THE PERFORMANCE AND RESILIENCE OF U.S. FIRMS DURING COVID-19

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Abstract

In this thesis I examine whether pre-characteristics of firms can explain both the COVID-19 impact on firm performance and the recovery period of firms after their COVID-19 impact. The firm performance is measured by means of the return on assets using data of approximately 23,000 firms across 66 industries. On average, firms experienced an increase in ROA due to COVID-19. Moreover, I found evidence that the industry is not the only determinant that explains the COVID-19 impact. Results show that there are significant differences in the COVID-19 impact between firms within the same industry. Furthermore, I found that larger firms, firms with limited leverage and firms with more liquidity experienced a more negative or a less positive impact from COVID-19. Regarding the recovery time of firms, I also found that there are differences between firms within the same industry. In addition, I found evidence that larger firms experience a longer recovery period than smaller firms. The results of this thesis can be relevant for managers, regulators, and investors. The results can help managers to create scenarios and better prepare to similar external effects, regulators can advise companies to better prepare for such events and investors can improve their investment portfolio.

Keywords: Pandemic; firm performance; COVID-19; U.S. firms; ROA; recovery

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1. Introduction

On 12 March 2020, the World Health Organization announced that COVID-19 caused a pandemic (World Health Organization (WHO), 2020). COVID-19 started in Wuhan, China. It is a virus which is highly infectious. Nobody anticipated that a virus could infect nearly every country in the world. An important aspect of COVID-19 is that it does not only lead to medical problems but also has a very high impact on the whole economy. A lot of countries went into lockdown, which meant that companies had to close their doors and people had to stay at home. The whole world became digital without much social contact. Due to the lockdown and other governmental measures to mitigate infections in every country, a lot of companies encountered difficulties. Companies had to continue to pay their fixed and personnel costs despite that they had less revenues in this period. Furthermore, employees became insecure because they did not know whether they could keep their jobs. However, despite all the negative consequences of COVID-19 some companies benefited from the pandemic. For example, companies in the telecommunication or technological sector performed on average very well, because their services were used significantly more than before.

In my research I will examine the impact of COVID-19 on firm performance. Furthermore, I will determine whether there are differences in the impact on the ROA between firms within the same industry. If there are differences, I will examine which pre-COVID-19 numbers could explain these differences between firms within the same industry. Finally, I will determine how quick firms recover after the impact of COVID-19. Here, I will also investigate if there are differences in recovery time between firms and whether the recovery period could be predicted with pre-COVID-19 numbers. I have stated two research questions that will be answered in this research paper.

The first research question is:

> ***"Can the COVID-19 impact on firm performance be explained by pre-COVID-19 firm-characteristics?"***

The second research question is:

> ***"Can the recovery time of firms after their COVID-19 impact be explained by pre-COVID-19 firm-characteristics?"***

This research can be valuable for a lot of stakeholders of the firms. Firstly, managers will benefit from my research. The results of my research can help managers to create strategies for similar situations. Also, it can mitigate the impact of a pandemic or any other big, external effect for their firm. Secondly, regulators will benefit from the results of my research. Regulators can advise and help firms to survive through such crises. Lastly, it has additional value for investors. The results can improve the portfolio of investors. Based on the results, they can invest in firms that performed better during the COVID-19 pandemic.

Three kinds of methods will be used. Firstly, I will use a two-sided paired sample t-test to determine the COVID-19 impact on the firms. Secondly, I will perform a t-test per firm to determine if there are differences in the COVID-19 impact between firms in the same industry. Furthermore, this test will also be used to determine if there are differences in the recovery time between firms within the same industry. The last method that I will use is a regression test. This test will be used to determine whether pre-COVID-19 financial characteristics could explain the COVID-19 impact on firms or the recovery time of firms.

Several results are achieved in this thesis. Firstly, I have looked at what the impact is of COVID-19 on the firm performance. I have determined this impact for every quarter of COVID-19. I have found that in each quarter of the COVID-19 period, firms experienced on average an increase in their ROA compared to the ROA in the pre-COVID-19 period. Secondly, I have examined whether there are differences in COVID-19 impact between firms within the same industry. I have found that for 30 of the 66 industries, there was a significant difference in COVID-19 impact between the firms. Thirdly, I have examined whether pre-COVID-19 financial characteristics could explain the COVID-19 impact on a firm. I have reached three findings. Larger firms, firms with less leverage, and firms with more liquidity experienced a more negative impact or a lower positive impact of COVID-19. Fourthly, I have examined if there are differences in recovery time between firms within the same industry. I have found that for 33 of the 58 industries, there was a significant difference in recovery time between the firms. Fifthly, I have examined whether pre-COVID-19 financial characteristics could explain the recovery time of a firm. I have reached one finding. Only the firm size variable can explain the recovery time of firms. Larger firms experienced a longer recovery period. The pre-COVID-19 variables leverage, and liquidity did not explain the recovery period of firms.

This thesis will contribute to the existing literature on several aspects. The first contribution of this research paper is that I considered a longer period than the other research papers that

are existing at the moment. Most existing papers only determined the impact of COVID-19 for the first few months of the COVID-19 period. However, I considered a sample period of a whole year. Another contribution is that I have measured the firm performance in return on assets (ROA). Most existing research papers have determined the impact of COVID-19 on the firm performance in stock prices. However, to determine the achieved performance of firms during COVID-19, I have used the return on assets. The third contribution is that I include U.S. listed firms from different industries. Including several different industries allow me to examine the differences in COVID-19 impact and recovery time between firms within the same industry. This will give new insights that are not examined yet.

There are three limitations for my research. The first limitation for my research is that my sample only consists of U.S. listed firms. This sample may not be representative for other countries or smaller firms. The second limitation of this research is the timing of this study. The moment that this research is written, the COVID-19 pandemic is still ongoing. Therefore, it is possible that there will become more relevant information available in the future. Furthermore, in the future the impact of COVID-19 on the longer term can be determined. The last limitation for this research is the time constraint. Due to time constraints, I only examined three pre-characteristics. Recommendations for future research would be to determine additional pre-characteristics that could explain the COVID-19 impact and recovery time of firms. Furthermore, due to the research time constraint, I only investigated the firm performance by means of the ROA. Recommendations for future research would be to also measure the impact in other firm performance measures like ROE.

The rest of the paper is structured as follows. Chapter 2 discusses prior literature of the COVID-19 impact and recovery period of firms after the COVID-19 impact. Chapter 3 describes the sample selection process and the methodology. Chapter 4 presents the results. In chapter 5 the conclusion is presented, and the limitations of this research are discussed.

2. Theoretical background

In this chapter, I describe and discuss prior literature on the impact of COVID-19 and the recovery of firms after the COVID-19 impact. Based on this theoretical background, I formulate several hypotheses which I will test during this research paper.

2.1. COVID-19 impact and firm performance

The World Health Organization (WHO) characterized COVID-19 as a pandemic on 11 March 2020 (World Health Organization (WHO), 2020). COVID-19 is a worldwide health emergency. Besides the enormous impact on health care, there is also a huge impact on the economy and the financial markets. Most countries in the world implemented mandatory lockdowns to control the infections of COVID-19 (Xiong, Wu, Hou, & Zhang, 2020). Non-essential companies had to close their doors for a certain period and the governments restricted non-essential travel (Chen & Yeh, 2021). These restrictions led to a reduction in demand for firms, which resulted in less income while the costs remained high. Therefore, the impact of the COVID-19 restrictions was probably big for the performance of companies.

