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The Impact of Open Market Share Repurchase Announcements During the COVID-19 Crisis

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Abstract

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The Impact of Open Market Share Repurchase Announcements During the COVID-19 Crisis

by Jesse VAN DEN BERG

This thesis examines how the COVID-19 pandemic affected the signaling impact of Open Market Share Repurchases (OMSR) in the U.S. An event study and regression analysis of 2,540 OMSR announcements ranging from 2015-2022 finds that several assumed benefits diminished amidst COVID-19. Despite the event study showing larger abnormal returns in general, the regression analysis shows no statistically significant pandemic increase after controlling for company characteristics. No evidence was found that company size or undervaluation amplified returns, contrasting signaling theories. Only companies with average free cash flow saw marginally higher returns during COVID-19. Pre-announcement underperformance and general market volatility changes also did not impact pandemic-period announcement returns. The results imply decreasing effectiveness of timing tactical repurchases during modern crises. This thesis provides unique evidence that OMSR announcements may no longer reliably boost crisis-stock performance, contributing to the evolving understanding of repurchase motivations.

Keywords: Open Market Share Repurchases (OMSR), COVID-19 crisis, Abnormal Returns, Event Study, Market Model, Short-Run Regression Analysis, Signaling Theory, Mispricing, Uncertainty, Company & Market Characteristics

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Chapter 1

Introduction

The COVID-19 pandemic triggered a great deal of turmoil in financial markets, sending equity prices plummeting and volatility skyrocketing even beyond that of the 2008 crisis levels (Baker et al., 2020). As restrictions forced the worldwide economy to come to a halt, most business decisions were suspended or put off in an attempt to conserve cash (Baldwin, 2020). In addition, U.S. companies within severely affected industries had to receive governmental support, conditional on the postponement of all dividends and buyback programs. Ultimately, this resulted in the largest decrease in repurchase activity since the 2008 financial crisis (Financial Times, 2020). Despite the chaotic market conditions, some companies continued their buyback programs or even announced new ones as they did in the past, where they have been used as flexible tools to boost stock prices. This thesis investigates whether the financial market's reaction to these repurchases changed during the pandemic and more specifically, how their motives were affected.

By examining repurchase announcements across the COVID-19 disruption, this research offers important economic insights. As repurchases surged to an all time high post pandemic, understanding the shifting motivational factors and their signaling effectiveness provides key insights on efficiently allocating capital during a crisis (Financial Times, 2020). This analysis expands academic literature by testing established financial theories on the matter in an unusual macroeconomic environment (Baker et al., 2020; Onali, 2020). Furthermore, the findings will provide guidance on how companies can generate shareholder returns responsibly during a crisis. This not only helps businesses strengthen themselves during these uncertain times but also provides stability to the market, emphasizing the social responsibility of companies.

The growing popularity of repurchases over the recent decades can be attributed to its greater flexibility compared to dividends Grullon and Michaely (2004) and Lee et al. (2010). Companies can repurchase shares through open market orders, tender offers, or private negotiations (Vermaelen, 2005). Open Market Share Repurchases dominate the market making up around 90% of all repurchases, likely due to their low cost and relative flexibility (Hsieh & Wang, 2009). Companies have a good level of freedom when it comes to the actual execution of their buybacks announcements. This, together with the potential stock price boosting benefits, drive their widespread use.

Two key motives often underlie repurchase announcements. First, share repurchases may allow managers to signal mispricing to the market caused by information symmetry, so as to boost their share prices (Grullon & Michaely, 2002; Ikenberry et al., 1995). Second, when investment opportunities are limited, agency costs can be minimized through repurchases by returning excess cash to shareholders (Jagannathan & Stephens, 2003). In general, share repurchases is a valuable instrument for companies and can be applied in a variety of circumstances for a variety of reasons.

Share repurchases during crises have also been studied. Research showed companies can use buybacks to signal undervaluation and boost stock prices amidst turmoil (H.-C.

Chen et al., 2018). Chakraborty et al. (2019) found that repurchase announcements continued to generate positive returns during the Global Financial Crisis in 2008 as well. However, most studies focused on suspending buyback programs despite extensive evidence of repurchases' upside. By examining the market's reaction to buybacks during the COVID pandemic, this thesis uncovers new insights on the potential positive signaling effect during crises. Consequently, the main research question this paper aims to answer is the following:

How did the COVID-19 pandemic affect the financial market's reaction to share repurchase programs in the US, and how did company specific variables impact announcement returns as compared to pre-COVID?

In this paper, an event study of over 2,500 announcements from 2015-2022 is conducted to estimate abnormal returns surrounding repurchase announcements. The regression analysis then uses these estimates to isolate the impact of company and market characteristic on announcement returns pre- and during COVID, comparing them and testing their changing relationships. Initial results suggest that repurchases may not reliably enhance crisis-period stock performance, contrasting historical trends (e.g., Grullon & Michaely, 2004).

By using the COVID-19 crisis as a natural experiment, this thesis provides unique evidence that companies should use caution when exploiting repurchase announcements during crises. The findings also offer shareholders and managers updated guidance for announcing repurchases based on fundamental company value as opposed to opportunistically using repurchase announcements as tactical tools during periods of economic stress.

Chapter 2

Theoretical Background

In this section an overview of the relevant literature will be discussed. Firstly, a general description of share repurchases is provided along with the motivations for companies to repurchase shares. Secondly, the performance of share repurchase measured through abnormal returns and the factors impacting these abnormal returns is reviewed. Thirdly, the behavior of the financial market surrounding the pandemic will be examined. Fourthly, financial literature on share repurchases during a crisis is discussed. Fifth, the financial market during the pandemic is discussed. And finally, the hypotheses will be formalized and supported.

2.1 Share repurchases

The most well-known methods through which corporations distribute wealth to their shareholders are dividends and share repurchases (Ikenberry et al., 1995). In academic literature, share repurchases are often mentioned as substitutes for dividends and therefore, most theories for both corporate pay-out methods are applicable to one another (Grullon & Michaely, 2002). There are many different types of motivations for a company to decide on a certain corporate pay-out policy, which all depends on company and shareholder characteristics (e.g., Hausch & Seward, 1993; Jacob & Jacob, 2013; Miller & Modigliani, 1961). However, over the last two decades share repurchases have become increasingly popular due to their flexibility when comparing to dividends. Companies can repurchase their own shares through either fixed price tender offer, Dutch auction tender offer, negotiated repurchase from private investors, using derivatives, or the most used option; an open-market share repurchase (Vermaelen, 2005). Also, even though a share repurchase announcement seems like a commitment, companies have some freedom to decide to go through with the share repurchase or otherwise.

An Open-Market Share Repurchase (**OMSR**) is a type of share repurchase where a company announces to buy back their own shares through an open order on the financial market based on a pre-determined dollar amount (Hsieh & Wang, 2009). It is the most common way to buy back stock from the market and it is also the cheapest. Grullon and Michaely (2004) state that between 1984 and 2000, over 90% of the repurchase announcements were OMSR. One possible explanation for the popularity of OMSR is that when a company announces an OMSR, they have the option and not the obligation to repurchase shares, giving company management a lot of flexibility regarding how, when, and if they were to execute the repurchase. As a result, it may take several years for a company to complete the buyback through an OMSR or sometimes the program is not even completed at all (Vermaelen, 2005).

2.2 Motivations for share repurchases

As previously mentioned, companies can have a variety of reasons to decide on a certain corporate pay-out policy. Hsieh and Wang (2009) identified six most used motives for share repurchases: (1) regulatory and tax environments, (2) free cash flows, (3) signaling and undervaluation, (4) capital structure, (5) takeover deterrence, and (6) employee stock options. The first three motives are the base-point for most theories according to Hsieh and Wang. However, most of the empirical evidence points towards the motives of signaling and undervaluation.

One of the main motivations for a company to decide to repurchase its own shares, referred to as the Traditional Signaling Hypothesis (**TSH**), can be related to Miller and Modigliani (1961) description of an imperfect market. Due to asymmetric information between a company's management and the financial market, in addition to an imperfect market, management can decide to strategically release information in their efforts to bias the market. This process, which can be referred to as signaling, is caused by private information being released to the public, including corporate events such as share repurchase announcements (Vermaelen, 1981). Depending on the importance of the informational contents of the release, the magnitude of the market's reaction can vary. Due to the imperfect market conditions, not all market participants are properly informed on the determinants of a company's value and can therefore wrongfully interpret these signals. As a result, the company's share price can be affected by these signals because market participants believe these convey information regarding future cash flow, allowing the share price to be manipulated by management. Building on this concept, the idea was born that a company's decision to go with a certain pay-out policy are not random actions, but rather a deliberate decision to send an explicit signal about the company's future earnings (Grullon & Michaely, 2004).

Grullon and Michaely (2004) also described three main implications following the signaling hypothesis. First, repurchase announcements must be accompanied by positive price changes. Meaning, that companies will experience a positive abnormal stock behavior immediately following the OMSR release. Second, following a repurchase announcement, positive news is expected regarding the company's cash flows and/or profitability. Because on average, if a company releases a signal which is not credible for the market, then this can have large negative consequences. As a result, the signal is most likely to only be released when positive news is expected. Third and finally, the market should immediately incorporate the information of the repurchase announcement and positively adjust their expectation about the company's future profitability.

In practice, this demonstrates itself as follows: After an OMSR order is announced, companies usually experience a share price increase due to the positive signal it provides regarding the company's future cash flow generating possibilities. Financial market participants believe that if a company's management is willing to repurchase its own shares, their assessment of the current market price is that the company is undervalued, and that the current share price does not reflect what the company is able to generate in income towards the future.

To conclude, OMSR can be motivated by several factors. The most commonly mentioned method, the TSH, can be an important instrument for company's management to signal to the outside world that they believe their company is undervalued(Vermaelen, 1981). Regardless, due to informational asymmetries between outsiders and companies' management as well as other company characteristics, the true reason behind a company's decision to repurchase shares still varies greatly and needs further clarification.

2.3 Abnormal Returns and OMSR announcements

OMSR announcements are generally perceived by the market as a positive signal regarding a company's performance. As a result, they can boost share price and generate abnormal returns. In this sub-section, abnormal returns will first be explained. After which, academic literature on abnormal returns following share repurchases will be examined. Finally, general remarks will be made regarding what to expect for a company's share price after a share repurchase announcement.

2.3.1 Abnormal Returns

Following a company event, its stock price may behave differently than what is expected based on economic theory. By examining share price behavior following a company event and calculating any deviations based on either company characteristics or historical share price behavior, abnormal returns can be estimated (Strong, 1992). An abnormal return is any return above or below what is expected to occur for the company in a normal situation, meaning following its estimated market path in the absence of any events. Abnormal returns can either be in favor of investors, generating a positive return, or otherwise. Depending on the informational content of the event, how it is perceived by the market, and the importance of the event, a certain outcome is reached. For example, if the information released is deemed positive for the company and is unexpected by the market, it will most likely generate a positive abnormal return.

2.3.2 Abnormal Returns and repurchase announcements

One way to assess the impact of OMSR announcements on a company's share price is through abnormal returns. Considering that outside investors see the announcement as positive news, according to the TSH a company's share price must be positively affected by the announcement, thereby generating a positive abnormal return. However, not all empirical studies showed pronounced effects, and in some papers, the abnormal return generated after an repurchase announcements is close to zero.

Ikenberry et al. (1995) examined the abnormal returns of US listed companies between 1980 and 1990. On average they found that the return on the market is not lower than the abnormal returns generated by a company following a repurchase announcement, implying that the announcements do not convey positive news. However, when controlling for company size and book-to-market ratio, evidence in favor of the TSH is found. If the company size is considered a proxy for information asymmetry, meaning that there is more information asymmetry between the market and smaller companies than with larger ones, then those less covered by analysts should experience higher abnormal return. Ikenberry et al. found evidence to support this and concluded that there is indeed evidence for the TSH. Furthermore, companies with relatively high book-to-market ratio are more likely to repurchase shares due to undervaluation, whereas low book-to-market ratio companies can have other motives. Again, when controlling for the book-to-market ratio, a positive abnormal return is found for the relatively high book-to-market companies, confirming the TSH, and a lower abnormal return for the relatively low book-to-market companies. Using a different methodology but the same data set as Ikenberry et al., Chan et al. (2007) also found evidence of positive abnormal returns following buyback announcements. For the US, several other papers found evidence for positive long run abnormal returns following repurchase announcements as well (e.g., McNally & Smith, 2007; Mitchell & Stafford, 2000; U. C. Peyer & Vermaelen, 2005; Yook, 2010).

Most of the previous research found evidence for long-run abnormal return with empirical evidence for the short-term returns pointing towards the same direction. In examining short run abnormal returns, Ikenberry et al. (1995) controlled for the percentage of total company shares intended for repurchase in the buyback announcement and found that the higher the percentage of company shares intended to repurchase, the higher the abnormal return. Further, when controlling for company size as a proxy for information asymmetries, they found that the higher the information asymmetry, which is the case for smaller companies, the larger abnormal returns are observed. Making the results consistent with the TSH. Another motivation for a company to decide on a share repurchase announcement can be related to employees' stock options (Kahle, 2002). In this paper, although abnormal returns following the OMSR announcements were found, it was a mere 1.6% as compared with an average of between 3-4% in previous empirical studies. The author stated that this could be the result of the changing motives for share repurchases; which in this case was due to the employee stock options. A final explanation for the short run abnormal returns is given by Gaspar et al. (2013). They found evidence that abnormal returns following repurchase announcements decrease with investors' horizons. Meaning, if investors have a more long-term orientation, the abnormal returns following the announcement decreases. Regardless, a positive abnormal return is observed. In contrast to earlier studies, e.g., Ikenberry et al., the authors did not find evidence of the importance of company size for abnormal returns implying that the level of asymmetric information does not matter. To summarize, even though academic literature provided a great variety of explanations for the abnormal returns surrounding OMSR announcements, the consensus is that positive abnormal returns are generated by the announcements.

2.4 Share repurchases during crisis period

On the 19th of October 1987 the first worldwide financial market crash took place. The entire stock market plummeted which is now referred to as 'Black Monday' (Bernhardt & Eckblad, 2013). In the month following the crash, over 250 US companies announced share buyback programs as compared with the 350 in the 9 months prior (Netter & Mitchell, 1989). Netter and Mitchell investigated this sudden surge in OMSR program announcements by examining stock price behavior of the companies that announced them. They found that stock prices of these companies declined abnormally during the crash period and prior to the announcement. However, after the announcement, the stock prices rebounded and companies were able to generate an average positive significant abnormal return of 3%. The researchers considered tax benefits and signaling mispricing to be the two most common explanations. Because of the uncertainty surrounding the cause of the crash, the rapid stock decline is used as a natural experiment to investigate mispricing. By announcing an OMSR, companies can signal undervaluation towards investors caused by the mispricing and making signaling the most likely motivation. The important thing to note here, is that the cause of the rapid market decline is unknown, and therefore the mispricing potential increases. The authors concluded that after the announcement, the mispricing was corrected and in most cases the actual repurchases were not even necessary. Building upon these findings, Comment and Jarrell (1991) investigated the signaling power of share repurchases as well. They showed that the magnitude of the (positive) stock return reaction caused by the announcement was inversely related to the stock's performance relative to the market before the announcement. This provided further evidence that underperformance in times of crisis generates relatively more positive abnormal returns.

The global financial crisis in 2008 has been a topic of interest for many financial researchers as well. Repurchase behavior surrounding this time period has been widely debated in financial literature (e.g., H.-C. Chen et al., 2018; Pirgaip & Dinçergök, 2019). Contrary to Comment and Jarrell (1991), H.-C. Chen et al. showed that companies that were overvalued prior to the financial crisis are more likely to announce a repurchase program and go through with the actual repurchases. In addition, they also found evidence that larger share repurchase programs were announced by less overvalued or undervalued companies. The findings also indicated that high cash flow companies are more likely to announce a repurchase program during the crisis than those with low cash flow.

Focusing more on actual repurchase activities, Pirgaip and Dinçergök (2019) looked at repurchase behavior for US companies between 1990 and 2017. They stated that high cash flow companies and/or larger ones are more likely to repurchase shares, which is a similar conclusion as drawn by Comment and Jarrell (1991). The paper further investigated repurchase activities under uncertainty by using the Economic Policy Uncertainty index by Baker et al. (2016) as a news-based uncertainty measure together with the implied volatility index for the S&P500 (VIX) as a control variable and market-based uncertainty measure. Interestingly, they concluded that under uncertain conditions companies are less likely to repurchase shares. Meaning, that high level market or policy uncertainty leads to less repurchases made. However, this does not mean that less announcements were made; only that companies are less likely to execute the repurchase.

Further diving into companies' characteristics and the likelihood of repurchasing shares during a crisis period, Iyer and Rao (2017) used the 2008 financial crisis to investigate share repurchases and the flexibility hypothesis. More specifically, they used the financial crisis as a natural experiment to test whether share repurchases are more flexible than dividends. Their general conclusion was that corporate payouts through repurchases did prove to be more flexible during a crisis than dividends because these programs are easier to halt. Interestingly, the authors also found that the companies that announced and repurchased shares during the crisis period were generally smaller in size, had lower leverage, had more liquidity, were relatively more profitable, and were more favorably valued by the market; meaning a higher MB ratio compared to dividend paying companies.

In a more recent paper, Z. Chen et al. (2022) investigated uncertainty during the COVID pandemic and found evidence for precautionary and signaling motives impacted by company characteristics. On average, the authors found that high policy uncertainty causes companies to reduce repurchases because of tighter external constraints, providing a precautionary motive. However, undervalued companies repurchase significantly more shares to signal undervaluation during times of high uncertainty, providing a signaling motive. The high market uncertainty causes company information to be harder to observe and as a result, repurchases are used to credibly signal this to the market. Overall, Z. Chen et al. showed that depending on the company's characteristics, there are both precautionary and signaling motives for repurchases during uncertain periods.

Finally, focusing more on abnormal returns following share repurchase announcements, Anolick et al. (2021) looked into the European market and investigated the effect of uncertainty on these abnormal returns between 2000 and 2017. With the addition of company specific variables, market- based determinants similar to that of Pirgaip and Dinçergök (2019) were also included to identify potential abnormal return drivers. The authors found that on average, an abnormal return of 1.4% was generated following a repurchase announcement. Also, the abnormal returns for companies were significantly higher when the level of uncertainty in the market was high. The economic rationale behind this, is that information asymmetry increases when uncertainty increases, therefore signaling undervaluation by using repurchase announcements becomes more effective.

To summarize, financial literature emphasizes that share repurchases are affected by macroeconomic and company-specific factors. The consensus is that during uncertain times, share repurchase announcements are a widely used tool by companies to signal undervaluation towards investors. The key factors that appear to impact abnormal returns tend to lie in the scale of the repurchase announcement, the level of information asymmetry, company size and existing performance indicators as well as investors' time horizon.

2.5 Impact of the COVID pandemic on the financial market

The World Health Organisation (WHO) officially announced the COVID-19 outbreak as a global pandemic on the 11^{th} of March 2020 (D. Zhang et al., 2020). In the US, the stock market experienced several crashes and eventually equities plummeted. The worldwide financial market was put under a lot of strain and the volatility in the market increased. In an effort to stabilize the market, the Federal Reserve announced a $700 billion quantitative easing program, but eventually was forced to increase this program even further to an unlimited one several days later. Banks being key beneficiaries of the program, were restricted in their expenditures and dividend pay-out policy including share repurchases (FED, 2021).

