ERASMUS UNIVERSITY ROTTERDAM

Erasmus School of Economics

Master Thesis Financial Economics

Undervaluation or Price Support?

What drives managers to announce share repurchases?

Evidence from short interest data for 2004 - 2020.

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Date final version: 16-12-202

Summary

Are repurchase announcements motivated by undervaluation or price support arguments? In this thesis I investigate managers' motivation for announcing share repurchases. Using repurchase data, short interest information and company fundamentals for every month from 2004 up until 2020, I test the effect of repurchase announcements on the monthly change in short interest. Using short interest as proxy for overvaluation I test whether short sellers view repurchase announcements as motivated by undervaluation or price support. Using regression analysis, I find a positive relation between the change in short interest in a month and whether a repurchase announcement was made in the month before. This result provides evidence for the price support motive for repurchase announcements; managers make repurchase announcements to support their share price against downward pressure. Running the regression separately over 2020 shows that this positive effect is almost three times larger in 2020. This shows that managers tried to support their share price amidst the uncertainty and decline of global markets due to the rise of the Covid-19 pandemic.

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1. Introduction

In September 2020, Microsoft announced that it had allocated 60 billion dollars towards buying back their own shares. The huge amount announced by the second largest company in de United States, is about the size of one-and-a-half times Microsoft's net income for 2020. It is among the largest repurchase programs announced to date, just behind Apple's announcements in 2018, 2019 and 2021 (Bass, 2021). Since the end of the Great Financial Crisis in 2008, share repurchases are on the rise, peaking at a record volume in 2018 and possibly setting new records this year. It is even so that during the first half of 2021, large U.S. companies spent more money on share repurchases than they have invested in the company through capital expenditures (Trentmann & Maurer, 2021). Despite the large growth in repurchases, the growth of dividends stays behind. Why do managers like to repurchase their company's shares so much? And what drives them to announce these huge repurchase programs?

Share repurchases are a flexible tool for management to return company value to shareholders. Like dividends, share repurchases return value to investors by transferring cash from the balance sheet to investors. Share repurchases might also provide potential short-term benefits to shareholders: higher earnings per share and often a rise in share price, although repurchases do not change fundamental company value (Dobbs & Rehm, 2005). Repurchases are generally seen as more flexible compared to committing to dividends because a decrease in dividends is often not well received by investors. This flexibility is one of the reasons that share repurchase programs are so wildly attractive to managers.

Whether the rapid rise in popularity of share repurchases is without negative effects is an upcoming debate. Unlike dividends for instance, they are not taxed. Critics of share repurchases state that it seems to be that firms prioritize repurchases before investments in future income. William Lazonick (2014) writes that "Corporate profitability is not translating into widespread economic prosperity", and that "The allocation of corporate profits to stock buybacks deserves much of the blame". He blames managers for choosing short-term gains in share price, and with it their own compensation, over long-term investments in production capacity or higher wages.

While returning cash to investors and flexibility are the main reasons in favor of repurchases, managers can have other motives repurchasing their share. Some potential motives to engage in share repurchases are undervaluation, lack of future growth opportunities, the prevention of EPS dilution and price support. A lot of research has been done to find out what drives managers to repurchase their companies' shares. One of the more dominant strings of literature states that managers announce repurchase programs when they believe their share is undervalued. In a 2005 survey among CEO's, undervaluation was the most mentioned motive for managers to repurchase their share (Brav,

Graham, Harvey, & Michaely, 2005). The flexibility of share repurchases would allow managers to time their repurchase to a moment they believe the price of their share is lower than it should be. This repurchase motive is more and more criticized. Repurchase announcements tend to spike in periods of economic boom, while they drop in periods of economic downturn. The same is happening to actual repurchases. Critics of the undervaluation motive argue that firms undertake repurchases to support and boost their share price. According to investment bankers, firms use repurchases strategically: they buy when the price goes down to limit the decline (Strumpf, 2014).

In this thesis, I investigate managers' motivations for announcing repurchase programs. The following research question is stated: *Are repurchase announcements motivated by undervaluation or price support arguments?* I use monthly data on repurchase announcements and on actual repurchases from U.S. listed companies. I use data on short interest to determine whether repurchase announcements are motivated by undervaluation or price support. Using short interest data together with data on share repurchases is relatively new (e.g., Bargeron & Bonaime, 2020; Christophe, Ferri, & Angel, 2004; Liu & Swanson, 2016; Zheng, 2020).

Short interest is the fraction of a company's shares outstanding that is currently sold short. Short selling is a trade where a short seller borrows a share which he sells, hoping that the price is lower when he must return (and therefore buy) the share to the original owner. If the price the short seller must pay when he returns the share is lower than the initial selling price, he takes the difference as profit. Short sellers are generally viewed as informed and sophisticated investors as the costs of short selling are relatively high (Diamond & Verrecchia, 1987). I state that this makes them market participants who can assess the motivation behind repurchase announcements. If they believe an announcement reveals undervaluation, they should unwind their positions to prevent losses as the market incorporates the favorable information released by the announcement. If they believe an announcement is motivated to support a share that they already viewed as overvalued, there is no reason to lower their short interest.

Two recent studies that use short interest data to assess the motivation behind and information content of actual repurchase decisions are those of Liu and Swanson (2016) and Bargeron and Bonaime (2020). Liu and Swanson (2016) find that firms increase repurchases when short interest increases, providing evidence for the price support motive. Bargeron and Bonaime (2020) argue that repurchases reveal inside information from the firm and that the information of the firm is superior. In other words, they argue that the short sellers are wrong if they increase their positions after repurchases, as they are motivated by undervaluation due to positive future information. Both papers will be discussed more elaborately in Section 2.

Using regression analysis, I find a positive relation between both repurchase announcements and change in short interest and between the change in actual repurchases and the change in short interest. The change in short interest increases almost four-and-a-half times in a month following a repurchase announcement. This indicates that short sellers identify managers' motivation to be associated with price support rather than undervaluation. I also find that announcements made by firms with a higher chance of being undervalued, proxied for by a high book-to-market ratio, are indeed more often associated with undervaluation by short sellers.

This study adds to the existing literature on share repurchase announcements and short interest by investigating the reaction of short sellers on both repurchase announcements and actual repurchases; using a longer sample period from 2004 up until 2020; and using short interest as proxy for overvaluation. This thesis is also one of the first to investigate whether managers' motives for share repurchase announcements changed during the Covid-19 pandemic in 2020. Using data for 2020 offers the opportunity to investigate short sellers' reaction on announcements made during the year that was heavily affected by Covid-19. I find that the change in short interest after a repurchase announcement is positive and almost three times larger during 2020 compared to the other years in the sample. I interpret this as evidence that managers, amidst the uncertainty caused by the pandemic, were even more motivated to support their share price using share repurchase announcements. This study also adds by using monthly data versus quarterly data as used by Liu and Swanson (2016) and Bargeron and Bonaime (2020), this allows a more accurate measurement of the change in short interest right after a repurchase announcement.