Prior research did already investigate the impact of COVID-19 on some firm characteristics. Devi et al. (2020) found that Indonesian public firms increased their activity (productivity ratio) and leverage ratio, while their liquidity and profitability ratio decreased during COVID-19. Another research written by Bloom et al. (2021) found that the revenue of U.S. firms decreased on average with 29% in the second quarter of 2020. The authors also found that there was a large difference in the sales impact between firms. They investigated that more than 40% of the U.S. firms reported a positive or zero impact on sales and more than 50% of the firms reported a loss. So, on average there is a negative impact on the sales of U.S. firms. In addition, prior research examined the impact of COVID-19 on the performance of Chinese firms, which is measured in stock prices. The authors found that COVID-19 did lead to a negative impact on the stock performance of Chinese firms (Shen, Fu, Pan, Yu, & Chen, 2020). Besides the prior research on the impact of COVID-19 on financial characteristics, there is still a lack of research on the impact of COVID-19 on the realized performance of U.S. firms. At this moment the financial performance was only measured in stock prices, which is the investor's perception of the performance of the firm (market-based measure), and in sales. However, there is still no research that investigated the impact on the realized effectiveness and

efficiency of the firm (accounting-based measure). Therefore, I am interested in the accounting-based measure of firm performance to examine the impact of COVID-19 for firms. I will use the ratio Return on Assets (ROA) to examine the firm performance. The ROA presents how much profit a firm can generate for each dollar that is invested in the firm's assets (Palepu, Healy, & Peek, 2019). I have formulated the following null hypothesis:

$H1_0$: The financial performance of companies is not affected by the COVID-19 pandemic

2.2. The differences and determinants of the COVID-19 impact

Prior research investigated the differences in COVID-19 impact between industries. These studies have clarified which industries have been hit the most and which industries the least. According to Ramelli and Wagner (2020), the staples and food retail is the industry with the least impact and the consumer services industry experienced the biggest impact of COVID-19. However, there is no research on the differences in COVID-19 impact on firm performance between firms within the same industry yet. There are two possible perspectives on this topic. On the one hand, the government often implemented restrictions for an entire industry. Therefore, I expect that firms within the same industry got the same governmental restrictions for COVID-19, and that they also experienced the same impact on their performance. On the other hand, I expect that the impact of firms within an industry can be very heterogeneous. As described above, Bloom et al. (2021) examined that there is a big difference in impact on sales across firms and across industries. More than 50% of the U.S. firms had a decline in their sales, whereas the rest of the firms experienced no impact or increased their sales during COVID-19. Moreover, I expect that each firm will respond to the pandemic in its own way. Firstly, some firms are more flexible in changing their activities or products. For example, some restaurants focused on home delivery of their food to continue their businesses (Morgan Stanley, 2020). Furthermore, some specific firm characteristics can lead to a different performance or stock market reaction than other firms in the industry. For example, Xiong et al. (2020) found that Chinese firms with high institutional investors experienced a more negative market reaction. In addition, the authors found that Chinese firms with more profitability, a larger scale, less fixed assets, more growth opportunities, and a higher combined leverage performed better on the stock market.

Because of the two possible perspectives on this topic, hypothesis 2 is written as a null hypothesis:

$H2_0$: There are no differences in the impact of COVID-19 on the financial performance between companies within the same industry

In case that there are differences between firms within the same industry, it is interesting to know what the reason is of these observed differences in COVID-19 impact on firm performance. Prior research already examined some financial characteristics of firms that explain their stock market reaction during COVID-19. I will use the findings from prior literature to determine which financial characteristics I would like to test for the explanation of the COVID-19 impact of firms on the ROA. As described above, Xiong et al. (2020) did research about some causes for these differences for Chinese firms related to their stock market reaction. Their results showed that Chinese firms with more profitability, a larger scale, less fixed assets, more growth opportunities, and a higher combined leverage performed better on the stock market during COVID-19. They also found that firms with high institutional investors experienced a more negative market reaction (Xiong, Wu, Hou, & Zhang, 2020). Unfortunately, Xiong et al. (2020) gave no economic explanations for their results. In addition, Song et al. (2021) examined which past characteristics could predict the degree of COVID-19 impact on the stock price for U.S. restaurants. The authors found that larger restaurants and restaurants with a worse ROA, more cash, more internationalization, and more leverage experienced a lower decline in stock prices than other restaurants (Song, Yeon, & Lee, 2021). Also Ding et al. (2020) did research about whether firm characteristics could explain the impact of COVID-19 on firms. They investigated the stock market reaction of firms from 61 different economies during COVID-19. The authors found that firms with stronger pre-COVID-19 financial data (larger profits, less debt, and more cash) experienced a milder drop in their stock returns. Furthermore, they found that firms that are controlled by government, families or large corporations experienced less impact of COVID-19 (Ding, Levine, Lin, & Xie, 2020). Moreover, Ramelli and Wagner (2020) also examined differences in the impact of COVID-19 on stock market reactions of firms. They found that firms that had high leverage and little cash holdings did poorly during COVID-19 (Ramelli & Wagner, 2020). Lastly, Kaczmarek et al. (2021) also found that firms in the tourism sector with limited leverage experienced a smaller impact

in their stock prices (Kaczmarek, Perez, Demir, & Zaremba, 2021). So, prior literature has some mixed evidence on the variable leverage and profitability but are consistent for the variables size and liquidity. In addition to the above prior literature, I will examine whether pre-COVID-19 financial data can explain the differences in impact of COVID-19 between firms within the same industry. My research will contribute to the current literature because none of the existing research described above have measured firm performance with the ROA. So, there is no research into the determinants which explain the differences in impact on the realized performance of firms instead of on the stock market. As explained in chapter 2.1, I will focus on the ROA because I would like to measure the operational effectiveness and efficiency of a firm. This is the reason why I will conduct a research that examines whether pre-COVID-19 numbers of firms can explain the differences in impact on ROA within the same industry. I will use three ratios as pre-COVID-19 numbers: firm size, leverage, and liquidity. I have formulated the following three null hypotheses, where each of the hypothesis is representing one pre-COVID-19 number:

$H3A_0$: The pre-COVID-19 variable firm size cannot explain the differences of the impact of COVID-19 on the financial performance of companies within the same industry

According to prior research, firm size has a positive relation with the firm performance, which is measured in ROA (Diaz & Pandey, 2019; Nguyen & Nguyen, 2020; Tailab, 2014). Prior research suggests that larger firms can make use of scale economy, which makes them more effective than smaller firms (Dogan, 2013). Furthermore, according to Ding et al. (2020), Song et al. (2021) and Xiong et al. (2020), larger firms experienced a less strong negative decrease in stock prices. The explanation of this could be that larger firms are able to withstand the effects of the COVID-19 period more effectively by means of their own funding. Based on this theoretical background, I expect that firm size will have a positive association on the COVID-19 impact of a firm. This will mean that a larger firm size will lead to a more positive impact or a less negative impact.

$H3B_0$: The pre-COVID-19 variable leverage cannot explain the differences of the impact of COVID-19 on the financial performance of companies within the same industry

Prior research showed that in general there is a negative relation between leverage and ROA (Dogan, 2013; Matar & Eneizan, 2018; Tailab, 2014). This means that firms that have a lot of

debt have a low profitability. The explanation is that the leverage of a firm leads to increased costs for resources. These increased costs lead to a lower profitability. In addition, there is a higher risk of uncertainty which can lead to unexpected losses (Kartikasari & Merianti, 2016). However, there is prior literature that shows a positive association between leverage and firm performance (Nguyen & Nguyen, 2020). The explanation for this positive association is that when the leverage is used efficiently, it can increase the firm performance (Kartikasari & Merianti, 2016). When I focus on the association between leverage and the firm performance (measured in stock prices) for COVID-19 specifically, there is still mixed evidence about this association. As described above, Xiong et al. (2020) and Song et al. (2021) determined that there is a positive association between leverage and COVID-19 impact while Ding et al. (2020), Ramelli & Wagner (2020), and Kaczmarek et al. (2021) showed a negative association between leverage and COVID-19 impact. Based on the above literature, there is a possibility that the variable leverage can explain the COVID-19 impact on a firm. Because the majority of the reviewed papers show a negative association between the variable leverage and the ROA of a firm, I expect that firms with more leverage will experience a more negative or a less positive COVID-19 impact.

$H3C_0$: The pre-COVID-19 variable liquidity cannot explain the differences of the impact of COVID-19 on the financial performance of companies within the same industry

Prior research shows a positive relation between liquidity and the firm performance that is measured in ROA (Matar & Eneizan, 2018; Nguyen & Nguyen, 2019; Tailab, 2014). When a firm has a lot of liquid assets, there is a decrease in liquidity risk. This can lead to an increase in the profitability of firms (Dogan, 2013). In addition, when a firm has a lot of liquid assets, it can pay its obligations when earnings are low, or the firm can cope with risks that are unforeseen (Matar & Eneizan, 2018). Furthermore, according to the research of Ding et al. (2020), Song et al. (2021) and Ramelli and Wagner (2020), firms with more cash experienced a less strong negative decrease in their stock prices during COVID-19. Song et al. (2021) also gives the explanation that firms with more liquidity are able to keep paying obligations and to withstand uncertainties during COVID-19. Based on the described prior literature, I expect that the variable liquidity can explain the COVID-19 impact of a firm. Hereby, liquidity will have a positive association on the COVID-19 impact of a firm. This will mean that a firm with more liquidity will lead to a more positive impact or a less negative impact.

2.3. The differences and determinants of the recovery period after COVID-19

After a few months of lockdowns, the relaxation of measures to prevent COVID-19 was finally possible. Worldwide, a lot of pharmaceutical firms worked hard to offer vaccines to beat COVID-19. On 11 December 2020, the first vaccine, called Pfizer-BioNTech, gained authorization. After this announcement, the U.S. announced their vaccine distribution plan (Stieb & Danner, 2020). Due to the decreasing infections and the increasing vaccinations, the government dared to open businesses again. On 6 May 2021, already one-third of the U.S. citizens had been vaccinated and this share is still increasing sharply (Davidson, 2021).

