The determinants of the effect of share repurchase announcements on the stock returns of technology companies

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ABSTRACT,
In this study, the short-term effect of share repurchase announcements on the stock returns of technology companies and the influence of two possible predictor variables upon this effect will be investigated. The effect of share repurchase announcements is examined through an event study and the influence of the predictor variables on this effect will be analyzed through regression analysis. The sample of repurchases consists of 114 repurchase announcements made from 2010 to the end of 2019. The statistically significant cumulative average abnormal return that was found for the isolated announcement window [0,1] is 1.732% with outliers and 1.722% excluding outliers. After this was proven the influence of the predictor variables, being the Market-to-Book value, and the Free Cash Flow on the stock returns was analyzed through a regression. Even though the coefficients of both of the predictor variables aligned with the posed hypotheses, the cumulative abnormal returns were not successfully explained by the predictor variables and there was little significance to these variables. Future research should be done to better explain the cumulative abnormal returns by adding relevant variables that have been omitted in this study.

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Keywords
Repurchase announcement, technology companies, cumulative abnormal return, payout, information asymmetry, signaling theory, free cash flow theory

1. INTRODUCTION

Share repurchases have become a controversial topic over the last few years (Fried, 2018; Wigglesworth, 2019). Some critiques on share repurchases by policymakers will be highlighted to show the relevancy of the subject.

A share repurchase occurs when a company elects to buy back shares from existing shareholders. Some executives believe that they can time the market with their repurchase decisions, so they accelerate repurchases when they believe their stock price is low. CFOs also are very conscious of how repurchases affect earnings per share. Finally, companies are likely to repurchase out of temporary earnings increases or when good investments are hard to find (Harvey et al., 2005). The buyback reduces the amount of equity outstanding as well.

In 2019 Senators Chuck Schumer and Bernie Sanders proposed a bill that would prohibit a corporation from buying back its stock unless it invests in workers and communities first (Sanders & Schumer, 2019). Two years ago democratic leaders within the United States government have called for or supported companies that receive bailouts to be banned from buying back their stocks indefinitely (Philips, 2020). Even as recently as last year Sen. Elizabeth Warren lambasted share buybacks as market manipulation made to inflate executive pay, calling them a poor use of excess corporate profits that could instead be reinvested in a business or workers (Franck, 2021).

Even though these discussions are going on, companies have not stopped repurchasing shares. In the United States for instance, companies announced $484bn in share buybacks in the first four months of 2021, the highest total in at least two decades, according to Goldman Sachs (Kasumov & Venkataramakrishnan, 2021). There are multiple reasons not to stop as surveys of corporate managers as well as the positive reception that buyback programs generally receive in the market suggest that these transactions are economically beneficial to shareholders(Chan et al., 2004).

Tech companies have been big buyers of their stock led by Apple, which bought back about $79 billion of stock in calendar 2019 (Bary, 2020). These and other technology firms occupy a central position in modern economies. They drive economic growth, and productivity gains and have created new industries and innovative products and processes. Their importance is reflected in the wide coverage they receive in the mass media and the business literature (Grinstein & Goldman, 2006).

Along with the new technologies and ways of doing business have also come new business strategies and new ways of making business decisions that will play important roles in determining whether companies thrive, fail, or just survive in these new market conditions. Now more than ever, it is critical for both investors and executives to understand how the market values technology companies. What factors most strongly influence share prices? And what factors do not seem to make much of a difference(Milano et al., 2016)?

In this research, the goal was to find out in what way share repurchase announcements influence the stock returns of technology companies and what the determinants are of this effect.

The research question that is answered in this thesis is: ‘What is the effect of share repurchase announcements on short-term stock returns of technology companies and what company factors are its determinants?’

To measure the effect the repurchase announcements have on the stock returns an event study was done. This event study follows a single-index market model. The repurchase announcement is the event that should lead to the cumulative abnormal return (or CAR) of stock prices.

After getting the CARs an attempt was made to explain these CARs with an ordinary least squares regression (OLS). The effect of two predictor variables was studied. The first one is undervaluation, which is measured by the Market-to-Book value as a proxy variable. As the information asymmetry is big as companies are mispriced repurchase announcements made by companies with higher Market-to-Book ratios were expected to offer less new information and thus offer a lesser signal and have a smaller effect on the stock returns and therefore the CARs. Free cash flow is the second predictor variable. A high level of free cash flow can lead to concern that managers may abuse slack resources and over-invest in sub-optimal projects, as share repurchases reduce free cash flow it is hypothesized that there is a positive relationship between the free cash flow and the CARs. In the study, two control variables were used. The first one is size to make sure the results are consistent for different sizes of companies as the other variables could all be influenced by the size. The second one is the cash flow to make sure it is the actual level of free cash flow that influences the returns not the level of total cash flow.

The companies the sample is based on are the companies that were in the Nasdaq-100 Technology Index by the end of 2019. It consists of 114 of their repurchase disclosures which were found over the period beginning in 2010 and going up to the end of 2019. The return of the Nasdaq-100 Technology Index is taken as the market return.