The remainder of this study is structured as follows: Section 2 elaborates on existing literature and develops hypotheses, Section 3 presents the data, Section 4 presents and explains the used research method, Section 5 presents and discusses found empirical results, and finally, Section 6 concludes this thesis and discusses certain limitations.

2. Literature and hypotheses development

This section elaborates on existing literature on share repurchase announcements, actual share repurchases, and prior research that uses short interest data to determine managers' motivation. Section 2.1 presents literature on repurchase announcements and actual repurchases and develops hypotheses 1 and 2. Section 2.2 develops hypothesis 3 concerning actual repurchases. Section 2.3 presents additional literature concerning uncertainty and repurchase behavior and develops hypothesis 4 on the effect of the Covid-19 pandemic on the motives to announce repurchase announcements during 2020.

2.1   Repurchase announcements

What it is that drives managers to repurchase their shares has been studied extensively and with mixed findings. Brav et al. (2005) find that managers state undervaluation of their company's stock as the most prominent reason to repurchase. Around 80 percent of the managers questioned in the survey mention undervaluation as reason to buy back their shares. If undervaluation is the reason why managers repurchase their shares, one would expect the stock market to adjust once the announcement is made public. The idea that repurchases announcements signal managers' inside information is known as the signaling hypothesis (Vermaelen, 1981).

Contrary to what one would expect based on the signaling hypothesis, markets have been found to underreact to the potential positive signal given by a repurchase announcement. Ikenberry, Lakonishok and Vermaelen (1995) are among the first to document initial underreaction to open market repurchase announcements. Over the ten-year period between 1980 and 1990, they find significant four-year buy-and-hold abnormal returns of 12.1% after a share repurchase announcement. These abnormal returns indicate initial underreaction by the market. They find this effect to be stronger for firms that have a higher possibility to be undervalued. Chance of being undervalued is proxied for by the book-to-market (BTM) ratio. Firms with a high BTM ratio have a book value that is relatively high compared to their market value, these companies are more likely to be undervalued compared to firms of which the market value is already relatively high to their book value (low BTM ratio).

Initial underreaction to repurchase announcements is also found by Payer and Vermaelen (2009) for the period from 1991 up until 2001. They document that the underreaction to repurchase announcements persists after the publication of Ikenberry et al. (1995). A more recent 2016 study, however, finds that the underreaction anomaly disappears after 2010. The authors attribute this to improved market efficiency (Fu & Huang, 2016). This implies that markets incorporate the information that is released by repurchase announcements directly after 2010.

While undervaluation has long been documented as the main reason for share repurchases, recent research started questioning whether undervaluation is indeed the main driver of repurchase announcements. The undervaluation argument has received critical media attention as well. One of the arguments that managers' compensation packages are for a large part based on stock performance, which gives them the incentive to boost their shares performance. A second argument is the number and size of repurchase announcements that are positively related to the performance of the economy. Firms tend to repurchase more during periods of economic growth than they do in periods of economic downturn, contrary to what the undervaluation motive would suggest (Lazonick, 2014).

Lazonick (2014) argues in Profits Without Prosperity that when 54% of corporate America's profits are being used to repurchase shares rather than to raise wages or investing in future growth; repurchases are mere short-term profits that undermine long term growth and income equality. The motive to boost share prices via repurchase announcements and actual repurchases is known as the price support motive. Chan, Ikenberry, Lee and Wang (2010) provide evidence that some managers use repurchase announcements as a cheap way of boosting their companies' share price in the short run, without buying the shares after the announcement. The price support motive implies that managers are supporting their share price through repurchase announcements and repurchases even though their share is not actually undervalued.

One group of market participant whose profit depends on identifying overvalued companies are short sellers. Short sellers are generally viewed as very well-informed and sophisticated investors as the costs of short selling are relatively high (Diamond & Verrecchia, 1987). This study will therefore use short interest as a proxy for overvaluation. If short sellers have high interest in a certain company, they believe the share price to be too high to its real value, in other words: the share is overvalued.

Short selling and share repurchases have very opposing effects on share prices. On the one hand short selling increases the supply of a share and might reveal negative information, in turn putting downward pressure on the share price. On the other hand, repurchases decrease supply of a share and might reveal positive information, boosting share prices. The dynamic between repurchases and short interest is investigated by Liu and Swanson (2016), who use short interest as a proxy for overvaluation. They argue that when a firm increases repurchases in the same quarter as short interest in the company increases, the repurchases are motivated by supporting the share price against downward price pressure. They document a positive relation between quarterly change in short interest and quarterly change in actual repurchases. They argue that managers repurchase their own overvalued stock out of price support motives.

Bargeron and Bonaime (2020) also investigate moments where companies actively disagree with short sellers by repurchasing their stock while short interest grows. They investigate which of the two parties has better information when these disagreeing trades happen. The authors find that firms have favorable information when repurchasing shares while short interest grows. This information is often released sometime after the repurchase. Therefore, they argue that repurchasing against short sellers is not likely motivated by price support, rather it is motivated by positive private information. Repurchasing shares out of positive private information is consistent with the undervaluation motive.

The studies discussed above do not agree on the motive for firms to engage in share repurchases. If a firm announces a share repurchase program, it provides the market with new information. Short sellers above all other market participants have the incentive to distinguish between repurchase announcements motivated by undervaluation due to favorable private information and those motivated by supporting overvalued shares. If repurchases are announced because the firm is currently undervalued, to prevent losses, short sellers do best to unwind their short positions as the market incorporates this favorable information leading to price increases. Short sellers hold interest in a certain company when they think it is overvalued. When a repurchase announcement is made to support an overvalued share of a company short sellers hold interest in, short sellers have no incentive to unwind their position as the share will stay overvalued.

Using monthly change in short interest and monthly repurchase announcements I try to find evidence in favor of either the undervaluation or the price support motive. I hypothesize that short sellers have the incentive to know the motivation behind repurchase announcements and will decrease their short positions if undervaluation drives repurchase announcements. If price support motivates share repurchases, they will keep or increase their short positions. Due to the mixed findings in previous academic research, I have no expectations on whether the change in short interest will decrease or increase but expect a significant reaction in one of the two directions. Therefore, I form the following hypothesis:

H1: Share repurchase announcements are followed by a significant change in short interest in the announcing company.