Since the daily COVID-19 cases are decreasing, the number of vaccinated people is increasing sharply, and the COVID-19 restrictions are lifted, firms are now able to start recovering from the impact of COVID-19. To determine the expected recovery time of firms, the authors Chen and Yeh (2021) examined the recovery of the stock prices of U.S. firms. The stock prices of firms recovered after 10 days, which was due to the announcement of quantitative easing of the fed (Chen & Yeh, 2021). This quantitative easing announcement created confidence for investors again. However, although the perception of investors does matter for the stock prices, it does not matter for the return on assets ratio which I use to measure firm performance. So, probably firms with a negative impact by COVID-19 will not recover their ROA as quick as their stock prices. Another research, written by Wang and Shiu (2014), showed that the average recovery period is 23 months for firms that are in financial distress.
So, there is still a lack of accounting research on the recovery of the realized performance of firms after the impact of COVID-19. As mentioned, at this moment there is only evidence of the recovery period of firms where the firm performance is measured in stock prices and for firms that are in financial distress. To measure the recovery of the effectiveness and efficiency of a firm, I will again use the ratio ROA. I will consider firms as recovered when they achieve the same return on assets ratio as before COVID-19. To test if there is a difference in recovery period for firms within the same industry, I formulated the following hypothesis in the null form:

$H4_0$: There are no differences in the recovery time between firms within the same industry from the impact of the COVID-19 pandemic

When hypothesis 2 shows differences in the COVID-19 impact between companies within the same industry, I also expect that hypothesis 4 will show differences in the recovery time of firms within the same industry. The reason for this is that I expect that firms that are impacted less can recover faster than firms that are impacted heavily. I think this because these firms still have the necessary resources to keep working and to invest in the firm, which can help them to recover quickly. In addition, firms with less impact are faster at the level at which the company was performing before COVID-19. On the other hand, it is possible that firms that are heavily impacted take more actions to deal with COVID-19, which can result in a quicker recovery. In summary, I suggest that firm's characteristics and unique responses to the COVID-19 situation leads to different recovery periods for each company. So, I expect that there is a difference in recovery time between firms within the same industry.

In case hypothesis 4 will show differences in recovery time between firms within the same industry, I will examine whether the pre-COVID-19 numbers of firms can explain these differences in the recovery period. Because COVID-19 is still not banned completely and firms are still recovering, there is almost no research about the recovery of firms after COVID-19 and the determinants of the differences in recovery time between firms yet. Despite the current lack of prior research, I do have certain expectations. I expect that the pre-COVID-19 numbers that can explain the difference in impact between firms in the same industry also can explain the difference in recovery time between firms in the same industry. Therefore, I will test the same three pre-COVID-19 characteristics and include impact as a control variable. Furthermore, due to the lack of economic explanation for the COVID-19 situation, I will use a research paper on recovery time after the global financial crisis of 2008 as an example to make some expectations on the determinants for the recovery time after COVID-19. Although these two crises differ in nature, both crises caused economic impact and uncertainty for firms (Strauss-Kahn, 2020). Medina (2012) did research about which pre-characteristics of manufacturing firms could explain the recovery time after the global financial crisis. He found that debt had a negative effect on the recovery time of a firm. An explanation for this is that leverage affect the growth possibility of a firm in many ways. Another explanation is that leverage leads to an increase in corporate risk and higher costs of external funds.
Similar to hypothesis 2, I will use the same three ratios as pre-COVID-19 numbers: firm size, leverage, and liquidity. In contrast to the previous studies, this performance will be measured

by means of the return on assets (ROA). The three formulated null hypotheses will be shown below, where each of the hypothesis is representing one pre-COVID-19 number. Because of the lack of research about the recovery of firms after COVID-19, it is hard to base my expectations on an economic background. Therefore, I use prior literature that examine the general association between the firm characteristics and the ROA.

$H5A_0$: The pre-COVID-19 variable firm size cannot explain the differences in the recovery period between firms within the same industry after COVID-19

Prior research shows that firm size has a positive association with firm performance that is measured in ROA (Nguyen & Nguyen, 2019; Pandey & Diaz, 2019; Tailab, 2014). Furthermore, larger firms can use scale economy that makes it possible to perform more effectively than smaller firms (Dogan, 2013). Therefore, I expect that larger firms are recovering faster from COVID-19 impact than smaller firms.

$H5B_0$: The pre-COVID-19 variable leverage cannot explain the differences in the recovery period between firms within the same industry after COVID-19.

Based on the research paper of Medina (2012), which is described above, I expect a negative association between the pre-characteristic leverage and the recovery time of a firm after a crisis. In addition, prior literature showed that in general there is a negative association between the leverage of a firm and their ROA (Dogan, 2013; Matar & Eneizan, 2018; Tailab, 2014). The explanation for this is that leverage leads to increased costs, and thus lower profitability and higher risks of uncertainty (Kartikasari & Merianti, 2016).

$H5C_0$: The pre-COVID-19 variable liquidity cannot explain the differences in the recovery period between firms within the same industry after COVID-19.

As described earlier, prior research found that in general there is a positive association between liquidity and the ROA of a firm (Matar & Eneizan, 2018; Nguyen & Nguyen, 2019; Tailab, 2014). A firm with more liquid assets, has a lower liquidity risk and therefore often a higher profitability (Dogan, 2013). Therefore, I expect that firms with more liquidity will recover faster from their COVID-19 impact.

3. Research design

In this chapter I will start with a description of the sample selection process. After that, I will describe the dependent and independent variables. Lastly, I will mention the methodology to test each hypothesis.

3.1. Data sources

This study examines the impact of COVID-19 on firm performance and the recovery of firms that had a negative impact. The data will be retrieved from the Wharton Research Data Services (WRDS) website. I will gather all necessary data from the database *Compustat – North America Daily – Fundamentals Quarterly*. This database consists of all quarterly data of U.S. firms to calculate the firm performance and pre-COVID-19 variables. I will gather all quarterly numbers in the period from October 2019 until March 2021.

3.2. Sample description

From the Compustat database, I gather 63,945 quarterly observations of 11,636 unique firms. Using programming language R, I drop all firms that do not have an ending fiscal year on 31 December. The remaining firms will now have reported their quarterly numbers on the same dates, which makes it easier to compare the performance of the companies each quarter. In addition, I removed all observations that do not have the U.S. as origin country. So, I removed firms from Canada and Mexico. Furthermore, to create multiple variables like ratios that will be used as pre-COVID-19 numbers, I drop all the firm quarterly observations with missing values. An exception is the baseline for the firm performance, if this value is missing, the whole firm is eliminated. Moreover, I remove all observations that do not have a SIC-code. Otherwise, I am not able to determine to which industry a firm belongs. Finally, the sample size consists of 23,007 quarterly observations of 4,142 firms. A summary of the sample selection process is shown in table 1 panel A.

The observations are from the period of October 2019 until March 2021. This sample period will be divided into two periods, as can be seen in figure 1. The first period is the pre-COVID-19 period. This pre-COVID-19 period starts in the last quarter of 2019. The numbers in this period are used to calculate the ROA and the pre-COVID-19 numbers in the pre-COVID-19 period.

Table 1

Panel A: Summary of the sample selection process

Sampling procedure	**Observations**	**Unique firms**
Quarterly financial data of North American firms	63,945	11,636
Less: Observations without fiscal end on 31 Dec	-11,295	-2,119
Less: Observations that are not located in the U.S.	-15,786	-2,843
Less: Observations with missing financial data	-13,857	-2,532
Less: Observations without SIC-code	0	0
Final sample	**23,007**	**4,142**

Panel B: Summary of quarterly observations per year

Year	**Observations**
2019	4,043
2020	15,195
2021	3,769
Total	**23,007**

In table 1 panel A the summary of the sample selection process is shown. The final sample consists of 23,007 quarterly firm-observations from 4,142 U.S. firms between October 2019 until March 2021. In table 1 panel B the summary of the quarterly firm-observations is shown per year. The final sample has 4,043 quarterly firm observations in 2019, 15,195 quarterly firm-observations in 2020 and 3,769 quarterly firm observations in 2021.

The second period is the COVID-19 period. This COVID-19 period starts in the first quarter of 2020 and ends with the first quarter of 2021. The first quarter of 2020 is chosen as starting date because in this quarter the WHO characterized COVID-19 as a pandemic, and the U.S. implemented a lockdown. The first quarter of 2021 is chosen as ending date because this is the quarter with the latest available quarterly numbers of the firms. The quarterly numbers in this COVID-19 period are used to calculate the impact and the recovery period of firms. A summary of the quarterly observations per year is shown in table 1 panel B.

