

UNIVERSITY OF LJUBLJANA
SCHOOL OF ECONOMICS AND BUSINESS

MASTER'S THESIS

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**WEALTH EFFECTS OF CORPORATE BUYBACK PROGRAM
ANNOUNCEMENTS**

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LIST OF ABBREVIATIONS

CEO	Chief executive officer
SIC codes	Standard Industrial Classification codes
United States	United States of America
USD	United States dollar

1 INTRODUCTION

Share repurchase or buyback is a process where a public company buys back its own shares from the existing shareholders. It is a form of corporate payout that has been gaining popularity since before the year 2000 and nowadays has become comparable to dividend payouts. In 2020, there were 825 billion USD worth of stocks bought back worldwide, among which 714 billion USD were only in the United States (Guest et al., 2023). Over the years from 2010 to 2019, there has been an observed rise in firms' leverage as firms' assets increased by more than their equity. Corporate payouts may not be the driving force for an increase in firms' leverage, but they certainly contribute to this, especially buybacks, as buybacks lower the equity and hence, by themselves, increase leverage ratios. Companies have thus been using buybacks as a leverage management tool (Aramonte, 2020). The matter becomes somewhat more controversial when cash paid out to shareholders is raised from debtholders, so-called leveraged buybacks, which have also increased during recent years (Light, 2019). Combined with increasing buyback activity, it is no surprise that buybacks have received much attention from economists and financial market researchers. But why do companies initiate buybacks? Some simply use them to distribute excess cash to shareholders, while others may use them to signal undervaluation of the company's stock to the market and the company's good prospects of future earnings. Buybacks can also be used as a takeover defence mechanism, to optimize capital structure, increase earnings per share ratios and other purposes. Buybacks are also very convenient because of their tax advantages and flexibility. They are flexible in the sense that the announcement of a buyback program does not commit a firm to actually follow through with it and can be cancelled at any point in time. Therefore, at the time of the announcement, market participants do not know if the company will complete the program or not, and, unless explicitly disclosed, they also do not know the source of the buyback funding. Nevertheless, existing literature primarily reports positive abnormal returns around the buyback announcements, which means that the market perceives buybacks as good news. But why? This has most often been attempted to be explained with signalling hypothesis, agency or free cash flow hypothesis and capital structuring hypothesis. Among the existing literature, one can find evidence to support all of the above hypotheses.

The aim of these master's thesis is not only to look at the abnormal returns around the announcements and trying to explain what influences them but to divide the buybacks based on how the program is carried out and search for the differences in abnormal returns, already at the announcement, among these buybacks, differences in factors influencing them, as well as checking if certain firms are more likely to execute buyback program one way or another. We do that by focusing on answering the following research questions, roughly divided into four main topics: (i) Do we observe somewhat similar abnormal returns on the market at the announcements of buyback programs regardless of how and if the companies carry them out? Or do we observe different abnormal returns? In this case, which firms exhibit the highest and which the lowest abnormal returns? Does the process of the programs actually

have an effect on abnormal returns around the announcements, considering we do not know what will happen with the programs in the future? (ii) Are most announced buyback programs actually completed? And what is the most common form of their funding? Can we find common characteristics of companies carrying out the program in a certain way that differentiate them from companies carrying out the program differently? (iii) Can some of the underlying companies' characteristics explain the direction and magnitude of the observed abnormal returns? And are there differences among the companies based on how the buyback program is carried out? And lastly, (iv) Do certain company characteristics prior to buyback make the company more or less likely to complete the buyback program, completely self-fund it or initiate leveraged buybacks? We aim to answer these questions, focusing only on the short-term announcement effects, with the use of appropriate methodology (event study for the first topic, descriptive statistic for the second, OLS cross-sectional regression analysis for the third and binary model for the last) on buyback programs in the United States during the years 2000 and 2019. Even though short-term buyback announcements are commonly studied, and among existing literature, one can find papers focusing on buyback programs that are not completed or papers focusing on leveraged buybacks, our master's thesis contributes to the existing literature by presenting a complete overview of abnormal returns based on how the program is carried out. This includes a full sample, as well as a breakdown on whether or not the buybacks are completed, financed exclusively with the companies' own resources and debt-financed. It also presents a complete overview of differences in companies' characteristics between these buybacks and companies' characteristics influencing the abnormal returns. In addition, we test for a few companies' characteristics in relation to the magnitude of abnormal returns that have not yet been looked for. Furthermore, our master's thesis also contributes by finding certain company characteristics that affect the likelihood of companies carrying out the buyback in a certain way, something that has not been researched so far.

The rest of the master's thesis is organized as follows. Section 2 summarizes the existing literature on buyback types, their motives, benefits and drawbacks, as well as findings on what affects completion rates, when it is beneficial to conduct leverage buybacks and presents observed abnormal returns around the announcements alongside relation to companies' characteristics influencing them. Section 3 discusses the event study methodology used to detect the abnormal returns around the announcements. The presented summary of methodology is tailored to the needs of the master's thesis and includes the methodology of non-parametric tests, cross-sectional regression and binary model. Section 4 describes the process of obtaining the data for the analysis, shows the process of buyback classification based on how the program is carried out, and presents the descriptive statistics of the analysed companies and buyback announcements. Section 5 discusses the findings of observed abnormal returns as well as results from non-parametric test, cross-sectional regression and binary model. The last section concludes.

2 BUYBACKS LITERATURE REVIEW

Share repurchase or buyback is a process where a public company, more precisely its management, buys back the company's own shares from the existing shareholders (CFI, 2025a). Like dividends, buybacks also represent a form of corporate payouts to shareholders, which have in total increased from 253 billion USD in 1988 to 1,7 trillion USD in 2020 in the United States. Buybacks alone have been gaining popularity and have become comparable to dividend payouts, both in their frequency and their amount. For comparison, in the United States, the amount of buybacks in 2020 (714 billion USD) was 11 times higher, in nominal terms, than their amount in 1988 (63 billion USD), while the amount of dividends increased only by a factor of 5, again in nominal terms, during the same time period. However, the increase in real terms of buyback amount is much lower and corresponds to a factor of 5, but it is still notably higher than the increase in real terms of dividends paid out, which equals a factor of 2, in the mentioned 32-year period. Buybacks are usually preferred by companies due to tax advantages and their flexibility in cash distribution, meaning that buybacks can be easily postponed or cut, making them adaptable to market conditions and the company's future outlook, whereas cuts in dividend payments are perceived as a negative signal in the market (Guest et al., 2023). The majority of all buybacks worldwide happen in North America. The repurchasing activity in 2020 strongly supports this fact, with buybacks in the United States representing 86,5% of worldwide repurchases (825 billion USD). Sector-wise, buybacks prevail in the financial sector, information technology, industrials and consumer discretionary, while activity is low in materials, real estate and utilities sectors (Scheid & Dholakia, 2023).

2.1 Types of buybacks

Various types of buybacks exist that differ from each other in the way prices are set, their amount is determined, and the time of the buyback is defined. The first option is known as Privately negotiated repurchase, where a company directly negotiates with specific shareholders for the amount and price of shares that the company will buy back from them. A company can also make a tender offer to the shareholders, known as Fixed price tender offer, where interested shareholders can sell their shares back to the company on a fixed date and at a fixed price, defined by the company itself. A Dutch auction is similar to Fixed price tender offer, only that the company specifies a range of possible prices, and the shareholders make their bids, including the minimum price at which they are prepared to sell their shares. Based on the demand and shareholders' bids, the company sets the price to finalize the buyback process. In all of the above-presented buyback types, the company buys back shares at a premium. This does not hold for the Open market share repurchase, where a company buys back its outstanding shares from the market at the current market price, usually over a prespecified period of months or years (CFI, 2025b). Another advantage of an Open market share repurchase is that the announcement of the program itself does not commit a firm to actually buy back its shares, whereas for other types of buybacks it does. This gives the

company the aforementioned flexibility and it is hence not surprising that the most common form of buyback is Open market share repurchase, representing 90% of all buyback announcements in value terms (Oded, 2005). Because of its wide use Open market share repurchase is hereinafter referred to only as “buyback” or “share repurchase”.

2.2 Buyback motives, their benefits and drawbacks

Besides the already mentioned tax advantage and flexibility, other possible motives exist for the company to repurchase shares. Buyback announcement can be used as a signalling mechanism, where a company (its management) signals to the market that its shares are undervalued. The need for such signalling arises because of asymmetric information between the management and the market. In essence, it signals the company’s good prospects of future earnings, and hence the market increases the valuation of the firm by increasing the share price (McNally, 1999). Undervaluation is a strongly supported motive for buyback initiation, and Ikenberry et al. (1995) show that value firms, firms with a low market-to-book (hereinafter “MTB”) ratio, are more inclined to repurchase shares for this reason. When firms repurchase shares, wealth transfers from shareholders who are selling their shares to the insiders and remaining shareholders. Therefore, doubts for insiders to abuse buybacks for their own benefit can arise, especially if the insiders hold the company’s shares. While there exists evidence that the average transaction value of insiders’ shares being sold around the announcements increases, there is no proof that insiders would systematically abuse the price increase around the announcements, but the higher transaction value is rather a result of a small number of large insider sales (Lewis & White, 2022).

Price increases around buyback announcements can also serve as a company’s defence mechanism from takeovers since the cost of the takeover rises. Additionally, takeovers can also be prevented by convincing shareholders that the firm’s value under current management is strong, thereby changing shareholders’ minds about selling shares to the raider. Buyback announcement does that, given that, if a firm’s value is small, managers would not be willing to make repurchase bids (Bagnoli et al., 1989). But share repurchases reduce the number of shares outstanding and therefore also the company’s equity for the value of repurchased shares. Because equity is reduced, companies’ leverage ratios increase, more severely if companies raise debt to finance buybacks, the so-called “leveraged buybacks”. Therefore, companies may use share repurchases as a way to reach their targeted leverage ratios, essentially achieving their optimal capital structure to maximize company value (Dittmar, 2000). While an increase in leverage can be beneficial to the company, it also poses additional risk by bearing higher financial distress costs. But these costs are shifted towards creditors or the public purse, which can encourage managers to engage in risky behaviour and overleverage the companies, as they count on public authorities to rescue them in case of default (Aramonte, 2020; Oudin & Adler, 2021). Even if the companies are not overleveraged, buybacks lower their liquidity, which might be needed in an economic downturn (Lazonick et al., 2020).

Nevertheless, another initiative by managers and executives is to meet or exceed the target earnings per share (hereinafter “EPS”) ratio, which can also be achieved with the help of buybacks. This is because a decrease in the number of shares outstanding, *ceteris paribus*, by formula increases the EPS (Hribar et al., 2006). Many managers admit that increasing EPS plays an important part in the repurchasing decisions (Brav et al., 2005) and Myers et al. (2006) find evidence of managers timing stock repurchases in a way that prevents decreases in EPS. The underlying reason for this behaviour is that managers’ compensation is often tied to EPS ratios. However, Lewis and Wite (2022) claim that the impact of buybacks on higher EPS is taken into account in the compensation plans and report no correlation between buybacks and EPS compensation, according to multiple studies. Buybacks can also help mitigate the conflicts of interest between management and shareholders. Namely, managers often wish for the companies to grow above their optimal size in order to have more resources under their control, have better managers’ compensation and other private benefits. However, the shareholders’ focus is on the maximization of the companies’ long-term value and do not wish to see resources being wasted by the management. Buybacks help to alleviate these wasteful expenditures by distributing excessive cash to shareholders and decreasing the resources under management’s control, which also decreases the agency costs (Jensen, 1996). Additionally, if the company does not have profitable investment opportunities, the distribution of cash to shareholders seems more convenient than investing in the negative net present value (hereinafter “negative NVP”) projects. The distributed cash can then be invested in other companies in need of financing for new projects, and hence, the capital at the macroeconomic level is better allocated (Oudin & Adler, 2021).

2.3 Determinants of the buyback completion rates

As already discussed, companies can announce buyback programs but do not have to follow through with them. In fact, Manconi et al. (2014) report that the average completion rate, in value terms, amounts to 75% a year after the announcement and increases to 93% four years after the announcement for repurchases in the United States during 1998 and 2008, and similarly strong repurchase activity, in value terms, is reported for the United Kingdom as well. But another study reports that only 45% of firms that announce the program actually repurchase shares and only 12% of firms repurchase more than 80% of the planned repurchase amount for buybacks in the United Kingdom between 1997 and 2006 (Andriosopoulos et al., 2013). The findings of completion rates are mixed, and a variety of reasons can explain why companies do not complete buyback programs.

Excessive cash, along with a lack of investment opportunities, is one of the reasons companies decide to initiate the buyback process instead of investing in negative NVP projects. However, if during the buyback process companies come across valuable investment opportunities, it is reasonable for companies to cancel buyback programs and invest in presented growth opportunities (Mietzner, 2017). In line with the above reasoning,

Andriosopoulos et al. (2013) find that larger firms are more likely to complete the program since they are usually more mature and have fewer investment opportunities. Another factor influencing the buyback completion is presented by Ikenberry et al. (1999), who find that value firms, which are mainly motivated to signal undervaluation, have higher completion rates than growth firms. Andriosopoulos et al. (2013) connect undervaluation to CEOs' characteristics, whereby they find that CEOs who are overconfident see their shares as undervalued and actually buy back more shares than other CEOs. Furthermore, they show that other CEOs' characteristics tend to affect the completion rates as well. Information disclosure also seems to be a strong signal of companies' intention to complete the buyback program, report Andriosopoulos et al. (2013). The more details companies reveal about the program at the announcement, the higher the likelihood of its completion. Other companies' characteristics, like levels of cash and dividend payouts, also impact the completion rates, whereby companies with high levels of cash and high dividend payouts exhibit higher completion rates. A positive connection between dividend payouts and buyback completion rates can be a supporting argument that buybacks do not substitute dividends but rather supplement them (Andriosopoulos et al., 2013). Existing literature also supports evidence for higher completion rates, the lower is length of the program, the lower is planned amount of repurchase and the lower is length between announcement and the actual start of repurchase (Andriosopoulos et al., 2013; Mietzner, 2017). While the source of funding does not seem to affect the completion rates (Lei & Zhang, 2016).

2.4 Appropriate use of debt to finance buyback programs

Besides the fact that companies are not obliged to complete the program, they are also not obliged to reveal the source of their funding; hence, most of the time, the source of funding remains unknown. When firms conduct leveraged buybacks, they raise cash from debtholders and pay it out to shareholders. As already mentioned, the result is a larger increase in firms' leverage and wealth transfer from debtholders to shareholders. Nevertheless, the amount of buyback financed with debt is increasing (Lei & Zhang, 2016; Oudin & Adler, 2021). Existing literature suggests that there are cases where leveraged buybacks can be beneficial for shareholders. For example, if the firm is underleveraged before the buyback announcement with substantial debt capacity, has a high marginal tax rate, or declining future growth options, leveraged buybacks, in fact, can help mitigate problems of information asymmetry connected to market undervaluation, increase tax benefits or reduce agency costs of free cash flows; hence, this leverage optimization indeed benefits shareholders. But those benefits of leveraged buybacks decrease with the amount of debt the firm has prior to the announcement, meaning that leveraged buybacks quite likely result in excessive debt, above its optimal level, which is detrimental to the firm's value. Not only can a firm miss positive NPV projects because it is not able to finance them, but the probability of bankruptcy is higher as well (Lei & Zhang, 2016).