I propose that short interest will decrease after a repurchase announcement if it is motivated by undervaluation. A company with a high BTM ratio is more likely to be undervalued as the market value is relatively low compared to the book value. Like Ikenberry, Lakonishok and Vermaelen (1995), I use the BTM ratio to proxy for the chance of undervaluation. In line with the reasoning behind hypothesis 1; I propose that if undervaluation drives repurchase announcements, the change in short interest will

be negative. As a high BTM indicates a higher chance of being undervalued I form the following hypothesis:

H2: The change in short interest is significantly lower after share repurchase announcements that are more likely to be associated with undervaluation, proxied for by a high Book-to-Market ratio.

2.2 Actual repurchases

Hypotheses one and two concern repurchase announcements. However, managers are under no obligation to buy shares under an announced program. Therefore, there could be a difference in the reaction on repurchase announcements and actual repurchase. If markets incorporate the information revealed with repurchase announcements efficiently as suggested by Fu et al. (2016) and short sellers adjust their position to the motive behind the repurchase, the actual repurchases made later would have no extra informational value for short sellers about the valuation of the company. The dataset used for this study has data on actual monthly repurchases. This allows for tests using real repurchase data, instead of only repurchase announcement data. I propose that short sellers incorporate the information about the motive for the repurchase announcement directly. Consequently, actual repurchases will not reveal more information and no reaction on short interest is expected. Therefore, the following hypothesis is stated:

H3: There will be no significant effect of actual repurchases on short interest.

If a significant effect is found, this could indicate that short sellers misjudged the motive behind the repurchase announcement. Another reason could be that repurchase announcements, due to their flexibility, lack credibility for short sellers to fully incorporate the information revealed.

2.3 Managers' motivation during Covid-19

The rise of the Covid-19 pandemic at the start of 2020 led to enormous uncertainty on the financial markets. Uncertainty peaked in March 2020 when U.S. stock markets fell almost 10 percent on March 12th, the biggest crash since 1987 according to the Financial Times (Samson et al., 2020). This period of large uncertainty offers an interesting setting to test managers' motives for making repurchase announcements.

Companies' payout policy is heavily dependent on future incomes. Therefore, uncertainty about future incomes should show a reaction on payout. As share repurchases are viewed as the more flexible part of payout, a direct reaction should be observed between uncertainty and repurchase activity (Pirgaip & Dinçergök, 2019). Indeed, the repurchase data shows a large drop in share repurchase announcements in 2020; many firms chose to suspend their repurchase programs. Consequently, 2020

had only 377 repurchase announcements, the lowest of any year in the sample. For example, in 2018 and 2019 a total of respectively 727 and 605 repurchase announcements were made. Next to the drop in share repurchase announcements, firms cut dividends five times more often in 2020 than they did during the Great Financial Crisis from 2007 to 2008 (Krieger, Mauck, & Pruitt, 2021). Both the data for repurchase announcements and the evidence found by Krieger et al. (2021) show that most managers chose to lower or suspend payouts and keep cash in their companies' balances.

Keeping cash in the company's balance during the uncertainty surrounding the Covid-19 pandemic proved to be a wise decision. Zheng (2020) finds that firms with higher cash holdings prior, and during the Covid-19 pandemic, performed significantly better in terms of investments, operating performance, financing, and payout compared to firms with lower cash holdings. Therefore, it is interesting to test what motivated managers that allocated cash to payouts and chose to announce repurchase programs during the Covid-19 pandemic. This thesis is one of the first to investigate the motives of managers that announced repurchase programs during the uncertainty caused by the Covid-19 pandemic in 2020, and how they might differ from motives in other years.

Few papers tested managers' motives for repurchase announcements during other periods of great financial uncertainty and falling prices. Walkup (2016) argues that falling share prices might make managers optimistic and motivate them to repurchase their share as they believe it to be undervalued. Chen, Harper and Iyer (2018) examine share repurchase announcements made during the Great Financial Crisis of 2007 to 2008. They find that the number of repurchase announcements drops significantly during the crisis. The authors construct a mispricing measure that estimates market value of equity to the intrinsic value of equity. They find a positive relation between the mispricing measure and repurchase announcements made during their sample period. This shows that firms which are overvalued prior to the crisis were more likely to announce share repurchases during the Great Financial Crisis. Therefore, it seems that optimistic managers who think their share is undervalued are mistaken, they are supporting their share price.

Uncertainty about future incomes should show a reaction on payout policy and therefore on repurchases. Prudent managers keep cash in their company's balance during the uncertainty caused by Covid-19, as Zheng (2020) finds this results in better company performance. They would therefore suspend rather than announce repurchase programs. Also, based on the result found by Chen, Harper and Iyer (2018), I expect managers of overvalued companies to be more inclined to support their share during the uncertainty and fall in share prices in 2020. Therefore, I propose that repurchase announcements made during the Covid-19 period will be, on average, associated with short sighted price support rather than with undervaluation. I hypothesize that short sellers have the incentive to

know the motive behind share repurchase announcements and will keep or increase their short position in the announcing company if price support motivates the repurchase announcement. Thus, I expect a positive relation between repurchase announcements made in 2020 and the change in short interest, and state the following hypothesis for the Covid-19 period:

H4: Share repurchase announcements during the Covid-19 period in 2020 are followed by a significant positive change in short interest in the announcing company.

3. Data

This thesis uses data from the CRSP and Compustat databases as well as a manually gathered dataset containing repurchase data over a period of 17 years, from 2004 to 2020. I obtain stock data from CRSP, this data includes daily shares outstanding, daily closing prices and daily traded volume for U.S. companies with ordinary shares (CRSP share codes 10 and 11). From this daily data, monthly average closing price, the highest and lowest monthly closing price, shares outstanding on the last day of the month and average monthly trading volume are calculated. Then I calculate monthly market capitalization by multiplying average closing price with shares outstanding.

Fundamental company data is obtained from the Compustat database. I obtain quarterly data on total assets, net income, common equity (book value), shares outstanding, debt in current liabilities as well as long-term total debt and data on cash and short-term assets. I use Compustat quarterly shares outstanding to fill months where CRSP shares outstanding are missing.

Data on monthly short interest is gathered from Compustat's supplementary short interest file for North America. The short interest file reports short interest on the last day of the month. As the data from Compustat reports short interest on the 15th and the last day of the month from 2007 onwards, I calculate the average of both days to obtain average short interest per month.

Data on monthly repurchase announcements and actual repurchases are owned by my supervisor A. Li. These data are obtained by downloading all relevant 10K and 10Q statements from the SEC EDGAR database. A Phyton program is used to extract the relevant repurchase information. Among others, the sample contains data on the number of shares that fall under the repurchase announcement, the number of shares repurchased during a month and the average price at which the shares are obtained. I create a dummy variable that equals one if a firm announces a repurchase program during that month. If the announcement is made before or on the 15th of the month, that month is set as announcement month. If the announcement is made on the 16th or later, the next month is set to be the announcement month.