Several papers have already investigated the impact of the pandemic on financial market volatility (e.g., Baker et al., 2020; Onali, 2020; Uddin et al., 2021; Yilmazkuday, 2021). For example, Baker et al. investigated the impact of several infectious disease outbreaks on financial market volatility over the past 100 years. By examining large daily stock price jumps and connecting these to previous outbreaks, Baker et al. were able to quantify the severity of the stock market's reaction to the pandemic. Not only was the impact of the pandemic more severe than that of the Spanish Flu, the level of financial market volatility also surpassed that of major financial market crises such as the 2008 financial market crisis. They concluded that the unprecedented market reaction was most likely not related to the mortality rate of the COVID virus, but more so due to the interconnectedness of the worldwide economy which was severely disrupted due to the pandemic. This is in line with Baldwin (2020) who stated that the imposed government measures damaged the global supply chain, reduced worldwide supply of goods and services, and therefore increased uncertainty. In addition, Onali (2020) explored the relationship between COVID-19 and stock market volatility, focusing on the pandemic's impact on various stock markets. The study identified a significant increase in volatility, emphasizing the influence of COVID-19 on market dynamics. Furthermore, Yilmazkuday (2021) investigated the effects of COVID-19 on the S&P 500 index, finding substantial evidence of the pandemic's impact on the index, further underscoring the widespread influence of the pandemic on financial markets.

In summary, the COVID-19 pandemic had a profound impact on financial markets globally. The United States stock market experienced crashes and significant declines in equity prices, while the global financial market faced heightened volatility and uncertainty. The Federal Reserve's swift intervention with quantitative easing aimed to stabilize the market, while banks received government support and faced restrictions on expenditures. Although research on the topic is still quite limited, it is evident that the pandemic's disruptive influence on financial market volatility exceeded other historical events and enabled us to examine the COVID crisis as a natural experiment that can lead to new insights on investor behavior during crises.

2.6 Hypothesis development

During a crisis period, financial literature has shown that OMSR announcements generate a positive abnormal return (e.g., Bernhardt & Eckblad, 2013; Comment & Jarrell, 1991; Netter & Mitchell, 1989). Therefore, considering the COVID period a crisis, a similar pattern is expected for repurchase announcements during this period. That is to say that during a crisis period, such as the COVID pandemic, the abnormal returns are expected to be larger as compared with a non crisis period. Consequently, the first hypothesis this research will examine is the following:

H1: Surrounding OMSR-announcements, companies in the U.S. experience a significant positive abnormal return during the COVID pandemic as compared with pre-pandemic.

Second, Ikenberry et al. (1995) consider company size as a proxy for information asymmetry between the financial market and companies. Compared with larger companies, smaller companies are less covered by analysts. This results in higher information asymmetry and thereby increases the importance of repurchase announcements as these contain valuable news on small companies. Therefore, in line with the TSH, when repurchases are announced, smaller companies experience relatively larger positive abnormal returns than large companies. To observe whether this effect upholds during financially uncertain periods such as the pandemic, the following hypothesis will be tested:

H2: During the COVID pandemic, smaller companies generated larger abnormal returns when announcing an OMSR as compared to relatively large companies in the US.

Third, the COVID pandemic severely interrupted worldwide supply chain (Baldwin, 2020). As a result, this led to uncertainty regarding future cash flow which saw stock prices go into a rapid decline as well. Grullon and Michaely (2004) found that companies with high free cash flow generate more positive abnormal returns as compared with those with low free cash flow due to repurchases being the most lucrative investment opportunity. During a crisis, the use of cash to strengthen a business position may be preferable. Therefore, companies with weak cash flow are deemed less positively when they announce a buy back during a crisis. Furthermore, according to H.-C. Chen et al. (2018), high cash flow companies are usually more likely to announce a repurchase program during a crisis than low cash flow companies. Nonetheless, contrary to the usual expectations for a positive effect, abnormal returns may be mitigated because cash could perhaps be put to other use rather than repurchases amidst a crisis. To examine whether the positive effect of a previously high cash flow position is still observed during the pandemic, the following hypothesis will be tested:

H3: Relatively high free cash flow companies generated larger abnormal returns following an OMSR announcement during the pandemic than relatively low free cash flow companies.

Fourth, as previously mentioned, mispricing can motivate a company to decide to repurchase its shares. If a company is highly undervalued in the market, they can choose to repurchase their own shares as they feel that this is a good investment opportunity. Therefore, announcing an OMSR can signal to the market that they are undervalued, and can positively affect the stock price generating positive abnormal returns. In order to quantify company undervaluation, Ikenberry et al. (1995) used the book-to-market equity ratio, where a high and low ratio, respectively, imply relative under- and overvaluation. During the pandemic most stock prices experienced rapid changes caused by uncertainty on the financial market (Onali, 2020). As a result, when companies experience a rapid stock price decline, this can increase their book-to-market equity ratio making it interesting for them to announce a share repurchase to possibly boost their stock price. In order to examine whether this was the case during the pandemic, the following hypothesis will be tested:

H4: Relatively undervalued companies that announce an OMSR during the pandemic are able to generate a more positive abnormal return than before.

Fifth, one of the findings from Netter and Mitchell (1989) was that higher positive abnormal returns were generated by companies with strong fundamentals, but with stock that were underperforming prior to the announcement, and stocks that experienced a rapidly declining prices due to the crisis. According to the authors, this would imply that a mispricing was corrected by the announcement. To examine whether the same pattern is observed during the COVID pandemic, the following hypothesis will be tested:

H5: Companies with underperforming stock prior to an OMSR announcement, experienced higher abnormal returns during the pandemic compared to pre-pandemic.

Sixth and final, the COVID pandemic has led to an increase in market uncertainty (Uddin et al., 2021). Even though repurchase announcements contain information that resolves uncertainty regarding the company's value in general, this is not necessarily the case when there is heightened market uncertainty (Baker et al., 2016). When market uncertainty is high, companies are less likely to announce a share repurchase program because high market uncertainty can impact abnormal return. To test whether the uncertainty reducing effect which repurchase announcements usually have is just as strong during uncertain market times as compared to more stable market times, the following hypothesis will be tested:

H6: The abnormal return following OMSR announcements during the pandemic is smaller than before the pandemic due to higher market uncertainty.

Table 2.1 shows the different hypotheses with their main variable of interest and in addition, with what sign these variables are expected to affect company abnormal returns.

TABLE 2.1: Hypothesis overview

Overview of the hypotheses. Column (1) and (2) show the hypothesis number and the description of the hypothesis respectively. In Column (3), the variable of interest each hypothesis aims to investigate is listed. The final Column (4) shows the expected relationship between the variable of interest and announcement abnormal returns.

Number	**Hypothesis X**	**Variable**	**AR**
1	Surrounding OMSR-announcements, companies in the U.S. experience a significant positive abnormal return during the COVID pandemic as compared with pre-pandemic.	Announcement	+
2	During the COVID pandemic, smaller companies generated larger abnormal returns when announcing an OMSR as compared to relatively large companies in the US.	Size	-
3	Relatively high free cash flow companies generated larger abnormal returns following an OMSR announcement during the pandemic than relatively low free cash flow companies.	Cash Flow	+
4	Relatively undervalued companies that announce an OMSR during the pandemic are able to generate a more positive abnormal return than before.	Book-to-Market equity ratio	+
5	Companies with underperforming stock prior to an OMSR announcement, experienced higher abnormal returns during the pandemic compared to pre-pandemic.	Underperformance	+
6	The abnormal return following OMSR announcements during the pandemic is smaller than before the pandemic due to higher market uncertainty.	Market Uncertainty	-

Chapter 3

Data

3.1 Repurchase Data

3.1.1 Announcement Dates

In order to determine what factors affect abnormal returns following share repurchase announcements in the US, share buyback announcements for US companies listed on the main stock exchanges are examined from April 2015 until March 2022. With consideration that the WHO declared the pandemic on the 11^{th} of March 2020, setting the sample to these dates ensures two (fiscal) years for companies in the sample ranging from April 2020 in year *t* to March in year 2021 *t + 1* and in year 2022 *t + 2* (Ntantamis & Zhou, 2022). The OMSR is the most common method to repurchase shares; around 90% of all share repurchases are on the open market Grullon and Michaely (2004). The aim of this study is to focus on OMSR and therefore, other methods are excluded from the sample. One reason for this is because other methods such as fixed price tender offers are less likely to have the same motives such as signaling, and are rarer in general (Comment & Jarrell, 1991).

The OMSR announcement dates are collected from the Refinitiv Eikon Database. Eikon provides a variety of financial data for the global market including accounting, stock price, and event data. Using the Eikon Deal Screener functionality, the share repurchase announcement dates can be identified for US companies within the sample time period. Extracting these share repurchase announcement dates leads to a total of 3,735 observations for 2,109 companies.

Furthermore, some companies within the sample period have more than one announcement per quarter. Following (Yook, 2010), it is not likely that when a company sends a signal such as a share repurchase announcement on a regular basis, the motive behind the announcement is to signal inside information or undervaluation. If this is the case, then the companies are more likely to have a different motivation to announce or repurchase shares (Jagannathan & Stephens, 2003). Therefore, it should be taken into account how many repurchase announcements are done by an individual company within the sample period. As a restriction, each company is allowed to have one repurchase announcement every quarter to ensure that the signal is still deemed credible by the market. This leads to a total of 2,615 announcements by 1,488 companies over the sample period from Eikon.

3.1.2 Abnormal Returns

For each company, the data to calculate the abnormal returns is obtained from the CRSP U.S. Daily stock information accessed through Wharton Research Data Services (WRDS). Using the Tickers and event dates that were obtained from the Eikon deal screener, the correct information for each company is extracted. For some companies the Tickers are manually added to the data set if these were missing from the Eikon data. The chosen market benchmark that will be used to estimate the abnormal returns is the CRSP value weighted index which is in line with Grullon and Michaely (2004). In addition, non-historical Tickers and Tickers in a different format, such as Tickers for certain class shares, are also manually changed to obtain regular historical company tickers, which are required by WRDS. Companies with missing stock price data, companies that were delisted, or companies that no longer exist were excluded from the sample here. Finally, any companies with overlapping events, id est more than one repurchase announcement within the event window of another announcement, are excluded from the sample. These resulted in a sample size comprising 2,563 announcements by 1,444 companies.

3.2 Company and Market characteristics

3.2.1 Company information

Financial and accounting information is extracted from the Compustat - Capital IQ Fundamentals Quarterly database and accessed through WRDS. This database provides (financial) company information for listed U.S. companies which is released in their quarterly earnings announcement. A wider range of data is collected here from January 2014 up until April 2022 to ensure proper estimation for all variables. The Tickers of the companies left in the sample after running the event study are used to extract the quarterly financial information from Compustat.

The book-to-market equity ratio (**BE/ME**), according to Fama and French (1993), is the ratio of the book value of a company's common stock (**BE**) to its market value (**ME**). Using the same definition of the BE as Fama and French (1997), the BE is calculated by taking the book value of stockholders' equity (total), adding balance sheet deferred taxes and investment tax credits (if available), adding post-retirement benefit liability (if available), and subtracting the book value of preferred stock. If the book value of preferred stock is not available, then either the redemption, liquidation, or par value (in that order), is used to estimate the book value of preferred stock. Consequently, the book value of shareholders equity will then either be the total shareholders equity, or the book value of current assets minus liabilities, and the book value of common/ordinary equity plus the par value of preferred stock. After estimating the BE with the available Compustat items, any companies with a negative book equity value are removed from the dataset. The following formula will be used to estimate the BE

$$\begin{aligned} BE &= \mathbf{TEQQ} + TXDBQ + TXDBQ + TXDITCQ - \underline{PSTKQ} \\ &= \mathbf{ACTQ\text{ - }LTQ} + TXDBQ + TXDBQ + TXDITCQ - \underline{PSTKQ} \\ &= \mathbf{CEQQ} + TXDBQ + TXDBQ + TXDITCQ \end{aligned} \tag{3.1}$$

where the Compustat item $TEQQ$ is the Total Shareholders Equity, $TXDBQ$ is the Deferred Taxes on the Balance Sheet, $TXDITCQ$ is the Deferred Taxes and Investment Tax Credit, $PSTKQ$ is the Total Preferred/Preference Stock Capital, $ACTQ$ is the Total Current Assets, LTQ is the Total Liabilities, and $CEQQ$ is the Total Common/Ordinary Equity.

Because the data set is based on quarterly earnings, the ME is calculated by multiplying a company's closing price with the number of shares outstanding for the preceding quarter. The BE/ME ratio is calculated for a quarter by using the BE and ME of the preceding one. As proxy for company size, instead of using the ME relative to the market as done by Ikenberry et al. (1995), the natural logarithm of the total assets will be used (Grullon & Michaely, 2004). Finally, companies with a missing BE/ME ratio were excluded from the sample.

The Free Cash Flow (**FCF**) is estimated similar to Howe et al. (1992) by using the formula derived from Lehn and Poulsen (1989). The measure for FCF is defined as the operating income before depreciation minus interest expenses, taxes, preferred dividends, and common dividends. Additionally, Howe et al. divide the FCF by the total assets to account for difference in company size. The value for FCF and total assets in the quarter prior to each announcement is used

$$FCF = OIBDPY - XINTY - (TXTQ - \Delta TXDBQ) - (UDVPY + PDVCY) - CDVCY \quad (3.2)$$

where the Compustat item $OIBDPY$ is the Operating Income Before Depreciation, $XINTY$ is the Total Interest and Related Expense, $TXTQ$ is the Total Income Taxes, $\Delta TXDBQ$ is the Quarterly difference for the Deferred Taxes on the Balance Sheet, $UDVPY$ is the Preferred Dividend Requirements, $PDVCY$ is the Cash Dividends on Preferred/Preference Stock, and finally, $CDVCY$ is the Cash Dividends on Common Stock. To correct for outliers, the variable for FCF was winsorized for the top and bottom 0.01th percentile. Instead of removing these observations, the values of the observations below and above the 1st and 99th percentile were changed to the value of the 1st and 99th percentile, respectively.

The final company variable that will be added as a control variable is the Leverage ratio. The Leverage ratio is defined similar to Grullon and Michaely (2004) as the total debt divided by the total assets. The items to estimate the Leverage ratio are also obtained from Compustat.

The four variables FCF, BE/ME ratio, Size and Leverage ratio will be calculated for each quarter. Consequently, when an announcement takes place in a certain quarter the value of these variables of that preceding quarter will be linked to this announcement date. Therefore, the values of these variables are automatically one lag behind.

3.2.2 Implied Volatility Index (VIX)

The Chicago Board Options Exchanges (**CBOE**) Indexes provide the Implied Volatility indices for all major US stock markets. Using WRDS, the closing price of the implied volatility index for the S&P500, or the VIX can be extracted. The VIX is a widely used measure to account for volatility in the financial market. If the VIX closing value is relatively high, then this indicates an increase in relative financial market volatility. The difference between the closing value for the VIX of each day with the previous trading day is calculated to depict changes in volatility instead of just the level. If there is a large difference for the VIX closing level, then this implies that the market uncertainty has either strongly increased or decreased, depending on the sign of the change.

3.3 Data Merging

In order to combine the datasets from different sources, several changes had to be made to create the main dataset. First, company announcement dates were linked to their most recent quarter. Meaning that for each company, the most recent quarterly earnings announcement date was connected to a share repurchase announcement date to obtain the most recent company information for that announcement. Therefore, the restriction was imposed that each company was only allowed to have a single announcement per quarter. In addition, if a company had more than one announcement date within two days, then this announcement was removed from the sample altogether due to a possible bias in the data. Because the observations for the FCF, BE/ME ratio, and Size are based on quarterly information, these earnings announcements were linked to repurchase announcements in the main data set based on quarter, year, and company Ticker. For each repurchase announcement, the quarterly accounting information for the previous quarter was linked to the announcement as it is the most recently available company financial information available to investors. Following which, VIX volatility information including closing values and daily changes, were merged with the main data set based on dates. This resulted in the final sample size of 2,540 announcements by 1,425 companies.

3.4 Descriptive Statistics

Table 3.1 shows the descriptive statistics for the main dataset. The average number of repurchase announcements each year was approximately 362. In previous literature, an increasing popularity of share repurchase announcements was mentioned. However, in this data set, the number of repurchases did not steadily increase. Rather, it fluctuated over the years. The year preceding and following the COVID pandemic showed the lowest number of share repurchase announcements in the sample period. However, the second year after COVID saw the second highest number of repurchase announcements made in a year. The total number of repurchase announcements in the sample period after merging the data was 2,540 made by 1,425 companies, implying that companies made announcements in multiple years over the sample time period.

TABLE 3.1: Descriptive Statistics

Descriptive statistics for the variables used in the analysis of open market share repurchase announcements from 2015-2022. The sample consisted of 2,540 announcements made by 1,425 unique companies listed on major U.S. stock exchanges. Information is obtained from Eikon and Compustat - Capital IQ. Variables included Book Equity, Market Equity, Total Equity, BE/ME ratio, and Free Cash Flow, number of announcements per year, and the number of unique companies. Statistics are shown per year pre-COVID and during COVID. The variable means are reported for each year and the row below shows the mean of the full sample.

	Book Equity	**Market Equity**	**Total Equity**	**BE/ME Ratio**	**Free Cash Flow**	**Nr. Announcements**	**Nr. companies**
03/15 - 02/16	3,503.65	8,664.48	3,139.82	0.71	147.97	487	445
03/16 - 02/17	6,630.05	12,569.47	5,989.81	0.64	236.96	337	318
03/17 - 02/18	7,123.17	14,820.08	6,834.77	0.62	270.14	329	306
03/18 - 02/19	7,165.99	19,254.17	6,904.45	0.57	329.54	420	392
03/19 - 02/20	8,775.46	19,528.80	8,106.76	0.72	261.41	238	235
03/20 - 02/21	7,987.16	15,964.19	7,618.97	0.92	215.90	271	263
03/21 - 02/22	5,971.89	21,211.05	5,594.53	0.59	264.07	458	418
Average(*Total*)	6,410.25	15,790.11	6,004.96	0.67	244.43	(*2,540*)	(*1,425*)
N	2,540	2,540	2,540	2,540	2,540	2,540	2,377[a]

[a]This is the count of the number of unique companies in each year making a repurchase announcement. The total number of unique companies over the full sample period is 1,425 and because some of these companies made multiple announcements in multiple years as well the total number of announcements is 2,540.

Chapter 4

Methodology

The main research question of this paper is centered on *How did the COVID-19 pandemic affect the financial market's reaction to share repurchase programs in the US, and how did company specific variables impact announcement returns as compared to pre-COVID*. This will be tested by examining the announcement abnormal returns pre- and during the pandemic under the effect of certain variables. This section will discuss the event study methodology followed by the hypotheses and their corresponding models.