The cumulative average abnormal return (or CAAR) over the event period of the sample is positive. Even when outliers are removed the CAAR remains positive. The results are significant.

The significantly positive CAAR could not be explained by any of the models that were used as 4.0% was the highest percentage of variance explained. The Market-to-Book ratio of companies was not proven to be a determinant of the abnormal returns as companies with a higher ratio did not experience significantly smaller cumulative abnormal returns. The free cash flow had a low explained variance and even though it seemed significant in the second and third models it was not significant enough considering the sample size, therefore there was not enough evidence to say it explained the positive CARs.

If there were a positive effect for a business fulfilling a certain determinant a company could choose to repurchase based on the level this determinant is at. This effect would then also be relevant for investment bankers and their analysts as this information could be used to predict positive future returns for companies. Finally, policymakers could take it into account as it could show them that repurchases offer value and are not just market manipulation made to inflate executive pay.

This paper will add to existing research by researching both a time frame that has not been studied yet and by researching the effects of repurchase announcements on technology firms specifically.

2. LITERATURE REVIEW

The effects of share repurchases on stock returns have been studied by several scholars. Most of these studies were done on open market repurchases made by general stock listed companies within the US. In these studies, several theories are proposed for buying back stock.

2.1 Payout

Share repurchases are not the only way corporations distribute cash. Another way to do this is by paying out dividends. Even

though both of these strategies intend to payout cash both of them are used to different effects.

Research done by Jaganathan, Stephens and Weisbach (2000) shows that dividends and repurchases are used at different stages in the business cycle by different types of firms. Stock repurchases are very pro-cyclical, while dividends increase steadily over time (Jagannathan et al., 2000). Dividends are paid by firms with higher 'permanent' operating cash flows, while repurchases are used by firms with higher `temporary', non-operating cash flows. Repurchasing firms also have much more volatile cash flows and distributions. Finally, firms repurchase stock following poor stock market performance and increase dividends following good performance (Jagannathan et al., 2000).

These results are consistent with the research done by Brav, Graham and Michaely (2005) as the managers interviewed in this paper stated that the flexibility of repurchases relative to dividends is one of the main reasons that repurchases have increased. This flexibility allows managers to alter payout in response to the availability of good investment opportunities, to accommodate time-varying attempts to affect EPS or stock valuation, to offset stock option dilution, or simply to return capital to investors at the appropriate time (Harvey et al., 2005).

2.2 Information asymmetry

Generally, information asymmetry may refer to asymmetric information or differential information between different agents (Chae, 2005). In this thesis, it is used to mean that insiders have superior information about a firm's future earnings prospects.

Survey evidence supports information asymmetry being relevant to research on share repurchases. Eighty-five percent of executives believe that repurchase decisions convey information, and almost every one of these executives Brav, Graham and Michaely (2005) interviewed shared that share repurchases convey management's confidence about the future. If there were no information asymmetry repurchase decisions would not convey information as that information would already be known to the market.

Since more information is publicly available for large firms than for small firms, this makes it less likely for the value of large firms′ stock to be mispriced. Therefore, investors should display indifference to share repurchase announcements made by large firms(Hatakeda & Isagawa, 2004).

For this reason, size was made a control variable. Size was operationalized by taking the decimal log of the gross sales. The decimal log of the gross sales was chosen as opposed to the market capitalization or the total assets as they were used in the other variables which would then form an unwarranted correlation.

The theories that will be explained below are two ways that are posed to alleviate the information asymmetry that exists between the insiders and the market.

2.3 Signaling theory

The hypothesis that has emerged as the most prevalent explanation as to why corporations repurchase their shares is the signaling hypothesis (Ikenberry et al., 1995; Liano et al., 2003). Vermaelen (2005) defined signaling in this context as: "An attempt to communicate to investors that their current forecasts about future performance are too pessimistic"

In an early paper on signaling in the job market by Spence, published in 1973 a signal is defined as observable characteristics belonging to the individual that are subject to manipulation by him. For this alterable characteristic to become an actual signal there need to be signaling costs that need to be negatively correlated with the individual's unknown productivity and there need to be a sufficient number of signals within the appropriate cost range (Spence, 1973).

Using that in this context it can be said that share repurchase announcements are observable characteristics that companies can manipulate from within. The main issue in relating the signaling theory to share repurchase announcements is finding where the signaling cost lies which is supposed to make the signal credible (Spence, 1973).

This is true as although open-market repurchase plans permit firms to repurchase their shares, they do not obligate them to do so (Stephens & Weisbach, 1998), which thus means that they are not necessarily related to the announcement. Stephens and Weisbach (1998) do find that in their sample of repurchase programs announced from 1981 through 1990 firms repurchase 74 to 82 percent of their announced target level of share repurchases. Other than the data showing most shares are repurchased which is costly as money is spent there is also another reason share repurchase announcements are costly. Research suggests that the market considers a firm's reputation when evaluating the credibility of open market repurchase announcements (Bonaimé, 2012). Research also suggests that firms develop a reputation with the completion rates of preceding repurchase announcements and that announcement returns are a function of lagged completion rates (Bonaimé, 2012). This suggests that making a repurchase announcement is costly as not following through on the announcement will harm future signaling attempts as these will be mistrusted which will lead to smaller returns.