The complete dataset has 793,424 observations, each representing a firm-month. 12,284 of those months are repurchase months. To obtain the final dataset, observations that have missing share, short interest, or fundamental company data, are dropped. This excludes 51,407 observations. I also exclude observations with short interest ratios above one. This excludes 771 firm-months of which 10 are repurchase months. In total 52,178 observations are dropped. The final dataset has 741,246 firm-months of which 11,634 are months in which a repurchase announcement is made.

4. Methodology

4.1 Repurchase announcements

I use regression analysis to study changes in monthly short interest following repurchase announcements. I test how short sellers identify the motive behind repurchase announcements and whether repurchase announcements have a significant effect on the change in short interest. I calculate the monthly change in short interest as dependent variable. The dummy variable for repurchase announcements is the main independent variable of interest. Using change in short interest rather than the absolute level controls for firm specific factors that stay the same over two consecutive months, without having to identify those. The full regression model depicted below incorporate several control variables, like the ones used by Liu and Swanson (2016).

$$
\begin{aligned}
\Delta ShortInterest_{i,t} \\
= \alpha &+ \beta_1 RepAnnouncement_{i,t-1} + \beta_2 BTM_{i,t} + \beta_3 Return_{i,t-1} \\
&+ \beta_4 Income_{i,t} + \beta_5 Cash_{i,t} + \beta_6 Debt_{i,t} + \beta_7 Size_{i,t} + \beta_8 Liquidity_{i,t} \\
&+ \beta_9 MarketReturn_{i,t} + \sum \beta_n YearMonth_n + \varepsilon_{i,t}
\end{aligned}
\tag{1}
$$

The dependent variable $\Delta ShortIntrest_{i,t}$ measures the change in short interest from month *t-1* to month *t*. Short interest is measured as the number of shares of a company sold short divided by its total shares outstanding. $\Delta ShortIntrest_{i,t}$ thus captures the change in the percentage of shorted stocks to a company's shares outstanding. When short sellers can identify under- and overvalued stocks, change in short interest can proxy for whether they view a repurchase announcement confirmation of overvaluation or undervaluation. A positive $\Delta ShortIntrest_{i,t}$ indicates that short interest has increased from month *t-1* to month *t* and implies that short sellers expect the stock price to go down in the future. This would suggest that the repurchase announcement is motivated by price support. A negative $\Delta ShortIntrest_{i,t}$ would suggest the opposite and indicates that undervaluation motivated the repurchase announcement.

The independent variable of interest in the regression model is $RepAnnouncement_{i,t-1}$ that will equal one if there was a repurchase announcement in the previous month. If announcements are judged to be signals for undervaluation on average, the coefficient β_1 will be negative as the undervaluation information will make short sellers unwind their short positions. If short sellers identify that repurchase announcements are motivated by price support, I state they are likely to keep or increase their short positions, resulting in a nonnegative β_1.

The other variables in the model are added to control for firm specific characteristics and the overall market. $BTM_{i,t}$ measures a company's book-to-market ratio and equals the ratio of book value of equity divided by its market value. $BTM_{i,t}$ is added to the regression as firms with high BTM ratios have a higher chance of being undervalued. Therefore, BTM ratio might explain some change in short interest.

$Return_{i,t-1}$ measures the raw return of company i at time is *t-1*. Returns might indicate company performance and expected future performance and can therefore influence short sellers' decisions. Companies with high returns in *t-1* might experience a drop in short interest in the following month if the performance is thought to persist. $MarketReturn_{i,t}$ is measured as the return on a value weighted U.S. portfolio and controls for market sentiment. $Income_{i,t}$ captures the firms quarterly operating income before depreciation and is deflated by total assets.

$Cash_{i,t}$ measures quarterly cash and short-term assets divided by total assets. $Debt_{i,t}$ is measured as short-term liabilities and long-term debt divided by total assets. $Size_{i,t}$ equals the natural logarithm of a company's market capitalisation. $Liquidity_{i,t}$ is measured as the number of stocks traded in a month divided by total shares outstanding. Control variables for size and liquidity are added to the regression as larger companies and more liquid stocks are likely easier and less costly to short. Finally, $YearMonth_n$ fixed effects are calculated to control for time variation in the change in short interest. An overview of all variables and definitions including database and database codes can be found in Appendix A: Table A1.

4.2   Book-to-Market Ratio

Academic literature has found that book-to-market (BTM) ratio can serve as a proxy for the possibility of under- or overvaluation. Firms with a high book-to-market ratio are more likely to be undervalued versus companies with a low book-to-market ratio. Therefore, a difference can be expected in the reaction to repurchase announcements by short sellers between these groups.

To test whether short sellers interpret the information released via a repurchase announcement differently for firms with a high BTM ratio, I divide the sample into four quartiles based on BTM ratio. The BTM ratios range from -0.99 in the lowest percentile to 3.87 in the highest percentile. I run regression Model 1 for each quartile separately.

In line with hypothesis two, I expect to find a less positive or more negative coefficient for β_1 in the higher quartiles. This would suggest that short sellers identify the announcements of firms with a higher chance of being undervalued more with undervaluation than for firms with a lower chance of being undervalued.

4.3 Actual Repurchases

To estimate the effect of actual repurchases on short interest I test the following model:

$$
\begin{aligned}
\Delta ShortInterest_{i,t} \\
= \alpha + \beta_1 \Delta ActualRepurchase_{i,t} + \beta_2 \Delta ActualRepurchase_{i,t-1} \\
+ \beta_3 BTM_{i,t} + \beta_4 Return_{i,t-1} + \beta_5 Income_{i,t} + \beta_6 Cash_{i,t} + \beta_7 Debt_{i,t} \\
+ \beta_8 Size_{i,t} + \beta_9 Liquidity_{i,t} + \beta_{10} MarketReturn_{i,t} \\
+ \sum \beta_n YearMonth_n + \varepsilon_{i,t}
\end{aligned}
\tag{2}
$$

In this regression model, $\Delta ActualRepurchase_{i,t}$ is the change in the variable *ActualRepurchase* from time *t-1* to time *t*. Actual repurchases are calculated as the ratio of the actual number of shares repurchased to total shares outstanding for company *i* at time *t*. As Liu and Swanson (2016) find that the first lag of the change in actual repurchases plays a significant role in explaining short interest due to anticipation of monthly repurchases for instance, this is also added to the model.

I propose that when markets are efficient and repurchase announcements are credible, there would be no more information conveyed by actual repurchases. When short sellers incorporate the motivation for a repurchase announcement in their positions directly, they will not need to adjust them once actual repurchases are made. Therefore, I expect the coefficient of $\Delta ActualRepurchase_{i,t}$ to be insignificant. If β_1 is significant, this means that the actual repurchase brings new information to the market, in that case I expect the sign of β_1 to be in the same direction as the coefficient of $RepAnnouncement_{i,t-1}$ in Model 1. When short sellers decide to hold their position after a repurchase announcement, the actual repurchase of the announced shares should not change that assessment. Control variables are identical to those in the announcement regression.

