)						-0.00316 (0.00156)					
Top Decile Pre-Pandemic Leverage Dummy		0.00145 (0.00225)						0.00316 (0.00156)				
Top Two Deciles Pandemic Leverage Dummy			-0.00229** (0.000289)						-0.00400** (0.000396)			
Top Two Deciles Pre-Pandemic Leverage Dummy				0.00229** (0.000289)						0.00400** (0.000396)		
Top Three Deciles Pandemic Leverage Dummy					-0.00130 (0.00116)						-0.00197 (0.00179)	
Top Three Deciles Pre-Pandemic Leverage Dummy						0.00130 (0.00116)						0.00197 (0.00179)
Liquid Asset Holding Rate							-0.0105 (0.00550)	-0.0105 (0.00550)	-0.0108 (0.00561)	-0.0108 (0.00561)	-0.0107 (0.00536)	-0.0107 (0.00536)
Long-Term Debt Change							0.0270* (0.00721)	0.0270* (0.00721)	0.0281* (0.00681)	0.0281* (0.00681)	0.0278* (0.00740)	0.0278* (0.00740)
Constant	-0.0304** (0.00361)	-0.0319** (0.00480)	-0.0304** (0.00354)	-0.0327** (0.00373)	-0.0305** (0.00354)	-0.0318** (0.00413)	-0.0340* (0.00878)	-0.0371* (0.00941)	-0.0339* (0.00869)	-0.0379* (0.00893)	-0.0339* (0.00871)	-0.0359* (0.00933)
N	9653	9653	9653	9653	9653	9653	7252	7252	7252	7252	7252	7252
adj. R ²	0.016	0.016	0.016	0.016	0.016	0.016	0.019	0.019	0.020	0.020	0.020	0.020

Standard Errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 3: Model 3 and 4 Regression Results

	Sales Growth	Sales Growth	Sales Growth	Sales Growth	Sales Growth	Sales Growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth
Logarithm of Sales	0.0028** (0.0003)	0.0028** (0.0003)	0.0028** (0.0003)	0.00284** (0.0003)	0.00284** (0.0003)	0.00284** (0.0003)	0.00311* (0.0008)	0.00311* (0.0008)	0.00313* (0.0008)	0.00313* (0.0008)	0.00313* (0.0008)	0.00313* (0.0008)
Total Equity	-154.7 (113.1)	-154.7 (113.1)	-155.9 (112.8)	-155.9 (112.8)	-156.5 (114.9)	-156.5 (114.9)	-125.6 (48.86)	-125.6 (48.86)	-126.4 (48.70)	-126.4 (48.70)	-128.7 (49.24)	-128.7 (49.24)
Total Liabilities	61.62 (67.17)	61.62 (67.17)	61.69 (67.11)	61.69 (67.11)	61.41 (67.19)	61.41 (67.19)	-84.99 (131.5)	-84.99 (131.5)	-86.70 (130.7)	-86.70 (130.7)	-86.84 (131.9)	-86.84 (131.9)
Change in Investments	-0.025*** (0.00172)	-0.0254** (0.00172)	-0.0252*** (0.00171)	-0.0252*** (0.00171)	-0.025*** (0.00165)	61.41 (67.19)						
Short-Term Investments	-0.0125 (0.00600)	-0.0125 (0.00600)	-0.0127 (0.00574)	-0.0127 (0.00574)	-0.0128 (0.00573)	-0.025*** (0.00165)	-0.00887 (0.0110)	-0.00887 (0.0110)	-0.00893 (0.0108)	-0.00893 (0.0108)	-0.00913 (0.0108)	-0.00913 (0.0108)
Top Decile Pandemic Leverage Dummy	-0.00145 (0.00225)						-0.00316 (0.00156)					
Top Decile Pre-Pandemic Leverage Dummy		0.00145 (0.00225)						0.00316 (0.00156)				
Top Two Deciles Pandemic Leverage Dummy			-0.00229** (0.000289)						-0.00400** (0.000396)			
Top Two Deciles Pre- Pandemic Leverage Dummy				0.00229** (0.000289)						0.00400** (0.000396)		
Top Three Deciles Pandemic Leverage Dummy					-0.00130 (0.00116)						-0.00197 (0.00179)	
Top Three Deciles Pre- Pandemic Leverage Dummy												0.00197 (0.00179)
Liquid Asset Holding Rate						0.00130 (0.00116)	-0.0105 (0.00550)	-0.0105 (0.00550)	-0.0108 (0.00561)	-0.0108 (0.00561)	-0.0107 (0.00536)	-0.0107 (0.00536)
Long-Term Debt							0.0270* (0.00721)	0.0270* (0.00721)	0.0281* (0.00681)	0.0281* (0.00681)	0.0278* (0.00740)	0.0278* (0.00740)
Constant	-0.0304** (0.00361)	-0.0319** (0.00480)	-0.0304** (0.00354)	-0.0327** (0.00373)	-0.0305** (0.00354)	-0.0318** (0.00413)	-0.0340* (0.00878)	-0.0371* (0.00941)	-0.0339* (0.00869)	-0.0379* (0.00893)	-0.0339* (0.00871)	-0.0359* (0.00933)
N	9653	9653	9653	9653	9653	9653	7252	7252	7252	7252	7252	7252
adj. R ²	0.016	0.016	0.016	0.016	0.016	0.016	0.019	0.019	0.020	0.020	0.020	0.020