There needs to be a significant number of signals within the appropriate cost range which simply means there needs to be a benefit to repurchasing shares in this context. There is a clear benefit to repurchasing shares as undervaluation is often seen as the primary reason to repurchase stock(Chan et al., 2004; Ikenberry et al., 1995; Vermaelen, 2005). As the shares are repurchased when the shares are expected to be undervalued the benefit is the profit that is made when the shares eventually rise to an appropriate level.

The signaling theory follows from two assumptions: information asymmetry as mentioned before, and undervaluation (Vermaelen, 1981). Undervaluation implies that based on the information asymmetry between the firm and the market, a firm may be misvalued (Dittmar, 2000). This undervaluation could be a result of investors undervaluing earnings (Grullon & Michaely, 2004), cash flow, or misjudging the firm being a risky investment (Vermaelen, 2005).

Harvey, Brav, Graham and Michaely (2005) report that 90% of all CFOs ″agree or strongly agree″ with the statement that they repurchase stock when their shares are undervalued. Making a repurchase announcement is thus argued as serving a valuable signal to a less informed marketplace (Harvey et al., 2005). This is in accordance with the signaling hypothesis.

The undervaluation of the company is often seen as the main reason to repurchase stock and one of the reasons to announce share repurchase announcements as mentioned in other research (Chan et al., 2004; Ikenberry et al., 1995; Vermaelen, 2005). It was used to try to explain the abnormal stock returns following the share repurchases. The proxy variable used to measure undervaluation is the market-to-book value.

A company with a low Market-to-Book value or MTB ratio is expected to be relatively undervalued, as its market value is low relative to the book value of its assets. Growth firms tend to have a high market-to-book ratio as their book value is expected to grow. The relation to the CARs is expected to be negative as a

lower market capitalization compared to the book value is a signal that the company is undervalued compared to other companies.

Other than undervaluation, the Market-to-Book ratio also proxies for investment opportunities (Kahle, 2001). As firms with good investment opportunities maximize shareholder value by using cash flow to finance investment, rather than repurchasing shares a negative relation between the cumulative abnormal returns and the Market-to-Book ratio was expected.

2.4 Free cash flow theory

The free cash flow theory first researched by Jensen (1986) is often mentioned in similar papers. The theory states that conflicts of interest between shareholders and managers over pay-out policies are especially severe when the organization generates substantial free cash flow.

Repurchases may be associated with a firm's transition from a higher growth phase to a lower growth phase. As firms become more mature their investment opportunity set becomes smaller(Grullon & Michaely, 2004). This declining amount of investment opportunities will then lead to extra free cash flow which is then open to be misused by management. At such a time it is more likely that managers give out cash under the pressure of shareholders(Grullon & Michaely, 2004).

If the market penalizes these firms out of concern that managers may abuse slack resources and over-invest in sub-optimal projects, managers can tax-efficiently recapture this penalty by disgorging cash through a share repurchase (Chan et al., 2004). As the concern of managers using these resources sub-optimally declines the financial performance is expected to rise.

As stated before, a declining amount of investment opportunities will lead to extra free cash flow which is open to be misused by management. As a proxy to measure free cash flow a formula close to the formula used by Andriosopoulos and Hoque (2011) and Dittmar (2000) was used. This proxy was chosen as it was used in other research (Andriosopoulos & Hoque, 2011; Dittmar, 2000).

To make sure it is the free cash flow that affects the CARs, not just the cash flow in general a control variable was introduced. This control variable is formed by taking the cash flow and dividing it by total assets

2.5 Empirical evidence

The actual effect of share repurchase announcements on the short-run stock returns of companies observed in the literature is mainly positive. The earliest article written by Ikenberry, Lakonishok and Vermaelen (1995) finds a 3.5% average market response to the share repurchase announcements. The research that was done by Chan, Ikenberry and Lee (2004) also reports positive results as they find a 3.2% announcement return. Kahle (2001) reported a 1.61% abnormal return in the announcement period in their research. Grullon and Michaely (2004) find an abnormal return of 2.71%. These last 2 abnormal returns being on the lower side could be explained by the fact that in both of these studies event windows from one day before to one day after the announcement were used whereas the first two listed studies used event windows from two days before to two days after the announcement. Kahle (2001) also explains the lower return by posing that the market recognized that repurchases in the 1990s are less likely to signal undervaluation. The paper by Manconi et al. (2018) finds cumulative average abnormal returns of American companies of 2.15% over the (-1,+1) window, 2.11% over the (-2,+2) window, and 2.02% over the (-3,+3) window.

The paper by Liano, Huang and Manakyan (2003) is specifically related to this research as it researches the intra-industry effects of stock repurchases on stock returns, even though the technology industry is not named as a specific industry. They found that short-term results support the signaling hypothesis as firms announcing stock repurchases earn significant abnormal returns of 3.02% percent on average during the announcement period, indicating investors interpret stock repurchase announcements as a favorable signal. With regards to the different industries, they found that markets view share repurchase announcements as favorable news for all industry segments, although the market reaction to share repurchase announcements does differ significantly across industries.