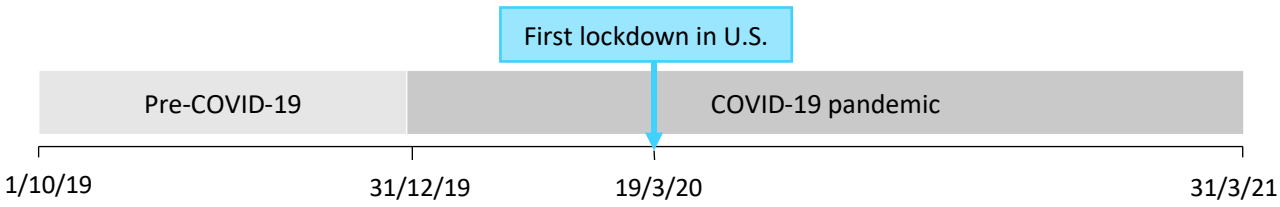

Figure 1: Research period

3.3. Dependent variables

3.3.1. Impact of COVID-19

To determine the impact of COVID-19 on firm performance, I will compare the ROA of each quarter during the COVID-19 pandemic with the ROA in the last quarter of the pre-COVID-19 period. Equation 1 will be used five times to determine the COVID-19 impact in each COVID-19 quarter. The COVID-19 impact will be computed in percentage points. To compute the COVID-19 impact ($CI_{F,t}$) on the firm performance, I use the following equation:

$$CI_{F,t} = ROA_{F,t} - ROA_{F,2019} \quad (1)$$

Where $ROA_{F,t}$ is the return on assets of firm F in quarter t in the COVID-19 period and $ROA_{F,2019}$ is the return on assets of firm F in the last quarter of the pre-COVID-19 period. The $ROA_{F,t}$ is measured by the net income of firm F in quarter t divided by the total assets of firm F at the end of quarter t. The $ROA_{F,2019}$ is measured by the net income of firm F in the last quarter of 2019 divided by the total assets of firm F in the last quarter of 2019. The $ROA_{F,t}$ and the $ROA_{F,2019}$ will be described in more detail in chapter 3.4.

3.3.2. Recovery time after COVID-19

Besides determining the COVID-19 impact on firms, I also want to examine whether firms have recovered from this initial impact. I will determine how long it takes for firms to recover from the COVID-19 impact. I will use a sample which only consists of firms that had a negative COVID-19 impact. I consider firms as recovered when they realize a ROA which is equal or higher than the pre-COVID-19 ROA. The recovery period is measured in quarters. The end of the quarter in which the firms recover is called the recovery date (RQ_F). Then, they recovered from the COVID-19 impact and perform like they did prior to the pandemic. This date will be compared with the first quarter of 2020 ($Q_{1,2020}$) because this is the date where these firms experienced their first COVID-19 impact. To compute the recovery period (RP_F) of firm F after the initial impact of COVID-19, I use the following equation:

$$RP_F = RQ_F - Q_{1,2020} \quad (2)$$

Where RQ_F is the first quarter when the ROA of firm F is equal or above to the pre-COVID-19 ROA, and $Q_{1,2020}$ is the quarter of the COVID-19 outbreak when firms in the sample experienced a negative impact.

3.4. Independent variables

3.4.1. ROA

There are two ways to measure the performance of a firm. The first method is a market-based measure, the second method is an accounting-based measure (Gentry & Shen, 2010). The market-based measure is based on an investors' perception of firm performance. A commonly used market-based measure is a firm's change in stock price. The accounting-based measure is based on profitability as a measure for the company's performance. An accounting-based measure reflects the firm's operational effectiveness and efficiency. So, such an accounting-based measure will focus more on the realized performance of the company itself, and not the performance according to investors. Because I want to examine whether the realized performance of the company is impacted due to COVID-19, I will use an accounting-based measure. In addition, prior research already investigated the impact of COVID-19 on a firm's stock price.

One of the accounting-based measures is the return on assets (ROA) of a firm, which I will use to measure firm performance. Hereby, I follow another research paper who examined firm performance during COVID-19 with the ROA (Hu & Zhang, 2021). The ROA shows how much profit a firm can generate for each dollar that is invested in the firm's assets (Palepu, Healy, & Peek, 2019). ROA is often used when there will be made a comparison of a firm's performance between periods (Corporate Finance Institute, sd). ROA is a measure that is widely available. Moreover, an advantage compared to other performance ratios like ROE is that the ROA is less vulnerable to financial engineering in the income statement. The reason for this is that ROA involves decisions for long-term assets which are more difficult to modify in short term. Finally, an advantage of ROA is that it has a holistic way. This means that it looks at both the assets which are needed to run the business and the performance according to the income statement (Hagel, Brown, Samoylova, & Lui, 2013). Due to the above advantages, I will use

ROA as a measure for firm performance. To compute the return on assets ($ROA_{F,t}$) of firm F in quarter t in the COVID-19 period, I use the following equation:

$$ROA_{F,t} = \frac{NI_{F,t}}{TA_{F,t}} * 100\% \quad (3)$$

Where $NI_{F,t}$ is the net income of firm F in quarter t and $TA_{F,t}$ are the total assets of firm F in quarter t.

3.4.2. Pre-COVID-19 ROA

To have a baseline for the firm performance which is not affected by COVID-19 yet, I will calculate the ROA for the last quarter of 2019 (pre-COVID-19 period). To compute the return on assets in the pre-COVID-19 period ($\mathrm{ROA}_{\mathrm{F},2019}$) of firm F, I will use the following equation:

$$ROA_{F,2019} = \frac{NI_{F,2019}}{TA_{F,2019}} * 100\% \quad (4)$$

Where $NI_{F,2019}$ is the net income of firm F in the last quarter of 2019 and $TA_{F,2019}$ are the total assets of firm F in the last quarter of 2019.

3.4.3. Pre-COVID-19 numbers

To examine whether pre-COVID-19 numbers can explain the impact and recovery time of firms during COVID-19, I will consider three basic financial characteristics of firms: firm size, leverage, and liquidity (Ding, Levine, Lin, & Xie, 2020). The pre-COVID-19 numbers are the realized numbers in the last quarter of 2019. These numbers from the fourth quarter of 2019 are not affected by COVID-19. Below, each financial characteristic will be described:

3.4.3.1. Firm size

To calculate the pre-COVID-19 firm size of firm F ($FS_{F,2019}$), I use the following equation:

$$FS_{F,2019} = \log(TA_{F,2019}) \quad (5)$$

Where $TA_{F,2019}$ is the total assets of firm F in the last quarter of 2019.

3.4.3.2. Leverage

To calculate the pre-COVID-19 leverage of firm F ($LEV_{F,2019}$), I use the following equation:

$$LEV_{F,2019} = \left(\frac{TD_{F,2019}}{TA_{F,2019}}\right) * 100\% \quad (6)$$

Where $TD_{F,2019}$ is the total debt of firm F in the last quarter of 2019, and $TA_{F,2019}$ is the total assets of firm F in the last quarter of 2019.

3.4.3.3. Liquidity

To calculate the pre-COVID-19 liquidity of firm F ($LIQ_{F,2019}$), I use the following equation:

$$LIQ_{F,2019} = \left(\frac{CASH_{F,2019} + SHI_{F,2019}}{TA_{F,2019}}\right) * 100\% \quad (7)$$

Where $CASH_{F,2019}$ is the cash of firm F in the last quarter of 2019, $SHI_{F,2019}$ is the short-term investments of firm F in the last quarter of 2019, and $TA_{F,2019}$ is the total assets of firm F in the last quarter of 2019.

3.5. Statistical tests and regression models

3.5.1. Impact of COVID-19

Hypothesis 1 will test whether the financial performance of companies is affected by the COVID-19 pandemic. To determine the impact of COVID-19 on firm performance, I will use equation 1. I will compare the ROA of each quarter during the COVID-19 period with the ROA of the last quarter in the pre-COVID-19 period. I will perform a t-test for each quarter to determine the short and long-term impact of COVID-19 on firm performance. To test null hypothesis 1, I will perform a two-sided paired sample t-test. Therefore, I will determine whether $CI_{F,t} = 0$.

3.5.2. Differences in COVID-19 impact within industries

In hypothesis 2, I will examine if there are differences between the COVID-19 impact of firms within the same industry. To test hypothesis 2, I will compare the impact on the performance of a firm and the average impact of companies within the same industry. The industry is determined by the company's two-digit SIC-code. The average impact of the industry is calculated by the average of all the COVID-19 impacts of the firms belonging to the same industry. To calculate the impact difference of firms within the same industry ($IDWI_{F,t}$), the following equation is used:

$$IDWI_{F,t} = CI_{F,t} - AVG\_CI\_IND_{I,t} \quad (8)$$

Where $CI_{F,t}$ stands for impact of firm F in the first quarter of COVID-19 and $AVG\_CI\_IND_{I,t}$ stands for the average impact of industry I in the first quarter of COVID-19, including firm F. To test null hypothesis 2, I will compute a t-statistic for every firm in the sample. In this test, I will determine whether $IDWI_{F,t} = 0$.