Lei and Zhang (2016) in their study of leveraged buybacks show that firms financing buybacks, partly or fully, with debt (hereinafter “debt-financed”) have a higher debt ratio, higher financial distress risk and lower cash prior to buyback announcement than firms financing buybacks exclusively with cash (hereinafter “cash-financed”). However, they also show that 81% of firms repurchasing shares with debt are underleveraged prior to buyback announcement, which supports the argument for beneficial use of leveraged buybacks. Moreover, they find that debt-financed repurchasing firms are larger, more mature, with more assets, have better operating performance, higher investments and higher dividends than cash-financed ones prior to the buyback announcement.

2.5 Reasons for abnormal returns around buyback announcements

Mentioned motives for buybacks in Section 2.2 lead to the development of multiple hypotheses, trying to explain the abnormal returns observed around buyback announcements. The most common and widely studied hypothesis are: (i) signalling hypothesis, which tries to explain abnormal returns as consequence of companies signal of undervaluation and higher future profitability than expected by the market, (ii) agency or free cash flow hypothesis, which reasons that abnormal returns are observed because funds are distributed to the shareholders instead of wasted by the management and (iii) capital structuring hypothesis, which suggests that buybacks help underleveraged firms to reach the optimal capital structure and these is reflected in abnormal returns. All of these three hypotheses view buybacks as a tool for increasing the companies’ value, which is communicated to the market through their announcements. In the rational market, the new information is immediately reflected in asset prices, and since all of the most commonly accepted hypotheses represent good news, the reflection in asset prices is mostly positive (Campbell et al., 1997; Eberhart & Siddique, 2004). Of course, buybacks have their drawbacks, and hence, the negative reactions can also be observed around the announcements. Pettit (2001) argues that negative signals can be sent with buyback announcements if managers, essentially insiders, themselves decide to participate in the buybacks, if the company operates in a high-growth industry, since it can backfire by the company being viewed as not capable of obtaining new opportunities, or simply, other contradictory information can outweigh the buyback signal.

But why are abnormal returns observed around the announcements if the mere announcement does not commit a company to actually follow through with the repurchase program? Bhattacharya and Jacobsen (2016) try to solve this puzzle, searching for the answers connected to the signalling hypothesis. They argue that buyback announcement attracts speculators’ attention, who then discover the company’s true value and the follow-up trades result in value corrections, hence price increases around the announcements. Consequently, companies do not have to repurchase any shares. However, this holds only for the companies that are largely underpriced, whereas companies with small underpricing have to actually repurchase shares to correct these mispricings. Because more undervalued

firms tend not to repurchase shares, the abnormal returns around the announcements, according to them, should actually be higher for companies not completing the repurchase programs than for companies completing the programs. Nevertheless, higher abnormal returns are observed around the announcements of tender offers than announcements of open market share repurchases (otherwise referred to as “buybacks” or “share repurchases” only). This is reasonable since announcement of tender offer is a commitment and hence represents a more credible signal, which is reflected in the abnormal returns (Vermaelen, 1981). This view is supported by other studies as well.

2.6 Review of abnormal returns around buyback announcements

The majority of studies of buybacks find positive cumulative average abnormal returns (hereinafter “CAAR”) around the buyback announcements. The value of CAARs usually differs depending on time period, geographical region, macroeconomic environment, industry, buyback frequency, completion rate, source of financing and other factors. Next, a few findings from different studies are presented to support the general statement above and summarized in Table 1.

Table 1: Review of abnormal returns around buyback announcements

Review of abnormal returns around buyback announcements					
Buyback sample	3-day CAAR (%)	5-day CAAR (%)	7-day CAAR (%)	Time period	Study
9 European countries	1,4			2000-2007	Anolick et al.: Time for Gift Giving: Abnormal Share Repurchase Returns and Uncertainty
NYSE	3,7			1970-1978	Vermaelen: Common Stock Repurchase and Market Signaling: An Empirical Study
USA		2		1994-2001	Lee et al.: Repurchases after being well known as good news
USA		1,2		2002-2006	Lee et al.: Repurchases after being well known as good news
USA		1,3		2007-2014	Lee et al.: Repurchases after being well known as good news
USA - Completers	1,1	1,2	1,1	1985-2009	Mietzner: Why do firms decide to stop their share repurchase programs?
USA - Non-completers	1,7	insignificant	insignificant	1985-2009	Mietzner: Why do firms decide to stop their share repurchase programs?
USA - cash-financed	2,7			1994-2012	Lei and Zhang: Leveraged buybacks
USA - debt-financed	2,2			1994-2012	Lei and Zhang: Leveraged buybacks
USA	2,2		2	1998-2008	Manconi et al.: Buybacks Around the World Market Timing, Governance and Regulation
Worldwide (excluding USA)	1,3		1,5	1998-2008	Manconi et al.: Buybacks Around the World Market Timing, Governance and Regulation

Source: own work

One of the earliest studies of buyback announcements between 1970 and 1978 already found positive abnormal returns, namely a three-day CAAR of 3,7% for stocks quoted on the NYSE (Vermaelen, 1981). Looking at a more relevant time period, Manconi et al. (2014) studied buybacks around the world from 1998 to 2008 and found a three-day CAAR of 1,3% on a global level, excluding the United States, and a three-day CAAR of 2,2% for the United States, whereas seven-day CAARs amounted to 1,5% and 2,0%, respectively. Three-day CAAR of buyback announcements made in nine European countries over the period of 2000

to 2017 amounts to 1,4%, according to Anolick et al. (2021). A study (Farrugia et al., 2011) of Australian companies finds positive abnormal returns around the buyback announcements as well, but higher for firms conducting buybacks more frequently and higher for announcements during low and medium economic states. Lee et al. (2020), who studied buybacks of companies in the United States, found lower abnormal returns around the announcements after the year 2001. More precisely, they report a five-day CAARs of 2,0% from 1994 to 2001, 1,2% from 2002 to 2006 and 1,3% from 2007 to 2014. Mietzner (2017) in his study of buybacks in the United States between 1985 and 2009 reports a three-day CAAR of 1,1% for companies completing the buyback program (hereinafter “Completers”) and 1,7% for companies not completing the program (hereinafter “Non-completers”). Looking at five-day and seven-day windows, Mietzner reports positive CAARs for Completers, 1,2% and 1,1%, respectively, while Non-completers have lower and statistically insignificant values of CAARs. Lei and Zhang’s (2016) study of leveraged buybacks in the United States between 1994 and 2012 reports positive three-day CAARs for both cash-financed repurchases and debt-financed ones. However, debt-financed ones have a lower CAAR, equalling to 2,2%, than cash-financed ones, equalling to 2,7%. Further deviation of leveraged buybacks shows a positive three-day CAAR of 2,0% for underleveraged firms prior to buyback announcement and 0,6% for the overleveraged ones, but the latter is also insignificant. The results indicate that markets react positively to leveraged buyback announcements made by underleveraged firms.

2.7 Potential determinants affecting abnormal returns at announcement

Certain firm characteristics prior to buybacks can affect the direction and magnitude of abnormal returns around the announcements. In fact, many studies have tried to explain these connections, in addition to examining abnormal returns. The connections found in previous studies are presented next.

The relation between abnormal returns around the announcement (hereinafter “abnormal returns”) and firm size is expected to be negative. This is because smaller firms are not so closely examined by the public, and hence the presence of asymmetric information is more common and greater in comparison to larger firms. Consequently, the buyback announcement of smaller firms signals more information to the market, which is reflected in the abnormal returns (Vermaelen, 1981). As a buyback announcement can also be used for signalling undervaluation, whereby more undervalued firms are anticipated to experience greater market correction, a negative relationship between MTB and abnormal returns is expected, as well as a negative relationship between pre-announcement abnormal return and abnormal returns. That is because low MTB ratios proxy for undervaluation, while low or negative pre-announcement abnormal returns serve as their most recent measures (Li & McNally, 2003). The companies with substantial amounts of free cash flows (hereinafter “FCF”) or cash holdings on the balance sheet are more likely to suffer from agency costs. Since a buyback transaction represents a cash outflow for the company, the possibility of

corporate resources being wasted by the management for their own benefit is reduced. Announcement, in this context, is therefore considered as good news, and a price increase is the consequence of an unexpected rise in cash payout to shareholders or merely an intention to do so. This is particularly true for the firms with more excess cash. Hence, a positive relation between cash holdings and abnormal returns is expected and the same holds for FCF (Jensen, 1996; Li & McNally, 2003). Companies with low levels of debt can use buybacks as a tool to increase their leverage and reach the optimal capital structure while increasing interest tax shield and firm value. Therefore, buyback announcements of underleveraged firms are considered good news, which is reflected in higher abnormal returns. The inverse relationship between level of debt and abnormal return is expected (Li & McNally, 2003; Vermaelen, 1981). Measures of firms' operating performance are not commonly used to explain the abnormal returns, but the study of Siang et al. (2020) finds a negative relationship between EPS and abnormal returns, while for the other measures, such as return on assets or return on equity, the study does not find evidence that these factors would influence the abnormal returns. Studies so far have found evidence for dividends being both substitutes and supplements to share repurchases. If dividends are substitutes, a negative relation with abnormal returns is expected, whereas, on the contrary, a positive relation with abnormal returns is expected because unexpected additional cash distribution is announced (Andriosopoulos et al., 2013; Grullon & Michaely, 2000).

To the best of our knowledge, in the existing literature, it has not been studied how and if the investment activities of firms and their investment opportunities influence the abnormal returns, but only the relationship with respect to completion rates has been studied. Thus, so far, we do not expect any specific relationship between firms' investments or their opportunities and abnormal returns, as we do not have the grounds for it. Similarly, the size of a buyback program is tested only in relation to completion rates but not to the abnormal returns. The firms' liquidity is discussed in the buyback literature, but again not tested whether it influences the abnormal returns; rather, just the differences among the groups of firms initiating buybacks are examined.

Because the above-mentioned variables are considered among the buyback literature, we are interested in whether they contribute anything to the abnormal returns. We try to examine these relations in our analysis, the findings of which are presented in Section 5.3.

3 EVENT STUDY METHODOLOGY

Given the assumption of rationality in the market, the new information should be immediately reflected in asset prices. That is why event studies are very convenient and nowadays a largely used tool in the literature for examining the impact of certain firm-specific or economy-wide events on the value of a firm, more precisely on the stock prices around the events. Such events can be mergers and acquisitions, earnings announcements, buyback announcements, announcements of macroeconomic variables and other events not

strictly related to financial economics, like the events in the field of law and regulations (Campbell et al., 1997). The essence of event study is to look at the actual return around the event, compare it to the expected return if the event would not occur and check if the so-called abnormal return is statistically different from zero. Additionally, it is also a common practise to look at the underlying reasons for the abnormal returns. Although event studies originated in 1933 when Dolley studied the effect of stock splits on their prices, it is the methodology presented by Ball and Brown in 1968 and Fama, Fisher, Jensen and Roll in 1969 that is fundamentally still in use today. Later researchers only added modifications to address complications caused by violations of certain statistical assumptions (Campbell et al., 1997). The literature on the event study is enormous, which is why the following summary of event study methodology is presented in relation to the needs of the master's thesis.

3.1 Wealth effects of an event measured with abnormal returns

3.1.1 Event of interest, timeline and setting the grounds

Every event study starts by identifying the event of interest, in our case, this is a buyback announcement, and the period over which the security prices are studied, the so-called event window. It is usually applied with daily data, more precisely with closing prices (Campbell et al., 1997), and in our case, with adjusted daily closing prices, following the study of Gupta (2017) of industry-wise buyback announcement effects. The use of daily data enables easier identification of abnormal returns, but the event date should be identified with precision (Armitage, 1995). Brown and Warner (1985) find that the likelihood of detecting abnormal returns is much higher with an event window consisting of one day in comparison to eleven days, which is why short event windows of $[0]$ or day of event, $[0, +1]$, $[-1, +1]$ and $[-2, +2]$ are chosen for the analysis. For example, the event window of $[-1, +1]$ represents a day before and a day after the event. These windows are commonly used in the event studies of buyback announcements, but the use of longer event windows is no exception; hence event window of $[-10, +10]$ is chosen as well.

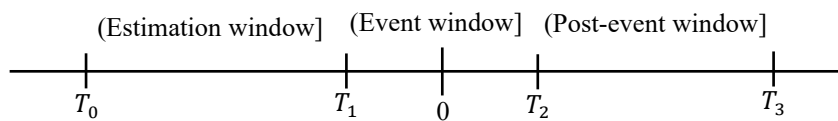
As already mentioned, abnormal returns are the actual returns of stock prices observed over the event window minus their normal returns over the event window, where normal returns represent expected returns if the event had not occurred. Abnormal return of company i and time t over the event window can be written as:

$$AR_{it}^* = R_{it}^* - E[R_{it}^* | X_t^*] \quad (1)$$

where AR_{it}^* , R_{it}^* and $E[R_{it}^* | X_t^*]$ are abnormal, actual and normal (or expected) returns of stock i at time t over the event window, where the latter are conditioned on X_t^* , the conditioning information for the normal performance model (Campbell et al., 1997). Normal returns of stock prices can be calculated with multiple models, usually with the use of data prior to the

event window. The mentioned calculation period is known as the estimation window, which should not overlap with the event window so that the event itself does not influence the estimation of the normal performance model's coefficients (Campbell et al., 1997). For studies using daily data, the typical length of the estimation window is between 100 and 300 days (Peterson, 1989), but Corrado and Zivney (1992) find that test statistics are »virtually unaffected« when as short as 89 days is used in the estimation window for the calculation of market model coefficients. And hence, the shortest among the typical lengths is chosen, more precisely, by following Campbell et al. (1997), the estimation window in this master's thesis consists of 120 days. Both the event and estimation windows are illustrated in Figure 1.