5. Empirical results

5.1 Descriptive statistics

The final sample covers 8,026 firms over the period from 2004 to 2020. In total the dataset consists of 741,246 firm-months of which 11,634 are firm-months in which a repurchase announcement was made (1.57%). Table 1 presents descriptive statistics for the final sample of dependent and independent variables. Looking at the total number of repurchase announcements made per firm, it shows that the average firm makes about 1.5 repurchase announcement over the sample period. However, the median firm does not repurchase shares (the median is 0). This results in large differences in the higher percentiles of the distribution: the firm with most repurchase announcement over the sample period has 25 repurchase announcements (not tabulated). The number of announcements at the 90th, 95th and 99th percentile is 5, 7 and 12 respectively (not tabulated).

The mean for $ShortInterest_t$ is 4.53% over the sample period (with a median of 2.3%). The monthly change, $\Delta ShortInterest_t$ has a mean of 0.01 percent and a median of 0 percent. These are small as the percentage of shares sold short is relatively stable over consecutive months for many companies. However, the changes in the 10th and 90th percentile are large with -0.7 and 0.8 percent, respectively.

The mean of $ActualRepurchase_t$ (0.19 percent of share outstanding) indicates that around 0.19% of shares outstanding are repurchased in an average month. However, most months do not have repurchases, hence the median is zero. Only looking at the months in which repurchases take place, the mean increases to 0.9% (not tabulated). This means that an average repurchase consists of almost one percent of a firms shares outstanding. The mean of $\Delta ActualRepurchase_t$ is -0.0000178, the number is low as most quarters tend to have a zero change. Moreover, increases in monthly repurchases are often followed by a decrease, resulting in a near zero mean. The change at the 10th and 90th percentile is more sizable and with -0.00017 and 0.00014, respectively, almost ten times the magnitude of the mean monthly change.

BTM_t has a mean of 0.61 and a median of 0.49, meaning that the book value of the average (median) company is about 60% (50%) of market value. Monthly $Return_t$ is mostly positive over the sample with a mean of 1.2%. The median, however, is around 0.3%, indicating that returns are skewed to the right with large positive returns pulling the mean up. Both the 10th and 90th percentile returns are of similar size with -12.6 and 12.5%. $MarketReturn_t$ is positive with a mean of 0.8 percent and a median of 1.2%.

Table 1: descriptive statistics. The table shows descriptive statistics of both the dependent as independent variables used in the regression models. Variables with * are multiplied by 100 to enhance readability. Rep. Announcement shows the distribution for the total number of repurchase announcements (RepAnnouncement=1) per firm code over the full sample period. $ShortInterest_t$ is the fraction of shares currently sold short to total shares outstanding. $\Delta ShortInterest_t$ is the change in ShortInterest from month t-1 to month t. $ActualRepurchase_t$ is the ratio of shares repurchased in month to total shares outstanding in month t. $\Delta ActualRepurchase_t$ is the change in $ActualRepurchase_t$ form month t-1 to month t. BTM_t is the ratio of book value of equity divided by market value. $Return_t$ is a company's raw return from month t-1 to month t. $Income_t$ is the ratio of a firm's quarterly income to total assets. $Cash_t$ is the ratio of a firm's quarterly cash and short-term assets to total assets. $Debt_t$ is the ratio of a firms quarterly short- and long-term debt to its total assets $Size_t$ is the natural logarithm of a firm's market capitalization. $Liquidity_t$ is the ratio of monthly traded shares to total shares outstanding in a company. $MarketReturn_t$ is the raw returns on a U.S. value-weighted portfolio from month t-1 to month t.

	Obs.	Mean	P10	Q1	Median	Q3	P90
Rep. Announcement	8,026	1.4495	0	0	0	2	5
ShortInterest$_t$	741,246	0.0453	0.0005	0.0053	0.0230	0.0579	0.1151
ΔShortInterest$_t$*	741,200	0.0137	-0.7232	-0.1953	-.00026	0.2042	0.8015
ActualRepurchase$_t$	741,246	0.0019	0	0	0	0	0.0019
ΔActualRepurchase$_t$*	741,200	-0.0018	-0.0174	0	0	0	0.0144
BTM$_t$	741,246	0.6105	0.1083	0.2587	0.4935	0.8171	1.2517
Return$_{t-1}$	741,246	0.0116	-0.1259	-0.0515	0.0030	0.0553	0.1246
Income$_t$	741,246	0.0045	-0.0523	0.0034	0.0191	0.0369	0.0558
Cash$_t$	741,246	0.2018	0.0130	0.0335	0.0985	0.2798	0.5827
Debt$_t$	741,246	0.2271	0	0.0288	0.1600	0.3344	0.5168
Size$_t$	741,246	20.029	17.376	18.510	19.958	21.429	22.792
Liquidity$_t$	741,246	0.1928	0.0182	0.0501	0.1161	0.2171	0.3780
MarketReturn$_t$	741,246	0.0080	-0.0429	-0.0147	0.0122	0.0327	0.0537

5.2   Repurchase announcement effect

Table 2 presents the results for three variations of Model 1, used to explain monthly change in short interest. The first version only uses $RepAnnouncement_{t-1}$ as independent variable and firm-fixed effects. The second version incorporates all control variables except the $YearMonth_n$ variable. The third column shows the results of running the full regression and therefore includes all control variables and both firm-fixed as well as time-fixed effects.

The coefficient of the primary variable of interest, $RepAnnouncement_{t-1}$ is very similar among all three variations. The coefficient is positive with a value of 0.000624 in column 1 and increases to 0.000634 when all control variables are added (column 3). $RepAnnouncement_{t-1}$ is significant at the 1% level in all three variations. The positive value suggests that, on average, short sellers increase their short positions slightly in the month following a repurchase announcement versus a month that is not following an announcement month, all other things equal.

The coefficient of 0.000634 means that the change in short interest is 0.000634 higher in the month following a repurchase announcement. As change in short interest is the change in the percentage of shares outstanding that is currently sold short, a coefficient of 0.000634 means that short interest increases 0.0634 percentage point in the month after a repurchase announcement, all other things equal. This change seems small but has high economic significance as the mean change in short interest is 0.000137. A change of 0.000634 is around 4.5 times the mean of change in short interest. This means that, all other things equal, change in short interest increases four-and-a-half times compared to an average month if the month is preceded by an announcement month. This result provides evidence in favor of the price support motive for share repurchases. If short sellers increase their position following repurchase announcements, they are not interpreting the announcement as information that the share is undervalued. A positive coefficient is in line with research supporting the price support motivation.