Standard Errors in parentheses
* p<0.05, **p<0.01, ***p<0.001

Table 4: Model 5 and 6 Regression Results

	Sales Growth	Sales Growth	Sales Growth	Sales Growth	Sales Growth	Sales Growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth	EBITDA growth
Logarithm of Sales	0.00129 ***	0.00129 ***	0.00129 ***	0.00129 ***	0.00130 ***	0.00130 ***	-9.76e-08	-9.76e-08	-9.32e-08	-9.32e-08	0.0000002	0.00000019
Total Equity	0.0573 (0.546)	(0.0002) 0.0573 (0.546)	(0.0002) 0.0570 (0.546)	(0.0002) 0.0570 (0.546)	(0.0002) 0.0536 (0.546)	(0.0002) 0.0536 (0.546)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000)	(0.00000154)
Total Liabilities	2.809*** (0.617)	2.809*** (0.617)	2.809*** (0.617)	2.809*** (0.617)	2.810*** (0.617)	2.810*** (0.617)						
Current Leverage Ratio	-0.0030 (0.0019)	-0.0030 (0.0019)	-0.0031 (0.002)	-0.0031 (0.002)	-0.0033 (0.002)	-0.0033 (0.002)						
Liquid Asset Holding Rate	-0.0067 (0.0059)	-0.0067 (0.0059)	-0.0067 (0.0059)	-0.0067 (0.0059)	-0.0067 (0.0059)	-0.0067 (0.0059)						
Change in Investments	-0.0150* (0.0069)	-0.0150* (0.0069)	-0.0149* (0.0070)	-0.0149* (0.0070)	-0.0144* (0.0070)	-0.0144* (0.0070)						
Top Decile Pandemic Leverage Dummy	-0.0006 (0.0017)						-0.000021 (0.00002)					
Top Decile Pre-Pandemic Leverage Dummy		0.00064 (0.0017)						0.0000218 (0.00002)				
Top Two Deciles Pandemic Leverage Dummy			-0.0005 (0.0007)						-0.00001* (0.00001)			
Top Two Deciles Pre-Pandemic Leverage Dummy				0.00053 (0.001)						0.0000066 (0.00001)		
Top Three Deciles Pandemic Leverage Dummy					-0.0015 (0.0008)						-0.000006 (0.00000)	
Top Three Deciles Pre-Pandemic Leverage Dummy						0.00149 (0.0008)						0.00000654 (0.00000485)
Short-Term Investments							0.0000383 (0.00011)	0.0000383 (0.00011)	0.0000356 (0.00011)	0.0000356 (0.00011)	0.0000120 (0.00006)	0.0000120 (0.0000666)
Long-Term Debt							-0.000036 (0.00006)	-0.000036 (0.00006)	-0.000036 (0.00006)	-0.000036 (0.00006)		
Constant	-0.0051 *** (0.0014)	-0.0057* (0.0023)	-0.0051 *** (0.0014)	-0.0056 ** (0.0017)	-0.0049 *** (0.0014)	-0.0064 *** (0.0016)	0.0000036 (0.00002)	-0.000018 (0.00003)	0.0000035 (0.00002)	-0.000003 (0.00002)	-0.000001 (0.00002)	-0.00000743 (0.0000179)
N	57006	57006	57006	57006	57006	57006	7796	7796	7796	7796	12298	12298
adj. R ²	0.011	0.011	0.011	0.011	0.011	0.011	-0.009	-0.009	-0.009	-0.009	-0.010	-0.010