Figure 1: Event study timeline



Source: adapted from (Campbell et al., 1997)

3.1.2 Choice of model for normal return calculations

As noted earlier, variety of models exists for the calculation of normal returns, some are based solely on statistical assumptions derived from stocks' returns behaviour (E.g. index model, average return model, constant-mean return model, market model and factor model), while others add economic restrictions with purpose of obtaining more accurate measures of normal returns as assumptions of investors' behaviour are taken into account (E.g. Capital Asset Pricing Model (hereinafter "CAPM") and Asset Pricing Theory (hereinafter "APT")). The index model is probably the simplest model, where it is assumed that the stock earns the market return at any point in time, hence having the market return as the normal one. Another simple model is the average return model, where the stock's normal return is the same as its average over the estimation window. A somewhat different model from the average return one is the constant-mean return model, where normal return equals its long-term average plus a disturbance term at time t . However, the most commonly used model is the market model, where it is assumed that the normal return of the stock is linearly related to the market return. Normal returns calculated from the market model do not contain variation related to market return, and because of that, these abnormal returns have lower variance than abnormal returns obtained from a constant-mean return model, which can increase the ability of event effect detection (Armitage, 1995; Campbell et al., 1997). Brown and Warner (1985), Dyckman et al. (1984), Brenner (1979) and Brick et al. (1989) all conclude that similar results are obtained with the index and market model; however market model is a bit more powerful (Armitage, 1995). On the other hand, results from the average return model are comparable to those obtained by the market model, but not when different observations (or stocks) in the sample share the same event date (also referred to as clustering). In that case,

the average return model fails to perform well, as Type I error (rejecting the null hypothesis when it is true) is more than four times higher than with the market model (Brown & Warner, 1985). According to Armitage (1995), Brick, in his 1989 paper, comes to a similar conclusion and that's because divergences from the mean are much more cross-correlated than stocks' market model errors, resulting in higher variance of returns and poorer model performance. In addition, the average return model is biased during bull and bear markets (Klein & Rosenfeld, 1987). The presented findings in the literature give reasons why the market model is the best choice to use in the master's thesis, in comparison to the three simple alternatives. Market model is in fact a one-factor model with the market index being the sole factor, but by adding more factors, such as industry index, factor for company's size and others, we get a multifactor model. The benefit of this model is that more of the variation in normal returns is explained because factors other than just the market are considered, and hence, the variance of abnormal returns is lower. However, this gain is very small and most applicable for cases when companies in the sample are in the same industry or the same market capitalization group (Campbell et al., 1997). Since our sample of companies (explained in detail in Section 4) does not have common characteristics, a market model is still the best choice. Lastly, let us take a quick look at economic models. CAPM is a model used to price risky assets where the expected (or in our case normal) return of the stock equals risk-free rate plus the risk premium for systematic, non-diversifiable market risk, since it is assumed that stock-specific risk can be diversified away (CFI, 2025c). The model has often been used for event studies until its deviations have been discovered, which question the economic restriction implemented by the model. On the other hand, APT, with its multifactor normal performance models, implements valid restrictions on mean returns, but its use in event studies is complicated and brings almost no benefit in comparison to the market model. For the mentioned reasons, economic models are hardly used in event studies and thus statistical models prevail (Campbell et al., 1997). After analysing most of the models for normal performance, the market model is chosen for the purposes of this master's thesis as it is widely used and has evidence of its good performance, like Armitage (1995, p. 26) concluded: »market model will perform as well as, if not better than, any alternative in most circumstances«. Market model is used to calculate the relationship between returns on a stock and returns on the market with ordinary least squares regression (hereinafter "OLS regression"). This relationship, obtained from market model coefficients, is then used to calculate stocks' expected returns conditioned on market returns, so in fact our normal returns during the event window (Armitage, 1995).

3.1.3 Calculating stocks' normal sensitivity to market movements

As noted earlier, the market model can be written as:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \epsilon_{it} \quad (2)$$

$$\text{with } E[\epsilon_{it}] = 0 \text{ and } Var[\epsilon_{it}] = \sigma_{\epsilon_i}^2$$

where R_{it} are stocks' i return at time t over estimation window, R_{mt} represents the returns of the market portfolio at time t over the estimation window, usually proxied by a certain market index and ϵ_{it} represents a disturbance term with a mean equal to zero, while α_i , β_i and $\sigma_{\epsilon_i}^2$ are the market model's parameters (Campbell et al., 1997). Regarding the proxy of the market, both value and equally weighted market indexes are used as a benchmark among existing event studies. Since Type I error is comparable between the use of two benchmark indexes when market model is used (Brown & Warner, 1980) and since, similar results are obtained with both indexes, according to Armitage (1995), we use the one available to us that is also relevant for the stock market in the United States: the S&P 500 value weighted index.

Next is a written regression system for an individual stock in the estimation window:

$$\begin{bmatrix} R_{i,T_{0+1}} \\ R_{i,T_{0+2}} \\ \vdots \\ R_{i,T_1} \end{bmatrix} = \begin{bmatrix} 1 & R_{m,T_{0+1}} \\ 1 & R_{m,T_{0+2}} \\ \vdots & \vdots \\ 1 & R_{m,T_1} \end{bmatrix} * \begin{bmatrix} \alpha_i \\ \beta_i \end{bmatrix} + \begin{bmatrix} \epsilon_{i,T_{0+1}} \\ \epsilon_{i,T_{0+2}} \\ \vdots \\ \epsilon_{i,T_1} \end{bmatrix} \quad \text{or} \quad (3)$$

$$R_i = R_{mi} * \theta_i + \epsilon_i$$

where R_i is $(L_1 * 1)$ vector of stock i returns at time t during the estimation window from $t = T_{0+1}$ to $t = T_1$, which results in 120 returns for each stock i over the estimation window. R_{mi} is $(L_1 * 2)$ matrix of vector of ones and vector of market index returns at time t during the estimation window, which is specific for each stock i . This is because event dates among stocks in the sample do not coincide on the same calendar date; hence, calendar dates in the estimation window differ across observations, which also leads to differences in the values of the market index. θ_i is $(2 * 1)$ vector of parameters for stock i , a constant α_i and β_i through which the relationship with the market is captured, while ϵ_i is $(L_1 * 1)$ vector of stock's i disturbance terms.

The estimates of market model parameters, or equivalently, the coefficients that minimize the sum of squared residuals (estimates of disturbance terms) of L_1 observations over the estimation window from T_{0+1} to T_1 , are:

$$\hat{\theta}_i = (R'_{mi} * R_{mi})^{-1} * R'_{mi} * R_i \quad (4)$$

an estimate of the variance of the disturbance term is:

$$\hat{\sigma}_{\epsilon_i}^2 = \frac{1}{L_1 - 2} * \hat{\epsilon}'_i * \hat{\epsilon}_i \quad (5)$$

while the estimate of the disturbance term itself is:

$$\hat{\epsilon}_i = R_i - R_{mi} * \hat{\theta}_i \quad (6)$$

and the variance of coefficients is:

$$Var[\hat{\theta}_i] = (R'_{mi} * R_{mi})^{-1} \sigma_{\varepsilon_i}^2 \quad (7)$$

The equations from (3) to (7) are adapted from (Campbell et al., 1997).

3.1.4 Calculation of abnormal returns

Once the coefficients of the market model are calculated, we can obtain the abnormal returns, AR_i^* , over the event window, whose vector for individual stock can be written as:

$$\begin{bmatrix} AR_{i,T_{1+1}}^* \\ AR_{i,T_{1+2}}^* \\ \vdots \\ AR_{i,T_2}^* \end{bmatrix} = \begin{bmatrix} R_{i,T_{1+1}}^* \\ R_{i,T_{1+2}}^* \\ \vdots \\ R_{i,T_2}^* \end{bmatrix} - \begin{bmatrix} 1 & R_{mi,T_{1+1}}^* \\ 1 & R_{mi,T_{1+2}}^* \\ \vdots & \vdots \\ 1 & R_{mi,T_2}^* \end{bmatrix} * \begin{bmatrix} \hat{\alpha}_i \\ \hat{\beta}_i \end{bmatrix} \quad \text{or} \quad (8)$$

$$AR_i^* = R_i^* - R_{mi}^* * \hat{\theta}_i$$

where R_i^* is $(L_2 * 1)$ vector of stock i returns at time t during the event window from $t = T_{1+1}$ to $t = T_2$, R_{mi} is $(L_2 * 2)$ matrix of vector of ones and vector of market index returns at time t during event window, again specific for each stock i, as the event dates differ in calendar time and $\hat{\theta}_i$ is $(2 * 1)$ vector of coefficients for stock i, obtained from the market model from the estimation window. L_2 varies depending on the chosen length of the event window, from 1 to 21 days (Campbell et al., 1997).

3.1.5 Aggregation of abnormal returns

Because conclusions about what kind of effect events have on average cannot be drawn from the abnormal returns of individual stocks for each time t in the event window, their aggregation is necessary. Aggregation can be done in two different ways: first through time and then across stocks, or vice versa. If aggregated first through time, we get cumulative abnormal return (hereinafter “CAR”) for each stock in the sample as follows:

$$CAR_i = \sum_{t=T_{1+1}}^{T_2} AR_i^* \quad (9)$$

where t varies based on the event window length. Next, aggregation across stocks results in cumulative average abnormal return (hereinafter “CAAR”) of the whole sample as well as for the specific subsamples (presented later) as follows:

$$CAAR = \sum_{i=1}^N CAR_i \quad (10)$$

where N represents the number of different stocks in the sample (as the sample is constructed to include only one event per firm) and varies for specific subsamples. However, if

aggregation is made first across stocks, we obtain the average abnormal return (hereinafter “AAR”) for each time t in the event window as follows:

$$AAR_t = \sum_{i=1}^N AR_i^* \quad (11)$$

where N again varies based on whether we aggregate the whole sample or specific subsamples. After aggregating through time, we again obtain CAAR:

$$CAAR = \sum_{t=T_1+1}^{T_2} AAR_t \quad (12)$$

where t again varies based on the event window length. Nevertheless, which step of the aggregation process is made first, the results of CAARs are the same. At this point is worth mentioning that we obtain multiple AARs and CAARs, values from which we can draw conclusions, because we test for different event windows and different sub/samples.

The equations from (8) to (12) are adapted from (Campbell et al., 1997).

3.1.6 Hypothesis and testing for statistical significance of abnormal returns

As already mentioned, event studies are based on testing whether the abnormal returns, in our case AARs and CAARs, are statistically significantly different from zero. For that purpose, one of the standard test statistics is used, more precisely, a Student's t-test. Our calculated abnormal returns are compared to their assumed distribution under the null hypothesis that the expectation of abnormal returns is zero (Kothari & Warner, 2006).

Null hypothesis:

$$H_0: AAR = 0 \text{ or } H_0: CAAR = 0 \quad (13)$$

Alternative:

$$H_A: AAR \neq 0 \text{ or } H_A: CAAR \neq 0 \quad (14)$$

Where AAR and CAAR are assumed to be normally distributed with a mean equal to zero and a variance of $\bar{\sigma}_{(T_1, T_2)}^2$:

$$AAR \sim N(0, \bar{\sigma}_{(T_1+1, T_2)}^2) \text{ or } CAAR \sim N(0, \bar{\sigma}_{(T_1+1, T_2)}^2) \quad (15)$$

adapted by (Campbell et al., 1997). The Student's t-test is then:

$$t = \frac{AAR-0}{\sqrt{\hat{\sigma}_{(T_1+1, T_2)}^2}} \sim t_{N-1, \alpha} \text{ or } t = \frac{CAAR-0}{\sqrt{\hat{\sigma}_{(T_1+1, T_2)}^2}} \sim t_{N-1, \alpha} \quad (16)$$

where $t_{N-1, \alpha}$ is the critical value of the test statistic for the corresponding degrees of freedom ($N-1$) and tested level of significance (α). If the calculated test statistic is higher than the

critical value, we can reject the tested null hypothesis and conclude that the specific AAR or CAAR is statistically significantly different from zero at the selected level of significance (Verbič et al., 2017). Standard error from the denominator in equation (16) is the square root of the variance from the event window that measures dispersion of individual (cumulative) abnormal returns from the corresponding averages and is typically calculated as:

$$\widehat{var}_a = \frac{1}{N^2} \sum_{i=1}^N (CAR_i - CAAR)^2 \quad (17)$$

The same logic applies to the variance of AAR. The variance estimator in equation (17) is robust to serial correlation (Campbell et al., 1997).

3.1.6.1 Clustering robust variance estimator

The presented variance of AAR and CAAR in equation (17) can be used in the test statistics in equation (16), meaning $\hat{\sigma}_{(T_1+1, T_2)}^2 = \widehat{var}_a$, only if there is no correlation between the (cumulative) abnormal returns of different stocks. This assumption is violated in the case of clustering, where the event windows of included stocks overlap in calendar time (Campbell et al., 1997). Consequently, the covariance terms between different stocks are not zero, and since the variance estimator in equation (17) does not account for them, the estimated variance is lower than it should be. This increases t-statistics in equation (16), making it easier to reject the null hypothesis, which increases the possibility of a Type I error (Kolari et al., 2018). Most of the literature gives a solution in the case of complete overlap of event windows, meaning that all stocks in the sample experience an event on the same calendar date. However, in our case, the event windows overlap only partially. Therefore, we follow the paper of Kolari et al. (2018), which provides a solution to the problem at hand. They control for the cross-sectional correlation through average covariance, taking into account the average length of overlapping event windows. So, the clustering robust (cumulative) abnormal return variance estimator is:

$$\hat{\sigma}_{(T_1+1, T_2)}^2 = \widehat{var}_a * (1 + \delta(N - 1)\hat{\gamma}) \quad (18)$$

where $\widehat{var}_a$ is the same as in equation (17), while the second term captures the cross-sectional correlation, thereby increasing the variance estimator. Delta (δ) »is the ratio of the average number of overlapping calendar days of the event windows to the length of event windows«, which can be written as:

$$\delta = \frac{\bar{\tau}}{\tau} \quad (19)$$

and gamma ($\hat{\gamma}$) is the estimator for the ratio of the average covariance between abnormal returns to their average variance, calculated as:

$$\hat{\gamma} = \frac{\bar{v}}{\bar{\sigma}^2} = \frac{n}{m} * \left(\frac{\hat{\sigma}_{cr}^2}{\bar{\sigma}^2} - 1 \right) \quad (20)$$

The estimator in equation (20) captures the average covariance ($\bar{v}$) and average variance ($\bar{\sigma}^2$) of abnormal returns based on estimates of disturbance terms obtained with OLS regression from the estimation window (equation (6)). More precisely, the covariance of residuals that have the same calendar day is taken into account. Let $\hat{\epsilon}_t$ be:

$$\hat{\epsilon}_t = \sum_{i=1}^{n_t} \hat{\epsilon}_{it} \quad (21)$$

the sum of all residuals that have the same calendar day, where n_t represents their total number on a specific day (t) in the estimation window. Then $\hat{\epsilon}_t^2$ is:

$$\hat{\epsilon}_t^2 = \sum_{i=1}^{n_t} \hat{\epsilon}_{it}^2 + \sum_{i \neq j}^{n_t} \hat{\epsilon}_{it} \hat{\epsilon}_{jt} \quad (22)$$

By summing these up over calendar days of the estimation windows, taking the average of cross-product terms and rearranging the equation (22), we obtain an estimator for the average covariance of the estimation window cross-sectional residuals:

$$\bar{v} = \frac{1}{m} \sum_{t=1}^L \sum_{i \neq j}^{n_t} \hat{\epsilon}_{it} \hat{\epsilon}_{jt} = \frac{1}{m} \left(\sum_{t=1}^L \hat{\epsilon}_t^2 - \sum_{t=1}^L \sum_{i=1}^{n_t} \hat{\epsilon}_{it}^2 \right) \quad (23)$$

Where L represents the total number of calendar days for which $n_t \geq 1$, while m is the total number of cross-product terms, hence $m = \sum_{t=1}^L n_t(n_t - 1)$ where it is seen that calendar days with only one residual do not contribute to the cross-product. Next, by separately averaging the terms inside parentheses in equation (23) with the total number of estimation window residuals of the stocks experiencing an event, defined as: $n = \sum_{t=1}^L n_t$, we get:

- Clustering robust estimator of the average of the estimation window residuals variances over the entire sample:

$$\hat{\sigma}_{cr}^2 = \frac{1}{n} \sum_{t=1}^L \hat{\epsilon}_t^2 \quad (24)$$

- and its clustering non-robust version:

$$\hat{\sigma}^2 = \frac{1}{n} \sum_{t=1}^L \sum_{i=1}^{n_t} \hat{\epsilon}_{it}^2 \quad (25)$$

Equations from (21) to (25) give all the necessary steps to calculate the gamma estimator in equation (20) needed for the computation of clustering robust (cumulative) abnormal return variance estimator (equation (18)) used in Student's t-test (equation (16)). Again, we obtain multiple variance estimators based on equation (18), one for each combination of sub/samples and tested time period in the event window.