4.1 Event Study

Event studies are a popular and widely used method in financial research to investigate the impact of an event on a company's share price. The event study methodology is based on calculating the normal performance of a company, without the occurrence of the event, and then comparing this ex-post to the company's actual performance surrounding the event. There are several methods that can be used to estimate a company's normal performance, ranging from the Constant Mean Return Model up until the 3- or 5-factor return model, and each of these models has its own benefits and limitations (MacKinlay, 1997). The objective of this study is to examine the market's reaction to OMSR announcements. Therefore, an event study will be performed to investigate the impact of these announcements on abnormal returns based on the methodology by Ikenberry et al. (1995).

4.1.1 Estimating Abnormal Returns

As mentioned in Section 4.1, there are several methods through which abnormal returns can be estimated. In line with Ikenberry et al. (1995), this paper uses the Market Model to estimate the abnormal returns. The market model is a statistical model that captures the relationship between a company's securities return and connects this to the market return. First, daily stock and market returns are requirements to estimate the market model parameters. Therefore, daily stock or market portfolio prices are converted to daily stock and market returns respectively using the following formula:

$$R_{i,t} = \frac{P_{i,t} - P_{i,t-1}}{P_{i,t-1}} \tag{4.1}$$

where $R_{i,t}$ is the return for company i's security at time t, and $P_{i,t}$ is the closing price for company i's security at time t. These returns depict the actual returns for the securities as observed. Consequently, the market model can now be used to estimate the parameters needed to calculate a company's expected return based on the market returns. In order to estimate the market model parameters to calculate these returns, for each company i the following formula is used

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \epsilon_{i,t} \tag{4.2}$$
$$E(\epsilon_{i,t} = 0) \quad var(\epsilon_{i,t}) = \sigma^2_{\epsilon_t}$$

where $R_{i,t}$ is the return for company i's security at time t, $R_{m,t}$ is the return on the market portfolio m at time t, and $\epsilon_{i,t}$ is the error term of the formula which has an expected value of zero. The parameters for α_i, β_i, and $\sigma^2_{\epsilon_t}$ are estimated by the market model based on the market and company return, where α_i depicts the average return for company i's security when the market return is zero, β_i is the correlation between company i's security return with the market return $R_{m,t}$ at time t, and finally $\sigma^2_{\epsilon_t}$ is the variance of the error term ϵ_t. For this analysis, daily returns are utilized and therefore, the risk free rate does not need to be taken in to account for this estimation (MacKinlay, 1997). Using the estimations from the market model, the abnormal returns can be calculated. Abnormal returns are calculated for each day during the Event period. However, the Event period is expanded beyond the window of interest to observe for insights related to the period surrounding the event as well. The abnormal return of a security during the Event period is calculated by subtracting the company's expected return from its ex post return. The expected return is based on the return which is not affected by the event and estimated using the company's previous stock returns through the market model. The formula to calculate the abnormal returns for each event date τ is

$$AR_{i,\tau} = R_{i,\tau} - E(R_{i,\tau}|R_{m,\tau}) \tag{4.3}$$

where $AR_{i,\tau}$ is the abnormal return for company i for time period τ, $R_{i,\tau}$ is the actual return, as observed in the data, for company i for time period τ, and finally, $E(R_{i,\tau}|R_{m,\tau})$ is the expected return for each company for time period τ calculated through Formula 4.2 based on the market return $R_{m,\tau}$.

Contrary to Ikenberry et al. (1995), Grullon and Michaely (2004) use the CRSP value weighted index instead of the equal weighted index to calculate their market returns. Therefore, deviating from the methodology from Ikenberry et al., this paper will follow Grullon and Michaely and use the CRSP value weighted index as a market benchmark. The value weighted index is the most widely used index and is the best option when examining larger more established companies with generally a higher market capitalization. Because these companies are also more likely to announce share repurchases as discussed in Section 2.1, the CRSP value weighted index is used as a market benchmark for the event study. Ikenberry et al. also examined the difference between other indices and/or performance measures and found that most deviations between the CARs of these measures happen after a period of 3 months following the event, which is outside of the event period. All in all, the CRSP value-weighted index gives the best representation as a market index for this sample.

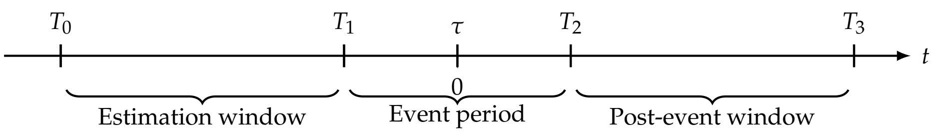

FIGURE 4.1: Time line for an event study

Figure 4.1 shows a general time line for an event study. For each company i an event study will be conducted, where the event is defined as an OMSR announcement and takes place for each company at event $t = \tau$. The *Estimation window* runs from (T_0, T_1) and depicts the time period before the Event period used to estimate the Market model parameters to calculate the abnormal returns. Important to note that the Event period and Estimation window should not overlap to ensure that the expected return parameters do not include any return impacted by the event. According to MacKinlay (1997), the Estimation window for an event study using daily returns must be between 100 and 300 trading days prior to the event. Because companies can have multiple announcements in a year with some falling within the same each quarter, there is a possibility that an event window of 100 trading days may include two announcements. In an attempt to mitigate the effect of earlier announcements on the parameters derived from the Estimation window, a large Estimation window will be used. By doing so, the effect of other announcements can be corrected by the estimation technique. In addition, sensitivity to other market fluctuations can be decreased and therefore, the maximum number of trading days as recommended by MacKinlay is used leading to the Estimation window (-270,-30). Consequently, the *Event period*, which runs from (T_1,T_2), will start immediately after the Estimation window leaving just one trading day as a gap in order to comply with the maximum number of trading days prior to the event. By using a wider Event period than the event itself, different abnormal returns can be aggregated over several windows to further distinguish the market's reaction. The final Event period will run from (-29,10).

4.1.2 Cumulative Abnormal Returns

After the abnormal returns are estimated, in order to investigate overall event inferences, the Cumulative Abnormal Return (**CAR**) can be computed (MacKinlay, 1997). The CARs are the aggregated abnormal returns for stock i from τ_1 to τ_2 under the restriction that $T_1 < \tau_1 \leq \tau_2 \leq T_2$. By calculating the CARs for different windows during the Event period, multiple window's can be investigated to isolate certain effects of the event. The formula to calculate the CAR is

$$CAR_i(\tau_1, \tau_2) = \sum_{\tau=\tau_1}^{\tau_2} AR_{i\tau} \tag{4.4}$$

where (τ_1, τ_2) is the window during the event period the CAR is calculated over time. Looking at OMSR announcements, three different windows will be used to calculate the CAR and show different market behavior surrounding and during the announcement (e.g., Comment & Jarrell, 1991; Ikenberry et al., 1995; Vermaelen, 1981). The first window will range from -20 to -3 days prior to the event in order to capture the abnormal returns just prior to the announcement and show any company underperformance prior to the announcements. The second window, ranging from -2 to +2, captures the initial market reaction to the announcement. And finally, the third window ranging from +3 to +10, will provide indication of any corrections from the market prior to the initial reaction.

In order to test whether the CARs for a certain period statistically differ from zero, conditional on a normal distribution for the abnormal returns, a two sided one sample t-test will be conducted. Because testing for a single event and its CAR is not really useful, the CARs of all events and companies are aggregated for the Event window across different events as well. The average CAR for all companies i over time (τ_1, τ_2) is calculated using the formula:

$$\overline{CAR}(\tau_1, \tau_2) = \frac{1}{n} \sum_{i=1}^{n} CAR_i(\tau_1, \tau_2) \tag{4.5}$$

where n is the number of companies and $\overline{CAR}(\tau_1, \tau_2)$ is the average CAR. Using the $\overline{CAR}$ the t-test can be conducted. The null hypothesis for this test is that the $\overline{CAR}(\tau_1, \tau_2)$

is not statistically significantly different from zero, and the alternative hypothesis is that the CAR is. In symbols this means that for $CAR(\tau_1, \tau_2)$ under the hypothesis

$$H_0 : \overline{CAR}(\tau_1, \tau_2) = 0 \mid H_a : \overline{CAR}(\tau_1, \tau_2) \neq 0$$

and test statistic

$$t = \frac{\overline{CAR}(\tau_1, \tau_2)}{\sigma(\overline{CAR}(\tau_1, \tau_2))} \tag{4.6}$$

where $\sigma(\overline{CAR}(\tau_1, \tau_2))$ is the variance for the average CAR computed using the method by MacKinlay (1997), the statistical significance can be tested.

In addition to regular t-tests on the differences between company characteristics, a Cross-Sectional t-test will also be conducted for certain average CARs. Because some companies may have multiple announcements in the sample, two additional parametric tests will be conducted to take into account possible overlapping event windows and distribution of abnormal returns in the CAR window. The first additional test will be the Patell Z test, which is robust against the aforementioned, but sensitive to cross-sectional correlation. The second test will be the Standardized Cross-Sectional Test, better known as the Boehmer et al., or BMP test. This test is still sensitive to cross-sectional correlation, and takes event induced volatility in to account. Under these two tests, the null hypothesis also states that the average cumulative abnormal returns do not statistically significantly differ from zero, whereas the alternative hypothesis states that they do (Boehmer et al., 1991; Patell, 1976). Finally, to deal with possible non normality issues, one non parametric test will be conducted; the Generalized Sign Test (Kolari & Pynnonen, 2011). The Generalized Sign Test is a non parametric test that accounts for all the aforementioned issues, however, these tests are less powerful and are best used alongside parametric tests (MacKinlay, 1997).

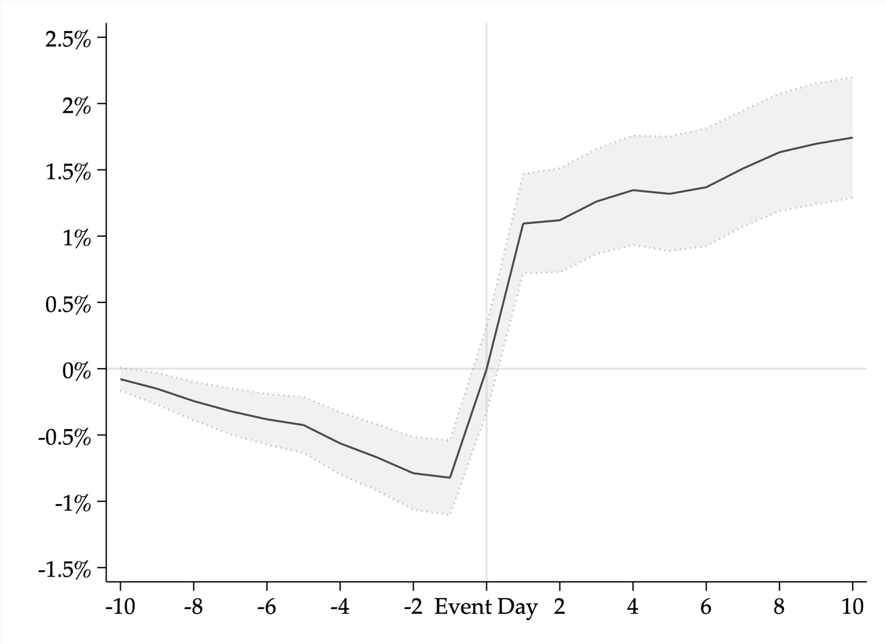

FIGURE 4.2: Average Cumulative Abnormal Returns (CAR) for Open Market Share Repurchase (OMSR) Announcements pre- and during the COVID-19 Pandemic

The graph presents the average CAR in percentage (%) on the Y-axis, representing the deviation from expected stock returns, against the number of days relative to the event day on the X-axis. The shaded area surrounding the vertical line illustrates the 95% confidence interval, calculated as ±1.96 multiplied by the standard error. The sample consists of US-listed companies that announced repurchases from April 2015 to March 2022.

Figure 4.2 shows the average CARs for the sample period. Prior to the event day, from $(-10, -1)$, the average CAR was negative and decreasing, confirming the pattern that most companies underperform before their announcement. The window $(-1, +1)$ contains the OMSR announcement itself and shows that the ARs strongly increased surrounding the announcement. After the event, positive abnormal returns remained and the average CAR continued to increase, which means that the market considered the announcements a positive signal. This figure shows a clear pattern that companies underperform just prior to their announcement, and outperform immediately after. Furthermore, the positive abnormal returns after the event appear larger than the negative ones before which implies a positive average CAR for the full window.

4.2 Regression Analysis

4.2.1 General impact of company characteristics on abnormal returns

In order to investigate the impact of company characteristics on OMSR announcement returns during the pandemic, first a basic model must be established for these characteristics. Company characteristics are important determinants for OMSR announcements and impact the abnormal returns generated by them. The basic model used for this analysis will build on the findings from Section 2.3 and is based on the analysis by Ikenberry et al. (1995). The four important determinants of the abnormal returns identified there are Company Size, Undervaluation, Cash, and finally Leverage. Ikenberry et al. defined company Size as the size of a certain company relative to the total market. However, for this thesis the natural logarithm of the total assets will be used to control for Company

Size, which is more in line with Grullon and Michaely (2004). The BE/ME and Free Cash Flow will be used to proxy for company Undervaluation and Cash, respectively, and is computed as mention in Section 3.2. Finally, Leverage will be defined as the ratio of total debt and total assets. Combining these four variables, the following base model can be estimated

$$CAR_i(\tau_1, \tau_2) = \alpha + \beta_1 ln(TotalAssets_{i,t}) + \beta_2^{CAT} FCF_{i,t} + \beta_3^{CAT} \frac{BE}{ME}_{i,t} + \beta_4 Leverage_{i,t} + \epsilon_{i,t} \quad (4.7)$$

where $ln(TotalAssets_{i,t})$ is the natural logarithm of the total assets, FCF and $\frac{BE}{ME}$, respectively, are the free cash flow and book-equity to market-equity ratio subdivided as a categorical variable in five quintiles, and finally, *Leverage* is leverage ratio, for each company i at time t. Conforming to the theoretical framework in Chapter 2, the sign of the coefficients for the base model is expected to be the following. First, the expectation for the constant $\alpha > 0$ due to the abnormal returns generally being positive regardless of the time period (see Section 2.3). Second, larger companies are expected to have a lower CARs than smaller companies according to the TSH because there is less information asymmetry between the market and investors. Hence, the coefficient for Company Size, which is proxied by the natural logarithm of the total assets is expected to be negative ($\beta_1 < 0$). Third, companies with a high cash flow generate a higher abnormal return due to repurchase announcements being perceived by the market as a sign of a relatively better cash position. Therefore, the CAR is expected to increase for companies with a relatively higher cash flow. For each subsequent quintile, the coefficients for the categorical variable free cash flow are expected to be positive and increase subsequently ($\beta_2^{CAT.5} > \beta_2^{CAT.4} > \beta_2^{CAT.3} > \beta_2^{CAT.2} > 0$). Fourth, companies with a high BE/ME ratio are more likely to repurchase shares than companies with a relatively low BE/ME ratio and generate higher abnormal returns. Considering the coefficients for the categorical variable $\frac{BE}{ME}_{i,t}$, the coefficient for each subsequent quintile is expected to be increasingly more positive ($\beta_3^{CAT.5} > \beta_3^{CAT.4} > \beta_3^{CAT.3} > \beta_3^{CAT.2} > 0$). Finally, higher leverage increases financial risk for a company, which decreases the CAR following a repurchase announcement. As a result, the coefficient for this variable is expected to be negative ($\beta_4 < 0$). Considering the expected signs of the base model coefficients, the base model will also be estimated to check whether used data set corresponds to the findings from the theoretical framework.

Several prior studies used quintile rankings as well when examining the impact of company characteristics. For example, Fama and French (1993) investigated risk factors affecting stock returns and grouped companies in quintiles based on their size and book-to-market ratios as well. Sorting companies in these five different groups enabled them to capture more nuanced differences across the distributions of those factors. Similarly, Gaspar et al. (2013) employed a quintile ranking in order to analyze how investor horizons impact repurchase announcement returns. Therefore, instead of using two categories for high and low FCF or BE/ME ratio companies, this study follows the aforementioned examples and uses a quintile ranking to capture more variation effect of these variables.

4.2.2 Impact of the pandemic on abnormal returns

In order to answer the first hypothesis, the overall effect of the pandemic on abnormal returns will be investigated. Section 2.3 provided the evidence from the financial literature on the effect of OMSR announcements on abnormal returns. The general consensus here was that OMSR announcements positively affect a company's share price, generating a positive abnormal return. In addition, Section 2.4 further investigated these abnormal returns during times of (financial) crisis, mostly focused on the impact of company or market characteristics on the repurchase announcement returns. This analysis will also investigate the general impact of the pandemic on abnormal returns however, to account for endogeneity issues the model will be extended using control variables from the base Model 4.7. Intending to assess the effect of the COVID pandemic on the announcement abnormal returns, this paper will estimate the following model based on the methodology by Comment and Jarrell (1991) & Anolick et al. (2021)

$$CAR_i(\tau_1, \tau_2) = \alpha + \beta_1 ln(TotalAssets_{i,t}) + \beta_2^{CAT} FCF_{i,t} + \beta_3^{CAT} \frac{BE}{ME}_{i,t} + \beta_4 Leverage_{i,t} + \beta_5 D_{i,t}^{COVID} + \epsilon_{i,t} \quad (4.8)$$

where $D_{i,t}^{COVID}$ is a dummy variable that takes on the value 1 when the announcement took place during a COVID year. Further combining the findings from Section 2.3 & 2.4, the following formal hypothesis can be defined.

Hypothesis 1. *Null:* The abnormal returns surrounding OMSR announcements were not larger during the COVID pandemic (meaning $\beta_5 = 0$). *Alternative:* During the COVID pandemic, companies experienced a more positive abnormal return (meaning $\beta_5 > 0$) surrounding OMSR announcements. The hypothesis will be tested using a one sided t-test.

4.2.3 Impact of company characteristics on abnormal returns during the pandemic

For the second hypothesis, the effect of company size during the COVID pandemic will be examined. As mentioned in Section 2.4, relatively smaller companies are more likely to repurchase shares during a crisis period than larger companies. Further, the abnormal returns for smaller companies when announcing an OMSR are larger than that of relatively larger companies, which is in line with the TSH (e.g., Grullon & Michaely, 2002, 2004; Ikenberry et al., 1995). Therefore, it is expected that as compared with larger companies, smaller companies are able to generate a higher abnormal return following a repurchase announcement during the COVID pandemic. In order to test this hypothesis, Model 4.7 will be extended in order to answer Hypothesis 2 as follows

$$CAR_i(\tau_1, \tau_2) = \alpha + \beta_1 ln(TotalAssets_{i,t}) + \beta_2^{CAT} FCF_{i,t} + \beta_3^{CAT} \frac{BE}{ME}_{i,t} + \beta_4 Leverage_{i,t} + \beta_6 ln(TotalAssets_{i,t}) * D_{i,t}^{COVID} + \epsilon_{i,t} \quad (4.9)$$

where the interaction term $ln(TotalAssets_{i,t}) * D_{i,t}^{COVID}$ depicts the additional effect of company size on abnormal returns during the pandemic for company i at time t. Building upon Model 4.9, the following formal hypothesis can be defined.