Standard Errors in parentheses
* p<0.05, **p<0.01, *** p<0.001

significance level. Therefore, this clearly shows the amount of leverage's influence on the risk assessments and on the financial and operational performance of companies.

Model 5 and 6, in Table 4, are grouped according to both industry and country. Thus, the country specifications per industry are taken into account. Splitting the data into a large number of groups results in the fixed effects being lost. This combination decreases the significance of some variables accordingly, such that the effect on the sales growth is no longer significant for any of the top three deciles of leverage being held per company. For the effect that this grouping has on the growth of EBITDA, it shows a significant effect at the top two deciles of leverage with a statistical significance at a 10% level. However, the adjusted R-squared value is negative, indicating that the model no longer holds any explanatory power when taking both the industry and country fixed effects.

When considering the R-square values of all models, these are similar to the findings of Opler and Titman (1994). Therefore, they show some explanatory power, but due to being very small still hold large room for improvement. For future research, other variables should be included. The small R-squared values could also be due to the restriction of only using lagged variables to explain the changes in a recent event and hence no current influence is being utilized in the regressions. However, the adjusted R-squared value, taking into account the increasing R-squared value due to an increase in variables, shows that some models hold no explanatory power. This is the case for Model 2 and Model 6. Thus, these regressions cannot be significantly estimated. The fact that the results may be statistically significant whilst the models are not aligns with Opler and Titman's (1994) findings as they do not find any statistically significant results on their operating income regressions. They explain their insignificant results due to the large cross-sectional variation. This also explains why the grouping per industry, country, or their combination leads to different significant results and

different model definitions with regards to the smallest MSE. This could also result from having an unbalanced panel-data data set.

The sales drops that are significant nevertheless show that the amount of leverage held does influence the financial and operational performance of companies during the pandemic negatively. Given the problematics that the sales decline could also be due to a firm downsizing, and therefore be a reversed causality issue, this comes along with the pandemic. During any pandemic that includes lockdowns, firm activities are hindered and decreased, hence their sales will represent this. Nevertheless, given that only the leverage with a two-year lag is considered, the reversed causality issue is taken care of.

Concluding Remarks, Limitations, and Future Recommendations

Given that the dummy variable of interest is negative for all models, even though some models are not significant due to a lack of data, I conclude that the higher amounts of leverage held decrease the firm's financial and operational performance during a pandemic. Taking into consideration specifically the leverage being in the top two deciles per industry or country grouping in any given year, it is evident that not enough data was present in the top decile to make any statistically significant conclusions. During the pandemic, it is seen that more firms have significant sales decline and a decline in EBITDA growth if they held leverage in the range of the top two deciles per industry and per country. Due to the random nature of the current pandemic and the usage of lagged variables, the reversed causality problem is minimized.

Overall, the decline is more significant for sales growth and hence the financial performance of the companies. Due to insufficient data and insignificant model choices, the effect on EBITDA growth is only statistically significant when grouping the errors and the variable specifications according to countries. This is logical as EBITDA growth during the

pandemic saw different levels of support by country. Given that I do not adjust for government subsidies or legal changes by country, this noise is greatly influential when only splitting the data set per industry. As the pandemic hit all industries, countries did not differentiate between industries to a large and accordingly, financial performance is more influenced in the short run during a pandemic compared to the operational performance of companies. After more analysis on the distribution of the data, for future regressions, the errors should be most appropriately modeled according to a Student T-Distribution (Appendix B).