Regarding the undervaluation, as measured by the Market-to-Book ratio, some support for it can be found in the literature. Repurchase announcements are associated with greater stock price increases if the firm is a value stock and thus has got a low book to market value (Manconi et al., 2018).

Other papers find more than only the undervaluation to be relevant as the papers by Kahle (2001) and Grullon and Michaely (2004) find evidence consistent with the free cash flow theory. In the paper by Kahle (2001) it is found that short-term repurchase announcement returns are positively related to the ratio of free cash flow to assets. Grullon and Michaely (2004) found evidence that suggests that reductions in free cash risk are sources of the positive market reaction to the repurchase announcement.

2.6 Hypothesis

The empirical evidence supports the positive outcome of these theories as all of the papers mentioned in the empirical evidence section find positive abnormal stock returns in the announcement period. It is also noted that markets interpret stock repurchase announcements as favorable news for all industry segments as tested in (Liano et al., 2003) which bodes well for the technology sector.

Compiling all these results the main hypothesis was made to be:

H1: The announcement to buy back shares on the open market has a positive effect on the CAAR of technological firms

The main theory the hypothesis is based on is the signaling theory. The papers by Kahle (2001), Liano, Huang and Manakyan (2003) and Manconi et al. (2018) support this theory. The factor is related to the relative undervaluation of the company which would make the repurchases alleviate more information asymmetry.

H2: The market-to-book ratio has a negative relationship with the CARs

Another theory that is posed is the free cash flow theory. This theory could influence the stock returns as repurchases are seen as a tax-effective way to disgorge cash and thus reducing the free cash flow as supported by Kahle′s (2001) research. As the free cash flow reduces the concern that managers may abuse these slack resources and over-invest in sub-optimal projects reduces as well. This decreased concern is expected to have a positive effect on the stock returns and thus the hypothesis.

H3: The free cash flow to assets ratio has a positive relationship with the CARs

3. METHODOLOGY

3.1 Event Study (Performance measure)

The effect of share repurchase announcements on the stock returns of technology firms was measured by measuring the returns of the stocks of the companies that have announced to repurchase their shares. An event study was done to measure these returns of the stocks using a single-index market model. The model used here is mainly based on the research by Seiler(2003) and MacKinlay (1997).

Firstly, the daily stock returns will be measured.

The way this was done is shown through this formula:

$$R_{it} = \ln\frac{P_{it}}{P_{it-1}} * 100$$

In this model R_{it} is the daily return for stock i on day t and P_{it} is the adjusted closing price of stock I on day t.

For the market model the regression that is done is expressed as:

$$ER_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

In this model ER_{it} is the expected daily return for stock i on day t, R_{mt} is the daily return on the Nasdaq-100 Technology Sector Index on day t and ε_{it} is the error that remains.

Using the estimated parameters α_i , being the intercept of the regression and β_i, being the slope of the regression the expected return was calculated by performing a regression analysis using the event period from -10 to +10 days where 0 is the event day. This period was used as the event date can be identified with a high degree of certainty, thus an excessively large event window is not necessary. At the same time, it is important to include several days before the event to determine if leakage occurred and several days after the event to determine if the meeting attendants waited a few days before trading in the market (Seiler, 2003).

$$ER_{it} = \alpha_i + \beta_i R_{mt}$$

$$AR_{it} = R_{it} - ER_{it}$$

As the standardized abnormal return or SAR will ultimately be computed the following formula is required:

$$SAR_{it} = \frac{AR_{it}}{\sqrt{var(AR_{it})}}$$

Where SARit is the standardized abnormal return of stock i on day t and $\sqrt{var(AR_{it})}$ is the square root of the variance of the AR for stock i at time t as used by Seiler (2003).

After the standardized abnormal return per day of a certain stock was calculated the returns of all these stocks needed to be added together. This was done via the Total Standardized Abnormal Return (or TSAR) formula which is shown below:

$$TSAR_t = \Sigma_{i=1}^{N} SAR_{it}$$

In this formula, N is the number of stocks in the sample.

Now it is possible to determine if the TSAR results are significant by using the Z-statistic determined by this formula:

$$Z_t = \frac{TSAR_t}{\sqrt{\Sigma_{i=1}^{N}\frac{D_i - 2}{D_i - 4}}}$$

In this formula D_i is the number of trading day returns for firm i in the estimation period.

After the abnormal return per day of the stocks was calculated these returns needed to be added together, this was done via the Cumulative Total Standardized Abnormal Return formula which is shown below:

$$Cumulative\ TSAR(\tau_1, \tau_2) = \Sigma_{T=\tau_1}^{\tau_2} TSAR_t$$

In this formula (τ_1, τ_2) is the event window, or (-10,+10).

The window wherein the standard errors were calculated was chosen to be based on both the research done by Ikenberry (1995) as well as the research done by Liano et al. (2003). -252 Days from the event to -11 days before the event was taken as this includes the full business year before the event excluding the event period as the average number of trading days in a business year is 252 for most years. An estimation window that is nearly equal to a business year is appropriate because it includes all possible seasonal cycles a company may go through.