3.2 Non-parametric test

The abnormal returns, obtained based on the methodology described in Section 3.1, are assumed to be normally distributed. However, the test statistics (Equation (16) in Section

3.1.6) can be mis-specified if the assumption of normality is violated, which can lead to inaccurate interpretations of the significance level of abnormal returns. According to Brown and Warner (1985), daily stock returns and hence also daily abnormal stock returns on the NYSE have a small degree of nonnormality, such that it does not affect the correctness of the test statistics. On the other hand, Campbell and Wasley (1993) report that stocks quoted on NASDAQ have a large degree of nonnormality present in their daily (abnormal) returns, which is observed also after the aggregation process. In fact, according to them, the distribution of AAR and CAAR of NASDAQ securities is skewed and has fatter tails, exhibiting larger extreme values, than the assumed normal distribution in test statistics. Because of these violations, the null hypothesis is rejected too often when there are no abnormal returns (Type I error). In such cases, the use of non-parametric tests is advised, as these tests do not require a specific assumption about the distribution of abnormal returns. In fact, many studies use non-parametric tests alongside the parametric ones, as the assumption of normality is rarely fulfilled among the actual data (Campbell et al., 1997).

To test whether the obtained AARs are distributed normally or not, we use the Shapiro-Wilk test. This test assumes that the data is normally distributed under the null hypothesis and is not normally distributed under the alternative hypothesis. To reject the null hypothesis at 5% significance level and accept the alternative of data being nonnormally distributed, the p-value of the Shapiro-Wilk test statistic needs to be lower than 0,05 (King & Eckersley, 2019). The most common and widely used non-parametric tests are the sign test and the rank test (Campbell et al., 1997). The sign test is very simple and straightforward, focusing only on the direction or sign of the abnormal returns. In essence, it assumes that under the null hypothesis, there is an equal proportion ($p = 0,5$) of abnormal returns being positive and negative. Hence, it looks for the number of positive abnormal returns relative to all and checks if the proportion of positive abnormal returns is higher or lower than 50% to make inferences about the effect of an event. Even though no specific assumption about distribution is needed, the sign test can still be mis-specified if the abnormal returns are skewed because the expected proportion of abnormal returns in this case may be higher or lower than the one assumed under the null hypothesis (Campbell et al., 1997). Due to this shortcoming, in our master's thesis, we perform a rank test, where the skewness in distribution of the abnormal returns is irrelevant for correct test specification (Corrado, 1989). When conducting Corrado's (1989) rank test, the procedure of obtaining the abnormal returns during the event window is the same as it is with the parametric test, up until the aggregation of abnormal returns. Once the abnormal returns are obtained, both from estimation and event windows, they are ranked based on their values, from smallest to highest, for each individual stock, where abnormal returns from the estimation windows are simply observed stocks' returns minus the corresponding market returns, proxied by the S&P500 index. The ranks (K_{it}) of abnormal returns (AR_{it}) are hence defined as:

$$K_{it} = rank(AR_{it}) \quad (26)$$

where t goes from T_{0+1} to T_1 over 120 estimation days and from T_{1+1} to T_2 over 21 days in the event window and i represents a specific stock. The higher abnormal returns get the higher rank, which ranges from 1 to 141 (K_{range}). The rank test compares the ranks of abnormal returns during the event window with the average rank ($\bar{K}$), where the latter is defined as:

$$\bar{K} = \frac{K_{range} + 1}{2} \quad (27)$$

The rank statistics for AARs ($T_{Rank_{AAR}}$) is then:

$$T_{Rank_{AAR}} = \frac{1}{N} \sum_{i=1}^N (K_{i0} - \bar{K}) / S(K) \quad (28)$$

where N is the number of stocks in the subsamples, (K_{i0}) is the rank of the abnormal return of stock i on the event date and $S(K)$ is the standard deviation calculated as:

$$S(K) = \sqrt{\frac{1}{T} \sum_{t=T_{0+1}}^{T_2} \left(\frac{1}{N} \sum_{i=1}^N K_{i0} - \bar{K} \right)^2} \quad (29)$$

which includes estimation and event window abnormal returns, hence T ranges from T_{0+1} to T_1 and from T_{1+1} to T_2 . A slight modification is needed when conducting a rank test for CAARs. By following Campbell and Wasley (1993), we define this rank statistic as ($T_{Rank_{CAAR}}$):

$$T_{Rank_{CAAR}} = \frac{\sum_{\tau=t_{1+1}}^{t_2} \bar{k}_\tau}{\sqrt{\sum_{\tau=t_{1+1}}^{t_2} s^2(\bar{k}_\tau)}} \quad (30)$$

where τ represents a chosen event window, larger than one day, and holds that its indices are between $T_{1+1} \leq t_{1+1} \leq \tau \leq t_2 \leq T_2$. $\bar{k}_\tau$ is the average excess-return rank of all stocks included in the subsample on a specific day τ , calculated by the same procedure as in the numerator of equation (28) and repeated for each day in the chosen event window, including the day of the event. The denominator of equation (30) accounts for a period of multiple days, but otherwise the standard deviation is calculated the same as in equation (29). Under the null hypothesis, for both rank statistics, equation (28) and equation (30), the excess-return ranks follow a uniform distribution based on the ranks included in the test and regardless of properties in the original distribution. Such rank statistics are well specified (Campbell & Wesley, 1993; Corrado, 1989).

3.3 OLS cross-sectional regression

In event studies, it is a common practice to not only look at the mean effects of the event on the stock prices but also to analyse the underlying factors contributing to the effect and its magnitude. For that reason, cross-sectional regression is also performed, where individual

(cumulative) abnormal returns are regressed against the companies' characteristics of interest, such as size, MTB, cash, etc. (Kothari & Warner, 2006). The cross-sectional regression equation can be written as:

$$CAR = X\lambda + \eta \quad (31)$$

where CAR is $(N * 1)$ vector of cumulative abnormal returns over the selected event window with variations of N depending on the number of stocks in the sub/samples. X is $(N * K)$ matrix with the first column of ones and $(K - 1)$ columns of companies' characteristics, which apply to all stocks experiencing an event. Lambda (λ) is the coefficient vector of $(K * 1)$ while eta (η) is the disturbance vector of $(N * 1)$. Lambda can be consistently estimated with OLS regression under the assumption that disturbance terms are not correlated with companies' characteristics, so if $E[X'\eta] = 0$. Then the OLS estimator is:

$$\hat{\lambda} = (X'X)^{-1}X' * CAR \quad (32)$$

Under the assumption of cross-sectionally uncorrelated disturbance terms (η) and their homoskedasticity, one can determine the statistical significance of coefficients in equation (32), using OLS standard errors, and hence draw conclusions about significant relations between firms' characteristics and cumulative abnormal returns. Whereby the variance of the OLS estimator, used in the significance test, is:

$$Var[\hat{\lambda}] = (X'X)^{-1}\sigma_{\eta}^2 \text{ where: } \hat{\sigma}_{\eta}^2 = \frac{1}{N-K} * \eta'\eta \quad (33)$$

whereas a significance test is a Student's t-test of a form:

$$t_{cs} = \frac{\hat{\lambda}_j - \lambda_j}{se(\hat{\lambda}_j)} \sim t_{N-K, \alpha} \quad (34)$$

adapted by (Verbič et al., 2017).

But if heteroskedasticity among the disturbance terms (η) is detected, it is accounted for using White's adjustment for heteroskedasticity, thereby ensuring consistent variance estimates for the significance test in equation (34), calculated as:

$$Var[\hat{\lambda}] = \frac{1}{N}(X'X)^{-1}[\sum_{i=1}^N x_i x_i' \hat{\eta}_i^2](X'X)^{-1} \quad (35)$$

where x_i' is the i -th row of matrix X and $\hat{\eta}_i$ is the i -th element of the vector $\hat{\eta}$ (Campbell et al., 1997). The companies' characteristics in matrix X in equation (31) are based on data from the year before the year of buyback announcements (Jain, 1982), which varies between the stocks due to different event dates.

We also check for the presence of multicollinearity in the cross-sectional regression model. Even though the multicollinearity does not affect the consistency of regression coefficients,

it makes them unreliable since their variance is inflated and Type II error (not rejecting the null hypothesis when it is false) can occur when testing for their significance. Firstly, we examine the correlations between the independent variables (companies' characteristics) included in the model and after the regression coefficients are obtained, we calculate their variance inflation factors (hereinafter "VIF"). This measure checks for the degree to which collinearity inflates the variance of the estimated regression coefficient and is calculated as:

$$VIF_i = \frac{1}{1-R_i^2} \quad (36)$$

where R_i^2 is the unadjusted R-squared from regression, where the i^{th} independent variable is regressed on all other independent variables included in the cross-sectional regression. If VIF_i is below 4, we do not exhibit the collinearity in the estimated regression coefficient, while a value above 10 indicates strong collinearity that should be accounted for (CFI, 2025d).

3.4 Binary model

In addition to performing OLS cross-sectional regression explained in Section 3.3, where we look at which firms' characteristics affect the abnormal returns around announcements and to what extent, we also perform a binary model, where we focus on examining whether the certain firms' characteristics significantly influence the likelihood of the buyback program being completed or not, fully equity financed or not and financed by debt or mixture of both, already at the announcement. The dependent variable in this model is a binary response, taking only values 0 or 1, for example, 0 for not completing the buyback program and 1 for completing it. Therefore, we can test with this model whether a certain firm characteristic, an independent variable, makes one outcome more or less likely than the other. The most commonly used binary models are probit and logit, which mainly differ from each other in the assumed distribution of independent variables, the former follows a standard normal distribution and the latter a logistic one. The model coefficients cannot be compared directly between the models because the underlying distributions have different variances, for probit it equals 1 and for logit to $\pi^2/3$. But after accounting for this, the obtained results are virtually the same unless the sample includes a large number of extreme values because the logistic distribution has thicker tails, similar to the Student-t distribution, than the standard normal (Klieštík et al., 2015). We therefore focus on the logit model, in terms of presenting its theory and reporting the obtained results. But for our internal side control, we also perform the probit model. The logit model specifies the probability of the outcome being 1, given certain independent variables, as the logistic function:

$$p = pr[y = 1|x] = F(x'\beta) = \Lambda(x'\beta) = \frac{1}{1+e^{-x'\beta}} \quad (37)$$

where predicted probabilities are limited between 0 and 1 ($0 \leq \Lambda(x'\beta) \leq 1$) and $x'\beta$ is a linear function of independent variables. The logit model can therefore be written as:

$$\ln\left(\frac{p}{1-p}\right) = b_0 + b_1x_1 + \dots b_kx_k \quad (38)$$

where the model's parameters are calculated using OLS regression techniques (Glantz & Kissell, 2014). After obtaining the coefficients, it is necessary to calculate marginal effects in order to observe the change in probability of the dependent variable (y) equalling 1 given a 1 unit change in an independent variable (x_k). Individual marginal effect is calculated as:

$$\frac{\partial p_i}{\partial x_{k,i}} = \Lambda'_i(x_i'\beta) * \beta_k = \Lambda_i(x_i'\beta) * (1 - \Lambda_i(x_i'\beta)) * \beta_k \quad (39)$$

where i represents an individual observation and k specific independent variable. The average marginal effect of specific coefficient k is obtained by simply taking the average of individual marginal effects (equation (39)) of all observations included in the model. The left-hand side of equation (38) is the log of odds, whereby the odds are defined as the probability of y equalling 1 relative to the probability of y equalling 0, known as the odds ratio. The goodness of fit of the model is assessed by looking at the correctly predicted values of y with the model relative to total predictions as well as looking at the pseudo R-squared, a measure that compares the log-likelihood of the model with all variables included (L_m) and log-likelihood of the model that contains only a constant ($L_{const.}$):

$$pseudo\ R\ squared = 1 - \frac{L_m}{L_{const.}} \quad (40)$$

where the lower the pseudo R-squared, the lower the explanatory power of our model, with an extreme example in case independent variables in our logit model do not have any explanatory power, meaning that our model is the same as the constant model and hence the value of pseudo R-squared is zero (Wooldridge, 2014).

4 DATA FOR THE ANALYSIS

The sample in the master's thesis includes publicly listed companies in the United States that made open market buyback announcements as well as ended their program between 1st of January 2000 and 31st of December 2019. The data about buyback announcements is obtained from the Capital IQ Pro database with an initial search including 9.149 observations, whereas the daily stock prices used to calculate their returns are obtained from Yahoo Finance. The data on the firm's characteristics is also obtained from the Capital IQ Pro database. The variables used in our analysis are explained in the master's thesis, where applicable, but the key variables are also summarized in Appendix 2.

4.1 Sample selection process

However, the primary sample needs some modifications. Firstly, the sample also includes observations that are not solely open market buyback announcements, but are rather mixed

with either tender offer, negotiated buyback or other, and hence 838 of these observations are removed as the focus is only on open market buybacks. An additional 3,355 observations are removed as there is no data available for either the planned amount of buyback at the time of announcement or the total value of actually repurchased shares at the end of the transaction. Both values are needed for separating buyback programs into Completed and Non-completed (criteria to be explained in Section 4.2). This is done by following Andriosopoulos et al. (2013), who calculated the completion rate of the announced buyback programs by dividing the total number of repurchased shares by the intended number of shares to be bought back at the announcement. Although we have available data in value terms rather than in the number of shares, the approach of obtaining the completion rate remains the same as in the mentioned study. Next, we eliminate 1,136 observations whose program did not end before the year 2020 since our initial search did not include a time restriction on when the program needs to end, no matter if it is completed or not. Additionally, we remove 60 regulated utility firms with SIC codes 481 and 491 to 494 as well as 962 financial institutions and their holding companies with SIC codes between 600 and 699. We support the removal of utility and financial firms with the study of Mietzner (2017) as well as Ding et al. (2020), as these firms are subject to specific regulation. As already noted in Section 3.1.1, in event studies, it is important that the day of the event is determined with as much precision as possible to obtain the most accurate results. In the Capital IQ Pro database base we can gather information on the announcement date (the date on which the transaction was announced) and the definitive agreement date (the date the deal event occurred). In some observations, the difference between the two dates can be as large as 178 days, and hence, there exists potential leakage of information to the market from the day the deal occurred till its announcement, which could undermine the study's accuracy. Therefore, only observations with matching announcement and definitive agreement dates are included in the sample, resulting in the removal of an additional 1,459 observations. Next, 43 observations are removed due to the unavailability of prices for certain stocks on Yahoo Finance. After describing the modification process, we now have 1,296 observations in the sample, but this sample also includes firms that have more than one buyback announcement in the 20-year observation period. Different studies have different solutions when dealing with subsequent buyback announcements. For example, the study of Bhattacharya and Jacobsen (2016) requires a 3-year break between the two buyback announcements in order to prevent the effect of the previous buyback program on stock prices from being captured in the estimation window of the subsequent buyback. Whereas the study of Ding et al. (2020) includes in their sample multiple buyback announcements made by the same firm within one year but does not obtain abnormal returns with the market model because the measurement of normal return during the estimation period would be biased. However, we address this issue by including only the firms' first buyback announcement. Besides, it is a common practice to include only the first announcement in event studies (Campbell et al., 1997). We end up with 593 observations, one per firm. Furthermore, 37 observations are lost because the announcement date is on a non-trading day or stock prices are not available throughout the entire estimation window. Lastly, 29

transactions are removed due to the unavailability of financial data needed for cross-sectional regression. Finally, our sample used in the master's thesis consists of 527 observations with only one announcement per firm. The sample selection process is summarized in Table 2.