Additional research would now be necessary to filter out more noise for explaining the change in EBITDA growth during the pandemic. For this, government subsidies and legal regulation changes should be analyzed as done in a similar study by Pindado and Rodrigues (2005). Furthermore, using non-linear regression to assess the changes leverage induces without using a dummy variable would be of interest, as it could result in a more specific analysis.

The weakness of neglecting the change on stock prices and the market value of the companies in this research design also calls for more analysis to be done. Without the effect measured on the market and share prices, a significant interpretational value is lost. As a firm's financial distress can often also come only from a change in the stock prices. For this study, this was not possible as the database used did not include the market value of debt for example, and hence a different database would have to be used. Furthermore, the data set should be extended and balanced to receive more significant outcomes. As can be seen, by the number of observations for each model, the different observations lead to a different power of the individual models. Overall, the insignificance of the two models and the low adjusted R-squared values lead to the conclusion that more economic variables are needed that better explain the relationship between the independent and dependent variables. Given that in this study I focus solely on financial terms, the inclusion of the previously mentioned government

subsidies would be an improvement, however, further research should be done to increase the models' explanatory power and more economically significant instruments should be used.

Overall, due to the ongoing nature of the pandemic estimation or prediction of post-pandemic conditions is not possible. Thus, after the pandemic is declared to be over, the direct influence and the years after that, the long run influence should be evaluated.

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Appendix A: Data Selection

Descriptive Statistics:

Variable	Obs	Mean	Std. dev.	Min	Max
Tobins Q	34,565	8.74e+07	6.06e+08	48343.94	5.18e+09
Logarithm of Sales	468,340	5.888025	2.982827	0	13.99817
Sales Growth	427,962	0.0044437	0.1005528	-0.4056391	0.5093042
EBITDA Growth	394,594	-0.0007603	0.007069	-0.047619	0.0238095
Leverage Ratio	186,202	0.2737556	0.1904654	0	1.054054
Total Equity Growth	254,618	-3.72e-06	0.0044631	-0.0285714	0.0266667
Total Liability Growth	238,391	0.0002298	0.0031496	-0.012987	0.0227273
Total Assets Growth	230,658	0.3124615	0.2334311	0.0091185	1.416667
Liquid Asset Holding Rate	277,819	-0.0005093	0.0900692	-0.3333333	0.3846154
Change in Investments	86,490	-0.0329648	0.0628833	0.3573319	0
Change in Short-Term Investments	16,116	-0.0019361	0.0426438	-0.1807781	0.1530849
Change in Long-Term Debt	190,946	0.00946	0.0613309	-0.1875	0.2592593
Pandemic	558,812	0.2366878	0.4250494	0	1
Pre-Pandemic	558,812	0.7633122	0.4250494	0	1

Leverage Dummy Variables:

Variable	Obs	Mean	Std. dev.	Min	Max
Dummy Top Decile of Leverage	558,812	0.019797	0.1393035	0	1
Dummy Top Two Deciles of Leverage	558,812	0.039242	0.1941708	0	1
Dummy Top Three Deciles of Leverage	558,812	0.058434	0.2345638	0	1
Top Decile of Leverage during the Pandemic	37.24	0.229918	0.2914909	0	1.054054
Top Two Deciles of Leverage during the Pandemic	18.62	0.268696	0.3397285	0	1.054054
Top Three Deciles of Leverage during the Pandemic	55.85	0.207024	0.2636876	0	1.054054

Models:

Model 1: Sales Growth Industry Fixed Effects

Top Decile: MSE = 0.010108770907190078

Top Two Deciles: MSE = 0.010108770907190078

Top Three Deciles: MSE = 0.010108045871154102

Sales Growth_{it}

$$\begin{aligned} &= \alpha_{it} + \beta_1 * \text{Logarithm of Sales}_{it} + \beta_2 \\ &* \text{Total Liabilities growth}_{it} + \beta_3 * \text{Liquid Asset Holding Rate}_{it} + \beta_4 \\ &* \text{Short - Term Investment Change}_{it} + \beta_5 * \text{Long - Term Debt Change}_{it} \\ &+ \beta_6 * \text{High - Leverage Dummy}_{it} * \text{Pandemic Dummy}_{it} + \epsilon \end{aligned}$$

Model 2: EBITDA Growth Industry Fixed Effects

Top Decile: MSE = 4.96502724245137e-05

Top Two Deciles: MSE = 4.965025297772688e-05

Top Three Deciles: MSE = 4.965062348845936e-05

EBITDA Growth_{it}

$$\begin{aligned} &= \alpha_{it} + \beta_1 * \text{Logarithm of Sales}_{it} + \beta_2 \\ &* \text{Total Liabilities growth}_{it} + \beta_3 * \text{Liquid Asset Holding Rate}_{it} + \beta_4 \\ &* \text{Short - Term Investment Change}_{it} + \beta_5 * \text{Tobins Q}_{it} + \beta_6 \\ &* \text{Current Leverage Ratio}_{it} + \beta_7 * \text{Top Leverage Decile}_{it} + \beta_8 \\ &* \text{High - Leverage Dummy}_{it} * \text{Pandemic Dummy}_{it} + \epsilon \end{aligned}$$

Model 3: Sales Growth Country Fixed Effects

Top Decile: MSE = 0.011537712823678447

Top Two Deciles: MSE = 0.011537439112533146

Top Three Deciles: MSE = 0.011536946598356796

Sales Growth_{it}

$$\begin{aligned} &= \alpha_{it} + \beta_1 * \text{Logarithm of Sales}_{it} + \beta_2 \\ &* \text{Total Equity growth}_{it} + \beta_3 * \text{Total Liability Growth}_{it} + \beta_4 \\ &* \text{Short - Term Investment Change}_{it} + \beta_5 * \text{Change in Investments}_{it} \\ &+ \beta_6 * \text{High - Leverage Dummy}_{it} * \text{Pandemic Dummy}_{it} + \epsilon \end{aligned}$$

Model 4: EBITDA Growth Country Fixed Effects

Top Decile: MSE = 5.499166674227099e-05

Top Two Deciles: MSE = 5.49917172999636e-05

Top Three Deciles: MSE = 5.4991217393190705e-05

EBITDA Growth_{it}

$$\begin{aligned} &= \alpha_{it} + \beta_1 * \text{Logarithm of Sales}_{it} + \beta_2 \\ &* \text{Total Equity growth}_{it} + \beta_3 * \text{Total Liability Growth}_{it} + \beta_4 \\ &* \text{Short - Term Investment Change}_{it} + \beta_5 * \text{Liquid Asset Holding Rate}_{it} \\ &+ \beta_6 * \text{Long - Term Debt Change}_{it} + \beta_7 * \text{High - Leverage Dummy}_{it} \\ &* \text{Pandemic Dummy}_{it} + \epsilon \end{aligned}$$

Model 5: Sales Growth Country and Industry Fixed Effects

Top Decile: MSE = 0.010073933811487782

Top Two Deciles: MSE = 0.010073676592215667

Top Three Deciles: MSE = 0.010073561900206786

$$\begin{aligned}
Sales\ Growth_{it} &= \alpha_{it} + \beta_1 * \text{Logarithm of Sales}_{it} + \beta_2 \\
&* \text{Total Equity growth}_{it} + \beta_3 * \text{Total Liability Growth}_{it} + \beta_4 \\
&* \text{Current Leverage Ratio}_{it} + \beta_5 * \text{Change in Investments}_{it} + \beta_6 \\
&* \text{Liquid Asset Holding Rate}_{it} + \beta_7 * \text{High – Leverage Dummy}_{it} \\
&* \text{Pandemic Dummy}_{it} + \epsilon
\end{aligned}$$