3.5.3. Association between COVID-19 impact and pre-COVID-19 numbers

After determining the COVID-19 impact of firms and whether there are differences in impact between firms in the same industry, I will examine if the COVID-19 impact of firms can be explained by pre-COVID-19 numbers in hypothesis 3. As described in chapter 3.4.3, three pre-COVID-19 numbers will be used. The following regression equation will be used to test hypothesis 3:

$$CI_{F,t} = \beta_0 + \beta_1 * FS_{F,2019} + \beta_2 * LEV_{F,2019} + \beta_3 * LIQ_{F,2019} + \delta_I + \varepsilon \quad (9)$$

Where $CI_{F,t}$ is the COVID-19 impact of firm F in the first quarter during COVID-19, $FS_{F,2019}$ is the firm size of firm F in 2019, $LEV_{F,2019}$ is the leverage of firm F in 2019 and $LIQ_{F,2019}$ is the liquidity of firm F in 2019. I include industry fixed effects (δ_I) to ignore time-varying industry factors. These industries are based on the two-digits SIC-code.

I will base my expectations for the coefficients on the prior literature described in chapter 2.2. Regarding the coefficient for $FS_{F,2019}$, I expect that firms of a larger size will experience a less negative or a higher positive impact than smaller firms. Because of this expectation, I test whether $\beta_1 > 0$ in this regression model. Regarding the coefficient $LEV_{F,2019}$, I expect that firms that have more debt will experience a more negative or a less positive impact of COVID-19 than firms with less debt. Therefore, I test whether $\beta_2 < 0$ in this regression model. Regarding the variable liquidity ($LIQ_{F,2019}$), I expect that firms that have more liquidity will experience a less negative or a higher positive impact than firms that possess fewer liquid assets. Therefore, I test whether $\beta_3 > 0$ in this regression model.

3.5.4. Differences in recovery time within industries

Hypothesis 4 will test whether there are no differences in the recovery period between firms within the same industry. The average recovery period of the industry is calculated by the average recovery period of each firm belonging to the same industry. The industry is again

determined by the company's two-digit SIC-code. To compute if there are differences in the recovery period of firms within the same industry ($RDWI_F$), I use the following equation:

$$RDWI_F = RP_F - AVG\_RP\_IND_I \quad (10)$$

Where RP_F is the recovery period of firm F and $AVG\_RP\_IND_I$ is the average recovery period of industry I, including firm F. To test null hypothesis 4, I will compute a t-statistic for every firm in the sample. In these tests, I will determine whether $RDWI_F = 0$.

3.5.5. Association between recovery period and pre-COVID-19 numbers

After determining the recovery period of firms and whether there are differences in the recovery period between firms within the same industry, I want to investigate if the pre-COVID-19 numbers of a firm can explain the recovery period of firms after their COVID-19 impact. I will use the pre-COVID-19 numbers as described in chapter 3.4.3. To test this hypothesis, I use the following regression equation:

$$RP_F = \beta_0 + \beta_1 * FS_{F,2019} + \beta_2 * LEV_{F,2019} + \beta_3 * LIQ_{F,2019} + \beta_4 * CI_{F,t} + \delta_I + \varepsilon \quad (11)$$

Where RP_F is the recovery period of firm F, $FS_{F,2019}$ is the firm size of firm F in 2019, $LEV_{F,2019}$ is the leverage of firm F in 2019, and $LIQ_{F,2019}$ is the liquidity of firm F in 2019. I include the COVID-19 impact ($CI_{F,t}$) of firm F in the first quarter as control variable. This control variable makes sure that the experienced impact is no moderating variable for the relationship between the firm characteristics and the recovery time. Moreover, I include industry fixed effects (δ_I) to absorb time-varying industry factors. These industries are based on the two-digits SIC-code.
I will base my expectations for the coefficients on the prior literature described in chapter 2.3. Regarding the variable firm size ($FS_{F,2019}$), I expect that firms of a larger size can recover faster than smaller firms. Therefore, I test whether $\beta_1 < 0$ in this regression model. Regarding the variable leverage ($LEV_{F,2019}$), I expect that highly indebted companies will take longer to recover. Therefore, I test whether $\beta_2 > 0$ in this regression model. Regarding the variable liquidity ($LIQ_{F,2019}$), I expect that firms that had a higher liquidity position before COVID-19 can recover faster than firms with small amount of liquid assets. Therefore, I test whether $\beta_3 < 0$ in this regression model.

4. Empirical results and analysis

This chapter starts with an overview of the descriptive statistics. After that, the empirical findings of all the hypotheses will be presented and discussed.

4.1. Descriptive statistics

Table 2 shows the descriptive statistics of all variables used in this research. The firm performance measures (ROA and ROA_{2019}) and the pre-COVID-19 numbers (FS_{2019}, LEV_{2019}, and LIQ_{2019}) are winsorized at the 5% level. As shown in table 2, the mean value of CI is positive, suggesting that U.S. firms experienced a positive impact on their ROA during COVID-19. In addition, the mean of the ROA during COVID-19 (ROA) is -3.268 percent and the mean of the ROA before COVID-19 (ROA_{2019}) is -4.658 percent. These variables also show that firms experienced a more positive impact in ROA during COVID-19. One important note to include is that the minimum of CI reveals that some firms experienced a negative impact. So, not all the firms experienced an increase in ROA. The mean of the IDWI is zero, because this variable is calculated by the comparison between the COVID-19 impact of a firm (CI) and the average weighted COVID-19 impact of the industry (AVG_CI_IND). The minimum and maximum value of the IDWI may reveal that there is a difference in COVID-19 impact between firms within the same industry. The number of observations for the pre-COVID-19 variables (FS_{2019}, LEV_{2019}, and LIQ_{2019}) and for the recovery period variables (RP, AVG_RP_IND, and RDWI) are lower, because each firm has only one value for each of these variables instead of 5 values per firm for each quarter. In addition, for the recovery period variables, only companies with a negative COVID-19 impact were used. The average firm size, leverage, and liquidity in 2019 are 6.420, 30.400% of the total assets, and 21.517% of the total assets respectively. The mean of RP is 1.563. This means that firms have an average recovery period of 1.563 quarters. The minimum of RP is 1 quarter, because only firms with a negative impact are used. Therefore, firms with a RP value of 0 are excluded. The maximum of RP is 4 quarters, because the sample period that is used ends after the first quarter of 2021. The mean of the RDWI is zero, because this variable is calculated by the comparison between the recovery period of a firm (RP) and the weighted average recovery period of the industry (AVG_RP_IND). The minimum and maximum value of the RDWI may reveal that there is a difference in recovery period between firms within the same industry.

Table 2

Descriptive statistics

	N	Mean	SD	Min	Median	Max
CI	18,619	1.389	7.993	-33.046	0.022	47.204
ROA	18,619	-3.268	8.216	-29.076	0.147	4.366
ROA_{2019}	18,619	-4.658	11.591	-42.838	0.231	3.970
AVG_CI_IND	18,619	1.389	1.851	-21.578	0.583	7.115
IDWI	18,619	0.000	7.776	-37.383	-0.201	46.848
FS_{2019}	4,018	6.420	2.894	-6.908	6.797	15.069
LEV_{2019}	4,018	28.449	88.848	0.000	16.399	3,143.028
LIQ_{2019}	4,018	21.517	28.184	0.000	7.384	100.000
RP	1,495	1.563	0.895	1.000	1.000	4.000
AVG_RP_IND	1,495	1.563	0.248	1.000	1.455	4.000
RDWI	1,495	0.000	0.860	-1.167	-0.450	2.625

This table presents the descriptive statistics of the key variables used in this research. CI represents the COVID-19 impact of firms; ROA represents the ROA during COVID-19; ROA_{2019} represents the ROA in the pre-COVID-19 period; AVG_CI_IND represents the weighted average COVID-19 impact of the industries; IDWI represents the impact difference between firms within the same industry; FS_{2019} represents the pre-COVID-19 firm size; LEV_{2019} represents the pre-COVID-19 leverage; LIQ_{2019} represents the pre-COVID-19 liquidity; RP represents the recovery period of firms after the COVID-19 impact; AVG_RP_IND represents the weighted average recovery period of the industries; RDWI represents the recovery period differences between firms within the same industry.