Table 2: Sample selection process and number of total observations in our sample

Sample selection process	
	No. of observations
Initial search	9.149
- open market buyback in mixture with other type of buyback	-838
- missing information for planned or actual amount of buyback	-3.355
- program not ending before 2020	-1.136
- regulated utility firms (SIC codes 481 and 491 to 494)	-60
- financial institutions (SIC codes between 600 and 699)	-962
- unable to identify announcement date with enough precision	-1.459
- unavailability of stock's prices	-43
=	1.296
- subsequent buybacks	-703
=	593
- announcement on non-trading day	-37
- unavailability of firm's financial data	-29
Our sample	527

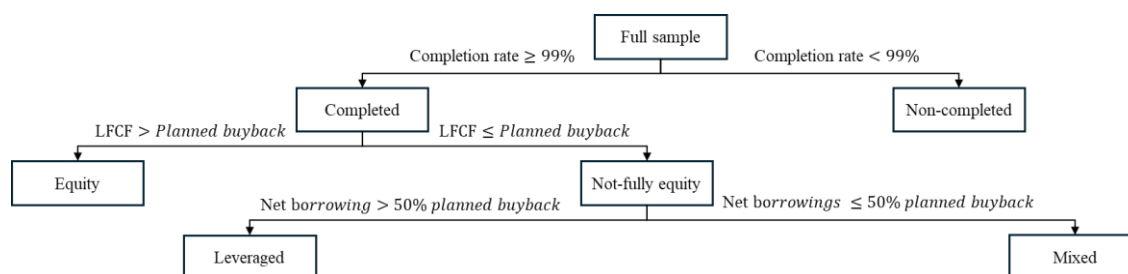
Source: own work

4.2 Full sample and subsamples

The Full sample of observations is divided based on buyback completion rate and source of funding. If the completion rate is equal to or above 99%, we define the buyback program as Completed; otherwise, as Non-completed. The Completed buybacks are further divided based on whether the firm uses only its own resources to finance the buyback program or not. For that reason, we look at the levered free cash flow (hereinafter “LFCF”) measure, which shows how much cash, generated from the company’s operating activities, is left after accounting for capital expenditure and interest payments for the company’s financial obligations (Capital IQ Pro). In essence, it is a measure of how much cash is available to the managers/shareholders for either (i) investing it back into the business, (ii) distributing it via dividends/buybacks or (iii) simply keeping it at the company’s balance sheet (Wave, 2025). Therefore, if the LFCF during the buyback period is higher than the amount of buyback itself, we assume that the company generates enough cash to fund this buyback program completely from its own resources and we define it as Equity buyback; otherwise, the buyback is classified as Not-fully equity financed one. Other companies’ own resources, like accumulated free reserves, use of securities premium account or issuance of new shares, can be used to finance buybacks (Kumari, 2024); however, for the purposes of this master’s thesis and based on the availability of data, the best measure for this division is the chosen LFCF measure. Next, by drawing from research of Farooqi (2004), we classify buyback as Leveraged, if the firm borrows more than 50% of the planned buyback amount during the buyback period, as substantial cash has been raised, possibly for the buyback. If the buyback

cannot be classified as Equity or Leveraged, it is most likely financed by both own resources and borrowed money and is hence classified as Mixed buyback. Figure 2 shows the buyback classification process.

Figure 2: Full sample and its subsample classification

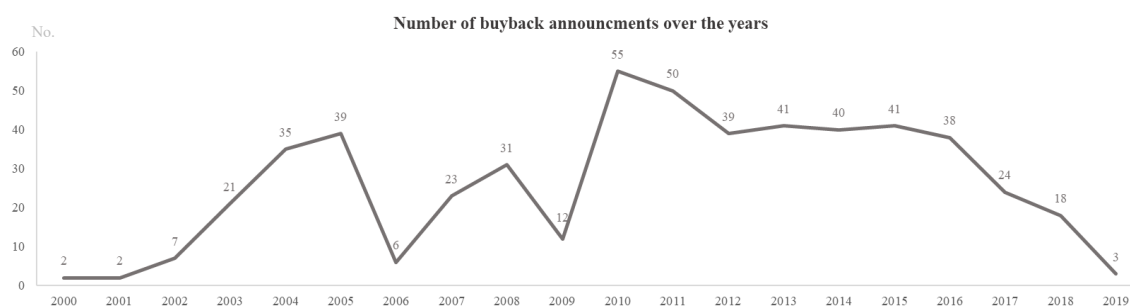


Source: own work

4.3 Descriptive statistics

Figure 3 shows the number of buyback announcements that the analysed companies made throughout the observation period. In 2000, only 3 announcements were made but in the following years, the upward trend was observed as buybacks gained popularity. Nonetheless, during the years of the Great Recession, the announcement activity is lower, with two noticeable drops, one just before its start in 2006 and the other in its last year in 2009. However, just a year later, companies made most announcements in the entire observation period, in total of 55. Announcement activity was steady during the years 2012 and 2016, followed by a decline when approaching the year 2019. Figure 3 nicely shows that during the economic downturns, companies made fewer buyback announcements.

Figure 3: Number of buyback announcements over the observation period



Source: own work

Sector-wise, half of the announcements are made in the consumer as well as technology, media and telecom sector, while the lowest amount of buybacks is announced in the financial and real estate sectors. The more detailed breakdown is presented in Table 3. More than half of the announced buybacks in the Technology, Media and Telecom sector are not completed. This could be due to a highly competitive and innovative sector, which presents a lot of

growth opportunities to the companies that need to take them if they want to keep up with their peers and keep operating in their sector. Consequently, companies may need to cancel their repurchase programs to invest in their businesses. To further look at the breakdown of Completed buybacks, we observe that Equity buybacks and Mixed buybacks prevail in the Consumer sector, while most of the Leveraged buybacks are made in the Industrials.

Table 3: Buyback announcements by sector and buyback sub/samples

Buybacks announcements by sector and buyback sub/samples																		
	Consumer		Technology, Media & Telecom		Industrials		Health Care		Materials		Energy and Utilities		Financials		Real Estate		Total	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Full sample	144	100	120	100	119	100	64	100	39	100	26	100	13	100	2	100	527	100
Non-completed	65	45	61	51	54	45	22	34	18	46	14	54	7	54	1	50	242	46
Completed	79	55	59	49	65	55	42	66	21	54	12	46	6	46	1	50	285	54
Equity	42	29	30	25	33	28	27	42	12	31	6	23	5	38	0	0	155	29
Not-fully equity	37	26	29	24	32	27	15	23	9	23	6	23	1	8	1	50	130	25
Leveraged	9	6	7	6	15	13	2	3	1	3	2	8	0	0	0	0	36	7
Mixed	28	19	22	18	17	14	13	20	8	21	4	15	1	8	1	50	94	18

Source: own work

Table 4 summarizes the buyback features of the companies included in the analysis. The Full sample consists of 527 buyback announcements, one per firm, from which 242 or 46% are from companies that do not complete the buyback program (hereinafter “Non-completers”) and, on average, repurchase 48% of the planned buyback amount at the announcement date. On average, the size of the planned buyback at the announcement amounts to 479 million USD for Non-completers, which is less than the companies that complete the buyback program (hereinafter “Completers”), with an average planned buyback amount of 980 million USD. Whereas the highest planned amount of buyback is announced by firms identified to fund the program from their own resources, on average, 1.169 million USD. These finding contradicts the existing literature presented in Section 2.3, stating that companies that plan to repurchase less tend to have higher completion rates. Buyback program, on average lasts 2,1 years for the Full sample, 1,7 years for Completers and 2,1 years for Non-completers, supporting the argument that the shorter the program’s period, the higher its completion. On average, companies start to repurchase shares 1,3 years after the announcement but for Non-completers this period is even longer and is equal to 1,9 years. Average length between buyback announcement and start of repurchase for Completers is 0,8 years; however, 163 companies start repurchasing right after announcement, 206 companies start repurchasing within a year from the day of announcement and only 79 companies later than one year. Based on our sample, we can confirm that the sooner the company starts with repurchase, the higher the completion rates. We already mentioned that 242 out of 527 companies do not finish the announced buyback program, which leaves us with 285 companies that do. Table 4 also shows that 155 buybacks of companies that complete the program are identified as Equity buybacks, whereas the remaining 130 as Not-fully equity financed buybacks, namely 36 are identified as Leveraged and 94 as Mixed buybacks.

Next, we look at firm characteristics of companies initiating the buyback and focus on the differences in characteristics depending on how the buyback is carried out. Firm characteristics are chosen based on the characteristics used in previous studies trying to explain either their connection to the abnormal returns or differences between the averages of groups based on how the buyback is carried out. Commonly, the firm's size is taken under

Table 4: Buyback features by sub/samples

Average buyback features by sub/samples					
Sub/samples	No. of observations	Size of planned buyback at the announcement (000 USD)	Completion rate (%)	Length of buyback process (in years)	Length between announcement and start of repurchase (in years)
Full sample	527	749.699	76	2,1	1,3
Non-completed	242	478.776	48	2,6	1,9
Completed	285	979.745	100	1,7	0,8
Equity	155	1.169.094	100	2,1	1,1
Not-fully equity	130	753.983	100	1,2	0,5
Leveraged	36	632.521	100	1,3	0,8
Mixed	94	800.501	100	1,1	0,4

The Table represents average buyback features by sub/samples where: Size of planned buyback at the announcement is the amount of shares company announces to repurchase in value terms; Completion rate is calculated as amount of shares bought back divided by size of planned buyback; Length of the buyback is the difference between the ending of the program (termination or completion) and announcement date; Length between announcement and start of repurchase is the difference between tranche 1 start date and announcement date.

Source: own work

review, hence we include it in the analysis, where we follow the papers of Lei and Zhang (2016), Andres et al. (2018) and Gupta and Wagner (2018) for its calculation. In the mentioned studies, the Size is proxied with the logarithmic value of the firm's total assets. We also include MTB value, which is the market value of equity, calculated as the number of shares outstanding times share price, divided by book value of equity, as in the study of Mietzner (2017). Cash and FCF are scaled with total assets, like in the studies of Andres et al. (2018) and Kahle (2002), respectively. To look at the firm's investment activities and opportunities we follow Mietzner (2017) and include: (i) firm's investment, which is measured as capital expenditure (capex) divided by total assets, (ii) firm's investment opportunities measured as annual change in total sales, since sales reflect expansion potential, which is connected to investment opportunities and (iii) annual change in capex to observe changes in additions to fixed assets. In the analysis, we also consider the firm's leverage, measured as total debt divided by total assets and the firm's credit risk, as does the study of Lei and Zhang (2016). This credit risk is measured with Altman's (1968) Z-score, by taking into account firm's working capital (WC), retained earnings (RE), earnings before interest and taxes (EBIT), market value of equity (MVE) and net sales (NS), where all variables are divided by total assets, except MVE which is divided by total liabilities. The z-score is calculated as:

$$z \text{ score} = 1,2 * WC + 1,4 * RE + 3,3 * EBIT + 0,6 * MVE + 1,0 * NS \quad (41)$$

where a lower value represents higher financial distress risk. More precisely, values between 0 and 1.800 represent a distress zone, where the risk of bankruptcy is high, a grey zone with moderate risk of bankruptcy follows, whereas values above 3.000 signify a good financial position and companies are in a safe zone. At this point is worth mentioning the limitation

of Altman's measure of credit risk as it is calculated, and thresholds of bankruptcy are assessed, based on the firm's data as well as business and macroeconomic environment from over 30 years prior to the start of our analysed time period. Hence, in our analysed time period, some other variables might influence the measure of credit risk that are not included in the calculation of the z-score, or the relation of included variables might be different in their magnitude. We also examine a firm's operating performance with return on equity (ROE), calculated as net income divided by total equity, and earnings per share (EPS). Lastly, the company's liquidity, measured with the quick ratio, and amount of dividends paid out to shareholders, again scaled by total assets, are under review. Because many variables are looked at in relation to total assets, let us examine the total assets of companies in the analysis in more detail. Included companies are quite large with a mean value of assets equalling 8,2 billion USD and ranging from as low as 1,6 million USD to as high as 647,8 billion USD, as shown in Table 5.

Table 5: Size of the companies in the analysis

Size of the companies in the analysis	
000 USD	Total assets
Min	1.599
Max	647.828.000
Mean	8.243.053
Median	1.551.015

Source: own work

Table 6 summarizes the average values of chosen firm characteristics by sub/samples at the end of the year preceding the announcement year. All the results that we interpret next refer to average values unless stated otherwise.

Table 6: Firm characteristics by sub/samples

Average firm characteristics by sub/samples													
Sub/samples	Size	MTB	Cash	FCF	Investment	Inv. Opp.	Capex change	Leverage	Z-score	ROE	EPS	Liquidity	Dividends
Full sample	6,1	2,4	0,14	0,03	0,04	0,15	0,28	0,21	3,885	0,10	0,55	2,72	0,01
Non-completed	5,9	2,7	0,15	0,03	0,04	0,17	0,25	0,22	4,671	0,08	0,09	2,85	0,02
Completed	6,4	2,1	0,14	0,03	0,04	0,13	0,30	0,20	3,232	0,11	1,43	2,62	0,01
Equity	6,5	1,4	0,12	0,03	0,04	0,14	0,24	0,22	2,234	0,10	1,02	2,27	0,01
Not-fully equity	6,2	3,1	0,16	0,03	0,05	0,13	0,37	0,17	4,422	0,12	1,92	3,03	0,01
<i>Leveraged</i>	<i>6,4</i>	<i>5,1</i>	<i>0,13</i>	<i>0,01</i>	<i>0,05</i>	<i>0,10</i>	<i>0,38</i>	<i>0,19</i>	<i>2,391</i>	<i>0,18</i>	<i>1,90</i>	<i>2,31</i>	<i>0,01</i>
<i>Mixed</i>	<i>6,1</i>	<i>2,3</i>	<i>0,17</i>	<i>0,04</i>	<i>0,04</i>	<i>0,14</i>	<i>0,37</i>	<i>0,16</i>	<i>5,199</i>	<i>0,10</i>	<i>1,92</i>	<i>3,31</i>	<i>0,01</i>

The Table represents average values of chosen firm characteristics by sub/samples where the data is gathered at the last day a year before buyback program is announced and: **Size** is log10 of total assets; **MTB** is market value of equity (number of shares outstanding * share price) divided by book value of equity; **Cash** is cash divided by total assets; **FCF** is free cash flows divided by total assets; **Investment** is capital expenditure divided by total assets; **Inv. opp.** (Investment opportunity) is annual change in total sales ($Sales_{t-1} - Sales_{t-2} / Sales_{t-2}$ where $t = 0$ is year of announcement); **Capex change** is yearly change in capital expenditure ($Capex_{t-1} - Capex_{t-2} / Capex_{t-2}$ where $t = 0$ is year of announcement); **Leverage** is total debt divided by total assets; **Z-score** is measure of credit risk defined by Altman (1968); **ROE (return on equity)** is a measure of operating performance and is calculated as net income divided by total equity; **EPS** is earnings per share measurement obtained from Capital IQ Pro; **Liquidity** is quick ratio (cash, cash equivalents and short-term receivables divided by total current liabilities); **Dividend** is dividends paid to shareholder divided by total assets.