Model 6: EBITDA Growth Country and Industry Fixed Effects

Top Decile: MSE = 5.034084648729038e-05

Top Two Deciles: MSE = 5.03409749384242e-05

$$\begin{aligned}
EBITDA\ Growth_{it} &= \alpha_{it} + \beta_1 * \text{Logarithm of Sales}_{it} + \beta_2 \\
&* \text{Short – Term Investment Change}_{it} + \beta_3 * \text{Long – Term Debt Change}_{it} \\
&+ \beta_4 * \text{High – Leverage Dummy}_{it} * \text{Pandemic Dummy}_{it} + \epsilon
\end{aligned}$$

Top Three Deciles: MSE = 5.034049863953264e-05

$$\begin{aligned}
EBITDA\ Growth_{it} &= \alpha_{it} + \beta_1 * \text{Logarithm of Sales}_{it} + \beta_2 \\
&* \text{Short – Term Investment Change}_{it} + \beta_3 * \text{High – Leverage Dummy}_{it} \\
&* \text{Pandemic Dummy}_{it} + \epsilon
\end{aligned}$$

Independent Variables:

Variable	Formula
Change in Long-Term Debt	The Long-Term Debt divided by total assets per company, taken at a 8 quarter lag.
Change in Short-Term Investments	The Short-Term Investments divided by total assets, taken at a 8 quarter lag.
Change in Investments	The total investments divided by total assets per company, taken at a 8 quarter lag.
Liquid Asset Holding Rate	Cash and Cash Equivalents divided by the total amount of assets, taken at a 8 quarter lag.
Leverage Ratio	The Total Long-Term Debt plus debt in current liabilities divided by the total assets, taken at a 8 quarter lag.
Market Value of Equity	Daily closing price times the total amount of shares outstanding.
Tobin's Q	Total amount of assets plus the market value of equity minus the ordinary equity. All of this divided by the total amount of assets.
Current Leverage Ratio	The current leverage divided by the total assets taken at a 8 quarter lag.
Equity Reserves Ratio	Total equity reserves divided by total assets taken at a 8 quarter lag.
Logarithm of Sales	The logarithm of the Sales Turnover.
Sales Growth	The first difference of the Sales Turnover
Total Equity Growth	The first difference of the total equity divided by total assets. This is taken at a 8 quarter lag.
Total Liabilities Growth	The first difference of the total liabilities divided by total assets. This is taken at a 8 quarter lag.

EBITDA Growth Pandemic	The first difference of EBITDA. This takes a value 0 for any time data point before March 2020. It takes value 1 for any time data point after March 2020.
Pre-Pandemic	This takes a value of 1 for any time data point before March 2020 and a value of 0 for any time data point after March 2020.
Top Decile of Leverage	This is the Leverage split into ten parts per industry, country, or both. Then this is the data set including only the top decile of this leverage.

Appendix B: Regression Diagnostics

OLS-Regressions require the errors to be identically and independently distributed.

1. When beginning the data analysis, to figure out which Fixed Effects to incorporate, we ran a Hausman test. This ended up not being appropriate, bringing me to the conclusion that the errors have to be clustered.

The Chi-squared value of the regressions, while seeing if the fixed effects or random effects estimator is more appropriate, failed to meet the asymptotic assumptions of the Hausman test.

STATA Output:

Note: the rank of the differenced variance matrix (4) does not equal the number of coefficients being tested (6); be sure this is what you expect, or there may be problems computing the test. Examine the output of your estimators for anything unexpected and possibly consider scaling your variables so that the coefficients are on a similar scale.

Variables	Coefficients			
	(b)	(B)	(b-B)	sqrt(diag(V_b-V_B))
	fe1	re1	Difference	Std. err.
Logarithm of Sales	0.064754	0.0094793	0.0552747	0.0010471
Total Liabilities Growth	-1.935994	-919.848	-1.016146	.
Liquid Asset Holding Rate	-0.0113262	-0.010886	-0.000439	.
Short-Term Investment Change	-0.0001484	-0.016653	0.0165052	.
Long-Term Debt Change	0.0218817	0.0370242	-0.015142	.