Hypothesis 2. *Null:* Company size did not impact abnormal returns surrounding OMSR announcements differently during the COVID pandemic (meaning $\beta_6 = 0$). *Alternative:* Smaller companies generated higher abnormal returns following an OMSR announcement during the COVID pandemic (meaning $\beta_6 < 0$). The sign of the variables in the base model is expected to remain unchanged for this Model 4.9. In order to test whether $\beta_6 < 0$, a one sided t-test will be conducted.

The third company characteristic based hypothesis builds upon the evidence from financial literature presented in Section 2.2 and emphasizes the impact of a company's cash position on repurchase announcements abnormal returns. Usually, the stronger a company's cash flow generating possibilities, the more positive the abnormal returns are because investors consider the buyback as a sign that this is the most lucrative investment opportunity an investor has. During a crisis, such as the COVID pandemic, companies may be more inclined to use their cash position to provide some financial stability for the company. Regardless, high cash flow companies are still most likely to repurchase shares during a crisis. Therefore, Hypothesis 3 aims to investigate whether the likelihood to repurchase shares during a crisis period, id est COVID, is caused by an additional positive effect on the CARs for a repurchasing company due to high free cash flows. Hence, the following model will be estimated to answer the hypothesis

$$CAR_i(\tau_1,\tau_2) = \alpha + \beta_1 ln(TotalAssets_{i,t}) + \beta_2^{CAT} FCF_{i,t} + \beta_3^{CAT} \frac{BE}{ME}_{i,t} + \beta_4 Leverage_{i,t} + \beta_7^{CAT} FCF_{i,t} * D_{i,t}^{COVID} + \epsilon_{i,t} \quad (4.10)$$

where the interaction term $FCF_{i,t} * D_{i,t}^{COVID}$ depicts the interaction term between the categorical variable $FCF_{i,t}$ and the COVID dummy, which will generate four coefficients for each company i at time t depending on the category they belong that depicts their difference to the base category 1 (id est the 20th quintile). Building upon Model 4.10, the following formal hypothesis can be defined.

Hypothesis 3. *Null:* The relative free cash flow level of a company did not impact company abnormal returns during the COVID pandemic (meaning $\beta_7^{CAT.5} = \beta_7^{CAT.4} = \beta_7^{CAT.3} = \beta_7^{CAT.2} = 0$). *Alternative:* When a companies relative free cash flow increased, the abnormal returns generated by OMSR announcements increased as well during the pandemic (meaning $\beta_7^{CAT.5} > \beta_7^{CAT.4} > \beta_7^{CAT.3} > \beta_7^{CAT.2} > 0$).

The fourth and final company characteristic investigates the hypothesis that undervaluation can be a motive to announce a share repurchase, due to this being perceived as a positive signal in the market which generates positive abnormal returns (Ikenberry et al., 1995). During the COVID pandemic, the US stock market experienced a rapid decline in stock prices as mentioned Section 2.5. This could lead to an increase in companies that perceive themselves as undervalued and in turn motivates them to announce a repurchase program during the pandemic. In order to examine whether announcing a share repurchase program during the pandemic generates any additional effect for a company Hypothesis 4 will be tested. Therefore, the following model will be used to test this effect

$$CAR_i(\tau_1,\tau_2) = \alpha + \beta_1 ln(TotalAssets_{i,t}) + \beta_2^{CAT} FCF_{i,t} + \beta_3^{CAT} \frac{BE}{ME}_{i,t} + \beta_4 Leverage_{i,t} + \beta_8^{CAT} \frac{BE}{ME}_{i,t} * D_{i,t}^{COVID} + \epsilon_{i,t} \quad (4.11)$$

where the interaction term $\frac{BE}{ME}_{i,t} * D_{i,t}^{COVID}$ depicts the interaction term between the categorical variable $\frac{BE}{ME}_{i,t}$ and the COVID dummy, which will generate four coefficients for each company i at time t depending on the category they belong that depicts their difference to the base category 1 (id est the 20th quintile). Building upon Model 4.11, the following formal hypothesis can be defined.

Hypothesis 4. *Null:* The relative under or over valuation of a company did not impact the abnormal returns generated by OMSR announcements during the pandemic (meaning $\beta_8^{CAT.5} = \beta_8^{CAT.4} = \beta_8^{CAT.3} = \beta_8^{CAT.2} = 0$). *Alternative:* Relatively higher undervalued company generated a more positive abnormal return following OMSR announcements during the pandemic (meaning $\beta_8^{CAT.5} > \beta_8^{CAT.4} > \beta_8^{CAT.3} > \beta_8^{CAT.2} > 0$).

4.2.4 Impact of market characteristics on abnormal returns during the pandemic

As mentioned in Section 2.5, the pandemic has had a significant impact on the financial market. For example, stock prices experienced sharp and rapid decline which caused a great deal of stress for investors. Netter and Mitchell (1989) found that when stock prices experienced a rapid stock price decline prior to the announcement, the OMSR generated a positive abnormal return during and immediately after the period of the announcement. Furthermore, Comment and Jarrell (1991) confirmed these findings and specified that only recent underperformance, id est maximum of two months, showed a significant positive buyback announcement return. Building upon these findings, it is expected that the OMSR announcement returns during COVID would follow a similar pattern. Considering event time τ, the CAR for the window in the event period ranging from $\tau - 20$ up until $\tau - 3$, id est 17 trading days prior to the event period, is used to measure stock price underperformance. Meaning, that if $CAR(-20, -3) < 0$, then the CAR surrounding and following the event is expected to be more positive during the COVID pandemic. The negative CAR before the event will be a measure for underperformance. Therefore, in order to test the underperformance Hypothesis 5 the following model will be estimated

$$CAR_i(\tau_1, \tau_2) = \alpha + \beta_5 D_{i,t}^{COVID} + \beta_9 D_{i,t}^{CAR_{neg}} + \beta_{10} D_{i,t}^{COVID} * D_{i,t}^{CAR_{neg}} \\ + FE_{i,t} + Base\ Model + \epsilon_{i,t} \quad (4.12)$$

where $D_{i,t}^{CAR_{neg}}$ is a dummy variable that takes on the value 1 when $CAR(-20, -3) < 0$ (underperforming stock) and 0 otherwise for each company i at time t, where $D_{i,t}^{COVID} * D_{i,t}^{CAR_{neg}}$ is the interaction term between the COVID dummy and the CAR dummy, $FE_{i,t}$ are company & time fixed effects, and *Base Model* are the base model variables. Building upon Model 4.12, the following formal hypothesis can be defined.

Hypothesis 5. *Null:* Stock underperformance prior to an OMSR announcement did not generate any significant abnormal returns during the pandemic (meaning $\beta_{10} = 0$). *Alternative:* Companies underperforming prior to an OMSR announcement during COVID were able to generate a higher abnormal return than without the crisis (meaning $\beta_{10} > 0$).

Company fixed effects are added to the model specification to account for company invariant characteristics and further reduce model variance. In addition, time fixed effects are added to account for time invariant characteristics. In an attempt to reduce omitted variable bias, the company variables from the base Model 4.7 will be estimated on the background to account for possible endogeneity. The sign of the coefficient $\beta 9$ is expected to be positive as well, due to underperformance usually positively impacting announcement returns (Section 2.3 & 2.4).

Finally, the COVID pandemic not only impacted the stock returns, but concerns related to future company revenue, governmental policies, the duration of the crisis, and more, all dramatically increased the overall financial market's uncertainty (Onali, 2020). One commonly used proxy for uncertainty is the level of the VIX. Usually, during periods with high market uncertainty, such as the COVID pandemic, companies are less likely to announce share repurchases. In the case that uncertainty is focused towards company value instead of overall market uncertainty, announcing a repurchase can resolve uncertainty for investors and increase share prices, making it more appealing for a company to announce the repurchase. However, if announcing a repurchase when the VIX is high causes a more negative abnormal return during the pandemic, this can indicate that the announcement does not resolve uncertainty regarding company value when uncertainty in the financial market is high. Conversely, if a positive abnormal return is generated regardless of the VIX level during the pandemic, then company value uncertainty is possibly resolved for investors. In order to examine the effect of uncertainty, the following model will be estimated which is based on Anolick et al. (2021)

$$CAR_i(\tau_1, \tau_2) = \alpha + \beta_1 D_{i,t}^{COVID} + \beta_{11} \Delta VIX_t + \beta_{12} D_{i,t}^{COVID} * \Delta VIX_t + FE_{sector,t} + Base\ Model + \epsilon_{i,t} \quad (4.13)$$

where ΔVIX_t is the first difference for the level of the VIX at time t, $D_{i,t}^{COVID} * \Delta VIX_t$ is the interaction term between the COVID dummy variable and the first difference of the VIX at time t, and $FE_{sector,t}$ are sector & time fixed effects. Building upon Model 4.13, the following formal hypothesis can be defined.

Hypothesis 6. *Null:* Financial market uncertainty did not affect OMSR announcement abnormal return during the pandemic (meaning $\beta_{12} = 0$). *Alternative:* When financial market uncertainty increased during the pandemic, the abnormal returns generated by OMSR announcements decreased (meaning $\beta_{12} < 0$).

Sector fixed effects are added to the model to take differences in sector characteristics and variance into account. Time fixed effects are also added to this model. Consequently, by adding these fixed effects the impact of the level of the VIX can be further isolated. Similar to Model 4.12, the base Model 4.7 variables will be estimated on the background in an attempt to minimize omitted variable bias.

4.3 Model specifications and testing

The models as presented in Section 4.2 will be estimated using cross-sectional regressions in addition to panel data specifications. In order to ensure the validity of the estimation methods and model specifications that are used for this paper, diagnostic tests need to be employed in order to assess and address any issues. These tests are crucial for obtaining reliable and unbiased estimates and ensuring econometric validity for the analysis. In addition, certain assumptions need to be made as well in order to comply with econometric standards and enable interpretation of the results.

As previously mentioned, the significance of the CARs will be assessed using different testing methods. First, for the general CAR analysis and variable specific CAR differences, assuming normality and no overlapping event windows, a t-test will be conducted. It is important to note that this will be a cross-sectional test to take into account cross-sectional and event-induced volatility. The other two parametric tests will be the Adjusted Patell Z test and the BMP test (Boehmer et al., 1991; Patell, 1976). Next, dropping the normality assumption and allowing for overlapping event windows, the

Generalized Sign test will be conducted (Brooks, 2019; Kolari & Pynnonen, 2011). Using these aforementioned tests, the significance of the average CAR for the three windows, which range from -20 to -3, -2 to +2, and +3 to +10, will be assessed for the full sample, as well as the two COVID years and the five years before COVID separately in order to examine the significance of the CARs.

Furthermore, for all six regression models the following tests are conducted or assumptions are made. First, to examine whether heteroscedasticity is present, the Breusch-Pagan test will be utilized. If heteroscedasticity is present in the error, then White's robust standard errors will be employed. Second, normal distribution of the errors is assumed due to the data set being sufficiently large. Third, Pearson's correlation matrix will be estimated and analyzed to investigate the relationship between the key variables, and take their potential multicollinearity into consideration. Also, in order to prevent multicollinearity issues due to the dummy variable trap, base category 1 is excluded from the regression for the categorical variables. Also, And finally, the data is assumed to be independently distributed (Brooks, 2019).

The cross-sectional regression approach is preferred for Models 4.8, 4.9, 4.10, and 4.11 over a panel data methodology using Fixed or Random Effects. As discussed by Gormley and Matsa (2014), including fixed or random effects can absorb parts of the cross-sectional variation that is of interest for these models, such as company characteristics. Using a cross-sectional regression analysis, the direct impact of these characteristics on the dependent variable can be properly assessed and will not be removed by the fixed or random effects. Even though panel data methods are less suited to isolate the effect of observed company characteristics, they can help control for possible omitted variable bias. Therefore, the panel data methodology will be used for Models 4.12 and 4.13, where the Hausmann test will determine whether fixed or random effect specifications need to be added to the model. The Hausman test compares the estimated coefficients from a fixed effects model with those from a random effects model. If fixed effects are identified, a fixed effects model will be employed to control for unobserved heterogeneity across companies. However, if these fixed effects are inadequate then random effects will be added to the models creating a mixed effects model (Brooks, 2019).

After the models are estimated, the coefficients will be tested to assess statistical significance of the estimations. By doing so, the significance and the sign of the relationships between the dependent variable and the independent variables can be evaluated. First, the significance of most individual coefficients will be examined by conducting one-sided t-tests. Each hypothesis that involves a null hypothesis that the coefficient is equal to zero, and an alternative hypothesis that the coefficient is greater or less than zero respectively for positive or negative relations, will be tested using this t-test. Consequently, by comparing the test statistic with the critical value for the desired level of significance, which will be $\alpha = 0.05$ or 5%, statistical evidence will be obtained to support or reject the specified hypotheses. Second, for the categorical variables, a joint hypothesis test will be employed to investigate the relationship across its different levels. The null hypothesis for this test will state that all the coefficients except for the base coefficient (e.g., $\beta_7^{CAT.5}, \beta_7^{CAT.4}, \beta_7^{CAT.3}, \beta_7^{CAT.2}$) are equal to zero, indicating no relationship. The alternative hypothesis will suggest that at least one of these coefficients is greater than zero, indicating a significant relationship. To conduct this joint hypothesis test, an F-test will be used employed (Brooks, 2019).

Chapter 5

Results

This chapter discusses the empirical outcome achieved through the use of the sample data and tests methodologies as outlined in Chapters 3 and 4 respectively. Firstly, the outcome of the event study will be examined through the CARs for the different variables in the data set with the relevant significance tests. Secondly, the tests used to obtain the correct model specifications will be discussed. Thirdly, the outcome of the regression analysis on abnormal returns during the pandemic along with the impact of company and market characteristics will be reviewed. These outcomes will then be used to evaluate the hypotheses from Section 2.6 and interrogate the methodologies employed. Finally, the overall robustness of the analysis is checked.

5.1 Event Study Results

The event study methodology outlined in Section 4.1 was used to estimate the abnormal returns for the sample of 2,563 OMSR announcements made by 1,444 companies. The average abnormal returns were aggregated over three different event windows as commonly done in financial literature to obtain the following CARs: pre-announcement $CAR(-20,-3)$, announcement $CAR(-2,+2)$, and post-announcement $CAR(+3,+10)$ (e.g., Comment & Jarrell, 1991; Ikenberry et al., 1995; Vermaelen, 1981). Using the Cross-Sectional T-test, the Patell Z test, the BMP test, and the non-parametric Generalized Sign test, the sample is then examined. Through this analysis, the significance of the data and the first indicative findings for Hypothesis 1 can be assessed. After adding the company characteristics for the Cross-Sectional Regression analysis, a total of 2,540 announcements for 1,425 companies remained in the event study results. These results were sorted based on different categories with the significance of the CARs for these categories tested using a t-test. The outcomes of this test are examined and the first indicative findings for Hypothesis 2, 3, and 4 are provided.

5.1.1 Cumulative Abnormal Returns during COVID

Table 5.1 shows the results for the four different tests on the average CARs over the *pre-COVID*, *COVID*, and *Full Sample* Period. The Cross Sectional T-test and BMP test showed the strongest significance out of all tests for the average CARs, whereas the Patell Z test had the lowest significance. One possible cause could be that unlike the BMP test, the Patell Z test does not account for event induced volatility (Boehmer et al., 1991). In addition, the BMP test is more robust against deviations from normality than the Cross-Sectional T-test. Therefore, the preferred parametric test of the three used, is the BMP test.

For the pre-announcement window, the CAR was -1.84% and significant on a 1% for the pre-COVID sample based on all four test statistics. This significant underperformance pre-announcement confirms the pattern observed by Netter and Mitchell (1989) for the period surrounding the 1987 crash. However, this disappeared during COVID as the CAR was insignificant at −0.71% here and did not differ from zero on at least a 10% level for any test. The loss of significance for this period could be attributed to lower expected returns amidst heightened volatility decreasing the abnormal returns (Yilmazkuday, 2021). Alternatively, the smaller COVID sample size may have impacted statistical significance and reduced test power (MacKinlay, 1997). For the full sample, the pre-announcement CAR was statistically significant on a 1% level for all test statistics, indicating overall pre-announcement underperformance.

The announcement window $CAR(-2, +2)$ was significantly positive for the pre-COVID sample at 1.60%, the COVID sample at 2.15%, and for the full sample at 1.76, on a 1% level for all tests except Patell Z where only a 5% and 10% level was observed for the pre-COVID and full sample respectively. The higher CAR during COVID indicates potentially larger announcement returns during the pandemic. This provides initial evidence consistent with findings from Netter and Mitchell (1989) & Comment and Jarrell (1991) who observed higher returns during the 1987 crash, supporting Hypothesis 1. The lower pre-COVID CAR compared to earlier literature may be attributed to changing market conditions and motivations the past decades (e.g., Ikenberry et al., 1995; McNally & Smith, 2007; Yook, 2010). More recent literature showed estimates much closer to this analysis, for example, Z. Chen et al. (2022) who found an average announcement CAR of 2.17% during COVID.

The post-announcement window $CAR(+3, +10)$ remained positive and significant for the pre-COVID sample at 0.47%, the COVID sample at 0.77%, and the full sample at 0.56%, on a 1% level for all tests except Patell Z where no significance was observed. These results are slightly higher than observed in earlier financial literature (e.g., Grullon & Michaely, 2004; Ikenberry et al., 1995). The outcome suggests a conservative initial market reaction to the announcement which was adjusted favorably afterwards, as emphasized by Liu and Ziebart (1997).

Overall, while pre-announcement underperformance disappeared during COVID, higher CARs were observed through multiple test statistics across the event windows. This implies larger OMSR announcement returns during as compared to pre-pandemic, similar to the pattern found in earlier financial crises (e.g., Comment & Jarrell, 1991; Netter & Mitchell, 1989). Although full statistical support for Hypothesis 1 is still evident, initial indicative evidence was found supporting larger announcement returns during COVID. Further analysis on the specific drivers is necessary to confirm the relationship.

TABLE 5.1: Cross Sectional T-test, Patell Z test, BMP test, and Generalized Sign Test for Cumulative Abnormal Returns

Results of the significance tests on the pre-announcement $\overline{CAR}(-20,-3)$, announcement $\overline{CAR}(-2,+2)$, and post-announcement $\overline{CAR}(+3,+10)$ for OMSR, tested for the pre-COVID, COVID, and Full Sample period. Four different test statistics are reported: Cross Sectional t-test (MacKinlay, 1997), Adjusted Patell Z test (Patell, 1976), BMP test (Boehmer et al., 1991), and Generalized Sign test (Brooks, 2019; Kolari & Pynnonen, 2011), all testing the hypothesis $H_0 : \overline{CAR}(\tau_1, \tau_2)$. The final column shows the number of announcements for each sample period. The tests are all calculated using either t- or z-statistics indicated in the row below the test name. The significance stars are based on the p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

		Cross Sectional t-test	**Patell Z test**	**BMP test**	**Generalized Sign test**	
	$\overline{CAR}$	t-stat	z-stat	t-stat	z-stat	N
Pre-COVID						
CAR(-20,-3)	-1.84%	-9.76***	-12.13***	-9.48***	-7.99***	1833
CAR(-2,+2)	1.60%	8.01***	15.22**	6.53***	11.69***	1833
CAR(+3,+10)	0.47%	3.21***	3.65	2.83***	3.14***	1833
COVID						
CAR(-20,-3)	-0.71%	-0.19	0.00	0.00	-0.99	730
CAR(-2,+2)	2.15%	8.32***	9.71	7.79***	7.70***	730
CAR(+3,+10)	0.77%	2.83***	2.64	2.71***	2.01**	730
Full Sample						
CAR(-20,-3)	-1.52%	-8.02***	-10.38***	-8.61***	-7.13***	2563
CAR(-2,+2)	1.76%	11.15***	18.05*	8.62***	13.98***	2563
CAR(+3,+10)	0.56%	4.27***	4.50	3.71***	3.62***	2563

5.1.2 Cumulative Abnormal Returns sorted by Company Characteristics

After the event study, the CAR results were sorted based on four key company characteristics: Free Cash Flow (FCF), Book-to-Market ratio (BE/ME), Size, and Leverage. These CARs were analyzed across three previously mentioned event windows to provide initial insights into the patterns expected for hypotheses 2-4. The differences between the most extreme categories [5] and [1] was also calculated and tested.