Source: own work

Table 6 shows that Completers are larger than Non-completers, have approximately the same level of investments a year prior to buyback announcements but have fewer investment opportunities. These findings are in line with Andriosopoulos et al. (2013) and Mietzner

(2017), showing that larger, more mature firms with lower investment opportunities complete their announced buyback programs. Surprisingly, Completers have a higher capex change than Non-completers, meaning that they increased their spending in fixed assets, from two years before to one year before the buyback announcements, by more than Non-completers. This is contrary to the findings of Mietzner (2017), who claims that companies complete repurchase programs if it is more valuable than an investment. But higher Capex change for Completers can prove to shareholders that companies can increase investments in their business alongside cash distribution, showing their good financial and business health. Moreover, Completers have lower MTB than Non-completers, which proves that more undervalued firms or value firms tend to complete the repurchase program, which is what previous studies conclude as well. Cash-wise, both in terms of cash on the balance sheet and free cash flows, Completers and Non-completers are almost the same, suggesting that this is not a factor differentiating the two. Further analysis of only Non-completers shows that the level of cash does not influence the completion rates, as the level of cash of the 10% of Non-completers with the lowest completion rates is virtually the same as the level of cash of the 10% of Non-completers with the highest completion rates, both in average and total term, as Table 7 shows. This could indicate that the free cash flow hypothesis cannot explain the buyback decisions, since agency costs seem to be the same regardless of completion rates, hence cannot be the motive to complete the buybacks. However, free cash flows are higher among Non-completers with higher completion rates, also presented in Table 7, suggesting that, nonetheless, higher agency costs could be a motive for buyback completion.

Table 7: Non-completers' cash and FCF breakdown by completion rates

Non-completers' cash and FCF breakdown by completion rates				
Rank of companies by completion rates	Average		Total	
	Cash	FCF	Cash	FCF
Lowest 10%	0,17	0,01	3,98	0,15
Highest 10%	0,16	0,04	3,88	0,93

The table represents average and total values of Cash and FCF for the top and bottom 10% of companies not completing the buyback program. Both measures are divided by total assets.

Source: own work

Referring again to Table 6, the leverage of Non-completers is slightly higher than for Completers, but the financial distress risk is lower for Non-completers. However, both are in good financial position, away from the risk of bankruptcy. Operating performance is better for Completers since their ROE and EPS are higher than for Non-completers. Mietzner (2017) argues that firms with better growth opportunities tend to hold on to liquid assets as they will need them in the future more than firms that do not have such a good option for growth. Since the results in Table 6 suggest that Non-completers are closer to growth firms and Completers to value firms, we can agree with just mentioned Mietzner's (2017) reasoning, since we observe higher liquidity for Non-completers than Completers. Non-completers pay out more dividends than Completers, suggesting that dividends are

substitutes and not supplements as found by Andriosopoulos et al. (2013). A more detailed analysis of Completers reveals that firms initiating Leveraged buybacks and Equity buybacks are similar in terms of their size but are larger than the ones initiating Mixed buybacks. MTB ratio is the lowest for the subsample of Equity buybacks, implying that these companies are value companies or undervalued and hence signalling their undervaluation could be the main reason for undertaking buybacks. Conversely, the subsample of Leveraged buybacks has the highest MTB ratio, a value of 5,1, meaning that these companies are overvalued, hence it is unreasonable to assume that these companies' motive for buybacks is signalling undervaluation. Somewhere in between, in terms of MTB ratio, are companies initiating Mixed buybacks, which have the highest amounts of cash and FCF, having the most potential for undertaking buybacks due to lowering agency costs. Investments and their opportunities are quite similar among subsamples of Completers, but the capex change is the highest for Not-fully equity financed ones. Leverage is the highest for companies undertaking Equity buybacks, while the lowest is for those undertaking Mixed buybacks, which is contrary to the findings of Lei and Zhang (2016). Nevertheless, debt ratios are quite low and below the level of the average target debt ratio of around 30%. Since the motive for companies to undertake Leveraged buybacks does not seem to be signalling undervaluation nor reducing agency costs and given that these companies' leverage is below the target, we can infer that reaching the optimal capital structure can be the reason for conducting Leveraged buybacks. But these companies have a low value of z-score, falling in the grey zone, meaning that their chance of bankruptcy is moderate. Surprisingly, companies carrying out Equity buybacks fall in the same category. Operating performance is better, and liquidity is higher for companies that do not fully finance buybacks from their own resources in comparison to those that do. There is no evident difference in the amount of dividends among the Completers. Lastly, we provide, in Table 8, a breakdown of the analysed companies by quotation on stock exchanges. The majority of companies are quoted on the New York Stock Exchange (hereinafter "NYSE"), more precisely 274 companies or 52% of all analysed companies. 222 companies or 42% of all companies are quoted on the National Association of Securities Dealers Automated Quotations (hereinafter "NASDAQ"), whereas only 31 companies are quoted on other stock exchanges in the United States. As approximately half of the companies announcing the buyback program are not quoted on the NYSE, we might be faced with the problem of nonnormality in stocks' (abnormal) returns.

Table 8: Breakdown of companies by quotation on stock exchanges

Companies in the analysis per stock exchange		
Exchange	Number of companies	% of companies
NYSE	274	52
NASDAQ	222	42
Other	31	6
Total	527	100

Source: own work

5 EVENT STUDY RESULTS

In this section, we present results obtained from the calculation of abnormal returns over the event windows, results from the non-parametric test, results from cross-sectional regression and results from the binary model.

5.1 Results of detected abnormal returns

Abnormal returns are obtained for the Full sample used in the analysis of this master's thesis as well as for subsamples based on how the program is carried out, as presented in Section 4.2. Moreover, we look at the abnormal returns over different event window lengths. Abnormal returns are examined at the aggregated level; hence, we talk about average abnormal returns (AARs) and cumulative average abnormal returns (CAARs). All of the results are presented in Table 9. In general, we obtain positive abnormal returns for all sub/samples and all event windows, which means that buyback announcements are considered as good news by the market participants, although not all are statistically significant.

The highest average abnormal return on the event day [0] is observed for Non-completed buybacks and amounts to 0,88% at the 5% significance level. This means that companies that announce the program but do not complete it, on average, have 0,88% higher returns on the event day as they would have if they had not announced the program; and we can claim, with 95% confidence, that the observed average abnormal return is not random. The second highest AAR is observed for Equity buybacks amounting to 0,85% at the 1% significance level, whereas the Not-fully equity financed buybacks have approximately half of their AAR and are statistically insignificant. Leveraged and Mixed buybacks have also insignificant AARs, but the entire Completed buyback sample has a statistically significant AAR of 0,64%. The fact that Non-completed buybacks have the highest market reaction on the event day could be the supporting evidence for Bhattacharya and Jacobsen (2016), claiming that the more undervalued firms can only announce the program but do not have to repurchase shares for the price correction. If that were true for stocks included in our analysis, abnormal returns would also be observed over longer event windows. However, in the five- and twenty-one-day event windows, [-2,+2] and [-10,+10], respectively, abnormal returns of Non-completed buybacks are statistically insignificant, even though the values are higher. The highest two-day CAAR over the event window [0,+1] is observed among Equity buybacks and equals to 2,16% at the 0,1% statistical significance. In fact, Equity buybacks have the highest value of CAARs over all event windows, which are always statistically significant at 0,1% or 1%. The twenty-one-day CAAR [-10,+10] of Equity buybacks equals to 2,55%. The results show that, except on the day of the event, the market reacts most favourably to buyback announcements made by firms that are able to finance the program completely from their own resources. The two-day CAARs are also statistically significant for the Full sample, Non-completed and Completed buyback, where all have CAARs around

1,7%. Less favourable but still significant market reaction is observed for Not-fully equity financed buybacks with CAAR equalling to 1,07%.

Table 9: AAR and CAAR based on sub/samples and different event windows lengths

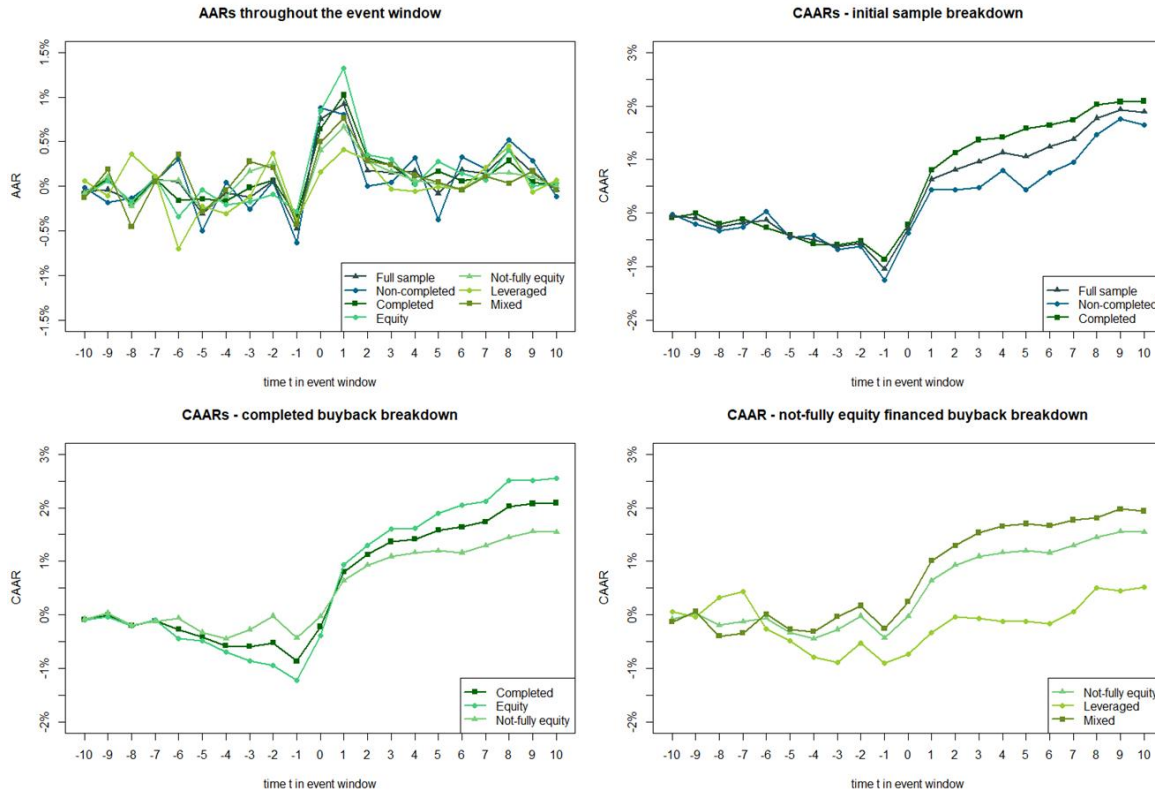
Abnormal returns by sub/samples and event window length																
Sub/samples	Event date [0]		Event w. [0,+1]		Event w. [-1,+1]		Event w. [-2,+2]		Event w. [-10,+10]		No. of observ.					
	AAR (%)	<i>t-test</i>	CAAR (%)	<i>t-test</i>	CAAR (%)	<i>t-test</i>	CAAR (%)	<i>t-test</i>	CAAR (%)	<i>t-test</i>						
Full sample	0,75	***	3,55	1,67	***	5,12	1,20	**	3,26	1,44	***	3,55	1,89	**	3,10	527
Non-completed	0,88	*	2,50	1,68	**	2,99	1,05	·	1,72	1,11		1,59	1,65		1,54	242
Completed	0,64	*	2,55	1,67	***	4,51	1,32	**	3,03	1,71	***	3,74	2,09	**	3,16	285
Equity	0,85	**	2,75	2,16	***	4,88	1,88	**	3,21	2,15	***	3,64	2,55	**	2,92	155
Not-fully equity	0,41		0,97	1,07	·	1,76	0,66		1,01	1,20	·	1,68	1,54		1,54	130
Leveraged	0,16		0,35	0,58		0,63	0,20		0,24	0,86		0,94	0,52		0,31	36
Mixed	0,50		0,91	1,26		1,65	0,84		0,99	1,33		1,44	1,94		1,58	94

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and · denotes significance at 10%
Note: t-test is shorter for Student's t-test

Source: own work

Three-day CAARs over the event window [-1,+1] range from 0,20% to 1,88%. The lowest CAARs are observed for all forms of Not-fully equity financed buybacks and the results are also statistically insignificant, whereas for the other forms of buybacks, statistically significant results are observed with values of CAARs above 1,00%. At a five-day event window [-2,+2], statistical significance is lost for Non-completed buybacks, but Not-fully equity finance buybacks have a statistically significant CAAR of 1,20%. Leveraged buybacks observe positive AAR and CAARs for all event windows, which could imply that firms initiating Leveraged buybacks are underleveraged, taking the opportunity to use buybacks' beneficial use till reaching the optimal capital allocation, but we cannot confirm that because results are statistically insignificant. A similar pattern is observed for Mixed buybacks with a bit higher magnitude of abnormal returns than Leveraged buybacks, but they are again all statistically insignificant. The AAR of the Full sample is 0,75% with statistical significance of 0,1% and increases to a CAAR of 1,89% at the 1% level of significance over a twenty-one-day event window. In general, results show that the abnormal returns are positive and increase with the length of the event window. However, higher abnormal returns are mostly observed around the announcements of Completed buybacks than Non-completed. Among Completed buybacks, abnormal returns are the highest around the announcements of Equity buybacks, whereas the other forms of completed buybacks have much lower and mostly statistically insignificant abnormal returns. Figure 4 shows the AARs and CAARs over the event windows of twenty one days, clearly showing the patterns discussed above and presented in Table 9. Consistent with other studies, we also observe a drop in stocks' abnormal returns a day before buyback announcements, as can be seen in Figure 4.

Figure 4: Graphs of AARs and CAARs based on sub/samples and 21-day event window



Source: own work

5.2 Result from the non-parametric test

Firstly, we check whether the assumption of normality is fulfilled. The results from the Shapiro-Wilk test cannot confirm normal distribution of AARs for the Full sample as well as for the subsamples of Completed buybacks and Equity buybacks, whereas for the other subsamples, the normality in abnormal returns can be assumed, as Table 10 presents. Nevertheless, the non-parametric rank test is conducted for all sub/samples.