This window was taken to eventually calculate the Z-statistic which tests whether the average Cumulative TSAR's are statistically significantly different from the null hypothesis of there being no abnormal returns. This test statistic is formed as follows:

$$Cumulative\ Z_t = \frac{1}{\sqrt{N}} \frac{\Sigma_{\tau_1}^{\tau_2} SAR_{it}}{\sqrt{(\tau_2 - \tau_1 + 1)\frac{D_i - 2}{D_i - 4}}}$$

From this, the p-value needs to be calculated which needs to be below 5% to be significant as the sample is large enough to take this measure.

The null hypothesis for this test is:

$$H_0 = E\left(Cumulative\ TSAR_{(\tau_1, \tau_2)}\right) = 0$$

From the earlier mentioned AR the CAR of the companies as well as the cumulative average abnormal return of the companies will be calculated.

To get from the AR to the CAR the abnormal returns needed to be accumulated, this was done via the Cumulative Abnormal Return formula which is shown below:

$$CAR_{it}(\tau_1, \tau_2) = \Sigma_{T=\tau_1}^{\tau_2} AR_{it}$$

In this formula, CARit is the cumulative abnormal return for (τ_1, τ_2), which is the event window, or (-10,+10) for now.

Now onto the last step in calculating the abnormal returns which is calculating the average of all the cumulative abnormal returns. This is how this was calculated:

$$CAAR_{it}(\tau_1, \tau_2) = \frac{1}{N} \Sigma CAR(\tau_1, \tau_2)$$

The cumulative abnormal return period that is taken is [0,1], meaning the CAR includes the event day and the day after the event day. This was done as the TSAR only showed significant abnormal returns on both of those days and the Cumulative TSAR started to show significant abnormal returns from that point on. It was also decided to use the winsorized CARs as the results were more significant when the outliers were excluded.

3.2 Variables

In this section, the independent variables and the control variables that were used to test the effect of company factors on the CARs will be explained.

The variables that will be explained are summarized in table 1, which is shown below.

Table 1: Summary of independent variables

Variable	Calculation

Market-to-Book ratio	$\frac{Book\ value\ Total\ Assets - Book\ value\ equit - (Shareprice * Shares\ Outstanding)}{Book\ value\ Total\ Assets}$
Free cash flow	$\frac{Earnings\ before\ taxes + Depreciation + Amortization\ and\ Depletion}{Total\ Assets}$
Size	$log_{10}(Total\ Sales)$
Cash flow	$\frac{Cash\ and\ Cash\ equivalents}{Total\ Assets}$

Signaling theory

Undervaluation is used to measure the strength of the signal. The proxy variable for undervaluation was determined to be the market-to-book ratio. The market-to-book ratio was chosen as a proxy variable as it is used in many papers (Chan et al., 2004; Ikenberry et al., 1995; Kahle, 2001).

The market-to-book ratio (MTB) is the following ratio:

$$MTB = \frac{Market\ capitalization}{Book\ value}$$

The market capitalization is calculated by taking the book value of the total assets – the book value of total equity + the market capitalization as seen by the market, being the price of the shares at the nearest business day to the release of the previous annual report times the number of shares outstanding. The Total Assets are used as the book value.

$$MTB = \frac{BV\ Total\ Assets - BV\ Total\ Equity + (Share\ price * Shares\ outstanding)}{BV\ Total\ Assets}$$

Free cash flow

The free cash flow will be calculated by a formula consisting of several financial components. This formula will be referred to as F from now on. This will be operationalized as a proxy, based on the formula of Dittmar (2000). The deferred charges were left out from the formula as a clear definition that could produce consistent data through the sources used on these charges for all of the companies was not found. The formula was also supplemented by amortization and depletion to make the formula more complete.

This could affect the results as companies that have engaged in many deferred charges or have a high level of amortization could have an underestimated value for the variable whereas companies not engaging in deferred charges or companies that have a high level of depletion could have a relatively overestimated value.

The formula that will be used to calculate free cash flow is the following:

Free cash flow = [EBT + depreciation + amortization and depletion] / TA

In this formula, EBT is the earnings before taxes of the preceding year and TA is the value of the total assets of the last year.

Control variables

Two control variables were selected for this test.

The first of those control variables is a size variable. The size is controlled by taking the decimal log of the gross sales of the companies.

The second control variable is a cash flow variable. This variable was controlled by dividing the cash and cash equivalents by the Total Assets.

3.3 The regression

To investigate the effect of the variables on technology firms' returns, several OLS regression models were used. SPSS is used to do the OLS regression analysis, while Excel was used to do the calculations required for the variables.

The first regression model used is the following.

$$Y_{it} = \alpha + \beta_0 F_{it-1} + \beta_1 M_{it-1} + \beta_2 S_{it-1} + \beta_3 C_{it-1} + \varepsilon_{it}$$

Where Y_{it} is the cumulative abnormal return for company i on time t. α is the intercept, β is the slope of the variable, F_{it-1} is the Free cash flow variable of company i taken from the last annual report, M_{it-1} is the Market-to-book variable of company i taken from the last annual report, S_{it-1} is the Size control variable of company i taken from the last annual report C_{it-1} is the Cashflow control variable of company i taken from the last annual report, and ε_{it} is the error.