For FCF, the pre-announcement CAR was most negative for the lowest FCF quintile at −2.40% and then gradually increased across quintiles up to −0.80% for the highest. This implies greater undervaluation for low FCF companies pre-announcements supports the signaling theory and confirms the pattern expected for Hypothesis 3 during COVID (Grullon & Michaely, 2004). The announcement CAR was lowest for the category [1] at −1.51% and highest for category [2] & [3] at 2.70% & 2.11% respectively, interestingly showing that repurchases were a weaker signal for high FCF companies (Jagannathan & Stephens, 2003). The strongest post-announcement adjustments occurred for low FCF companies as well at 1.17%, indicating a conservative initial market reaction.

For the BE/ME ratio, the most undervalued quintile had a pre-announcement CAR of 0.06%, as prices reflected fundamentals which were low due to mispricing. Less undervalued quintiles showed larger negative CARs up to −2.79% for category [2], confirming signaling theory and the expectations for Hypothesis 4 that undervalued companies generate higher announcement returns during COVID (Ikenberry et al., 1995). The most undervalued quintile then saw the highest announcement $CAR(-2,+2)$ at 2.52%, correcting the prior mispricing through the repurchase (Grullon & Michaely, 2002). Only for categories [2] to [5] post-announcement adjustments were made ranging from 0.35% to 1.47%, suggesting that the signal for the lowest quintile was non-credible (−0.54%).

Regarding Size, smaller companies underperformed the most pre-announcement at −3.25% due to information asymmetries and mispricing. As a result, supporting Hypothesis 2 which implied that smaller companies would see higher announcement returns during COVID. Larger companies saw minimal underperformance at −0.73% caused by greater analyst coverage. As expected, smaller companies had the highest announcement CAR at 3.53% due to their stronger signaling impact, while larger companies generated the lowest CAR at 0.64% due to minimal new information (Ikenberry et al., 1995). Greater post-announcement adjustments occurred for smaller companies at 1.09%, pointing to a conservative initial reaction.

For Leverage, low leverage companies (category [1]) unexpectedly underperformed the most pre-announcement which is interesting considering their relatively low debt compared to equity. However, they did then see the highest announcement CAR at 2.81% as the market corrected its previous underestimation. High leverage companies had the lowest underperformance pre-announcement but then also generated the lowest announcement returns at 0.96%. These initial event study results for leverage confirm the patterns mentioned by Grullon and Michaely (2004).

In general, the patterns observed in the CARs align with the expectations for Hypotheses 2-4 and earlier financial literature. Further regression analysis can isolate the effects of these company characteristics and examine the differences during COVID.

TABLE 5.2: Cumulative Abnormal Returns per Category

Results of the pre-announcement $\overline{CAR}(-20,-3)$, announcement $\overline{CAR}(-2,+2)$, and post-announcement $\overline{CAR}(+3,+10)$ in percentage for OMSR, sorted by company characteristic. The $\overline{CAR}$ are calculated based on quintiles for *Free Cash Flow*, *BE/ME Ratio*, *Size*, and *Leverage*. The difference between categories [5] and [1] is computed for each characteristic per event window. For each characteristic, quintile, and difference, the $\overline{CAR}$ is tested using a two sample t-test, under $H_0 : \overline{CAR}(\tau_1, \tau_2)$. The t-statistic is reported in parentheses. The significance stars are based on the p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

		Days relative to repurchase announcement		
	N	**-20 to -3**	**-2 to +2**	**+3 to +10**
All companies	2,540	-1.52%***	1.76%***	0.56%***
		(-8.02)	(11.15)	(4.26)
Free Cash Flow				
1 (Low)	452	-2.40%***	1.51%***	1.17%***
		(-4.46)	(3.33)	(2.89)
2	517	-2.20%***	2.70%***	0.37%
		(-4.80)	(7.26)	(1.19)
3	521	-1.14%***	2.11%***	0.53%**
		(-2.80)	(5.83)	(1.97)
4	521	-1.16%***	1.32%***	0.31%
		(-2.84)	(4.22)	(1.27)
5 (High)	529	-0.80%***	1.15%***	0.45%**
		(-2.73)	(4.63)	(2.05)
Dif [5-1]		1.60%***	-0.36%	0.72%
		(2.68)	(-0.72)	(-1.60)
BE/ME Ratio				
1 (Low)	439	-2.00%***	1.22%***	-0.54%**
		(-4.62)	(3.34)	(-2.07)
2	526	-2.79%***	1.66%***	0.35%
		(-6.46)	(5.08)	(1.26)
3	524	-2.31%***	1.86%***	0.39%
		(-5.27)	(5.22)	(1.56)
4	521	-0.63%*	1.45%***	0.96%***
		(-1.65)	(4.25)	(3.33)
5 (High)	530	0.06%	2.52%***	1.47%***
		(0.14)	(6.83)	(4.14)
Dif [5-1]		2.06%***	1.30%**	2.01%***
		(3.39)	(2.50)	(4.45)
Size				
1 (Small)	508	-3.25%***	3.53%***	1.09%***
		(-5.88)	(8.42)	(2.74)
2	508	-1.75%***	1.89%***	0.56%*
		(-4.00)	(4.92)	(1.84)
3	508	-1.31%***	1.82%***	0.55%**
		(-3.18)	(5.06)	(2.07)
4	508	-0.62%	0.97%***	0.33%
		(-1.61)	(2.70)	(1.25)
5 (Large)	507	-0.73%**	0.64%***	0.27%
		(-2.46)	(3.09)	(1.31)

Dif [5-1]		2.52%***	-2.89%***	-0.82%*
		(4.01)	(-6.18)	(-1.83)
Leverage Ratio				
1 (Low)	508	-3.28%***	2.81%***	1.10%***
		(-6.14)	(6.80)	(3.19)
2	508	-1.56%***	1.83%***	0.50%
		(-3.68)	(5.10)	(1.54)
3	508	-1.83%***	1.78%***	0.64%**
		(-4.49)	(4.82)	(2.35)
4	508	-0.75%*	1.46%***	0.29%
		(-1.90)	(3.89)	(1.03)
5 (High)	507	-0.24%	0.96%***	0.27%
		(-0.71)	(4.20)	(1.14)
Dif [5-1]		3.04%***	-1.85%***	-0.84%**
		(4.80)	(-3.92)	(-2.00)

5.2 Regression Results

Through the Market Model, the CARs for the repurchase announcements have been estimated for all sample companies. The announcement $CAR(-2, +2)$ will now serve as dependent variable in the six regression models, which aim to provide statistical evidence to answer the hypotheses from Section 2.6 and investigate factors impacting abnormal returns during the pandemic. Ultimately, this will answer the research question for this paper: *How did the COVID-19 pandemic affect the financial market's reaction to share repurchase programs in the US, and how did company specific variables impact announcement returns as compared to pre-COVID.*

5.2.1 Model Specifications

As described in Section 4.3, several assumptions must be made and statistical tests must be conducted in order to obtain the correct model specifications. One common issue for financial data is heteroscedastic errors which can be tested through the Breusch and Pagan (1979) test. For all six models, heteroscedasticity was present in the errors. To address this, robust Clustered Standard Errors were added (MacKinlay, 1997). Because companies can have multiple announcements per year causing correlation between abnormal returns, these errors were clustered by company.

Model 4.8, 4.9, 4.10, and 4.11 will be estimated using pooled OLS. However, for Models 4.12 and 4.13 a panel data methodology will be employed which is more appropriate to deal with unobserved heterogeneity and time or company invariant omitted variables. The Hausmann test is used to determine whether fixed, random, or mixed effects are the appropriate model specification (Brooks, 2019). The Hausman test determined that fixed effects were appropriate to control for unobserved heterogeneity. Therefore, time and company (or alternatively *sector*) fixed effects will be included for the models.

In Appendix A, Pearson's Correlation matrix is presented in Table A.1 to provide insights into the relationship between the variables used in this analysis. Most correlations in the table are below 0.3, indicating limited to no multicollinearity concerns(Brooks, 2019). However, a few correlation stand out. The negative correlation between company Size (natural logarithm of Total Assets) and BE/ME ratio is -0.46, which aligns with the expectation that smaller companies tent to have higher BE/ME ratio due to mispricing issues (Grullon & Michaely, 2004). The high correlation between market value of total assets is unsurprising either, as both serve as proxies for companies and neither is used in a model together. More notably are the correlations between the COVID dummy variables and company specific factors such as Size, BE/ME ratio, and Leverage. This suggests pronounced differences in company characteristics pre- and during the pandemic, which was also the main takeaway from Section 2.5. The regression analysis will be used to further investigate this relationship and therefore, multicollinearity is not an problem here. Overall, the assumption of no multicollinearity is met as the correlation matrix did not find significant issues between variables that question model validity.

5.2.2 Regression Results the general impact of company characteristics on abnormal returns

All six regression models included the base Model 4.7 coefficients to prevent omitted variable bias and decrease model noise. For Models 4.8, 4.9, 4.10, and 4.11, the base model coefficients are included in Table 5.3. The base model included control variables for Size, FCF, BE/ME Ratio, and Leverage. Even though these variables were not included to find evidence on their relationship with announcement returns, they do provide insights into the general impact of these characteristics. As these coefficients remain relatively constant, they will be discussed in general for all models.

The Size coefficient was negative and significant for all models, aligning with the TSH that smaller companies see higher returns caused by greater information asymmetry (Grullon & Michaely, 2004; Ikenberry et al., 1995). Both the FCF and BE/ME ratio categorical variables showed positive coefficients, with their highest quintile showing statistical significance and the largest returns compared to the lowest quintile. This matches the expectation from the literature review that high FCF and undervalued companies generate larger abnormal returns as their repurchases signal strong cash positions and undervaluation (Grullon and Michaely, 2004; Ikenberry et al., 1995). For the Leverage ratio, the coefficient was negative as predicted, since higher leverage increases financial risk and thereby decreases returns (Grullon and Michaely, 2004). However, it was insignificant in this sample.

Overall, the base model coefficients were largely in line with previous financial literature on the motives and factors impacting repurchase announcement returns. This provides sufficient evidence of the validity of the data set and therefore, it can be used to analyze the pandemic's impact on the relationship of these company characteristics with the announcement returns.

5.2.3 Regression Results on the impact of the pandemic on abnormal returns

The first hypothesis aimed to investigate whether the financial market's reaction to repurchase announcements during the pandemic differs from pre-pandemic, as relationship that was observed in past financial crises (Comment & Jarrell, 1991; Netter & Mitchell, 1989). To answer this, Model 4.8 was estimated using a pooled OLS regression and the results are displayed in Column (1) of Table 5.3. The COVID dummy variable was the main factor of interest. While the coefficient was positive at 0.0054, indicating that announcement returns were 0.54% higher amidst COVID, it was statistically insignificant. In contrast, the constant term was significant at the 1% level with a value of 0.0545 or 5.45%, which is significantly higher than the pre-pandemic literature average abnormal return from Section 2.3. However, as the values of the control variables cannot be zero, this coefficient cannot be interpreted. Although the initial event study comparison showed higher raw returns during COVID, when controlling for other factors in the regression analysis, no statistical evidence was found of this relationship.

The low (adjusted) R^2 value indicates that the model had limited explanatory power, implying substantial omitted variable bias regardless of the base model control variables. As a result, the model could lack significance due to unobserved factors driving the return variation rather than the independent variable. Alternatively, the volatility of the pandemic period could increase noise as well in isolating the COVID effect on returns (Section 2.5). Considering Iyer and Rao (2017) found a decreased likelihood for repurchases during the 2008 financial crisis, this may be due to abnormal returns not increasing amidst turmoil.

Overall, Hypothesis 1 on larger announcement returns during COVID was rejected, deviating from the pattern observed for past crisis events. While the initial findings remain relevant, as average CARs were higher during COVID and a positive regression coefficient was found, economic implications are that OMSR announcements may no longer reliably boost crisis-period stock performance. Companies should focus on other factors generating long-term shareholder returns rather than timing their repurchases. Further research into alternative model specifications and future crises may provide more insights into this evolving relationship.

5.2.4 Cross-Sectional Regression Results on Company Characteristics during COVID

Focusing on the impact of Company Characteristics on pandemic OMSR announcement returns, three hypotheses were formalized and then investigated. The models to answer Hypothesis 2, 3 and 4 are extensions of the base Model 4.7, whose variables serve as control variables in order to investigate the interaction terms for Models 4.9, 4.10, and 4.11. Generally, these coefficients remained constant in sign, magnitude, and significance for all three models as previously discussed. The results are presented in Table 5.3.

The second hypothesis aimed to investigate whether company size affects OMSR announcement returns differently during COVID compared to pre-pandemic. Model 4.9 was estimated using pooled OLS to answer this hypothesis and the results are presented in Column (2) of Table 5.3. The independent variable of interest here was the interaction effect between Size and the COVID dummy. The value of the coefficient is slightly positive at 0.04% but shows no significance on at least a 10% significance level. Meaning, there is insufficient statistical evidence to prove that there is an additional relationship between company size and OMSR announcement return during the pandemic.

The lack of statistical significance deviates from some prior literature such as Ikenberry et al. (1995) who found that smaller companies generate larger abnormal returns following repurchase announcements caused by greater information asymmetry, supporting the signaling hypothesis. Considering Iyer and Rao (2017) found smaller companies to repurchase more amidst crisis, this is likely not due to larger abnormal returns. However, other studies such as Gaspar et al. (2013) and Kahle (2002) did not find evidence that size impacted abnormal returns, indicating mixed results. This implies that other drivers likely affect crisis announcement return. The positive sign of the interaction effect also contradicts the hypothesized negative relationship. Economically, the near zero magnitude indicates a minor practical impact even if it was significant.

Possible limitations include the relatively low R^2, which indicates that there are substantial unobserved factors driving returns. Also, Anolick et al. (2021) found an additional size effect using an uncertainty measure rather than time period, suggesting that the methodology may matter. Overall, even though statistical evidence is lacking, the results imply that announcement returns are not more biased amidst COVID. This challenges the assumption that smaller companies have stronger signaling power during crises. Managers should not overweight size when considering repurchase announcements in unstable times.

In conclusion, the null hypothesis cannot be rejected for Hypothesis 2. This means that company size did not impact abnormal returns surrounding OMSR announcements differently during the COVID pandemic. While limitations exist, the analysis implies that the benefits of smaller size for signaling do not amplify during modern crises.

The third hypothesis aimed to investigate the impact of company free cash flow during the pandemic as compared to pre-pandemic. For this hypothesis, Model 4.10 was estimated through pooled OLS and the results are presented in Column (3) of Table 5.3. The independent variable of interest here was the interaction term between the FCF categories and the COVID dummy variable. Of the five interaction coefficients, only two show statistical significance at a 10% significance level. Specifically, the coefficients for FCF categories [2] and [3] during COVID indicate that the $CAR(-2, +2)$ increases by 1.55% and 1.47% respectively. This corresponds with the higher average CAR for these categories observed in Table 5.2. The outcome of the joint test showed no statistical significance either for the categorical coefficients.

The significant coefficients for average FCF companies partially aligns with H.-C. Chen et al. (2018) who found that average to high FCF companies are more likely to announce buybacks during a crisis, presumably caused by higher announcement returns. However, the lack of significance of the highest quintiles contradicts Grullon and Michaely (2004) who observed higher returns for high FCF companies as these repurchases signal strong cash positions. This finding is more in line with Howe et al. (1992) who also found an insignificant coefficient for high FCF companies. The strong negative return for low FCF companies during is in line with finance theory, however shows no statistical significance.

Possible limitations that may have caused the lack of statistical significance include the low R^2, similar to the two previous models. In addition, the FCF quintiles were based on the full sample which perhaps resulted in the high FCF observations not occurring during COVID specifically. Overall, the findings suggest that average FCF companies generate larger abnormal returns amidst a crisis. Apparently, the market perceives signals from these companies as stronger than that of high FCF companies.

In conclusion, insufficient support was found in favor of Hypothesis 3. Thus, the null hypothesis cannot be rejected, meaning that the high FCF level of a company did not impact abnormal returns during the pandemic compared to pre-pandemic. While average FCF companies saw higher returns amidst COVID, the effect disappears for the highest quintile. Managers should carefully assess the best use of a cash surplus considering the market conditions rather than blindly using it for a buyback.

The fourth hypothesis aimed to investigate the final company characteristic, which is undervaluation. According to the TSH, if a company is undervalued this can be signaled to the market by announcing an OMSR which generates positive abnormal returns (Ikenberry et al., 1995). Again, Model 4.11 was estimated through pooled OLS and the results are presented in Column (4) of Table 5.3. The independent variable of interest here was the interaction term between the categorical variable for BE/ME ratio, which is a proxy for undervaluation, and the COVID dummy variable. Looking at the results, none of the coefficients showed any statistical significance on at least a 10% significance level. The joint test also showed no statistical significance for the coefficients combined.

While statistical evidence is lacking in the sample, the coefficients can still be interpreted economically. The positive sign on the higher BE/ME categories align with signaling theory (Grullon & Michaely, 2002; Jagannathan & Stephens, 2003), even though the forth quintile coefficient is negative. This non-monotonic pattern provides no clear economic implications regarding the effect of a crisis on signaling undervaluation. However, similar inconsistencies were also found by Anolick et al. (2021) who also showed no statistical significance for the BE/ME ratio during crises.

Possible reasons for the lack of statistical significance again include the limited sample size during COVID and the relatively low R^2, indicating that certain factors may be omitted. Also, similar to the FCF, the BE/ME quintiles were based on the full sample, creating a measurement error causing undervalued companies possibly not being captured during COVID specifically. Overall, this analysis did not find evidence that signaling benefits from undervaluation differ between regular and crisis periods. Managers should continue to focus on fundamental value rather than trying to exploit anomalies caused by crisis-related mispricing. However, limitations imply that the relationship possibly required further research with alternative data and methods.

In conclusion, the expectation for Hypothesis 4 was that relatively undervalued companies would experience stronger OMSR announcement abnormal returns during COVID. However, there was insufficient statistical and economic evidence to prove this relationship. Thus, the hypothesis could not be rejected, meaning undervaluation did not generate additional abnormal returns for OMSR announcements during the pandemic compared to pre-pandemic.