Dummy for Top Decile Leverage During the Pandemic	0.000975	0.0005722	0.0004028	.
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b = Consistent under H0 and Ha; obtained from xtreg.

B = Inconsistent under Ha, efficient under H0; obtained from xtreg.

Test of H0: Difference in coefficients not systematic

$\chi^2(4) = (b-B)'[(V_b - V_B)^{-1}](b-B) = -88.00$

Warning: $\chi^2 < 0 \implies$ model fitted on these data fails to meet the asymptotic assumptions of the Hausman test; see suest for a generalized test.

(StataCorp 2021)

2. Violations of time-series independence, if present should have been taken care of through the inclusion of lags. Thus, the contemporaneous variables are all no longer contemporaneous in the most recent quarter but lagged by eight quarters to ensure independence.

3. The Shapiro Wild W Test is being used to check for normally distributed errors. The p-value indicates that the errors are distributed normally. Hence if P-value is larger than 0.05 there is no significant evidence that the errors are not normally distributed.

Given Model 1, the Shapiro Wild W test is run on error clustering for first the combinatory variable of industries and year, secondly for Industry and the time variable grouped, and thirdly for the individual firms and the time variable. As can be seen below, however, the residuals are not normally distributed, wherefore clustering is necessary.

Shapiro–Wilk W test for normal data for Model 1 (Top Decile of leverage being held)					
Variable	Obs	W	V	z	Prob>z
Residual (Time and Firms)	7,116	0.80102	736674	17.507	0.00000
Residual (Time and Industry)	7,284	0.73799	990108	18.304	0.00000
Residual (Industry and Year combination)	7,292	0.75612	922479	18.117	0.00000

Note: The normal approximation to the sampling distribution of W' is valid for $4 \leq n \leq 2000$.

(StataCorp 2021)

4. Given that the errors are not normally distributed, we decided to cluster them and utilize their fixed effects. Thus, the variables that were absorbed during the regression were the combinatory variable of the industry and time, the country and time, as well as the combination of industry, country and time variables.

To increase the robustness of the errors, we clustered the errors for the fixed effects groups of each regression model. The error clustering is done by comparing the multi-clustering of both the time and industry or country cluster separately, to their combinatory variable. The combination variable is taken for the regression outputs in this paper. Thus, an indicator variable that represents the fixed effects of the time and industry or country variable is taken for all regressions. The absorbed function by the used regression command is equivalent to using an additional dummy variable for each absorbed variable.

The regression command used, furthermore removes singleton groups by default. This is done to stop the bias of the standard errors. The normal robust estimation of heteroscedasticity-consistent standard errors cannot be used, as in fixed-effects panel regressions, the robust command will lead to inconsistent errors. This is due to more than one dimension being fixed. As the individual and time period do not grow asymptotically, the errors have to be clustered according to the different panel data dimensions. The cluster command that is used will hence estimate consistent standard errors, even if all observations are correlated inside different groups. (StataCorp 2021)

The most common pitfalls that Stata warns you about include the singleton observations not being dropped. Given the automatic dropping of these observations, this pitfall is resolved. As the dimensions are fixed across time and either industry or country, the errors have to be

clustered. The fact that the dimensions are not asymptotic altogether, which would have been another way to ensure that no clustering of errors is needed and normal robust standard error calculations could have been used, is given in the Hausman Test output. (StataCorp 2021)

5. After checking the errors and finding that these are not normally distributed, and hence have to be clustered, we check the data for its significance. The following T-Test was conducted with the hereon following results:

Variables Tested	Significance
Sales Growth and the Top Decile of Leverage	$\Pr(T > t) = 0.1927$
Sales Growth and the Top Two Deciles of Leverage	$\Pr(T > t) = 0.0186$
Sales Growth and the Top Three Deciles of Leverage	$\Pr(T > t) = 0.0001$

These results clearly show that the data set for the top decile is too small. The probability of it being repeated is not significant and only after the top two deciles of leverage are taken, then the data becomes statistically significant. The data set is thus distributed according to a Students T-Distribution. This can be further seen when looking at the Q-Q Plots of the errors.