To check whether or not outliers impacted the significance of the relationship between the independent variables and the CARs it was chosen to winsorize the variables in a separate regression model.

These first two models are the full models including the control variables. A third model was used for a regression that excluded these control variables. This model is shown below.

$$Y_{it} = \alpha + \beta_0 F_{it-1} + \beta_1 M_{it-1} + \varepsilon_{it}$$

3.4 Outliers

In this thesis, If outliers were excluded it was chosen to winsorize the data using the average plus or minus 2 times the standard deviation which means around 95% of the data will be left untouched following the empirical rules.

3.5 Endogeneity

With regards to endogeneity, it needs to be taken into consideration that repurchases and cumulative abnormal returns are endogenous variables. This endogeneity could influence the relation between the two variables. The repurchases and cumulative abnormal returns can be affected by external factors such as increased cash flow and the increased information asymmetry for smaller companies. The two control variables are used to try to control for some of the endogeneity as well as only using the companies listed in the NDXT-100 which will hopefully limit the endogeneity incorporated in the results.

4. DATA

To measure the volume of the buyback announcements technology companies have made and the performance of these companies the performance and the open market share repurchase announcements of technology companies within the Nasdaq-100 Technology Sector Index were reviewed.

The stock price data was collected via Yahoo Finance. This is done here as it has all of the data needed including the level of the NDXT-100. The data of the companies were gathered from 2010 up to 2019[1] to make it as recent as possible.

The decision was made to report on the companies that were components within the NDXT-100 by the end of 2019 instead of excluding companies when they fall out of the index to focus on the most relevant companies for now and thereby make sure that as many share repurchase announcements were made following the crash that happened in that year.

[1] 2020 was not included as the influence of the coronavirus on the market returns could skew the results. The research that was done by Ikenberry et al. (1995) also excluded a quarter in 1987

the research delivers a conclusion which could be relevant for future decisions on repurchases.

Table 2: Abnormal returns for event window [-10,10] as well as isolated announcement window [0,1]

	Abnormal returns						*Abnormal returns Winsorized*					
Days	AAR	Z-stat	P-value	CAAR	Z-stat	P-value	AAR	Z-stat	P-value	CAAR	Z-stat	P-value
-10	0.081%	0.438	0.661	0.081%	0.179	0.858	0.036%	0.264	0.792	0.036%	0.108	0.914
-9	-0.160%	-1.718	0.086	-0.079%	-0.484	0.629	-0.071%	-1.046	0.296	-0.035%	-0.296	0.768
-8	0.045%	-0.131	0.896	-0.034%	-0.499	0.618	0.076%	0.229	0.819	0.041%	-0.196	0.845
-7	-0.060%	-0.676	0.499	-0.094%	-0.696	0.487	-0.029%	-0.429	0.668	0.012%	-0.328	0.743
-6	-0.200%	-1.551	0.121	-0.294%	-1.150	0.250	-0.169%	-1.261	0.207	-0.157%	-0.710	0.478
-5	-0.329%	-2.219	0.027*	-0.623%	-1.766	0.077	-0.223%	-1.694	0.090	-0.380%	-1.187	0.235
-4	0.121%	0.995	0.320	-0.502%	-1.403	0.161	0.093%	0.796	0.426	-0.287%	-0.907	0.364
-3	0.250%	2.140	0.032*	-0.253%	-0.755	0.450	0.177%	1.487	0.137	-0.109%	-0.459	0.646
-2	-0.105%	-0.250	0.803	-0.358%	-0.794	0.427	-0.072%	-0.011	0.992	-0.181%	-0.445	0.656
-1	-0.011%	0.104	0.917	-0.370%	-0.740	0.459	-0.006%	0.072	0.943	-0.188%	-0.412	0.681
0	0.349%	3.141	0.002**	-0.020%	0.068	0.945	0.461%	3.981	0.000**	0.274%	0.597	0.551
1	1.383%	10.877	0.000**	1.362%	2.705	0.007**	1.261%	9.936	0.000**	1.535%	2.989	0.003**
2	0.054%	0.182	0.855	1.416%	2.671	0.008**	0.045%	0.146	0.884	1.580%	2.939	0.003**
3	0.103%	0.992	0.321	1.519%	2.828	0.005**	0.114%	1.037	0.300	1.693%	3.099	0.002**
4	-0.216%	-1.489	0.137	1.303%	2.423	0.015*	-0.232%	-1.601	0.109	1.461%	2.662	0.008**
5	0.003%	-0.069	0.945	1.307%	2.350	0.019*	-0.012%	-0.181	0.856	1.449%	2.558	0.011*
6	0.107%	0.775	0.438	1.414%	2.461	0.014*	0.069%	0.508	0.612	1.518%	2.608	0.009**
7	-0.074%	-0.479	0.632	1.340%	2.307	0.021*	-0.046%	-0.341	0.733	1.472%	2.479	0.013*
8	-0.094%	-1.041	0.298	1.245%	2.046	0.041*	-0.086%	-0.910	0.363	1.387%	2.242	0.025*
9	-0.026%	-0.090	0.928	1.220%	1.987	0.047*	0.084%	0.766	0.444	1.471%	2.349	0.019*
10	-0.069%	-0.520	0.603	1.151%	1.846	0.065	-0.072%	-0.474	0.635	1.399%	2.211	0.027*
[0,1]				1.732%	9.913	0.000**				1.722%	9.841	0.000**