TABLE 5.3: Cross-Sectional Regression Results for Model 1, 2, 3, and 4

Results of the cross-sectional regression analysis examining the impact of company characteristics on Open Market Share Repurchase (OMSR) announcement cumulative abnormal returns (CARs). Four models are estimated using pooled OLS regression with robust standard errors clustered by company. The dependent variable is the $CAR(-2, +2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The key independent variables are interactions between company characteristics and a COVID-19 dummy variable to assess differences in the relationship during the pandemic compared to pre-pandemic. The COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). The first column shows the variables for the company characteristics which are Size (*natural logarithm of total assets*), Free Cash Flow quintiles, BE/ME ratio quintiles, and Leverage ratio, where the first quintile is omitted for the categorical variables without interaction effect due to multicollinearity. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2, +2)$. Robust standard errors are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification			
	(1)	(2)	(3)	(4)
	CAR(-2,+2)	**CAR(-2,+2)**	**CAR(-2,+2)**	**CAR(-2,+2)**
Size	-0.0058***	-0.0059***	-0.0057***	-0.0058***
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
FCF [2]	0.0023	0.0025	-0.0042	0.0024
	(0.0067)	(0.0067)	(0.0067)	(0.0067)
FCF [3]	0.0059	0.0061	-0.0006	0.0065
	(0.0062)	(0.0062)	(0.0061)	(0.0062)
FCF [4]	0.0053	0.0056	0.0021	0.0055
	(0.0060)	(0.0060)	(0.0056)	(0.0060)
FCF [5]	0.0156**	0.0158**	0.0125**	0.0156**
	(0.0065)	(0.0065)	(0.0061)	(0.0064)
BE/ME Ratio [2]	0.0046	0.0044	0.0045	0.0037
	(0.0049)	(0.0049)	(0.0049)	(0.0055)
BE/ME Ratio [3]	0.0087	0.0085	0.0085	0.0075
	(0.0053)	(0.0053)	(0.0053)	(0.0056)
BE/ME Ratio [4]	0.0072	0.0071	0.0070	0.0106*
	(0.0053)	(0.0053)	(0.0054)	(0.0055)
BE/ME Ratio [5]	0.0166***	0.0168***	0.0157***	0.0185***
	(0.0058)	(0.0058)	(0.0058)	(0.0063)
Leverage	-0.0079	-0.0074	-0.0099	-0.0072
	(0.0082)	(0.0083)	(0.0082)	(0.0082)
COVID	0.0059			
	(0.0041)			
Size # COVID		0.0004		
		(0.0004)		
FCF [1] # COVID			-0.0104	
			(0.0151)	
FCF [2] # COVID			0.0155*	
			(0.0087)	
FCF [3] # COVID			0.0147*	
			(0.0081)	
FCF [4] # COVID			0.0037	
			(0.0078)	
FCF [5] # COVID			0.0027	
			(0.0061)	

BE/ME Ratio [1] # COVID				0.0078
				(0.0088)
BE/ME Ratio [2] # COVID				0.0124
				(0.0084)
BE/ME Ratio [3] # COVID				0.0135
				(0.0099)
BE/ME Ratio [4] # COVID				-0.0040
				(0.0092)
BE/ME Ratio [5] # COVID				0.0023
				(0.0088)
Constant	0.0545***	0.0557***	0.0593***	0.0534***
	(0.0103)	(0.0104)	(0.0102)	(0.0105)
N	2,540	2,540	2,540	2,540
R^2	0.0204	0.0196	0.0229	0.0217
Adjusted R^2	0.0161	0.0153	0.0171	0.0159

5.2.5 Cross-Sectional Regression Results on Market Characteristics during COVID

The final part of the regression results aimed to investigate the effect of Market Characteristics on OMSR announcement abnormal returns. Two final hypotheses were formalized and investigated using a Cross-Sectional Regression panel data-model with Fixed Effects. In Table 5.4, the results for Models 4.12 and 4.13 are presented.

The fifth hypothesis examined the impact of Stock Underperformance during the pandemic and more specifically, whether the announcement abnormal returns were more positively affected by recent Stock Underperformance. This pattern was observed similarly for past crises and therefore, expected during COVID as well (Chakraborty et al., 2019; Netter & Mitchell, 1989). The results for the regression model of Hypothesis 5 are presented in Column (1) of Table 5.4. The constant is positive at 2.31% and significant at a 1% level, indicating overall positive abnormal returns for the sample. However, this estimate is lower than observed in some prior literature, again potentially reflecting the diminishing signaling power of repurchases over time. The coefficient on stock underperformance is negative at −0.96% with a 5% significance level, implying underperformance in general negatively affects announcement returns. This contrasts with Netter and Mitchell (1989) who found positive returns.

The independent variable of interest, which was the interaction term between COVID and stock underperformance, is positive but lacks statistical significance, aligning with Fu and Huang (2016) who observed a diminishing underperformance relationship over time as valuation methods improve. While the statistical evidence is inconclusive, economically the small interaction coefficient implies a negligible positive impact of underperformance on announcement returns during COVID. This weak relationship was also found by De Cesari et al. (2011) and Anolick et al. (2021), who also discovered inconsistent or mixed results for the effect of underperformance on repurchase returns during crises.

Limitations like the low R^2 indicate that unobserved factors may be driving the announcement returns (Brooks, 2019). Overall, this analysis did not find significant evidence that companies can reliably exploit underperformance anomalies by timing repurchase announcements amidst COVID. More research is needed, but these initial findings do suggest that the benefits of correcting mispricing through repurchase signaling continues to diminish in modern crises (Fu & Huang, 2016).

In conclusion, insufficient statistical or economic evidence was found to support Hypothesis 5. Thus, the null hypothesis cannot be rejected. This implies decreasing benefits of signaling mispricing through repurchase announcements for these modern crises unless based on fundamental company characteristics, possibly caused by modern valuation methods improving and providing reliable estimates not impacted by the announcements. However, further research remains evident.

The sixth and final hypothesis investigated the impact of financial market uncertainty on OMSR announcement abnormal returns during the pandemic through a commonly used uncertainty proxy: the daily change of the level of the VIX. The hypothesis predicted that heightened general market uncertainty would decrease the abnormal returns following OMSR announcements, as less company-specific value uncertainty is resolved when market uncertainty is high Anolick et al. (2021). The results of this model are presented in Column (2) of Table 5.4. The constant is positive and significant on a 1% level, suggesting an average abnormal return of 1.75% for the full sample period. This aligns with estimates in prior literature on average OMSR announcement returns (See Section 2.3). The VIX change coefficient is negative at −0.73% as predicted, implying that larger volatility changes reduce abnormal returns, but also remains insignificant both statistically and economically as this jump requires a 100% daily VIX increase.

The independent variable of interest, which is the interaction between COVID and changes in the VIX, is positive at 1.09% but insignificant. This implies that there is minimal but positive impact of market volatility changes on OMSR announcement returns during COVID, which contrasts the negative relationship hypothesized. While statistical evidence overall remains inconclusive, economically the coefficients suggest negligible impact of general market uncertainty changes on OMSR abnormal returns during COVID. This weak relationship aligns with Baker et al. (2016) who found that high uncertainty decreases the number of repurchases, possibly caused by announcement returns declining. Also, perhaps Anolick et al. (2021) found the negative relationship because they primarily investigated the European market and used its VIX counterpart, the VSTOXX, to measure uncertainty.

The insignificant results may be due to the fact that the VIX provides a very general measure of market uncertainty, rather than focusing on the policy uncertainty which was exceptionally high during the pandemic (see Section 2.5). Also, as U. Peyer and Vermaelen (2009) discussed, repurchase anomalies arise from mispricing tied to insider information. Therefore, general volatility should not be susceptible to exploitation for generating abnormal returns as this is common information.

Limitations such as possibly different results for other uncertainty measures as well as the low (adjusted) R^2 remain. Overall, the analysis did not find significant evidence that companies should adjust repurchase decisions based on general financial market uncertainty during a crisis. More research is needed with alternative measures and model specifications to prove a definitive answer.

In conclusion, the null hypothesis could not be rejected, implying that market uncertainty did not significantly impact OMSR announcement returns during the pandemic. Investors could have picked up on the anomaly caused by uncertainty changes and through trading diminished its effect. While limitations exist, the initial findings suggest that companies may not need to alter their repurchase announcement decisions based on general volatility spikes in modern crises.

TABLE 5.4: Cross-Sectional Regression Results for Model 5 and 6

Results of the panel data regression analysis examining the impact of market characteristics on Open Market Share Repurchase (OMSR) announcement cumulative abnormal returns (CARs) during COVID-19. Two models are estimated using panel data regression with company, industry, or time fixed effects. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The key independent variables are interactions between market characteristics and a COVID-19 dummy variable to assess differences in the relationship during the pandemic compared to pre-pandemic. The COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). Model 5 investigates pre-announcement 20-day Stock Underperformance and Model 6 investigates the changes in the VIX (Implied Volatility Index for the S&P500). The first column shows the variable names. Control variables of the base model are included but not reported. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors clustered by company are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification	
	(5)	(6)
	CAR(-2,+2)	**CAR(-2,+2)**
COVID	-0.0016	0.0008
	(0.0056)	(0.0045)
Stock Underperformance	-0.0096**	
	(0.0045)	
Stock Underperformance # COVID	0.0029	
	(0.0087)	
VIX change		-0.0073
		(0.0287)
VIX change # COVID		0.0109
		(0.0543)
Constant	0.0231***	0.0175***
	(0.0029)	(0.0013)
Base Model variables	YES	YES
Company FE	YES	NO
Industry FE	NO	YES
Time FE	YES	YES
N	2,540	2,540
R^2	0.0145	0.0111
Adjusted R^2	0.0118	0.0084

5.3 Robustness

In this section, a final check on the robustness of the results will be conducted. In the first subsection, the robustness of the model specifications will be examined by slightly altering variables definitions and how they are used in the regression analyses. The second part will investigate how the results are impacted by sample criteria and re-estimate the regression analyses using different (sub)samples. In Appendix B the tables with the results of the robustness check are reported.

5.3.1 Changing Model Specifications

To assess whether the original regression results from Section 5.2 were robust, the model specifications were altered in several ways and then re-estimated to provide a check whether the conclusions would persist. For all models four models containing the base Model 4.7 variables, Models 4.8, 4.9, 4.10, and 4.11, the categorical variables' dummy coefficients are replaced by a single multinomial variable. This new multinomial coefficient depicts how much the dependent variable increases when the category does by [1]. For Size a completely new measure is used. For Model 4.12, the stock price underperformance measure increased from 20 days prior to an announcement to 40 days similar to Comment and Jarrell (1991). Finally, the uncertainty measure in Model 4.13 is replaced by the natural logarithm of the VIX following Pirgaip and Dinçergök (2019) as opposed to the daily change of the VIX.

In column (1) of Table B.1 the results for Model 4.8 with the altered model specifications from the base Model 4.7 are presented. The COVID dummy stayed positive at 0.55% implying higher pandemic abnormal returns, however statistically indistinguishable from zero even with the adjusted control variables. The constant continued being significant but increased strongly up to 4.57%, yet still cannot be interpreted. In spite of the changes, the evidence continues to fail to indicate larger announcement returns amidst the pandemic. The original lack of support for Hypothesis 1 appears robust to specification changes.

For Hypothesis 2, instead of using the company Size measure by Grullon and Michaely (2002), the natural logarithm of market value of equity was used similar to H. Zhang (2005). The general effect of Size remained statistically significant at a 1% level, positive in sign, and only increased slightly in magnitude. The interaction term continued to lack significance, implying no additional impact of company Size on signaling benefits during the pandemic. The conclusion that repurchase motives are not more biased by size when uncertainty rises held steady.

In terms of the third hypothesis on FCF, a different outcome emerged in the robustness check results using the alternative model specifications. The general effect of FCF is no longer statistically significant, contradicting expectations on agency costs & signaling theory. However, the modified multinomial FCF variable yielded a significant interaction with the COVID dummy, whereas it did not in the original model. As seen in Table 5.2, this effect was likely driven by the underlying distribution of the data, as average FCF companies generated larger returns in the initial results and not necessarily the higher categories. This new interaction coefficient implies larger abnormal returns for higher quintiles, providing evidence in favor of Hypothesis 3. Though statistical significance on a 10% is found, economically, relevance of 0.17% increases for each quintile remain questionable. Considering the original lack of support of the incremental impact of FCF amidst COVID, the overall results are mixed and a definitive conclusion remains evident.

The final column (4) of Table B.1 shows Model 4.11 using a multinomial coefficient for BE/ME ratio to investigate Hypothesis 4 on the effect of undervaluation. The statistical significance for the general positive signaling effect for undervalued companies remained further confirming Grullon and Michaely (2004). However, so did the statistical insignificance for the interaction term. Though the increasing coefficient confirms larger returns for more undervalued companies, no statistical evidence of this incremental effect is found proving reasonable robustness of the original conclusion.

Table B.2 reports the alternative specifications for Model 4.12 and 4.13. For the fifth hypothesis, modifying the length of the underperformance measure did not affect the interaction term with the COVID dummy. The evidence continues to suggest disappearing benefits from correcting mispricing through repurchase announcements without proper backing by fundamental company value. This lack of support appears robust even when changing the measure and Hypothesis 5 remains unaccepted.

Finally, the sixth hypothesis on uncertainty also remained unsupported when using a modifying the volatility proxy. The second column of Table B.2 shows the re-estimated model. The pandemic interaction effect remained both statistically and economically significant, providing no additional evidence that general market uncertainty impacts returns differently during COVID.

In summary, largely similar conclusions emerged across five of the six hypotheses when changing model specifications, adding confidence to the original findings. Only Hypothesis 3 showed potential sensitivity to changes in the FCF's measurement. Further research into the drivers of repurchase announcements during crises seems necessary to fully confirm the evolving relationship.

5.3.2 Changing Sample Criteria

A final assessment of the robustness of the results from Section 5.2 will be made by changing the sample criteria two ways. The first alternative sample subdivides the full sample in a pre-COVID and COVID sample. The second alternative sample will distinguish between frequent and non-frequent repurchasing companies.

First, the pre-COVID and COVID sample were analyzed by estimating the base Model 4.7 as interaction effects became unnecessary, and are reported in Column (1) & (2) of Table B.3 respectively. For company Size, the coefficient became increasingly more negative from -0.39% to 1.10% during COVID, which aligns with the expectation that Size impacts announcement return more amidst COVID. When testing the difference between the two coefficients, a significant difference on a 5% level was observed. This outcome confirms the second hypothesis and implies that benefits for smaller companies to announce a repurchase may re-emerge in future crises as well.

For high FCF companies, announcement returns are now insignificant pre-COVID and show little economic significance either with an estimated coefficient of 0.58%. During COVID, these companies show an estimated coefficient of 3.36% with economic meaning and statistical significance on a 10% level. This outcome better fits signaling theory which assumes incremental benefits of large FCF for repurchase announcements when uncertainty rises, confirming the third hypothesis. However, for the fourth hypothesis on undervaluation the opposite occurred - the highest BE/ME quintile was significant pre-COVID at 1.34% on a 5% level but not during despite remaining positive, rejecting the hypothesis.

Second, frequent versus non-frequent repurchasing companies were examined and the results are presented in Tables B.5, B.6, B.7, and B.8. Frequent repurchasing companies repurchase more than once over the full sample period, whereas non frequent repurchasing companies do not. More significance emerged for frequent repurchases, fitting their stronger signaling motives. No notable changes were found for the company characteristics interaction effects in both samples. However, underperforming non-frequent repurchasing companies generated statistically significant negative returns during COVID, implying changed motives for them amidst a crisis. Overall, the results remain largely similar and show little differences, confirming general robustness of the initial findings.

In conclusion, the findings were largely robust across sub samples with some key exceptions, such as Size and FCF effects appearing more beneficial and significant during a crisis, and undervaluation providing a stronger signal in less uncertain times. For non-frequent underperforming companies, the benefits of announcing repurchases have apparently shifted and creates new research possibilities.

Chapter 6

Conclusion

The COVID pandemic has had an enormous impact on the worldwide economy. During such uncertain times, academic stylized facts are often challenged as their effect can vary greatly in a crisis. Considering the pandemic as a natural experiment, this paper investigates Open Market Share Repurchase (OMSR) announcements for US companies by examining factors known to impact the financial market's reaction and more specifically, to determine how these may vary during COVID. As OMSR has become a popular method for companies to signal their performance to the market and distribute cash to investors, it is important to keep in mind that the effect of such corporate events may differ when certain conditions prevail. In order to examine this, the following research question was investigated in this paper *How did the COVID-19 pandemic affect the financial market's reaction to share repurchase programs in the US, and how did company specific variables impact announcement returns as compared to pre-COVID?* From the literary review, six hypotheses were crafted to answer the research question. Through an event study the financial market's reaction were quantified and then used as input for a cross-sectional regression analysis. Ultimately, the outcomes of this analysis helped identify the motives and conditions for managers to announce OMSR during a crisis. As the COVID pandemic is fairly recent, the analysis could only be conducted in the short term due to the limitation of data. The evidence reported is based on a sample of 2,540 repurchase announcements by 1,425 companies in the U.S. from April 2015 to March 2022.

As supported by the theoretical background, OMSR was identified as the most commonly used and widely researched method to repurchase shares. First, in order to assess the differences in announcement abnormal returns during COVID compared to pre-COVID, a comparison was conducted between CARs from the event study. Second, as derived from earlier financial literature, this analysis was focused on the three main motives of Mispricing, Agency costs, and Signaling for a company to repurchase shares, and tested them by examining the company characteristics of Size, Free Cash Flow, and Undervaluation. Finally, the impact of market conditions including Stock Underperformance and overall financial market uncertainty were investigated.

Initial results of the event study showed notable resemblance to those of earlier studies. However, the average abnormal return of the sample was found to be slightly lower. Considering OMSR announcements' rising popularity in earlier works, this outcome was unexpected. Usually financial anomalies such as abnormal returns disappear when the factors causing them became more publicly known. However, in the case of OMSR, the market picks up on their initial undervaluation mistake through a signal which is the announcement. As a result, the abnormal returns represent the market correcting itself rather than an anomaly caused by the mispricing, resulting in the effect persisting (U. Peyer & Vermaelen, 2009). Further, the event study results also showed higher CARs during the pandemic compared to pre-pandemic as expected for the first hypothesis. After the results were sorted by company characteristics and analyzed for the pre-, during, and post-event period, the observed patterns confirmed the expectations for hypotheses 2, 3, and 4, as well.

Using the event study results, several cross-sectional regressions were conducted to assess the differences between abnormal returns pre-pandemic compared to during the pandemic. For the first hypothesis, the expectation was that OMSR announcement returns would be significantly higher during COVID based on evidence from past financial crises (e.g., Bernhardt & Eckblad, 2013; Comment & Jarrell, 1991; Netter & Mitchell, 1989). However, even though the initial event study results showed higher CARs between the periods, the cross-sectional regression did not yield any statistical nor economical significant evidence to confirm this. As a result, the hypothesis could not be accepted. Considering valuation methods for investors have improved over the past few decades, it has most likely decrease crisis-induced mispricing, and directly challenges the notion that signaling has a more powerful effect during modern periods of downturn (Fu & Huang, 2016). Conclusively, companies should reconsider OMSR announcements being reliable instruments to boost stock prices amidst turmoil.