Figure 1: Q-Q Plot on the normality of the standard errors of the Top Decile of Leverage

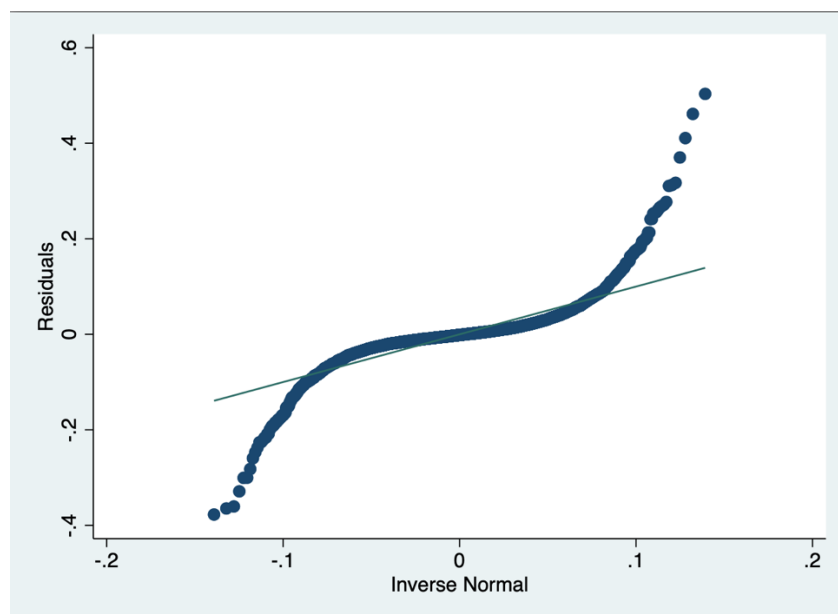


Figure 2: Q-Q Plot on the normality of the standard errors of the Top Two Deciles of Leverage

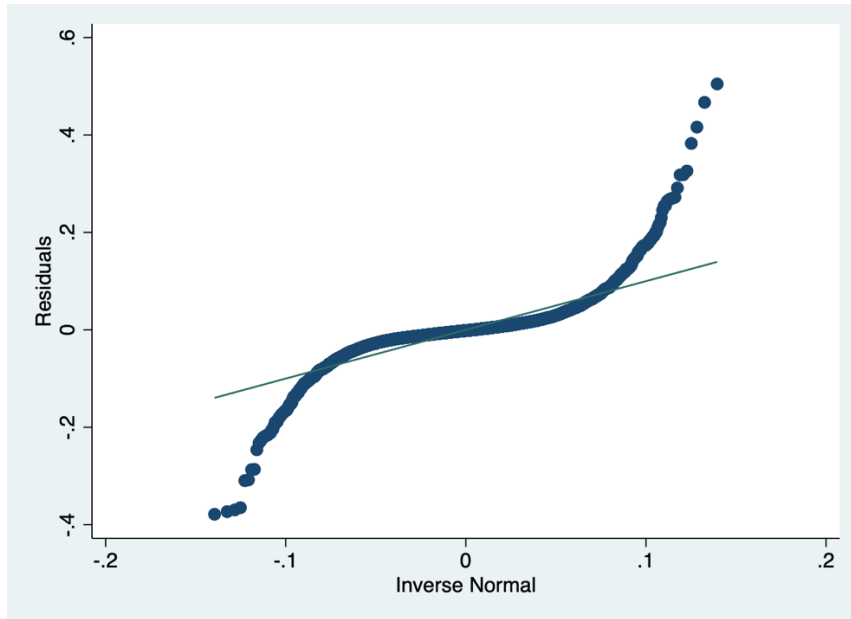


Figure 3: Q-Q Plot on the normality of the standard errors of the Top Three Deciles of Leverage