**= p<0.05 **=p<0.01*

To make sure that there is no overlap between the estimation and event window only one announcement per year was registered. If this would not be done it could lead to biased return estimators in the estimation window, already capturing the influence from the preceding event as the piece on event studies by MacKinlay done in 1997 explains.

5. RESULTS

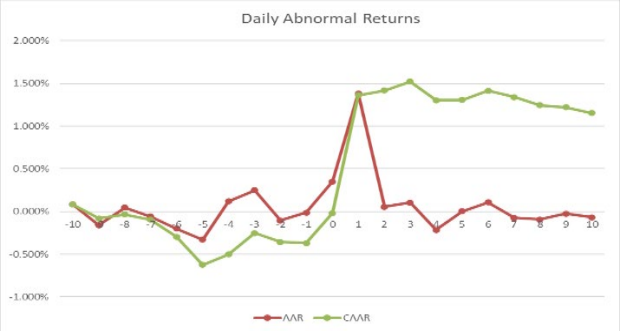
5.1 Event Study

To investigate whether announcing buying back shares on the open market makes for positive abnormal returns the first results that will be illustrated are the abnormal returns from the event study.

In this event study, the observation window over which the AAR and CAAR are calculated to include the 21 days around the buyback announcement [-10,10]. These returns over time are visualized in figure 1.

In this graph, the positive AAR and CAAR over time can already be seen. These positive returns are further explained in table 2.

Figure 1: Graph of the AAR and the CAAR



From the CAAR and the AAR, it can be seen that the returns turn significantly positive on the event date and the day after. The AAR has p-values lower than 0.01 for both days and the CAAR remained significantly positive with a p-value of under 0.05 for nearly all of the days following the event date with all of the days remaining significantly positive when outliers are winsorized. The winsorized returns provided the strongest proof for the first hypothesis as the AAR is significantly positive solely shortly after the event date.

The isolated announcement window [0,1], as well as the AARs, have a low enough p-value (α=0.05) that the null hypothesis of there not being significantly positive announcement returns can be refused.

Because the event date and the day after were significantly positive this isolated announcement window [0,1] was calculated separately and used in the regression analysis. As the Winsorized returns were more significant overall the CARs used in the regression were also winsorized.

5.2 Regression

Now that the positive relationship between announcing repurchases and the announcement returns is found it is time to try to explain this relationship.

5.2.1 Descriptive statistics

The descriptive statistics of the dependent, independent, and, control variables are displayed on the next page in table 3.

Table 3: Descriptive statistics

Variables:	*CAR [0,1]*	*MTB*	*F*	*SIZE*	*CASH*
Count	114	114	114	114	114
Mean	.017	2.634	.092	9.768	.172
Median	.014	2.329	.087	9.617	.143
Std. Dev.	.038	1.427	.076	.562	.111
Minimum	-.094	.577	-.087	8.840	.006
Maximum	.111	13.337	.299	11.360	.535

5.2.2 Collinearity

To make sure there is no collinearity a Pearson correlation matrix was made. This correlation matrix can be seen in table 4.

Significant coefficients were found between the independent variables as well as the correlation between the control variables. Because this significance was found a variance inflation factor analysis was done and the tolerance was calculated.

The variance inflation factors are not very high as the 24.1% the variance is inflated for in the free cash flow variable is the highest inflation factor seen in table 5. The level of tolerance also shows that the regression can be done without worrying about collinearity as 80.6% of the variance in the least unique variable, the free cash flow variable is unique to this variable.

As these numbers are not high enough to find evidence for collinearity the regression was started next.

Table 4: Pearson's correlation matrix

Variables:	*CAR [0,1]*	*MTB*	*F*	*SIZE*	*CASH*
CAR	1	.000	.145	.112	-.080
MTB	.000	1	.420*	.087	.008
F	.145	.420*	1	.162	.020
SIZE	.112	.087	.086	1	-.252*
CASH	-.080	.008	.020	-.252*	1

** = p<0.01*

Table 5: Collinearity statistics

Variables:	*MTB*	*F*	*SIZE*	*CASH*
VIF	1.214	1.241	1.101	1.072
Collinearity tolerance	.823	.806	.908	.933

5.2.3 Regression analysis

The regression was first split into two parts, one with outliers and one without them. The coefficients, the T-stats, and the R-squared that were found are shown in table 6. The first model shows the results of the regression with the outliers of the independent variables unedited, and the second model shows the results with the outliers winsorized for these variables.