Moving on to the company characteristics, the impact of company size on OMSR announcement abnormal returns was first examined. Based on financial literature, the expectation was that smaller companies would generate larger abnormal returns during COVID because they are more likely to repurchase shares amidst a crisis and because they have a stronger signaling impact which is caused by less analyst scrutiny(Grullon & Michaely, 2004; Iyer & Rao, 2017). In general, even though the regression results showed that Size inversely affects announcement abnormal returns, no incremental impact occurred for larger companies during COVID specifically. Thus, the second hypothesis was rejected, suggesting that analyst valuations are not more biased by size during uncertain times. Consequently, how investors assess announcements based on the companies' size does not change amidst a crisis. The COVID pandemic did not amplify possible size-based signaling advantages for smaller companies, implying that managers should not over-consider company size when deciding on making a repurchase announcement.

The next company characteristic that was examined in the cross sectional regression analysis was the Free Cash Flow. For this characteristic, it was hypothesized that companies with high preexisting free cash flows would experience greater OMSR announcement abnormal return during COVID. This was based on H.-C. Chen et al. (2018) who found evidence that these companies announce more buybacks during a crisis or during more uncertain time periods (Chakraborty et al., 2019). However, the outcome of this empirical analysis found that only companies with average cash flow experienced a significant increase in abnormal returns, whereas companies with more excessive cash reserves saw no additional advantage. Therefore, the hypothesis was partially rejected by the data. Howe et al. (1992) observed a similar pattern for high FCF companies and showed that a strong FCF position does not impact returns outside periods of crisis. These outcomes suggest that cash reserves should be a reasonable but not an excessively important factor to optimally time a repurchase announcement during financially uncertain periods, as excessively large free cash flows fail to create further positive market reaction. Companies should always thoroughly assess and explore other options to use their excess cash position regardless of the time period; either to retain it in order to explore alternative growth options, or to use it to repurchase shares and return some value back to their shareholders.

The third and final company characteristic was the book equity to market equity ratio, which served as a proxy for undervaluation. This fourth hypothesis purports that companies experiencing more severe stock undervaluation would generate significantly larger announcement abnormal returns during COVID caused by the presumably crisis-induced mispricing (Ikenberry et al., 1995; U. C. Peyer & Vermaelen, 2005). The empirical analysis from this paper found no statistically or economically significant evidence on a relationship between the pre-existing undervaluation of a company and its subsequently realized repurchase announcement returns during a crisis. Thus, the hypothesis was rejected by the data. This outcome suggests that the decision to execute a repurchase announcement should not differ between regular and crisis times, since the benefits from signaling undervaluation do not amplify in modern times. As a result, management should stay focused on their companies' fundamental value and not get distracted into using OMSR when temporary undervaluation is experienced during crisis periods.

Next, the first market characteristics explored using panel data analysis was stock underperformance. The predictions from hypothesis five were that larger pre-announcement stock underperformance would substantially increase the abnormal returns during the COVID crisis, similar to what was observed in past crisis events (Chakraborty et al., 2019; Netter & Mitchell, 1989). However, this analysis did not find evidence that OMSR abnormal returns are sensitive to the severity of stock underperformance on a company level. As a result, the hypothesis was rejected. This outcome is supported by emerging literature emphasizing that the benefits of correcting underperformance through repurchase announcements are disappearing over the recent decades due to improving shareholder valuation methods (Fu & Huang, 2016). These findings indicate that company management should motivate repurchases based on properly assessed factors impacting company value instead of exploiting anomalies caused by equity underperformance during times of crisis.

Finally, the last panel data regression examined the empirical evidence for the market characteristic uncertainty. The hypothesis predicted that heightened general market uncertainty would decrease abnormal returns following OMSR announcements, as less uncertainty regarding company value is resolved by the announcement (Anolick et al., 2021). Ultimately, this would also explain why repurchase volume decreased significantly during earlier crises (e.g., Baker et al., 2016). However, the panel data regression results fail to provide evidence in favor of this hypothesis, resulting in its rejection. Meaning, there is no statistically or economically significant relationship between general volatility or uncertain market conditions and the returns achieved by companies announcing repurchase programs. This finding indicates that strategically planned repurchases focused on signaling actual value should not be re-evaluated during times with severe systematic financial market uncertainties. Meaning, managers do not need to defer nor avoid such corporate actions due to heightened volatility in crisis periods such as the pandemic.

In conclusion, this thesis provides empirical evidence indicating that numerous assumed benefits of OMSR announcements as observed during past crises are slowly diminishing or disappearing possibly caused by modern valuation methods being more robust towards mispricing. There is also the added possibility that as the COVID pandemic was the event of a generation which was both unprecedented in scale and impact, the level of uncertainty and unpredictability drowned out the market's usual behavior as compared with past crises. Company managers across all industries must be aware of this potential shift away from these previously assumed crisis-specific repurchase announcement advantages, and aim to continue to optimally serve more long-run shareholders' interests. Future academic research will remain essential to fully confirm the resilience of these findings. Nonetheless, this thesis offers a unique initial empirical insight on the first indications that open market share repurchase announcements may no longer yield expected tactical returns that are tied to the market conditions during crises in the 21st century.

6.1 Limitations and Recommendations

While this study offers unique insights into OMSR announcements and their shifting effectiveness during crisis periods, several limitations have to be taken into account that can be tackled in future research. First, the analysis focused on short term announcement returns as opposed to long-run post-announcement stock performance. Examining such a longer window could reveal whether the announcement effects are sustainable the months after the announcement as well (e.g., Chan et al., 2007; Ikenberry et al., 1995). Second, the COVID pandemic was a crisis event associated with high idiosyncratic risk caused by the unique characteristics of the period such as a worldwide lockdown (Baker et al., 2020). Perhaps when analyzing other recessionary periods with more typical macroeconomic causes similar to the 2008 financial crisis, further distinctions can be made between the findings to identify those unique to the pandemic's turmoil, as compared with those that are more general to a crisis. By comparing the effectiveness of announcements across different (future), crises the impact of the nature of the downturn may also be assessed.

Third, as mentioned, the statistical power of some of the models used in this analysis was fairly limited. Due to the rapidly evolving pandemic conditions, data was sparsely available which substantially decreased the sample size. Analyzing larger samples over longer periods could potentially increase the statistical power of the models and detect more subtle effects that were not evident in the shorter window used in this analysis. This could perhaps also be solved by the use of different databases, such as the SEC Edgar Database as proposed by Busch and Obernberger (2017) to derive announcement dates and may yield more observations.

Fourth, the market model was estimated using a very long estimation period, causing event clustering as a possible issue as companies can announce multiple OMSR in close succession (Kolari & Pynnönen, 2010). This can result in cross-correlation of abnormal returns and reduce the overall power of significance tests. A longer estimation window of 270 days was used here in an attempt to mitigate the distortions of event study clustering. However, another solution could be to implement a bootstrapping procedure (Kothari & Warner, 2007). Through bootstrapping, a large number of possible return distributions are simulated by randomly re-sampling the actual observations of the abnormal returns that suffer from event-clustering. The new empirical distribution obtained using this procedure deals with any possible cross-correlation of the returns. As a result, better tests statistics that adjust for possible clustering effects can be calculated. Further, not only does the bootstrapping improve the overall power of the tests, it also meant that the restriction on the number of announcements in a quarter need not apply and this can increase the overall sample size. Implementing this technique in a future study could help further distinguish the factors driving announcement abnormal returns during a crisis.

Fifth, the focus of this analysis was only on the US market; by exploring international evidence on repurchase announcements, new evidence could arise on the motives, execution, and effectiveness of the announcements. For example, in the European market, Anolick et al. (2021) observed effects that this empirical analysis did not find which could be the result of regulatory or cultural differences. Consequently, these differences could then be used by companies to improve the overall effectiveness of their announcements.

Sixth, instead of using financial databases and large scale quantitative analysis, perhaps more in-depth research methods such as interviewing company's management could lead to new insights. One such example is provided by Brav et al. (2005) who surveyed financial executives in order to derive the factors that impact their dividend and share repurchase decisions. Through this qualitative research method, new insights can be provided on how internal motivations and considerations to repurchase shares can shift during crises when contrasted with more stable periods.

Seventh, there might be differences across industries or companies' lifecycle stages that impact the effectiveness of OMSR announcement returns during a crisis. The COVID pandemic affected industries and countries in different ways (D. Zhang et al., 2020). As a result, certain industry traits can cause some sectors to experience larger repurchase abnormal returns under uncertain conditions (De Cesari et al., 2011). In addition, differentiating lifecycle stages of companies can allow researchers to distinguish between more mature and established companies versus younger and growing companies as well. Ultimately, incorporating these industry and lifecycle specific perspectives can provide deeper understandings into when repurchases are most effective during crisis periods.

And finally, this paper focuses on six main characteristics why companies may repurchase stock during a crisis. However, there are other possible factors mentioned in financial literature that may explain this repurchase behavior as well. For example, the compensation structure of company's management can result in agency issues which may affect the impact of repurchases (e.g., Howe et al., 1992; Lakonishok & Vermaelen, 1990). Furthermore, the effect of taxation can be explored as this could also impact the decision to repurchase shares (e.g., Jacob & Jacob, 2013). And lastly, substituting dividends for repurchases or vice versa may also affect the repurchase decision and provide new insights on signaling (e.g., Grullon & Michaely, 2002; Hausch & Seward, 1993).

Appendix A

Results

TABLE A.1: Correlation Matrix

Pearson's correlation matrix showing correlations between the pre-announcement $CAR(-20,-3)$, announcement $CAR(-2,+2)$, and post-announcement $CAR(+3,+10)$ and all other variables. The variables in the table are Company Size is calculated as the natural logarithm of total assets, Free Cash Flow, Leverage, Underperformance, ΔVIX is the change of the VIX, VIX level is the level of the VIX, Market Value is the market value of Equity, and the COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). The p-values are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	1.	**2.**	**3.**	**4.**	**5.**	**6.**	**7.**	**8.**	**9.**	**10.**	**11.**	**12.**
1. CAR(-2,+2)	1.0000											
2. CAR(-20,-3)	-0.0478**	1.0000										
	(0.0159)											
3. CAR(+3,+10)	-0.0706***	-0.0146	1.0000									
	(0.0004)	(0.4624)										
4. Size	-0.1158***	0.0927***	-0.0501**	1.0000								
	(0.0000)	(0.0000)	(0.0116)									
5. FCF	-0.0232	0.0241	-0.0269	0.5007***	1.0000							
	(0.2416)	(0.2243)	(0.1751)	(0.0000)								
6. BE/ME Ratio	0.0601***	0.0959***	0.1317***	-0.0046	-0.1049***	1.0000						
	(0.0024)	(0.0000)	(0.0000)	(0.8154)	(0.0000)							
7. Leverage	-0.0734***	0.1002***	-0.0417**	0.4793***	0.1075***	0.0764***	1.0000					
	(0.0002)	(0.0000)	(0.0358)	(0.0000)	(0.0000)	(0.0001)						
8. Underperformance	-0.0105	-0.6859***	-0.0047	-0.0301	0.0018	-0.0631***	-0.0424**	1.0000				
	(0.5956)	(0.0000)	(0.8126)	(0.1295)	(0.9283)	(0.0015)	(0.0326)					
9. ΔVIX	-0.0224	-0.0266	-0.0011	-0.0750***	-0.0608***	-0.0279	-0.0359*	0.0262	1.0000			
	(0.2592)	(0.1810)	(0.9571)	(0.0002)	(0.0022)	(0.1601)	(0.0710)	(0.1870)				
10. VIX Level	-0.0300	-0.0820***	0.0336*	-0.0357*	-0.0516***	0.0492**	0.0334*	0.0347*	0.2267***	1.0000		
	(0.1307)	(0.0000)	(0.0909)	(0.0721)	(0.0093)	(0.0131)	(0.0922)	(0.0804)	(0.0000)			
11. Market Value	-0.0251	0.0117	-0.0312	0.3798***	0.6585***	-0.1263***	0.0594***	-0.0031	-0.0209	-0.0230	1.0000	
	(0.2065)	(0.5556)	(0.1156)	(0.0000)	(0.0000)	(0.0000)	(0.0028)	(0.8759)	(0.2936)	(0.2468)		
12. COVID Dummy	0.0305	0.0545***	0.0204	0.0462**	0.0014	0.0569***	0.0967***	-0.0542*	0.0310	0.4957***	0.0360*	1.0000
	(0.1248)	(0.0060)	(0.3036)	(0.0198)	(0.9420)	(0.0042)	(0.0000)	(0.0063)	(0.1185)	(0.0000)	(0.0699)	

Appendix B

Robustness Check

TABLE B.1: Robustness: Model Specifications for Model 1, 2, 3, and 4

Robustness check results for changing the model specifications of the results of cross-sectional regression analysis examining the impact of company characteristics on Open Market Share Repurchase (OMSR) announcement cumulative abnormal returns (CARs). Four models are estimated using pooled OLS regression with robust standard errors clustered by company. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The key independent variables are interactions between company characteristics and a COVID-19 dummy variable to assess differences in the relationship during the pandemic compared to pre-pandemic. The COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). The first column shows the variables for the company characteristics which are Size (*natural logarithm of the market value of equity*), Free Cash Flow (multinomial variable), BE/ME ratio (multinomial variable), and Leverage ratio. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification			
	(1)	(2)	(3)	(4)
	CAR(-2,+2)	**CAR(-2,+2)**	**CAR(-2,+2)**	**CAR(-2,+2)**
Size	-0.0055***	-0.0056***	-0.0055***	-0.0055***
	(0.0010)	(0.0010)	(0.0010)	(0.0010)
FCF	0.0031*	0.0032*	0.0027	0.0032*
	(0.0016)	(0.0016)	(0.0016)	(0.0016)
BE/ME Ratio	0.0035***	0.0036***	0.0035***	0.0032**
	(0.0013)	(0.0013)	(0.0013)	(0.0013)
Leverage	-0.0097	-0.0091	-0.0094	-0.0095
	(0.0076)	(0.0076)	(0.0075)	(0.0076)
COVID	0.0055			
	(0.0041)			
Size # COVID		0.0003		
		(0.0004)		
FCF # COVID			0.0017*	
			(0.0010)	
BE/ME Ratio # COVID				0.0011
				(0.0012)
Constant	0.0457***	0.0468***	0.0470***	0.0471***
	(0.0078)	(0.0079)	(0.0078)	(0.0079)
N	2,540	2,540	2,540	2,540
R^2	0.0189	0.0181	0.0189	0.0183
Adjusted R^2	0.0170	0.0162	0.0170	0.0164

TABLE B.2: Robustness: Model Specifications for Model 5 and 6

Robustness check results for changing the model specifications of the panel data regression analysis examining the impact of market characteristics on Open Market Share Repurchase (OMSR) announcement cumulative abnormal returns (CARs) during COVID-19. Two models are estimated using panel data regression with company, industry, or time fixed effects. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The key independent variables are interactions between market characteristics and a COVID-19 dummy variable to assess differences in the relationship during the pandemic compared to pre-pandemic. The COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). Model 5 investigates pre-announcement 40-day Stock Underperformance and Model 6 investigates the level of the VIX (Implied Volatility Index for the S&P500). The first column shows the variable names. Control variables of the base model are included but not reported. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors clustered by company are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification	
	(5)	(6)
	CAR(-2,+2)	**CAR(-2,+2)**
COVID	-0.0016	0.0264
	(0.0053)	(0.0171)
Stock Underperformance	-0.0094**	
	(0.0045)	
Stock Underperformance # COVID	0.0038	
	(0.0087)	
VIX level		0.0001
		(0.0005)
VIX level # COVID		0.0011
		(0.0008)
Constant	0.0233***	0.0166***
	(0.0027)	(0.0074)
Base Model variables	YES	YES
Company FE	YES	NO
Industry FE	NO	YES
Time FE	YES	YES
N	2,540	2,540
R^2	0.0143	0.0189
Adjusted R^2	0.0115	0.0162

TABLE B.3: Robustness: Changing COVID sample: Base Model

Results of the Robustness check on the pre-COVID and COVID sample. The base Model is estimated using pooled OLS regression for the pre-COVID and COVID sample with robust standard errors clustered by company. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The first column shows the variables for the company characteristics which are Size (*natural logarithm of total assets*), Free Cash Flow quintiles, BE/ME ratio quintiles, and Leverage ratio, where the first quintile is omitted for the categorical variables without interaction effect due to multicollinearity. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Base Model	
	Pre-COVID	COVID
	CAR(-2,+2)	**CAR(-2,+2)**
Size	-0.0039***	-0.0110***
	(0.0014)	(0.0029)
FCF [2]	-0.0050	0.0182
	(0.0067)	(0.0137)
FCF [3]	-0.0039	0.0185
	(0.0061)	(0.0139)
FCF [4]	-0.0029	0.0173
	(0.0055)	(0.0148)
FCF [5]	0.0058	0.0336*
	(0.0060)	(0.0175)
BE/ME Ratio [2]	0.0005	0.0104
	(0.0054)	(0.0109)
BE/ME Ratio [3]	0.0040	0.0057
	(0.0055)	(0.0123)
BE/ME Ratio [4]	0.0077	-0.0050
	(0.0052)	(0.0117)
BE/ME Ratio [5]	0.0134**	0.0175
	(0.0060)	(0.0137)
Leverage	-0.0086	-0.0100
	(0.0091)	(0.0170)
Constant	0.0492***	0.0964***
	(0.0108)	(0.0200)
N	1810	730
R^2	0.0148	0.0442
Adjusted R^2	0.0093	0.0309

TABLE B.4: Robustness: Changing COVID sample: Model 5 and 6

Results of the Robustness check on the pre-COVID and COVID sample. Two models are estimated using panel data regression with company, industry, or time fixed effects for two different samples. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. Model 5 investigates pre-announcement 20-day Stock Underperformance and Model 6 investigates the changes in the VIX (Implied Volatility Index for the S&P500). The first column shows the variable names. Control variables of the base model are included but not reported. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors clustered by company are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification			
	(5)	(6)	(5)	(6)
	Pre-COVID		COVID	
	CAR(-2,+2)	**CAR(-2,+2)**	**CAR(-2,+2)**	**CAR(-2,+2)**
Stock Underperformance	-0.0102**		-0.0109	
	(0.0049)		(0.0101)	
VIX change		0.0004		-0.0188
		(0.0332)		(0.0437)
Constant	0.0220***	0.0162***	0.0271***	0.0218***
	(0.0028)	(0.0000)	(0.0052)	(0.0003)
Base Model variables	YES	YES	YES	YES
Company FE	YES	NO	YES	NO
Industry FE	NO	YES	NO	YES
Time FE	YES	YES	YES	YES
N	1810	1810	730	730
R^2	0.0343	0.0314	0.0557	0.0557
Adjusted R^2	0.0316	0.0287	0.0491	0.0492