An unexpected sign is taken by the coefficient of the book-to-market ratio (BTM_t). The coefficient is positive whereas a negative coefficient would indicate that firms with higher a BTM ratio face a lower change in short interest. However, the coefficient of BTM_t is statistically insignificant so it provides no further insight in the effect of book-to-market ratio on changes in short interest. Section 5.3 further investigates the effect of the BTM ratio on changes is short interest.

The coefficient of $Return_1$ is significant at the 5% level and takes on the expected negative sign. This indicates that strong returns in month t-1 have a negative effect on the change in short interest in from month t-1 to month t. This could be because short sellers believe the strong price performance of a company's stock is going to persist and therefore want to lower their positions.

Other significant coefficients in this regression model are those for $Income_t$, $Cash_t$, $Size_t$, $Liquidity_t$, and $MarketReturn_t$. Both the coefficients of $Income_t$, and $Cash_t$, take on a positive sign and are statistically significant at the 5% level. This implies that firms with more cash and operating income, relative to their total assets, see a more positive change in short interest versus firms with low cash and operating income on average. Large cash holdings could give rise to agency problems which short sellers believe to hindering performance. This might explain the positive coefficient.

$Size_t$ is found to have a negative effect on the change in monthly short interest and is statistically significant at the 1% level. While one might expect size to have an effect of similar sign with liquidity, its economic significance is that this negative coefficient might indicate that the price performance of large companies is more constant. This makes these companies less attractive to short as large downward swings in price are less likely. Also short interest in larger companies is likely more constant over time. This would explain the negative sign for the coefficient of the $Size_t$. $Liquidity_t$ takes on the expected positive sign and is statistically significant at the 1% level. This result is economically relevant as more liquid shares are likely less difficult and costly to borrow for a short sale.

The coefficient for the variable for $MarketReturn_t$ is significant at the 1% level and negative. It is larger in magnitude than all other coefficients in the model. This result has economic significance as well. If the market is performing very well this will have a negative effect on changes in short interest, lowering short interest overall. A one percent higher market return leads to a decrease in the change in short interest of 3.8 percent.

Based on the results presented in the section above, the first hypothesis can be accepted: there is a significant effect of repurchase announcements on the change in short interest. The effect found is positive and therefore provides evidence for the price support argument of repurchase announcements.

Table 2: relation between changes in Short Interest (dependent variable) and lagged repurchase announcements. Three variations of Model 1 are presented. Column (1) only includes lagged RepAnnouncement as independent variable and controls for firm-fixed effects. Column (2) includes all control variables except the YearMonth variable. Column (3) shows the coefficients of running the full regression model, including YearMonth fixed effects. Variable descriptions can be found in Section 4 and Table A1. The t-statistics are in parenthesis. ***, ** and * indicate two tailed statistical significance at 1%, 5% and 10% levels, respectively.

	$\Delta ShortInterest_t$		
	(1)	(2)	(3)
$RepAnnouncement_{t-1}$	0.000624***	0.000635***	0.000634***
	(4.15)	(4.24)	(4.27)
BTM_t		0.000014	0.000026
		(0.50)	(0.97)
$Return_{t-1}$		-0.000516**	-0.000565**
		(-2.21)	(-2.22)
$Income_t$		0.000647***	0.000596***
		(2.87)	(2.89)
$Cash_t$		0.000806***	0.000577***
		(4.15)	(2.97)
$Debt_t$		0.000002	0.000004
		(0.92)	(1.61)
$Size_t$		0.000004	-0.000176***
		(0.10)	(-4.03)
$Liquidity_t$		0.001872***	0.001903***
		(7.10)	(7.08)
$MarketReturn_t$		-0.001621***	-0.038207***
		(-3.99)	(-5.55)
$Constant$	0.000150***	-0.000441	0.003836***
	(62.92)	(-0.58)	(4.24)
Observations	730,717	730,717	730,717
R-squared	0.000031	0.006322	0.025455
Company FE	YES	YES	YES
Time FE	NO	NO	YES

5.3   Book-to-Market Ratio

To test whether there is a difference in the perception of repurchase announcements between firms with low and high book-to-market ratios, I divided the sample in quartiles based on book-to-market ratio. The results for the regression analysis for each of the quartiles is presented in Table 3.

The results are very different among quartiles. The $RepAnnouncement_{t-1}$ coefficient is positive among all quartiles but only has statistical significance for the second, third and fourth quartile of the distribution. Firms that are in the second quartile of the BTM distribution see an increase in the change in short interest from month *t-1* to month *t* of 0.000788 following a repurchase announcement in month *t-1*, all other things equal. The coefficient drops to 0.000682 in the fourth quartile. This is consistent with short sellers, on average, identifying repurchase announcements made by firms that fall in the highest quartile of the BTM distribution more often with undervaluation.

Different from the results presented in Section 5.2 are the coefficients for BTM_t. Splitting the sample in quartiles makes the coefficient negative and statistically significant for the 2nd and 3rd quartile, while Table 2 presents positive and insignificant coefficients for the BTM_t variable. This result provides further evidence for the importance of book-to-market ratios in determining possible undervaluation. The negative coefficients in the regression model for the second and third quartile indicate that a higher BTM ratio has a negative effect on the change in short interest: a high book-to-market ratio is more likely to be associated with undervaluation and short sellers identify this.

The results from splitting the sample based on BTM ratio provide evidence in favor of the second hypothesis. Although the coefficient for $RepAnnouncement_{t-1}$ is still positive, it is lower for announcements made by firms that are in the upper half of the book-to-market distribution. Furthermore, the BTM_t coefficient is found to be significant and negative for the middle half of the distribution. In these quartiles, a higher BTM ratio has a negative effect on the change in short interest from month *t-1* to month *t*. Both results imply that the change in short interest is lower after a repurchase announcement that is more likely to be motivated by undervaluation, as proxied for by the BTM ratio. I therefore accept the second hypothesis.

Table 3: relation between changes in Short Interest (dependent variable) and lagged repurchase announcements split for each quartile of the book-to-market ratio distribution. Variable descriptions can be found in Section 4 and Table A1. The t-statistics are in parenthesis. ***, ** and * indicate two tailed statistical significance at 1%, 5% and 10% levels, respectively.