4.2. Impact COVID-19 on firm performance

The first test that I will perform will be a paired sample t-test. In this test I will compare the quarterly ROA of a firm during COVID-19 with the pre-COVID-19 quarterly ROA. The test is performed to determine the impact of COVID-19 on the performance of firms. The test is done for each COVID-19 quarter to determine the short and long-term impact on firms.

In table 3 the results of each t-test are shown. In the first quarter the mean difference has a value of 0.237. This result suggests that the firm performance, i.e. the quarterly ROA, has increased with 0.237 percentage points after the COVID-19 outbreak. This means that most of the firms did not experience a negative impact from COVID-19 but performed better during the COVID-19 period than they did before COVID-19. If I compare the mean differences of the quarters, I can conclude that in the first quarter of COVID-19, firms experienced on average the smallest positive increase. However, this result is only significant at the 10% level ($p = 0.060$). In quarter 2, firms experienced an average increase of 0.960 percentage points compared to the pre-COVID-19 period. This result is significant at the 1% level ($p = 0.000$). In the third quarter, the performance of firms, i.e. the ROA, is still increasing. On average, firms had an increase in their quarterly ROA with 1.751 percentage points in the third quarter compared to the pre-COVID-19 period.

Table 3

Paired sample t-test of $CI_t = 0$

				95% Confidence interval of the difference					
	Mean	Std Dev.	Std Error	Lower	Upper	t	df	Sig (2-tailed)	
Q1 2020	0.237	544.077	8.880	-0.010	0.484	1.884	3753	0.060	*
Q2 2020	0.960	511.331	8.340	0.715	1.205	7.682	3758	0.000	***
Q3 2020	1.751	483.080	7.930	1.496	2.007	13.453	3710	0.000	***
Q4 2020	1.595	506.228	8.310	1.338	1.853	12.146	3710	0.000	***
Q1 2021	2.430	450.971	7.430	2.156	2.704	17.399	3683	0.000	***

This table reports the results of the paired sample t-test of CI_t. The results show how the firm performance during COVID-19 (ROA) has changed compared to the pre-COVID-19 firm performance (PRE_ROA). So, the mean is the average difference between ROA and PRE_ROA. ***, **, and * denote statistical significance at the 1%, 5% and 10% levels, respectively.

The ROA in the third quarter is increasing more sharply compared to the first and second quarter. These bigger differences between the ROA during COVID-19 and before COVID-19 can be the consequence of lifting restrictions in the U.S during the second and third quarter. For example, states removed lockdowns in the second or third quarter (BBC, 2020). In the fourth quarter the mean difference is 1.595 percentage points, which suggests that the performance of firms, i.e. the ROA of a firm, is still increasing but less sharply than in the previous quarter. The result is significant at the 1% level (p = 0.000). The explanation for this milder increase in firm performance is that the COVID-19 cases are increasing sharply, and states are reimplementing COVID-19 restrictions in the fourth quarter of 2020 (Silverstein, 2020). The last quarter that I included in the t-test is the first quarter of 2021. The mean difference of this test is 2.430, which suggest that the performance of firms increased on average with 2.430 percentage points compared to the pre-COVID-19 period. This result is significant at the 1% level (p = 0.000). The difference in mean of the last test is bigger than all the other COVID-19 quarters. This can be explained by lifting restrictions because of the decrease in COVID-19 cases and the increase in the number of vaccinated people every day (CNBC, 2021). Based on the results in table 3 for hypothesis 1, the null hypothesis can be rejected for all the quarters that are included in the sample period. Therefore, I can conclude that the average financial performance of companies, i.e. the ROA of the firms, is positively affected by the COVID-19 pandemic. One important note to include is that not all firms are positively affected by COVID-19, which is shown in table 2.

4.2.1. Differences in COVID-19 impact within industries

Now that I have determined that the performance of firms is affected by the COVID-19 pandemic, I am interested in whether there are differences in COVID-19 impact between firms within the same industry. To determine if there are differences within industries, I perform a t-test for each firm in the sample. So, for each firm in the sample the t-statistic and the corresponding p-value is calculated. The dependent variable for this test is the Impact Difference Within Industries (IDWI). The IDWI of the firm is compared to the value zero, because the null hypothesis is that I expect that IDWI = 0. Table 4 presents the results of the p-values. Because of the large sample size, I only present the proportions of firms in the industry with their respective p-value. These industries are determined by the two-digit SIC-code. Table 9 in the appendix shows the full industry-name of each SIC-code. The second column ($p < 0.01$) contains the percentage of firms in the industry that have a p-value below 0.01. This means that these firms have a significant difference in impact compared to their industry average with a significance level of 1%. As can be seen in the table, a lot of firms in the industries are significant at the 1% level. The third column ($0.01 < p < 0.05$) contains the percentage of firms in the industry that have a p-value between 0.01 and 0.05. These firms also have a significant difference in impact compared to their industry average, but with a lower significance level of 5%. The fourth column ($0.05 < p < 0.1$) shows the percentage of firms in the industry that have a p-value between 0.05 and 0.1. Again, these firms have a significant difference in impact compared to their industry average, but with a significance level of 10%. The fifth column ($p > 0.10$) contains the percentage of firms in the industry that have a p-value that is higher than 0.10. This means that these firms do not significantly differ in impact compared to their industry average. For 30 industries of the 66 industries, most of the firms have significant results. So based on the results, I can conclude that there is a difference in COVID-19 impact between firms within the same industry. Therefore, I can reject the null hypothesis.

4.2.2. Association between COVID-19 impact and pre-COVID-19 numbers

From the results in 4.2.1, I can conclude that there are differences between firms in the same industry. Because firms were exposed to the same governmental measures to prevent COVID-19, I find it interesting to know what the explanation is for the differences in impact between firms in the same industry.

Table 4

T-test per firm of IDWI = 0

SIC	p < 0.01	0.01 < p < 0.05	0.05 < p < 0.1	p > 0.1
1	0%	0%	0%	100%
7	0%	0%	0%	100%
8	25%	25%	25%	25%
10	31%	0%	0%	69%
12	23%	23%	38%	15%
13	61%	6%	6%	26%
14	21%	0%	7%	71%
15	29%	14%	14%	43%
16	8%	8%	8%	77%
17	14%	0%	14%	71%
20	43%	26%	15%	15%
21	0%	0%	0%	100%
22	0%	20%	20%	60%
23	25%	0%	0%	75%
24	27%	0%	0%	73%
25	33%	0%	0%	67%
26	26%	5%	0%	68%
27	27%	18%	0%	55%
28	89%	3%	0%	8%
29	38%	6%	13%	44%
30	61%	11%	6%	22%
31	0%	0%	0%	100%
32	27%	0%	36%	36%
33	36%	14%	9%	41%
34	22%	3%	3%	72%
35	36%	16%	9%	39%
36	75%	8%	4%	13%
37	38%	10%	3%	49%
38	71%	9%	3%	17%
39	50%	5%	0%	45%
40	0%	33%	0%	67%
41	0%	0%	0%	100%
42	35%	10%	15%	40%
44	33%	0%	0%	67%
45	33%	17%	22%	28%
46	17%	17%	42%	25%
47	20%	10%	10%	60%
48	37%	19%	9%	34%
49	29%	7%	5%	58%
50	25%	6%	8%	60%

51	35%	9%	18%	38%
52	0%	20%	20%	60%
54	0%	20%	0%	80%
55	38%	0%	19%	44%
57	0%	0%	0%	100%
58	24%	3%	6%	67%
59	14%	0%	5%	81%
60	73%	6%	4%	17%
61	35%	6%	6%	53%
62	28%	16%	9%	48%
63	66%	13%	1%	21%
64	15%	31%	8%	46%
65	34%	11%	6%	49%
67	91%	2%	1%	7%
70	25%	8%	0%	67%
72	0%	0%	0%	100%
73	61%	11%	6%	22%
75	0%	20%	0%	80%
78	10%	30%	0%	60%
79	37%	7%	0%	57%
80	65%	12%	7%	16%
81	25%	25%	25%	25%
82	22%	0%	11%	67%
83	0%	0%	0%	100%
87	39%	2%	5%	54%
99	28%	3%	4%	65%

This table reports the results of the t-tests per firm of IDWI = 0. The table shows the proportions of firms in the industry with the respective p-value. The results show whether there are differences in COVID-19 impact between firms within the same industry. Firms with a p-value below < 0.01 (second column) have a significant result at the 1% level. Firms with a p-value between 0.01 and 0.05 (third column) have a significant result at the 5% level. Firms with a p-value between 0.05 and 0.10 (fourth column) have a significant result at the 10% level. Firms with a p-value above 0.10 (fifth column) do not have a significant result.