Table 10: Results from the Shapiro-Wilk test based on sub/samples

Results from Shapiro Wilk test			
Sub/samples	W statistics	p-value	Normal distribution
Full sample	0,90	0,03	No
Non-completed	0,97	0,81	Yes
Completed	0,86	0,01	No
Equity	0,84	0,00	No
Not-fully equity	0,97	0,65	Yes
Leveraged	0,96	0,49	Yes
Mixed	0,97	0,74	Yes

Source: own work

Results in the previous section (Section 5.1) show that we obtain statistically significant abnormal returns for three datasets, namely Full sample, Completed buybacks and Equity buybacks, whose assumption of normality turns out to be violated. That makes us question the statistical significance of results since the test statistic used in Section 5.1 assumes normal distribution. However, results of the rank test, which does not require a normal distribution, show that all of these abnormal returns are still statistically significant, as can be seen from Table 11. In general, with the rank test, we obtain a higher level of statistical significance of abnormal returns, obtain three additional statistically significant values of CAARs and lose statistical significance of one CAAR. Except for one CAAR, all obtained abnormal returns with the rank test are also positive. We can therefore claim that the market reacts positively to announcements of buyback programs since we detect positive abnormal returns with both methods. Results from the rank test are shown in Table 11. The highest AAR on the day of the event [0] is observed for the Full sample, followed by Equity buybacks, Completed buybacks and Non-completed buybacks. We notice that Non-completed buybacks no longer have higher AAR compared to the subsample of Completed buybacks. This time, we detect the highest values of CAARs for the Full sample, and this applies to all possible event windows. The two-day CAAR [0,+1] of Non-completed buybacks is actually higher than for Completed but that reverses in all the remaining longer event windows. However, the five- and twenty-one-day CAARs, [-2,+2] and [-10,+10], of Noncompleted buybacks remain statistically significant, whereas with the t-test we lose their significance. Among the Completed buybacks, we observe the highest CAARs for Equity buybacks, no matter which event window we look at. In fact, we mostly report statistically insignificant abnormal returns for all forms of Not-fully equity financed buybacks. Statistically significant abnormal returns are observed only for the two-day event window, where we observe a higher CAAR for Mixed buybacks compared to Leveraged buybacks. This two-day CAAR of Mixed buybacks is statistically significant with the rank test but not with the previous t-test. While the statistical significance of five-day CAAR for Not-fully equity financed buybacks is lost with the rank test.

Table 11: Rank statistics based on sub/samples and different event window lengths

Rank statistics by sub/samples and event window length												
Sub/samples	Event date [0]		Event w. [0,+1]		Event w. [-1,+1]		Event w. [-2,+2]		Event w. [-10,+10]		No. of observ.	
	Rank stat.	p-value	Rank stat.	p-value	Rank stat.	p-value	Rank stat.	p-value	Rank stat.	p-value		
Full sample	4,73	***	0,00	***	7,31	***	0,00	***	4,20	***	0,00	527
Non-completed	3,69	***	0,00	***	5,94	***	0,00	***	2,90	**	0,00	242
Completed	3,91	***	0,00	***	5,82	***	0,00	***	3,82	***	0,00	285
Equity	4,05	***	0,00	***	5,90	***	0,00	***	4,13	***	0,00	155
Not-fully equity	1,62		0,11	*	2,54	*	0,01		1,25		0,21	130
Leveraged	0,81		0,42		1,74	.	0,08		0,67		0,51	36
Mixed	1,44		0,15	*	2,01	*	0,04		1,09		0,28	94

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and . denotes significance at 10%
Note: Rank stat. is rank statistics obtained from Corrado's rank test and its modification by Campbell and Wasley

Source: own work

5.3 Results from cross-sectional regression

We try to explain the obtained abnormal returns around buyback announcements with certain buyback or firm-specific characteristics, which are chosen based on relations found by existing literature presented in Section 2.7. For that purpose, we perform a cross-sectional regression where cumulative abnormal returns (CARs) are regressed against these characteristics. We report results from OLS cross-sectional regression where the dependent variable is 3-day CAR, but we obtain qualitatively the same results with other models where dependent variable is CAR over all the other lengths of event windows. We perform separate cross-sectional regression for the Full sample and each individual subsample. In addition, we gradually add independent variables to the model in a way to firstly test if abnormal returns can be explained by one of the most popular hypothesis – signalling hypothesis, agency or free cash flow hypothesis and capital structuring hypothesis (Model 1), next we test also for firm size and firm's investment activity (Model 2) and lastly, we include all other controlling variables based on existing literature (Model 3). All independent variables, connected to firms' characteristics, in cross-sectional regression are Size, MTB, Prior CAR, Cash, FCF, Investment, Investment opportunity, Capex change, Leverage, ROE, EPS, Liquidity and Dividend dummy. Except for the Prior CAR and Dividend dummy, all of these firms' characteristics are explained in Section 4.3. Prior CAR is included because it shows the firm's short-term over- or undervaluation. For its calculation, we follow and slightly modify the approach of Lei and Zhang (2016). The Prior CAR, therefore, is the sum of the firm's stock returns minus returns on the value-weighted S&P 500 index over 31 days to 11 days prior to the buyback announcement. We include the Dividend dummy, equalling 1 if the firm pays out dividends and 0 otherwise, rather than the exact amount of dividends paid, as we only try to explain if there exists a difference in abnormal returns between the companies paying out dividends and the companies that do not, searching for a substitute/supplement explanation and not a specific relationship with abnormal returns. We also include two buyback-related characteristics as independent variables, in particular the size of planned buyback at the announcement (Buyback size) and Completion rate, both already explained in Section 4.3.

Correlation between the variables included in cross-sectional regression is, in general, low, as it can be seen from Table 12, with a mean correlation equalling to 0,02. However, there are a few exceptions. The highest correlation is observed between variables ROE and MTB, which is expected since high ROE suggests a company's high profitability, which can be reflected in stocks' prices, thereby, by the formula, directly increasing the MTB measure. Somewhat high correlation is also observed between variables FCF and Cash but is again expected since most companies primarily generate cash from their operations. Even though we observe rather high correlations between the two mentioned pairs of variables, the cross-sectional regression model does not possess the risk of high multicollinearity.

Table 12: Correlation between the variables included in cross-sectional regression

Correlation between the variables included in cross-sectional regression															
Variables	Size	MTB	Prior CAR	Cash	FCF	Investment	Inv.Opp.	Capex change	Leverage	ROE	EPS	Liquidity	Dividend dummy	Buyback size	Completion rate
Size	1,00	0,00	0,16	-0,40	-0,20	0,05	-0,18	-0,16	0,29	0,07	0,09	-0,34	0,40	-0,13	0,33
MTB	0,00	1,00	-0,04	0,03	-0,03	0,02	0,09	0,02	-0,09	0,83	0,01	0,05	-0,04	-0,03	-0,02
Prior CAR	0,16	-0,04	1,00	-0,06	-0,04	-0,05	-0,13	-0,01	0,03	-0,01	0,06	-0,08	0,14	-0,04	0,05
Cash	-0,40	0,03	-0,06	1,00	0,55	-0,08	0,22	0,19	-0,37	-0,04	-0,05	0,42	-0,26	0,21	-0,02
FCF	-0,20	-0,03	-0,04	0,55	1,00	-0,14	0,22	0,07	-0,17	-0,09	0,01	0,33	-0,12	0,14	-0,01
Investment	0,05	0,02	-0,05	-0,08	-0,14	1,00	0,01	0,22	0,09	0,04	-0,01	-0,13	0,04	0,00	-0,03
Inv.Opp.	-0,18	0,09	-0,13	0,22	0,22	0,01	1,00	0,22	-0,09	0,11	0,08	0,16	-0,15	0,23	-0,08
Capex change	-0,16	0,02	-0,01	0,19	0,07	0,22	0,22	1,00	-0,11	0,04	0,04	0,21	-0,10	0,02	-0,05
Leverage	0,29	-0,09	0,03	-0,37	-0,17	0,09	-0,09	-0,11	1,00	-0,07	-0,09	-0,30	0,16	0,03	0,00
ROE	0,07	0,83	-0,01	-0,04	-0,09	0,04	0,11	0,04	-0,07	1,00	0,21	0,00	0,06	-0,04	0,05
EPS	0,09	0,01	0,06	-0,05	0,01	-0,01	0,08	0,04	-0,09	0,21	1,00	0,02	0,11	0,06	0,09
Liquidity	-0,34	0,05	-0,08	0,42	0,33	-0,13	0,16	0,21	-0,30	0,00	0,02	1,00	-0,23	0,09	-0,06
Dividend dummy	0,40	-0,04	0,14	-0,26	-0,12	0,04	-0,15	-0,10	0,16	0,06	0,11	-0,23	1,00	-0,04	0,05
Buyback size	-0,13	-0,03	-0,04	0,21	0,14	0,00	0,23	0,02	0,03	-0,04	0,06	0,09	-0,04	1,00	0,08
Completion rate	0,33	-0,02	0,05	-0,02	-0,01	-0,03	-0,08	-0,05	0,00	0,05	0,09	-0,06	0,05	0,08	1,00

Source: own work

We also check for collinearity in the estimated regression coefficients for every model and based on the VIF measures, we can conclude that the regression coefficients do not exhibit high collinearity. We report VIF values only for the Full sample, Table 13, but this holds true for every coefficient in every other model performed as well, with the exception of two models. Namely, Model 3 for Completed buybacks and Model 3 for Equity buybacks, where high collinearity is detected among the variables MTB and ROE. Since the problem of collinearity is not detected for MTB in Model 1 and Model 2, where the MTB coefficient is already statistically insignificant in both subsamples (presented later), we do not correct for the collinearity of MTB in Model 3. Collinearity in ROE is also not accounted for, since this is only a controlling variable and is also insignificant in models of other subsamples where this variable does not exhibit high collinearity (presented later).

Table 13: VIF values of variables included in cross-sectional regression for Full sample

VIF values of variables in OLS cross-sectional regression			
Independent variables	Full sample		
	Model 1 VIF	Model 2 VIF	Model 3 VIF
Size		1,270	1,664
MTB	1,085	1,022	3,670
Prior CAR	1,017	1,045	1,055
Cash	1,494	1,796	1,927
FCF	1,401	1,483	1,531
Investment		1,095	1,114
Inv.Opp.		1,141	1,221
Capex change		1,155	1,195
Leverage	1,149	1,210	1,281
ROE			3,891
EPS			1,198
Liquidity			1,378
Dividend dummy			1,271
Buyback size			1,145
Completion rate			1,205

Source: own work

We find supporting evidence for the signalling hypothesis when performing the OLS cross-sectional regression for the Full sample, presented in Table 14. Both MTB and Prior CAR coefficients are negative but only the latter is statistically significant in all three models. Thus, we can only confirm that the more the company is undervalued in the short-term before the announcement, the higher the abnormal return, but it is not possible to verify the relation of general undervaluation or of value firms with abnormal returns. Anyhow, we find evidence to support the signalling hypothesis, in particular, if the Prior CAR increases by one percentage point, the 3-day CARs on average, *ceteris paribus*, decrease by 0,09 percentage points in Model 1 and decrease by 0,1 percentage points in Model 2 and Model 3. Because an increase in Prior CAR means less undervalued stock, the lower abnormal return is observed. Conversely, a decrease in Prior CAR results in an increase of abnormal returns in the same magnitude, which supports the theory of the signalling hypothesis, which argues that signalling undervaluation with buyback announcements results in higher abnormal returns. We do not find evidence to support the agency or free cash flow hypothesis and capital structuring hypothesis in the simplest model, Model 1, as well as the other two, which include variables to test other relations as well. Although coefficients for cash (positive) and leverage (negative) are as expected and in line with the theory, they are statistically insignificant. The coefficient for FCF is surprisingly negative but also statistically insignificant; otherwise, it would suggest that the more cash the firm generates, the more negative is the market reaction to the buyback announcement and would contradict the free cash flow hypothesis. With higher FCFs, there is a potential for higher agency costs, but the buyback announcement communicates the anticipated action of the firm to lower these costs, which should be, according to the theory, perceived as good news.

When adding variables for firms' investment activity in Model 2, we find that the less investment opportunities the company has prior to the buyback announcement, the higher is abnormal return around the announcement. This inverse relation suggests that the market does not penalize the company because of its lack of investment opportunities and future growth prospects but rather appreciates that cash is distributed back to shareholders when the company faces such conditions. Specifically, our results show that if the annual change in investment opportunity (variable *Inv.opp.*) increases by one percentage point, the 3-day CARs on average, *ceteris paribus*, decrease by 0,01 percentage points and vice versa. We also obtain a statistically significant coefficient for the variable *Capex change*, whereby we observe a positive relationship. More precisely, if the annual change in capex increases by one percentage point, the 3-day CARs on average, *ceteris paribus*, increase by 0,01 percentage points. The market may react positively to a buyback announcement in this context because the company is in good financial and business health, as it can increase investments into its own assets/business and return more cash to shareholders in addition to potential dividends. Anyhow, the effect of both detected investment relations with abnormal returns is very small. We test for the relationship between the size of the firm and abnormal returns in this model as well but do not find statistically significant results, although the sign of the coefficient is negative as expected.

When adding controlling variables to the model, Model 3, statistical significance is lost for the firm's investment opportunity, while coefficients for Prior CAR and Capex change remain statistically significant. Like the studies so far, we are also unable to confirm the relation between firms' operating performance, measured by ROE, and abnormal returns, because the estimated coefficient is statistically insignificant. The estimated EPS coefficient suggests a negative relation with abnormal returns, which is what studies have found so far, but cannot be validated. We are also unable to provide evidence supporting the relationship between firms' liquidity and abnormal returns. The coefficient for the dividend dummy suggests that buybacks are substitutes for dividends, as companies paying out dividends have, on average, lower abnormal returns than the companies that do not pay out dividends, all else being equal. But the result is insignificant, suggesting that whether companies pay out dividends or not is an irrelevant factor for observed abnormal returns at announcements. We are also unable to confirm the relationship of buyback featured characteristics with abnormal returns for our Full sample. Otherwise, results would indicate that the market reacts more positively to announcements of smaller buybacks and that higher abnormal returns are observed with higher completion rates. The overall regression Model 1 and Model 2 are significant at 5% on 5 and 521 degrees of freedom, and at 10% on 9 and 517 degrees of freedom, respectively, with Multiple R-squared of 2,1% and 3,2%, respectively, and residual standard error of 8,4% and 8,5%, respectively. The explanatory power of the models is quite low; however, the models still provide a better fit to the data than models with no independent variables would. It is reasonable to observe lower explanatory power and larger residual standard errors in OLS regression models trying to explain abnormal returns around the buyback announcements with firm-specific characteristics, because there is a large amount of external factors in the market that influence the returns. The overall regression Model 3 is statistically insignificant, meaning that the model as a whole does not explain the abnormal returns well.