	$\Delta ShortInterest_t$			
	1st Quartile	2nd Quartile	3rd Quartile	4th Quartile
$RepAnnouncement_{t-1}$	0.000477	0.000788***	0.000759***	0.000682**
	(1.42)	(2.96)	(3.36)	(2.19)
BTM_t	0.000016	-0.002005***	-0.000972**	0.000055
	(0.45)	(-2.88)	(-2.53)	(0.61)
$Return_{t-1}$	-0.000266	-0.002024***	-0.000602**	-0.001506**
	(-1.52)	(-3.37)	(-2.05)	(-2.40)
$Income_t$	0.000353*	0.005194***	0.002741**	-0.000233
	(1.82)	(3.36)	(2.07)	(-0.15)
$Cash_t$	0.001890***	-0.000020	-0.000365	-0.001441***
	(4.44)	(-0.03)	(-0.81)	(-2.60)
$Debt_t$	-0.000001	0.000250	-0.000069	0.000172
	(-0.63)	(0.47)	(-0.14)	(0.27)
$Size_t$	-0.000266**	-0.000325***	-0.000488***	-0.000468***
	(-2.54)	(-2.93)	(-4.58)	(-3.49)
$Liquidity_t$	0.002021***	0.002795***	0.002066***	0.001451***
	(3.24)	(7.08)	(3.46)	(4.72)
$MarketReturn_t$	-0.064633***	-0.025154*	-0.002294	-0.015934
	(-3.79)	(-1.90)	(-0.18)	(-1.22)
Constant	0.004976**	0.007431***	0.010347***	0.009968***
	(2.24)	(3.10)	(4.68)	(3.67)
Observations	182,081	182,442	182,826	183,368
R-squared	0.021150	0.035358	0.036879	0.026185
Company FE	YES	YES	YES	YES
Time FE	YES	YES	YES	YES

5.4 Actual repurchases

The results thus far concerned the effects of repurchase announcements on the change in short interest. Short sellers are found to increase their short positions following repurchase announcements, indicating that they believe that repurchases are motivated by price support. If repurchase announcements are credible announcements that reveal information, and short sellers incorporate this information directly, actual repurchases would not convey extra information and should therefore not influence prices or short interest in a company's stock.

Table 4 shows the results of the running regression Model 2. In this model, monthly change in actual repurchases is used as independent variable to estimate whether actual repurchases do influence change in monthly short interest. The coefficients for the variables of interest, $\Delta ActualRepurchase_t$ and its first lag, are positive and statistically significant at the 5% level. Comparing the coefficient with the coefficient from the regression on repurchase announcements in Table 2 (column 3) makes clear that the effect of the change in actual repurchases is several times smaller than the effect from repurchase announcements (0.000189 versus 0.000634, respectively). However, the effect of the change in actual repurchases is significantly different from zero, indicating that actual repurchases do reveal extra information to short sellers. Another explanation for the positive coefficient is that short sellers initially underreact to repurchase announcements. Underreaction could be motivated by the belief that firms only use the repurchase announcement to boost share price but never actually intend to make the repurchases, which is consistent with price support. The significant coefficient of the change in actual repurchases in month *t-1* indicates that short sellers consider whether the change from month *t-1* to month *t* was preceded by an increase or decrease in repurchases from month *t-2* to month *t-1*. The coefficients of the control variables take on the same sign and are of similar size as found by running the full model on repurchase announcements in Table 2.

Based on the found results, I reject the third hypothesis. The effect of actual repurchases on short interest is found to be positive and significant. Actual repurchases do reveal extra information to short sellers, or they have initially underreacted to the announcement. As expected, the reaction is in the same direction as the effect from repurchase announcements.

| | $\Delta ShortInterest_t$ |
	(1)
$\Delta ActualRepurchase_t$	0.000189**
	(2.24)
$\Delta ActualRepurchase_{t-1}$	0.000147**
	(2.28)
BTM_t	0.000026
	(0.97)
$Return_{t-1}$	-0.000571**
	(-2.21)
$Income_t$	0.000598***
	(2.90)
$Cash_t$	0.000580***
	(2.98)
$Debt_t$	0.000004
	(1.61)
$Size_t$	-0.000174***
	(-3.97)
$Liquidity_t$	0.001903***
	(7.08)
$MarketReturn_t$	-0.038003***
	(-5.52)
Constant	0.003790***
	(4.19)
Observations	730,671
R-squared	0.025435
Company FE	YES
Time FE	YES

5.5   Announcements during Covid-19

Previous results concern the full sample period from 2004 up until 2020. The used dataset allows for the comparison between the year 2020 and prior years. In 2020, the financial markets were heavily impacted by the rise of the Covid-19 pandemic and all the uncertainty surrounding the virus. Due to the uncertainty, many companies announced to suspend repurchase programs and temporarily stop buying back their own shares. Though repurchase announcements reached their lowest point in 2020 compared to the other years in the sample period, 377 announcements were made. Most repurchase programs were announced just before the crash in March 2020 or in the second half of the year.

Table 5 presents the results from running regression Model 1 on the period from 2004 to 2019 and for 2020 separately. Running the regression for the year 2020 allows for testing the motives of manages during the Covid-19 pandemic. Results for the years from 2004 to 2019 are very similar to the results found in Section 5.2. However, the results for 2020 on its own differ substantially. Most results are in line with expectations based on the reasoning of hypothesis 4.

The main variable of interest: $RepAnnouncement_{t-1}$, remains statistically significant at the 1% level and has a positive sign in the 2020 regression. The effect of repurchase announcements made in 2020 is positive and significant with a coefficient of 0.001792. The effect in 2020 is almost three times the size of the effect in the 2004-2019 period. The result is economically significant as it shows that short sellers, on average, identified repurchase announcements made in 2020 with price support. The effect is stronger than for the other years. A larger coefficient is expected if short sellers believe that more managers are making repurchase announcements out of price support motives on average, and therefore short sellers increase their short positions.

Another meaningful result is that the coefficients of both $Return_{t-1}$ and $MarketReturn_t$ turn insignificant in 2020 versus the years from 2004 to 2019. This indicates that individual stock return as well as overall market performance becomes less important in explaining change in short interest in 2020. The coefficient for $Size_t$ is 45 times larger in 2020. It goes from -0.000141 to -0.006395 and stays statistically significant. It is likely that large companies were expected to steer trough the uncertainty caused by the Covid-19 pandemic better than smaller companies and short sellers therefore decreased their positions in larger companies. This could explain the difference in size between the coefficient for $Size_t$ in 2020 compared to 2004-2019. Also the difference in the constant, between the two time periods, changes meaningfully and is more than 40 times larger in 2020. The higher constant in the model for the year 2020 indicates that the overall average change in short interest is larger in 2020.

The positive coefficient of the repurchase announcement variable in 2020 provides evidence in favor of hypothesis four. The positive and larger coefficient of lagged repurchase announcement means that share repurchase announcements made in 2020 are met with a larger increase in the change of short interest versus announcements made from 2004 to 2019. Therefore, I accept hypothesis four which states that share repurchase announcements made during the Covid-19 period in 2020 are followed by a positive change in short interest. This provides evidence that repurchase announcements made during the Covid-19 pandemic in 2020 are, on average, motivated by price support rather than undervaluation.