Table 6: Regression results

	Full model		*Full model, with winsorized independent variables*		*Winsorized independent variables without control variables*		*Free cash flow isolated and winsorized*	
Variables:	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat	Coefficient	T-stat
Constant	-.031	-.471	-.031	-.437	.013	1.805*	.010	1.790*
MTB	-.002	-.731	-.002	-.673	-.002	-.684		
F	.083	1.582	.092	1.704*	.094	1.734*	.078	1.598
SIZE	.005	.766	.005	.710				
CASH	-.022	-.653	-.027	-.752				
R-SQUARED	.038		.040		.026		.022	

** = p<0.1*

The results do not provide clear evidence to prove a strong relationship between the dependent variable and the independent variables. An R-squared close to 1 would demonstrate a strong relationship between the dependent and the independent variables and, the biggest R-squared found here is 0.040, meaning 4.0% of the variances of the CARs can be explained by the second model.

Overall the results were not very significant. The Market-to-Book value did have a negative coefficient as the hypothesis suggests. It did however not return a low p-value or a significant T-stat and thus provided no statistical evidence for the second hypothesis. The coefficient of the Free cash flow variable also followed the hypothesis by being positive. The variable resulted in a p-value under 10%, this is not clear evidence though as the sample size is not large enough to use the alpha of 10%.

The second model showed that excluding the outliers did not significantly positively impact the strength of the relationship between the variables as the R-squared is only slightly higher than it is without control variables and the p-values of the variables are not significantly lower than when the outliers are included. The lower p-value did show that the model was slightly more significant which is why the other models that were tested used winsorized variables.

The absence of the control variables which was tested in the third model did not have a big effect on the significance of the relationship between the variables, the p-values were slightly lower meaning the significance was slightly higher.

To further check whether the free cash flow had a strong relationship a fourth model was tested, just testing the free cash flow. From this model, it can be concluded that there is no significant relationship between free cash flow and the CARs and there was thus no proof found for the third hypothesis.

5.2.4 Robustness

The sample could have formed a problem that lead to insignificant results for the predictor variables. The sample was somewhat smaller than in other studies. The thing is that when researching a specific subset of companies in this timeframe a much larger sample size is not realistic. The paper by Liano, Huang, and Manakyan (2003) on industry-specific returns used an even smaller sample per industry for example. As the sample was collected not only by checking Orbis but mostly manual research it was deemed extensive enough in this case.

To check for collinearity between the variables of the regression the Pearson correlation was calculated. There were two pairs of variables that showed significance. After doing a variance inflation faction analysis and calculating the Collinearity tolerance the collinearity was rejected.

The goodness of fit of the model was tested as well. The model including both all of the predictor variables and the control variables resulted in an R-squared of .040. This means that 4.0% of the variances of the CARs can be explained. One possible explanation for this number being so low is that omitted variable bias could have occurred.

6. CONCLUSION

The positive cumulative average abnormal returns observed in the announcement period show that announcing share repurchases has a positive effect on the short-term financial returns of the companies, with and without outliers. Over the announcement period [0,1], which was further analyzed the cumulative average abnormal return that was found is 1.732% with outliers and 1.722% without outliers. These returns are both very significant as the p-values that were found are below 1%.

The OLS regression that was done to test the effect of the two predictor variables did not provide sufficient proof for the posed hypotheses. There was a negative relationship between the Market-to-Book value and the CARs as posed in the hypothesis but it was not statistically significant. The free cash flow also aligned with the hypothesis as it had a positive relationship with the CARs but even though the p-value was below 10% in the models with the winsorized outliers the p-value was still too high to reject the null hypothesis for this sample size. After omitting the Market-to-Book value the positive relationship between the free cash flow and the CARs also became less significant.

6.1 Limitations

There are several limitations to this study that should be mentioned. Firstly, the study focused on large technology companies as the sample of companies remained within the NASDAQ-100 index. The results may not be applicable to all technology firms for this reason.

Secondly, it was decided to only take one buyback announcement per business year into account. The announcements that were left out may have influenced the result of the study.

Lastly, most of the values of the predictor and control variables are taken from the preceding annual report from where the buyback was announced. These values may have changed in the time between the annual report and when the buyback was done.

6.2 Contributions

The thesis has contributed to the finance literature by showing the short-term positive effect buybacks have on companies in the technology sector specifically and by casting doubt on the predictor variables most used in research.

The thesis contribution to practitioners is that it provides an argument to companies in the technology sector to not disregard buybacks.

6.3 Recommendations

The recommendations for future research are that more research should be done regarding the influence of buybacks in specific industries and what company factors impact that influence. The technology industry specifically is also still interesting to be researched further. The predictor variables used in this study were not able to explain the CARs of the companies which makes it interesting to do further research including other variables.

The main recommendation to the practitioners in the technology industry would be not to discount buybacks and look into whether they are the right option for your company. Investors should look out for technology companies that are going to announce share repurchases as this usually indicates short-term positive stock returns.

7. APPENDIX

Appendix A: Repurchases made by year

Year	*Repurchases*
2019	8
2018	15
2017	10
2016	13
2015	13
2014	13
2013	9
2012	13
2011	8
2010	12
Total	*114*

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