I will examine whether pre-COVID-19 numbers of firms could explain the degree of impact that a firm experienced during COVID-19. Therefore, I perform a regression test. Table 5 shows the regression results for the explanation of the COVID-19 impact on firm performance with pre-COVID-19 numbers. The dependent variable that is used in this regression is the COVID-19 impact of the firm (CI). The coefficient firm size is negative and significant at the 1% level. The negative value for FS_{2019} means that larger firms experienced a more negative or a less positive COVID-19 impact. This result is not consistent with my expectation, which was that larger firms experienced a less negative or a more positive impact.

Table 5
Regression results of association between pre-COVID-19 variables and COVID-19 impact

	CI	
FS_{2019}	-0.986	***
	(0.000)	
LEV_{2019}	0.002	***
	(0.000)	
LIQ_{2019}	-0.031	***
	(0.000)	
IND	Yes	
N	18554	
R^2	0.092	

This table reports the regression results of hypothesis 3. The results show whether pre-COVID-19 numbers can explain the COVID-19 impact of a firm. The dependent variable is the COVID-19 impact (CI). The independent variables are the pre-COVID-19 numbers for firm size (FS_{2019}), leverage (LEV_{2019}), and liquidity (LIQ_{2019}). Table 8 in the appendix provides detailed variable definitions. I include industry fixed effects. Estimated t-statistics are reported below the coefficients in parentheses. ***, **, and * denote significance levels at 1%, 5% and 10% levels, respectively.

A possible explanation for this different result is that larger and often more international firms are more affected by all the different implemented restrictions of each country with which they trade. This can lead to less or even no sales while production costs stay high. In addition, it can cost a larger firm more time and money to allow all the employees to work from home. The second coefficient of leverage (LEV_{2019}) is positive and significant at the 1% level. This result suggests that firms with more leverage experienced a less negative impact or a higher positive impact than firms with less leverage. The result differs from my expectation in chapter 2.2. A possible explanation for this result could be that firms that borrowed money in 2019, have more money to spend than other firms. With this money these firms are able to keep paying their obligations and to withstand uncertainties during COVID-19. Furthermore, it could be the case that firms that wanted to borrow money could borrow less easily or with stricter conditions. Another explanation is that firms with high leverage use this leverage efficiently, which mitigates the COVID-19 impact (Kartikasari & Merianti, 2016). The coefficient for liquidity (LIQ_{2019}) is also negative and significant at the 1% level. This result suggests that firms with more liquidity experienced a more negative or a less positive impact than firms with less liquidity. This result is not consistent with my expectation in chapter 2.2. A possible explanation could be that the short-term investments of a firm have become less worth due to COVID-19. This could have affected the liquidity of the company, so they had less money to withstand uncertainties.

4.3. Recovery period of firms after COVID-19 impact

4.3.1. Differences in recovery period within industries

In chapter 4.2.1, I examined differences in COVID-19 impact between firms within the same industry. Due to this result, I am interested whether there are also differences in the recovery period between firms within the same industry. I perform a t-test to examine differences in the recovery periods between firms within the same industry. So, for each firm in the sample the t-statistic and the corresponding p-value is calculated. Table 6 presents the p-value results of these tests. The dependent variable for this test is the recovery period difference within industries (RDWI). For the calculation of the t-statistic, the RDWI of the firm is compared to the value zero, because in the null hypothesis I expect that RDWI = 0. Because of the large sample size, I only present the proportions of firms in the industry with their respective p-value. These industries are determined by the two-digit SIC-code. Table 9 in the appendix shows the full industry-name of each SIC-code. The second column ($p < 0.01$) contains the percentage of firms in the industry that have a p-value below 0.01. This means that these firms have a significant difference in the recovery period compared to their industry average with a significance level of 1%. As can be seen in the table, a lot of firms in the industries are significant at the 1% level. The third column ($0.01 < p < 0.05$) shows the percentage of firms in the industry that have a p-value between 0.01 and 0.05. These firms also have a significant difference in the recovery period compared to their industry average, but with a lower significance level of 5%. The fourth column ($0.05 < p < 0.1$) contains the percentage of firms in the industry that have a p-value between 0.05 and 0.1. Again, these firms have a significant difference in recovery period compared to their industry average, but with a significance level of 10%. The fifth column ($p > 0.10$) shows the percentage of firms in the industry that have a p-value that is higher than 0.10. This means that these firms do not significantly differ in recovery period compared to their industry average. For 33 industries of the 58 industries, most of the firms have significant results. So based on the results, I can conclude that there is a difference in the recovery period between firms within the same industry. Therefore, I can reject the null hypothesis.

Table 6

T-test per firm of RDWI = 0

SIC	p < 0.01	0.01 < p < 0.05	0.05 < p < 0.1	p > 0.1
7	25%	25%	25%	25%
10	20%	0%	0%	80%
12	17%	0%	33%	50%
13	73%	0%	0%	27%
14	17%	0%	0%	83%
15	0%	0%	0%	100%
16	17%	0%	0%	83%
17	0%	0%	0%	100%
20	15%	0%	0%	85%
22	25%	25%	25%	25%
23	0%	0%	25%	75%
24	0%	0%	0%	100%
25	25%	25%	25%	25%
26	17%	0%	0%	83%
27	13%	0%	50%	38%
28	100%	0%	0%	0%
29	17%	0%	0%	83%
30	0%	38%	63%	0%
31	25%	25%	25%	25%
32	14%	0%	0%	86%
33	0%	20%	0%	80%
34	14%	14%	0%	71%
35	76%	0%	0%	24%
36	100%	0%	0%	0%
37	100%	0%	0%	0%
38	100%	0%	0%	0%
39	33%	0%	67%	0%
41	25%	25%	25%	25%
42	0%	20%	0%	80%
44	0%	20%	0%	80%
46	0%	0%	25%	75%
47	0%	0%	0%	100%
48	100%	0%	0%	0%
49	95%	0%	5%	0%
50	19%	0%	81%	0%
51	67%	8%	0%	25%
52	25%	25%	25%	25%
55	0%	0%	25%	75%
58	25%	50%	0%	25%
59	25%	25%	25%	25%

60	85%	0%	0%	15%
61	56%	0%	0%	44%
62	18%	82%	0%	0%
63	100%	0%	0%	0%
64	25%	25%	25%	25%
65	28%	72%	0%	0%
67	100%	0%	0%	0%
70	0%	0%	25%	75%
72	0%	0%	0%	100%
73	100%	0%	0%	0%
75	0%	0%	0%	100%
78	0%	0%	0%	100%
79	25%	0%	75%	0%
80	93%	0%	0%	7%
82	0%	0%	25%	75%
83	25%	25%	25%	25%
87	25%	0%	75%	0%
99	20%	0%	0%	80%

This table reports the results of the t-tests per firm. The table shows the proportions of firms in the industry with the respective p-value. The results show whether there are differences in the recovery period between firms within the same industry. Firms with a p-value below < 0.01 (second column) have a significant result at the 1% level. Firms with a p-value between 0.01 and 0.05 (third column) have a significant result at the 5% level. Firms with a p-value between 0.05 and 0.10 (fourth column) have a significant result at the 10% level. Firms with a p-value above 0.10 (fifth column) do not have a significant result.

4.3.2. Association between recovery period and pre-COVID-19 numbers

Because of the significant differences in the recovery time between firms within the same industry, I am interested whether pre-COVID-19 numbers of firms can explain the recovery period of firms after their COVID-19 impact. This regression test will be similar to the test for hypothesis 3 in chapter 4.2.2. Table 7 presents the regression results of this test. The regression model includes a control variable, which is the COVID-19 impact of the firm (CI). The dependent variable is the recovery period of a firm, measured in quarters.

The coefficient firm size (FS_{2019}) is positive and significant. This result suggests that larger firms have a larger recovery period than firms that are smaller. The sign of the coefficient differs from my expectation. A possible explanation for the positive value of firm size is that the trade of larger (international) firms is more affected by the implemented restrictions of each country in which the firm trades. The international trade will probably take longer to reperform on normal levels because each country has its own COVID-19 situation and policy to prevent COVID-19. In addition, large companies may no longer take advantage of their economies of scale, leaving them with large costs.

Table 7
Regression results of association between pre-COVID-19 variables and recovery period

	RP	
FS_{2019}	0.042	***
	(0.000)	
LEV_{2019}	0.000	
	(0.462)	
LIQ_{2019}	0.000	
	(0.664)	
CI	0.011	***
	(0.000)	
IND	Yes	
N	1495	
R^2	0.048	

This table reports the regression results of hypothesis 5. The results show whether pre-COVID-19 numbers can explain the recovery period of a firm. The dependent variable is the recovery period (RP). The independent variables are the pre-COVID-19 numbers for firm size (FS_{2019}), leverage (LEV_{2019}), and liquidity (LIQ_{2019}). Table 8 in the appendix provides detailed variable definitions. I include the COVID-19 impact of the firm (CI) as control variable. I include industry fixed effects. Estimated t-statistics are reported below the coefficients in parentheses. ***, **, and * denote significance levels at 1%, 5% and 10% levels, respectively.