Table 5: relation between changes in short interest (dependent variable) and lagged repurchase announcements. The results are split between the years 2004-2019 and 2020 separately. Variable descriptions can be found in Section 4 and Table A1. The t-statistics are in parenthesis. ***, ** and * indicate two tailed statistical significance at 1%, 5% and 10% levels, respectively.

	$\Delta ShortInterest_t$	
	Year 2004-2019	Year 2020
$RepAnnouncement_{t-1}$	0.000601***	0.001792***
	(3.96)	(3.29)
BTM_t	0.000020	0.000532
	(0.73)	(0.81)
$Return_{t-1}$	-0.000357*	-0.000967
	(-1.76)	(-1.14)
$Income_t$	0.000629***	-0.001934
	(2.94)	(-0.55)
$Cash_t$	0.000487**	0.006989***
	(2.40)	(3.05)
$Debt_t$	0.000005	-0.001688
	(1.63)	(-0.69)
$Size_t$	-0.000141***	-0.006395***
	(-3.22)	(-4.43)
$Liquidity_t$	0.002218***	0.001591***
	(4.68)	(6.54)
$MarketReturn_t$	-0.035966***	-0.000915
	(-4.35)	(-0.10)
Constant	0.003116***	0.129781***
	(3.45)	(4.38)
Observations	692,845	37,872
R-squared	0.026447	0.028277
Company FE	YES	YES
Time FE	YES	YES

6. Conclusion and discussion

This thesis adds to research on the motivation for share repurchase announcements. The main contribution of this thesis is the use of a long sample period from 2004 up until 2020. Therefore, including the Covid-19 period. Also, I use monthly instead of quarterly data. The following research question is stated: *Are repurchase announcements motivated by undervaluation or price-support arguments?* Data on short interest is used to proxy for overvaluation to assess managers' motivation for announcing share repurchases. I assume that short sellers can identify managers' motives for making a repurchase announcement. An increase in the monthly change in short interest provides evidence for price support, whereas a decrease in the change in short interest provides evidence for the undervaluation motive.

Using regression analysis to test the effect of a repurchase announcement on short interest as well as the effect of actual repurchases on short interest, I find the following: first, share repurchase announcements are followed by a significantly positive change in the change of short interest in the announcing company the month after the announcement. This result confirms hypothesis one. As the effect is positive, this shows that managers are motivated by price support. Second, founded on previous literature that uses BTM ratio as proxy for undervaluation, I test whether change in short interest is significantly lower for firms with a higher BTM ratio. The change in short interest after a repurchase announcement is less positive for the second half of the book-to-market ratio distribution. This suggests that repurchase announcements, made by managers of firms with a higher chance of being undervalued, are indeed more often motivated by undervaluation. Therefore, hypothesis 2 is accepted. Third, a regression using actual repurchase data is run to test whether short sellers incorporate the information content of repurchase announcement directly. I find that actual repurchases do have a significant effect on short interest. This rejects hypothesis three and means that actual repurchases do release new information to short sellers. This may be due to the lack of credibility of repurchase announcements and initial underreaction by short sellers. Fourth, I find that repurchase announcements are followed by a significant positive change in short interest during 2020. This is in line with hypothesis four and shows that managers tried to support their share price during the Covid-19 pandemic in 2020. This effect is three times larger compared to the effect of repurchase announcements in the 2004 to 2019 period. Thus, repurchase announcements made during the Covid-19 period are even more likely to be motivated by price support than announcements in normal times.

I am aware of the limitations of this thesis and will address some briefly while also making recommendations for future research. This thesis uses regression analysis to estimate the effect of share repurchase announcements on short interest to address the research question. For simplicity, a

dummy variable is used to mark a certain month as repurchase month. Consequently, differences between repurchase announcements are not considered. Repurchase announcements differ substantially in size (i.e., the number of shares that can be bought or the total dollar amount) and program duration (how long managers can buy shares under this program). These factors might influence the reaction of short sellers. Considering characteristics of different repurchase announcements could improve this thesis further.

Based on established literature, short interest is used as proxy for overvaluation. However, a substantial part of overall short sales is done by hedge funds or institutional investors who combine a long position with a short position as part of their hedging strategy. These short positions, therefore, are not a sign of overvaluation. A good extension of this thesis would be to filter out this part of short sales and only consider a form of abnormal short selling following a repurchase announcement. However, this would be very hard to do on a large scale due to data availability. In addition, short interest could be influenced by many other factors. Although I have tried to include a most complete set of control variables, I cannot be entirely sure that short interest is not influenced by other factors than the ones included in the regression. Though using short interest as proxy for overvaluation is bound to certain limitations, it offers a unique way of investigating how market participants value companies and information content of announcements.

Given these limitations, I still strongly believe that the results of this thesis are of economic significance. All four hypotheses point to the same answer on the research question: managers, on average, are motivated by price support when they are announcing share repurchase programs. The evidence that actual repurchases also have a positive effect on the change in short interest, strengthens this conclusion. Interestingly, this thesis finds this positive effect to be even larger during the year of Covid-19. Whether this urge to support share price is wrong, remains a political discussion. More research on the long-term effects of price supporting repurchase announcements could help to steer this debate.

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Appendix A: definition of variables

Table A1: variable definitions including the used database. The CRSP or Compustat variable names are included in parenthesis. Closing prices are monthly averages and are calculated using daily share price data from CRSP.

Variable	Database	Definition
$RepAnnouncement_i$	Manual	Dummy variable that equals 1 in the month a repurchase announcement was made by company i.
$ActualRepurchase_i$	Manual/CRSP	Total number of shares repurchased / Shares outstanding (shrout)
ShortIntrest	Compustat	Adjusted short interest (shortintadj) / Shares outstanding (shrout)
BTM	Compustat	Book value of equity (ceqq) / market value of equity. Where market value of equity equals the average closing price * shares outstanding (shrout).
Return	CRSP	Monthly raw return: (average closing price month t - average closing price month t-1) / Average closing price month t-1
Income	Compustat	Operating income before depreciation (oibdpq) / Total assets (atq)
Cash	Compustat	Cash and Short-Term Investments (cheq) / Total assets (atq)
Debt	Compustat	(Debt in Current Liabilities (dlcq) + Long-Term Debt Total (dlttq)) / Total assets (atq)
Size	CRSP	Log(Market Capitalization). Where Market Capitalization is average monthly closing price * shares outstanding (shrout)
Liquidity	Compustat/CRSP	Common shares traded (cshtrm) / Shares outstanding (shrout)
MarketReturn	CRSP	Value-weighted return including dividends (vwretd)