TABLE B.5: Robustness: Frequent Repurchasers Sample: Model 1, 2, 3, and 4

Results of the Robustness check on frequent repurchasers. Four models are estimated using pooled OLS regression with robust standard errors clustered by company. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The key independent variables are interactions between company characteristics and a COVID-19 dummy variable to assess differences in the relationship during the pandemic compared to pre-pandemic. The COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). The first column shows the variables for the company characteristics which are Size (*natural logarithm of total assets*), Free Cash Flow quintiles, BE/ME ratio quintiles, and Leverage ratio, where the first quintile is omitted for the categorical variables without interaction effect due to multicollinearity. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification			
	(1)	(2)	(3)	(4)
	CAR(-2,+2)	**CAR(-2,+2)**	**CAR(-2,+2)**	**CAR(-2,+2)**
Size	-0.0043***	-0.0044***	-0.0043***	-0.0043***
	(0.0015)	(0.0015)	(0.0015)	(0.0015)
FCF [2]	0.0051	0.0053	-0.0020	0.0052
	(0.0082)	(0.0082)	(0.0086)	(0.0081)
FCF [3]	0.0077	0.0079	0.0015	0.0089
	(0.0071)	(0.0071)	(0.0074)	(0.0071)
FCF [4]	0.0049	0.0052	0.0042	0.0053
	(0.0062)	(0.0062)	(0.0065)	(0.0061)
FCF [5]	0.0112*	0.0115*	0.0112	0.0115*
	(0.0066)	(0.0066)	(0.0068)	(0.0066)
BE/ME Ratio [2]	0.0063	0.0062	0.0056	0.0013
	(0.0051)	(0.0051)	(0.0051)	(0.0061)
BE/ME Ratio [3]	0.0103*	0.0101*	0.0096*	0.0068
	(0.0055)	(0.0055)	(0.0055)	(0.0062)
BE/ME Ratio [4]	0.0111**	0.0112**	0.0107**	0.0110*
	(0.0052)	(0.0052)	(0.0053)	(0.0057)
BE/ME Ratio [5]	0.0203***	0.0206***	0.0187***	0.0229***
	(0.0068)	(0.0068)	(0.0067)	(0.0071)
Leverage	-0.0124	-0.0116	-0.0145	-0.0118
	(0.0103)	(0.0103)	(0.0102)	(0.0103)
COVID	0.0068			
	(0.0044)			
Size # COVID		0.0005		
		(0.0004)		
FCF [1] # COVID			-0.0040	
			(0.0151)	
FCF [2] # COVID			0.0222*	
			(0.0129)	
FCF [3] # COVID			0.0198*	
			(0.0103)	
FCF [4] # COVID			0.0002	
			(0.0070)	
FCF [5] # COVID			-0.0020	
			(0.0059)	

BE/ME Ratio [1] # COVID				0.0014
				(0.0076)
BE/ME Ratio [2] # COVID				0.0219**
				(0.0096)
BE/ME Ratio [3] # COVID				0.0160
				(0.0100)
BE/ME Ratio [4] # COVID				0.0019
				(0.0081)
BE/ME Ratio [5] # COVID				-0.0039
				(0.0120)
Constant	0.0422***	0.0436***	0.0470***	0.0429***
	(0.0119)	(0.0119)	(0.0120)	(0.0121)
N	1656	1656	1656	1656
R^2	0.0236	0.0225	0.0282	0.0272
Adjusted R^2	0.0171	0.0160	0.0194	0.0183

TABLE B.6: Robustness: Frequent Repurchasers Sample: Model 5 and 6

Results of the Robustness check on frequent repurchasers. Two models are estimated using panel data regression with company, industry, or time fixed effects. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The key independent variables are interactions between market characteristics and a COVID-19 dummy variable to assess differences in the relationship during the pandemic compared to pre-pandemic. The COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). Model 5 investigates pre-announcement 20-day Stock Underperformance and Model 6 investigates the changes in the VIX (Implied Volatility Index for the S&P500). The first column shows the variable names. Control variables of the base model are included but not reported. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors clustered by company are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification	
	(5)	(6)
	CAR(-2,+2)	**CAR(-2,+2)**
COVID	-0.0021	0.0008
	(0.0057)	(0.0045)
Stock Underperformance	-0.0098**	
	(0.0046)	
Stock Underperformance # COVID	0.0039	
	(0.0089)	
VIX change		-0.0062
		(0.0293)
VIX change # COVID		0.0122
		(0.0547)
Constant	0.0211***	0.0155***
	(0.0029)	(0.0012)
Base Model variables	YES	YES
Company FE	YES	NO
Industry FE	NO	YES
Time FE	YES	YES
N	1656	1656
R^2	0.0138	0.0105
Adjusted R^2	0.0096	0.0063

TABLE B.7: Robustness: Non-Frequent Repurchasers Sample: Model 1, 2, 3, and 4

Results of the Robustness check on non-frequent repurchasers. Four models are estimated using pooled OLS regression with robust standard errors clustered by company. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The key independent variables are interactions between company characteristics and a COVID-19 dummy variable to assess differences in the relationship during the pandemic compared to pre-pandemic. The COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). The first column shows the variables for the company characteristics which are Size (*natural logarithm of total assets*), Free Cash Flow quintiles, BE/ME ratio quintiles, and Leverage ratio, where the first quintile is omitted for the categorical variables without interaction effect due to multicollinearity. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification			
	(1)	(2)	(3)	(4)
	CAR(-2,+2)	**CAR(-2,+2)**	**CAR(-2,+2)**	**CAR(-2,+2)**
Size	-0.0086***	-0.0085***	-0.0083***	-0.0086***
	(0.0026)	(0.0026)	(0.0026)	(0.0026)
FCF [2]	-0.0008	-0.0006	-0.0065	-0.0012
	(0.0108)	(0.0107)	(0.0104)	(0.0108)
FCF [3]	0.0041	0.0045	-0.0018	0.0040
	(0.0110)	(0.0109)	(0.0108)	(0.0111)
FCF [4]	0.0071	0.0074	-0.0010	0.0071
	(0.0120)	(0.0120)	(0.0108)	(0.0120)
FCF [5]	0.0297**	0.0302**	0.0191	0.0293**
	(0.0139)	(0.0140)	(0.0121)	(0.0139)
BE/ME Ratio [2]	0.0003	-0.0001	0.0003	0.0074
	(0.0110)	(0.0110)	(0.0111)	(0.0118)
BE/ME Ratio [3]	0.0041	0.0038	0.0043	0.0068
	(0.0116)	(0.0117)	(0.0116)	(0.0121)
BE/ME Ratio [4]	-0.0025	-0.0029	-0.0029	0.0077
	(0.0124)	(0.0124)	(0.0125)	(0.0126)
BE/ME Ratio [5]	0.0084	0.0084	0.0077	0.0101
	(0.0112)	(0.0112)	(0.0112)	(0.0123)
Leverage	-0.0027	-0.0025	-0.0048	-0.0019
	(0.0136)	(0.0136)	(0.0136)	(0.0135)
COVID	0.0035			
	(0.0082)			
Size # COVID		-0.0000		
		(0.0010)		
FCF [1] # COVID			-0.0174	
			(0.0270)	
FCF [2] # COVID			0.0075	
			(0.0111)	
FCF [3] # COVID			0.0059	
			(0.0131)	
FCF [4] # COVID			0.0119	
			(0.0198)	
FCF [5] # COVID			0.0143	
			(0.0161)	

BE/ME Ratio [1] # COVID				0.0153
				(0.0199)
BE/ME Ratio [2] # COVID				-0.0072
				(0.0167)
BE/ME Ratio [3] # COVID				0.0095
				(0.0183)
BE/ME Ratio [4] # COVID				-0.0176
				(0.0234)
BE/ME Ratio [5] # COVID				0.0117
				(0.0121)
Constant	0.0788***	0.0793***	0.0828***	0.0742***
	(0.0196)	(0.0199)	(0.0196)	(0.0203)
N	884	884	884	884
R^2	0.0202	0.0199	0.0231	0.0238
Adjusted R^2	0.0078	0.0075	0.0062	0.0069

TABLE B.8: Robustness: Non-Frequent Repurchasers Sample: Model 5 and 6

Results of the Robustness check on non-frequent repurchasers. Two models are estimated using panel data regression with company, industry, or time fixed effects. The dependent variable is the $CAR(-2,+2)$ representing the market's reaction to the announcement and is calculated using the Market Model with the CRSP Value Weighted Index as market index. The key independent variables are interactions between market characteristics and a COVID-19 dummy variable to assess differences in the relationship during the pandemic compared to pre-pandemic. The COVID dummy variable indicates whether the announcement was during COVID (1) or pre-pandemic (0). Model 5 investigates pre-announcement 20-day Stock Underperformance and Model 6 investigates the changes in the VIX (Implied Volatility Index for the S&P500). The first column shows the variable names. Control variables of the base model are included but not reported. The regression coefficient $*100$ depicts the percentage change of the $CAR(-2,+2)$. Robust standard errors clustered by company are reported between parentheses. The significance stars are based on p-values * p<0.1 , ** p<0.05, and *** p<0.01, and denote statistical significance at the 10%, 5%, and 1% level respectively.

	Model Specification	
	(5)	(6)
	CAR(-2,+2)	**CAR(-2,+2)**
COVID	0.0000	0.0000
	(.)	(.)
Stock Underperformance	-0.0043	
	(0.0172)	
Stock Underperformance # COVID	-0.0654***	
	(0.0185)	
VIX change		-0.0591
		(0.1131)
VIX change # COVID		-0.5488
		(0.3703)
Constant	0.0351***	0.0223***
	(0.0068)	(0.0004)
Base Model variables	YES	YES
Company FE	YES	NO
Industry FE	NO	YES
Time FE	YES	YES
N	884	884
R^2	0.0552	0.0641
Adjusted R^2	0.0530	0.0620

Bibliography

Anolick, N., Batten, J. A., Kinateder, H., & Wagner, N. (2021). Time for gift giving: Abnormal share repurchase returns and uncertainty. *Journal of Corporate Finance*, *66*, 101787.

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring economic policy uncertainty. *The quarterly journal of economics*, *131*(4), 1593–1636.

Baker, S. R., Bloom, N., Davis, S. J., Kost, K., Sammon, M., & Viratyosin, T. (2020). The unprecedented stock market reaction to covid-19. *The review of asset pricing studies*, *10*(4), 742–758.

Baldwin, R. (2020). The supply side matters: Guns versus butter, covid-style. *VOX CEPR Policy Portal*, *22*.

Bernhardt, D., & Eckblad, M. (2013). Stock market crash of 1987. *Federal Reserve Bank of Chicago*.

Boehmer, E., Masumeci, J., & Poulsen, A. B. (1991). Event-study methodology under conditions of event-induced variance. *Journal of Financial Economics*, *30*(2), 253–272. https://doi.org/https://doi.org/10.1016/0304-405X(91)90032-F

Brav, A., Graham, J. R., Harvey, C. R., & Michaely, R. (2005). Payout policy in the 21st century. *Journal of financial economics*, *77*(3), 483–527.

Breusch, T. S., & Pagan, A. R. (1979). A simple test for heteroscedasticity and random coefficient variation. *Econometrica: Journal of the econometric society*, 1287–1294.

Brooks, C. (2019). *Introductory econometrics for finance*. Cambridge university press.

Busch, P., & Obernberger, S. (2017). Actual share repurchases, price efficiency, and the information content of stock prices. *The review of financial studies*, *30*(1), 324–362.

Chakraborty, A., Grant, J. L., Trahan, E. A., & Varma, B. (2019). Seeking alpha from share repurchases. *The Journal of Investing*, *29*(1), 61–79.

Chan, K., Ikenberry, D. L., & Lee, I. (2007). Do managers time the market? evidence from open-market share repurchases. *Journal of Banking & Finance*, *31*(9), 2673–2694.

Chen, H.-C., Harper, J. T., & Iyer, S. R. (2018). Economic shock and share repurchases. *The North American Journal of Economics and Finance*, *44*, 254–264.

Chen, Z., Lei, Z., & Xia, C. (2022). Precautionary versus signalling motive of share repurchases: Evidence from policy uncertainty and the covid-19 crisis. *British Journal of Management*.

Comment, R., & Jarrell, G. A. (1991). The relative signalling power of dutch-auction and fixed-price self-tender offers and open-market share repurchases. *The Journal of Finance*, *46*(4), 1243–1271.

De Cesari, A., Espenlaub, S., & Khurshed, A. (2011). Stock repurchases and treasury share sales: Do they stabilize price and enhance liquidity? *Journal of Corporate Finance*, *17*(5), 1558–1579.

Fama, E. F., & French, K. R. (1993). Common risk factors in the returns on stocks and bonds. *Journal of financial economics*, *33*(1), 3–56.

Fama, E. F., & French, K. R. (1997). Industry costs of equity. *Journal of financial economics*, *43*(2), 153–193.

FED. (2021). Federal Reserve announces temporary and additional restrictions on bank holding company dividends and share repurchases currently in place will end for most firms after June 30, based on results from upcoming stress test. https://www.federalreserve.gov/newsevents/pressreleases/bcreg20210325a.htm

Financial Times. (2020). US share buybacks almost cut in half by pandemic. https://www.ft.com/content/c60ea33a-9bea-49ff-b967-86149203412a

Fu, F., & Huang, S. (2016). The persistence of long-run abnormal returns following stock repurchases and offerings. *Management Science*, *62*(4), 964–984.

Gaspar, J.-M., Massa, M., Matos, P., Patgiri, R., & Rehman, Z. (2013). Payout policy choices and shareholder investment horizons. *Review of Finance*, *17*(1), 261–320.

Gormley, T. A., & Matsa, D. A. (2014). Common errors: How to (and not to) control for unobserved heterogeneity. *The Review of Financial Studies*, *27*(2), 617–661.

Grullon, G., & Michaely, R. (2002). Dividends, share repurchases, and the substitution hypothesis. *the Journal of Finance*, *57*(4), 1649–1684.

Grullon, G., & Michaely, R. (2004). The information content of share repurchase programs. *The Journal of Finance*, *59*(2), 651–680.

Hausch, D. B., & Seward, J. K. (1993). Signaling with dividends and share repurchases: A choice between deterministic and stochastic cash disbursements. *The Review of Financial Studies*, *6*(1), 121–154.

Howe, K. M., He, J., & Kao, G. W. (1992). One-time cash flow announcements and free cash-flow theory: Share repurchases and special dividends. *The Journal of Finance*, *47*(5), 1963–1975.

Hsieh, J., & Wang, Q. (2009). Stock repurchases: Theory and evidence. *Available at SSRN 1395943*.

Ikenberry, D., Lakonishok, J., & Vermaelen, T. (1995). Market underreaction to open market share repurchases. *Journal of financial economics*, *39*(2-3), 181–208.

Iyer, S. R., & Rao, R. P. (2017). Share repurchases and the flexibility hypothesis. *Journal of financial research*, *40*(3), 287–313.

Jacob, M., & Jacob, M. (2013). Taxation, dividends, and share repurchases: Taking evidence global. *Journal of Financial and Quantitative Analysis*, *48*(4), 1241–1269.

Jagannathan, M., & Stephens, C. (2003). Motives for multiple open-market repurchase programs. *Financial management*, 71–91.

Kahle, K. M. (2002). When a buyback isn'ta buyback: Open market repurchases and employee options. *Journal of Financial Economics*, *63*(2), 235–261.

Kolari, J. W., & Pynnonen, S. (2011). Nonparametric rank tests for event studies. *Journal of Empirical Finance*, *18*(5), 953–971.

Kolari, J. W., & Pynnönen, S. (2010). Event study testing with cross-sectional correlation of abnormal returns. *The Review of financial studies*, *23*(11), 3996–4025.

Kothari, S. P., & Warner, J. B. (2007). Econometrics of event studies. In *Handbook of empirical corporate finance* (pp. 3–36). Elsevier.

Lakonishok, J., & Vermaelen, T. (1990). Anomalous price behavior around repurchase tender offers. *The Journal of Finance*, *45*(2), 455–477.

Lee, C. I., Ejara, D. D., & Gleason, K. C. (2010). An empirical analysis of european stock repurchases. *Journal of Multinational Financial Management*, *20*, 114–125.

Lehn, K., & Poulsen, A. (1989). Free cash flow and stockholder gains in going private transactions. *the Journal of Finance*, *44*(3), 771–787.

Liu, C.-S., & Ziebart, D. A. (1997). Stock returns and open-market stock repurchase announcements. *Financial Review*, *32*(4), 709–728.

MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of economic literature*, *35*(1), 13–39.

McNally, W. J., & Smith, B. F. (2007). Long-run returns following open market share repurchases. *Journal of Banking & Finance*, *31*(3), 703–717.

Miller, M. H., & Modigliani, F. (1961). Dividend policy, growth, and the valuation of shares. *the Journal of Business*, *34*(4), 411–433.

Mitchell, M. L., & Stafford, E. (2000). Managerial decisions and long-term stock price performance. *The Journal of Business*, *73*(3), 287–329.

Netter, J. M., & Mitchell, M. L. (1989). Stock-repurchase announcements and insider transactions after the october 1987 stock market crash. *Financial Management*, 84–96.

Ntantamis, C., & Zhou, J. (2022). Corporate payout, cash holdings, and the covid-19 crisis: Evidence from the g-7 countries. *Finance Research Letters*, *50*, 103275.

Onali, E. (2020). Covid-19 and stock market volatility. *Available at SSRN 3571453*.

Patell, J. M. (1976). Corporate forecasts of earnings per share and stock price behavior: Empirical test. *Journal of accounting research*, 246–276.

Peyer, U., & Vermaelen, T. (2009). The nature and persistence of buyback anomalies. *The Review of Financial Studies*, *22*(4), 1693–1745.

Peyer, U. C., & Vermaelen, T. (2005). The many facets of privately negotiated stock repurchases. *Journal of Financial Economics*, *75*(2), 361–395.

Pirgaip, B., & Dinçergök, B. (2019). Share repurchases under uncertainty: Us evidence. *Finance Research Letters*, *30*, 130–138.

Strong, N. (1992). Modelling abnormal returns: A review article. *Journal of Business Finance & Accounting*, *19*(4), 533–553.

Uddin, M., Chowdhury, A., Anderson, K., & Chaudhuri, K. (2021). The effect of covid–19 pandemic on global stock market volatility: Can economic strength help to manage the uncertainty? *Journal of Business Research*, *128*, 31–44.

Vermaelen, T. (1981). Common stock repurchases and market signalling: An empirical study. *Journal of financial economics*, *9*(2), 139–183.

Vermaelen, T. (2005). Share repurchases. *Foundations and Trends® in Finance*, *1*(3), 171–268.

Yilmazkuday, H. (2021). Covid-19 effects on the s&p 500 index. *Applied Economics Letters*, 1–7.

Yook, K. C. (2010). Long-run stock performance following stock repurchases. *The Quarterly Review of Economics and Finance*, *50*(3), 323–331.

Zhang, D., Hu, M., & Ji, Q. (2020). Financial markets under the global pandemic of covid-19. *Finance research letters*, *36*, 101528.

Zhang, H. (2005). Share price performance following actual share repurchases. *Journal of Banking & Finance*, *29*(7), 1887–1901.