The significant result means that the size of the firm in 2019 could explain the recovery period of the firm after COVID-19. So, I could reject the null hypothesis for the variable firm size. The coefficient leverage (LEV_{2019}) is zero and insignificant. This result suggests that the leverage of a firm in 2019 could not explain the recovery time of firms after their COVID-19 impact. Therefore, I could not reject the null hypothesis for the variable leverage. The coefficient for liquidity (LIQ_{2019}) is also zero and insignificant. Again, this result suggests that the liquidity position of a firm in 2019 could not explain the recovery period of firms after their COVID-19 impact. Therefore, I could not reject the null hypothesis for the variable liquidity. Lastly, the coefficient for the control variable COVID-19 impact (CI) is positive and significant. This means that firms with a less negative COVID-19 impact, do have a longer recovery period. An explanation for this result could be that firms that have a more negative impact take more actions to deal with the COVID-19 pandemic, which could lead to smaller recovery period. In addition, firms with less negative impact may not take actions and wait for the economy to recover, which can lead to a longer recovery period.

5. Conclusion

In this thesis two research questions are answered. The first research question that is answered is: “Can the COVID-19 impact on firm performance be explained by pre-COVID-19 characteristics?”. To answer this question, I first determined the COVID-19 impact on the firm performance. I have determined this impact for every quarter in the COVID-19 period. I have found that in each quarter of the COVID-19 period, firms experienced an increase in their ROA. So, the conclusion of this first test is that U.S. firms experienced on average a positive impact of COVID-19. This means that I can reject null hypothesis 1. Secondly, I have examined whether there are differences in COVID-19 impact between firms within the same industry. I have found that for 30 of the 66 industries, there was a significant difference in COVID-19 impact between the firms. So, there is a difference in COVID-19 impact between firms within the same industry. This allows me to reject null hypothesis 2. Thirdly, I have examined whether pre-COVID-19 financial characteristics could explain the COVID-19 impact of a firm. I have reached three findings. Larger firms, firms with less leverage, and firms with more liquidity experienced a more negative or a lower positive impact of COVID-19. So, to answer the first research question, the variables firm size, leverage and liquidity could explain the COVID-19 impact on firm performance. This means that I can reject null hypotheses H3A, H3B and H3C. The second research question that is answered is: “Can the recovery time of firms after the COVID-19 impact be explained by pre-COVID-19 characteristics?”. Firstly, I have examined if there are differences in recovery time between firms within the same industry. I have found that for 33 of the 58 industries, there was a significant difference in recovery time between firms. So, I can conclude that there is a difference in recovery time between firms within the same industry. This allows me to reject null hypothesis 4. Secondly, I have examined whether pre-COVID-19 financial characteristics could explain the recovery time of a firm. I have reached one finding. Only the variable firm size can explain the recovery time of firms. I found evidence that larger firms do have a longer recovery period. The variables leverage and liquidity could not explain the recovery time of firms. So, to answer the second research question, firm size is the only variable of the three that could explain the recovery time of firms after their COVID-19 impact. This means that I can only reject null hypothesis H3A with regards to the variable firm size.

This paper can be relevant for several stakeholders of firms. Firstly, managers will benefit from this research. The results that are found can help managers to create new strategies for similar situations. This can be helpful as preparation for events or shocks like this crisis. This can mitigate the impact of the pandemic or any other external effect for their firm. Secondly, regulators can benefit from the results of this research. Regulators can help and advice firms to survive through such crises. Lastly, it has additional value for investors. Investors can use the results to improve their investment portfolio. These investors can use the findings to invest in firms with certain pre-characteristics that did better during the COVID-19 pandemic. There are three limitations for my research. The first limitation for my research is that my sample only consists of U.S. listed firms. This sample may not be representative for other countries or smaller firms. The second limitation of this research is the timing of this study. The moment that this research is written, the COVID-19 pandemic is still ongoing. Therefore, it is possible that there will become more relevant information available in the future. Furthermore, in the future the impact of COVID-19 on the longer term can be determined. The last limitation for this research is the time constraint. Due to time constraints, I only examined three pre-characteristics. Recommendations for future research would be to determine additional pre-characteristics that could explain the COVID-19 impact and recovery time of firms. Furthermore, due to the research time constraint, I only investigated the firm performance by means of the ROA. Recommendations for future research would be to also measure the impact by other firm performance measures like ROE.

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7. Appendix

Table 8
Variable description

Variables	Description of variables
$CI_{F,t}$	COVID-19 impact of firm F in quarter t
$ROA_{F,t}$	Return On Assets of firm F in quarter t during COVID-19
$NI_{F,t}$	Net income of firm F in quarter t
$TA_{F,t}$	Total assets of firm F in quarter t
$ROA_{F,2019}$	Return On Assets of firm F in last quarter of pre-COVID-19 period
$NI_{F,2019}$	Net income of firm F in last quarter of pre-COVID-19 period
$TA_{F,2019}$	Total assets of firm F in last quarter of pre-COVID-19 period
RP_F	Recovery period of firm F
RQ_F	Recovery quarter of firm F
$Q_{1,2020}$	First quarter of 2020
$FS_{F,2019}$	Firm size of firm F in 2019
$LEV_{F,2019}$	Leverage of firm F in 2019
$LIQ_{F,2019}$	Liquidity of firm F in 2019
$TA_{F,2019}$	Total assets of firm F in 2019
$TD_{F,2019}$	Total debt of firm F in 2019
$CASH_{F,2019}$	Cash of firm F in 2019
$SHI_{F,2019}$	Short-term investments of firm F in 2019
$IDWI_{F,t}$	Impact Difference Within Industries of firm F in quarter t
$AVG\_CI\_IND_I$	Average COVID-19 impact of industry I in quarter t
$RDWI_F$	Recovery Difference Within Industries of firm F
$AVG\_RP\_IND_I$	Average recovery period of industry I

In this table a description is given of each variable used in this study.

Table 9

SIC-code with industry description

SIC-code	Industry description
1	Agricultural Production - Crops
7	Agricultural Services
8	Forestry
10	Metal Mining
12	Coal Mining
13	Oil and Gas Extraction
14	Mining and quarrying of Nonmetallic Minerals
15	Construction - General Contractors & Operative Builders
16	Heavy Construction, Contractor
17	Construction - Special Trade Contractors
20	Food and Kindred Products
21	Tobacco Products
22	Textile Mill Products
23	Apparel, Finished Products from Fabrics & Similar Materials
24	Lumber and Wood Products, Except Furniture
25	Furniture and Fixtures
26	Paper and Allied Products
27	Printing, Publishing and Allied Industries
28	Chemicals and Allied Products
29	Petroleum Refining and Related Industries
30	Rubber and Miscellaneous Plastic Products
31	Leather and Leather Products
32	Stone, Clay, Glass, and Concrete Products
33	Primary Metal Industries
34	Fabricated Metal Products
35	Industrial and Commercial Machinery and Computer Equipment
36	Electronic & Other Electrical Equipment & Components
37	Transportation Equipment
38	Measuring, Photographic, Medical, & Optical Goods, & Clocks
39	Miscellaneous Manufacturing Industries
40	Railroad Transportation
41	Local & Suburban Transit & Interurban Highway Transportation
42	Motor Freight Transportation
44	Water Transportation
45	Transportation by Air
46	Pipelines, Except Natural Gas
47	Transportation Services
48	Communications
49	Electric, Gas and Sanitary Services
50	Wholesale Trade - Durable Goods
51	Wholesale Trade - Nondurable Goods
52	Building Materials, Hardware, Garden Supplies & Mobile Homes
53	General Merchandise Stores

54	Food Stores
55	Automotive Dealers and Gasoline Service Stations
56	Apparel and Accessory Stores
57	Home Furniture, Furnishings and Equipment Stores
58	Eating and Drinking Places
59	Miscellaneous Retail
60	Depository Institutions
61	Non-depository Credit Institutions
62	Security & Commodity Brokers, Dealers, Exchanges & Services
63	Insurance Carriers
64	Insurance Agents, Brokers and Service
65	Real Estate
67	Holding and Other Investment Offices
70	Hotels, Rooming Houses, Camps, and Other Lodging Places
72	Personal Services
73	Business Services
75	Automotive Repair, Services and Parking
78	Motion Pictures
79	Amusement and Recreation Services
80	Health Services
81	Legal Services
82	Educational Services
83	Social Services
87	Engineering, Accounting, Research, and Management Services
99	Non-classifiable Establishments

In this table each SIC-code is followed by the description of the industry.