Next, we look at the subsamples of Non-completed and Completed buybacks, presented in Table 15. As with the Full sample, we provide evidence to support the signalling hypothesis in terms of short-term undervaluation also for the subsample of Non-completed and Completed buybacks. The effect is, however, larger for the former, also in comparison to the Full sample. To be precise, if the Prior CAR increases by one percentage point, the 3-day CARs of Non-completed buybacks, on average, *ceteris paribus*, decrease by approximately 0,11 to 0,12 percentage points, whereas the 3-day CARs of Completed buybacks observe a decrease in the range of 0,08 to 0,09. For all three models of Non-completed buybacks, we obtain negative and statistically significant coefficients for firms' leverage, meaning that the lower the level of a firm's leverage, the higher the abnormal return. To be exact, if leverage increases by one percentage point, the 3-day CARs of Non-completed buybacks, on average, *ceteris paribus*, decrease by approximately 0,05 to 0,06 percentage points. This finding suggests that abnormal returns are observed due to the attempt of underleveraged firms to reach the optimal capital structure and take advantage of buybacks' beneficial use along the way, which is in line with the existing literature, and hence we can confirm the capital

structuring hypothesis with our subsample of Non-completed buybacks but not with the subsample of Completed buybacks. For the latter, in addition to supporting evidence for the signalling hypothesis, we again find a significantly positive relation between abnormal returns and change in capital expenditure. With Model 3, we additionally obtain a statistically significant positive coefficient for liquidity but the effect on abnormal return is close to zero. The positive relation makes sense, since buybacks additionally lower a firm's liquidity and hence is reasonable that the market reacts more favourably to buyback announcements made by firms with more liquid assets prior to the announcement. We also

Table 14: OLS cross-sectional results for Full sample

Results from OLS cross-sectional regression			
Dependent variable: 3-day CAR [-1,+1]	Full sample		
	Model 1	Model 2	Model 3
Independent variables	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)
Intercept	0,0127 (1,645)	0,0112 (0,3095)	0,0141 (0,3542)
Size		-0,0001 (-0,0252)	-0,0016 (-0,2474)
MTB	-0,0002 (-0,669)	-0,0002 (-0,3545)	-0,0005 (-0,8387)
Prior CAR	-0,0943 (-2,812)	-0,0989 (-2,3374)	-0,0956 (-2,2018)
Cash	0,0187 (0,571)	0,0120 (0,3532)	0,0121 (0,3076)
FCF	-0,0679 (-1,436)	-0,0514 (-1,0471)	-0,0472 (-0,9021)
Investment		0,0627 (0,7254)	0,0700 (0,7603)
Inv.Opp.		-0,0146 (-1,6949)	-0,0113 (-1,0528)
Capex change		0,0077 (2,4284)	0,0073 (2,1640)
Leverage	-0,0193 (-1,018)	-0,0189 (-0,6687)	-0,0154 (-0,4740)
ROE			0,0065 (0,4994)
EPS			-0,0003 (-0,4937)
Liquidity			0,0001 (0,0236)
Dividend dummy			-0,0047 (-0,5159)
Buyback size			-0,0289 (-0,7322)
Completion rate			0,0134 (1,0316)
No. of observations	527	527	527
Residual standard error	0,0839 on 521 DF	0,0846 on 517 DF	0,0855 on 511 DF
Multiple R-squared	0,02135	0,03224	0,03976
Adjusted R-squared	0,01196	0,01539	0,01158
F-statistic	2,273 on 5 and 521 DF *	1,699 on 9 and 517 DF .	1,2021 on 15 and 511 DF

The Table represents results of cross-sectional regression by sub/samples where 3-days CARs are regressed against chosen firm characteristics. The firms' characteristics data (independent variables) are gathered at the last day a year before buyback program is announced where: **Size** is log10 of total assets; **MTB** is market value of equity (number of shares outstanding * share price) divided by book value of equity; **Prior CAR** is 21-days cumulative abnormal return of the firm (sum of stock's returns minus returns on value weighted S&P500 index) from 31 days to 11 days prior to the buyback announcement; **Cash** is cash divided by total assets; **FCF** is free cash flows divided by total assets; **Investment** is capital expenditure divided by total assets; **Inv. opp.** (Investment opportunity) is annual change in total sales ($Sales_{t-1} - Sales_{t-2} / Sales_{t-2}$ where $t = 0$ is year of announcement); **Capex change** is yearly change in capital expenditure ($Capex_{t-1} - Capex_{t-2} / Capex_{t-2}$ where $t = 0$ is year of announcement); **Leverage** is total debt divided by total assets; **ROE** (return on equity) is a measure of operating performance and is calculated as net income divided by total equity; **EPS** is earnings per share measurement obtained from Capital IQ Pro ; **Liquidity** is quick ratio (cash, cash equivalents and short-term receivables divided by total current liabilities); **Dividend dummy** equals 1 if dividends are paid to shareholder and 0 otherwise; **Buyback size** is the amount of shares company announces to repurchase in value terms divided by total assets; **Completion rate** is amount of shares bought back in value terms divided by buyback size.

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and . denotes significance at 10%

Source: own work

find a negative relation between buyback size and abnormal returns for Completed buybacks. Namely, if the ratio of buyback size increases by one percentage point, the 3-day CARs on average, ceteris paribus, decrease by 0,09 percentage points. The market could react more

positively to announcements of smaller buybacks because these buyback programs are more likely to be completed. Regardless of the reason why a company decides to repurchase shares, the signal is more credible if the company actually goes through with it and hence the effect is larger. But this sample includes only completed buyback programs; therefore, the reason for higher abnormal returns when smaller buybacks are announced lies elsewhere. The market may react less favourably to larger buyback program announcements because these repurchases: (i) have a larger effect on capital structure, thereby risking overleveraging, (ii) reduce firms' liquidity more strongly and (iii) can indicate fewer investment opportunities; all of which put firms in a more vulnerable position. Model 1 of Non-completed buybacks is the only model of Completed and Non-completed subsamples that is overall significant. It is significant at 5% on 5 and 236 degrees of freedom, with Multiple R-squared of 4,8% and residual standard error of 9,4%.

Table 15: OLS cross-sectional results for Non-completed and Completed subsamples

Results from OLS cross-sectional regression						
Dependent variable: 3-day CAR [-1,+1]	Non-completed			Completed		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Independent variables	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)
Intercept	0,0211 (1,7250)	0,0199 (0,3950)	0,0359 (0,6820)	0,0009 (0,0890)	0,0093 (0,2220)	-0,0130 (-0,2800)
Size		-0,0006 (-0,0700)	-0,0038 (-0,4180)		-0,0013 (-0,2100)	0,0036 (0,5330)
MTB	-0,0013 (-1,0340)	-0,0012 (-0,9160)	-0,0013 (-0,9700)	0,0000 (-0,0990)	0,0000 (-0,1170)	-0,0001 (-0,1160)
Prior CAR	-0,1213 (-2,4000) *	-0,1203 (-2,3420) *	-0,1142 (-2,1590) *	-0,0778 (-1,7230)	-0,0861 (-1,8690)	-0,0809 (-1,7570)
Cash	0,0103 (0,2110)	0,0018 (0,0350)	-0,0053 (-0,0940)	0,0396 (0,8630)	0,0217 (0,4540)	-0,0018 (-0,0370)
FCF	-0,1080 (-1,5890)	-0,0942 (-1,3500)	-0,0702 (-0,9530)	-0,0060 (-0,0870)	0,0090 (0,1300)	0,0242 (0,3510)
Investment		0,1206 (0,8150)	0,1144 (0,7600)		0,0193 (0,1460)	0,0679 (0,5110)
Inv. Opp.		-0,0052 (-0,3410)	-0,0046 (-0,2770)		-0,0206 (-1,1530)	-0,0249 (-1,3900)
Capex change		0,0059 (0,9750)	0,0084 (1,3190)		0,0108 (1,8780)	0,0101 (1,7710)
Leverage	-0,0502 (-1,8640)	-0,0525 (-1,8790)	-0,0681 (-2,2120) *	0,0269 (0,9410)	0,0296 (1,0040)	0,0187 (0,6230)
ROE			-0,0044 (-0,1980)			-0,0023 (-0,1420)
EPS			-0,0004 (-0,6770)			-0,0001 (-0,1870)
Liquidity			-0,0028 (-0,8910)			0,0044 (1,8840)
Dividend dummy			0,0067 (0,4730)			-0,0115 (-1,1610)
Buyback size			0,0188 (0,5730)			-0,0877 (-2,7380) **
Completion rate			0,0204 (0,9320)			
No. of observations	242	242	242	285	285	285
Residual standard error	0,0941 on 236 DF	0,0945 on 232 DF	0,0951 on 226 DF	0,074 on 279 DF	0,0740 on 275 DF	0,0730 on 270 DF
Multiple R-squared	0,04833	0,05689	0,06875	0,01441	0,02991	0,07308
Adjusted R-squared	0,02817	0,02031	0,006936	-0,003251	-0,001843	0,02502
F-statistic	2,397 on 5 and 236 DF *	1,555 on 9 and 232 DF	1,112 on 15 and 226 DF	0,816 on 5 and 279 DF	0,942 on 9 and 275 DF	1,521 on 14 and 270 DF

The Table represents results of cross-sectional regression by sub/samples where 3-days CARs are regressed against chosen firm characteristics. The firms' characteristics data (independent variables) are gathered at the last day a year before buyback program is announced where: **Size** is log10 of total assets; **MTB** is market value of equity (number of shares outstanding * share price) divided by book value of equity; **Prior CAR** is 21-days cumulative abnormal return of the firm (sum of stock's returns minus returns on value weighted S&P500 index) from 31 days to 11 days prior to the buyback announcement; **Cash** is cash divided by total assets; **FCF** is free cash flows divided by total assets; **Investment** is capital expenditure divided by total assets; **Inv. opp.** (Investment opportunity) is annual change in total sales (Sales_{t+1} - Sales_t / Sales_t where t = 0 is year of announcement); **Capex change** is yearly change in capital expenditure (Capex_{t+1} - Capex_t / Capex_t where t = 0 is year of announcement); **Leverage** is total debt divided by total assets; **ROE** (return on equity) is a measure of operating performance and is calculated as net income divided by total equity; **EPS** is earnings per share measurement obtained from Capital IQ Pro; **Liquidity** is quick ratio (cash, cash equivalents and short-term receivables divided by total current liabilities); **Dividend dummy** equals 1 if dividends are paid to shareholder and 0 otherwise; **Buyback size** is the amount of shares company announces to repurchase in value terms divided by total assets; **Completion rate** is amount of shares bought back in value terms divided by buyback size.

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and · denotes significance at 10%

Source: own work

The OLS cross-sectional regression results of the further breakdown of the Completed buybacks subsample are presented in Table 16. We are unable to confirm any of the most commonly tested hypotheses with the subsample of Equity buybacks. In fact, the only

Table 16: OLS cross-sectional results for Equity and Not-fully equity financed

Results from OLS cross-sectional regression						
Dependent variable: 3-day CAR [-1,+1]	Equity			Not-fully equity		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Independent variables	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)
Intercept	0,0030 (0,2020)	0,0568 (1,0070)	0,0579 (0,8940)	-0,0046 (-0,2900)	-0,0256 (-0,4020)	-0,1012 (-1,3420)
Size		-0,0089 (-1,0740)	-0,0070 (-0,7740)		0,0041 (0,4230)	0,0145 (1,2640)
MTB	0,0001 (0,2210)	0,0001 (0,2120)	0,0002 (0,1010)	-0,0006 (-0,8550)	-0,0006 (-0,8550)	0,0001 (0,0880)
Prior CAR	-0,0273 (-0,4390)	-0,0160 (-0,2500)	-0,0179 (-0,2790)	-0,1428 (-2,1380)	-0,1852 (-2,6720)	-0,1731 (-2,4690)
Cash	0,1170 (1,5730)	0,1007 (1,3200)	0,0283 (0,3300)	0,0183 (0,3020)	-0,0080 (-0,1250)	-0,0099 (-0,1530)
FCF	-0,0864 (-0,7430)	-0,0846 (-0,7200)	-0,0532 (-0,4510)	0,0244 (0,2760)	0,0604 (0,6850)	0,0604 (0,6830)
Investment		0,0816 (0,3640)	0,2699 (1,1700)		-0,0565 (-0,3320)	0,0181 (0,1030)
Inv.Opp.		-0,0015 (-0,0570)	-0,0093 (-0,3480)		-0,0401 (-1,5710)	-0,0458 (-1,7290)
Capex change		0,0032 (0,3600)	0,0019 (0,2070)		0,0186 (2,3770)	0,0188 (2,3680)
Leverage	0,0156 (0,4080)	0,0280 (0,7040)	0,0077 (0,1950)	0,0329 (0,7510)	0,0247 (0,5480)	0,0365 (0,7740)
ROE			-0,0084 (-0,2280)			-0,0405 (-1,0890)
EPS			0,0001 (0,2410)			0,0010 (0,5340)
Liquidity			0,0063 (1,1390)			0,0049 (1,7900)
Dividend dummy			-0,0122 (-0,8920)			-0,0101 (-0,6400)
Buyback size			-0,1164 (-2,9280)	**		-0,0203 (-0,3340)
Completion rate						
No. of observations	155	155	155	130	130	130
Residual standard error	0,0737 on 149 DF	0,0743 on 145 DF	0,0726 on 140 DF	0,074 on 124 DF	0,0734 on 120 DF	0,0734 on 115 DF
Multiple R-squared	0,01905	0,03061	0,105	0,04281	0,09549	0,1331
Adjusted R-squared	-0,01386	-0,02956	0,01549	0,004216	0,02765	0,02761
F-statistic	0,579 on 5 and 149 DF	0,509 on 9 and 145 DF	1,173 on 14 and 140 DF	1,109 on 5 and 124 DF	1,408 on 9 and 120 DF	1,262 on 14 and 115 DF

The Table represents results of cross-sectional regression by sub/samples where 3-days CARs are regressed against chosen firm characteristics. The firms' characteristics data (independent variables) are gathered at the last day a year before buyback program is announced where: **Size** is log10 of total assets; **MTB** is market value of equity (number of shares outstanding * share price) divided by book value of equity; **Prior CAR** is 21-days cumulative abnormal return of the firm (sum of stock's returns minus returns on value weighted S&P500 index) from 31 days to 11 days prior to the buyback announcement; **Cash** is cash divided by total assets; **FCF** is free cash flows divided by total assets; **Investment** is capital expenditure divided by total assets; **Inv. opp.** (Investment opportunity) is annual change in total sales ($Sales_{t+1} - Sales_t / Sales_t$ where $t = 0$ is year of announcement); **Capex change** is yearly change in capital expenditure ($Capex_{t+1} - Capex_t / Capex_t$ where $t = 0$ is year of announcement); **Leverage** is total debt divided by total assets; **ROE** (return on equity) is a measure of operating performance and is calculated as net income divided by total equity; **EPS** is earnings per share measurement obtained from Capital IQ Pro; **Liquidity** is quick ratio (cash, cash equivalents and short-term receivables divided by total current liabilities); **Dividend dummy** equals 1 if dividends are paid to shareholder and 0 otherwise; **Buyback size** is the amount of shares company announces to repurchase in value terms divided by total assets; **Completion rate** is amount of shares bought back in value terms divided by buyback size.

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and . denotes significance at 10%

Source: own work

relation with abnormal returns that we are able to find for companies that complete and self-fund buybacks is the size of the announced buyback program. Likewise, for Completed buybacks, the relation is also negative for Equity buybacks, but the latter has a bigger effect. Namely, if the ratio of buyback size increases by one percentage point, the 3-day CARs, on average, ceteris paribus, decrease by 0,12 percentage points for Equity buybacks. With Not-fully equity financed buybacks, we can again confirm the signalling hypothesis in terms of short-term undervaluation with all three models, and we observe the largest effect on the abnormal returns so far. More specifically, if the Prior CAR increases by one percentage point, the 3-day CARs of Not-fully equity financed buybacks, on average, ceteris paribus, decrease by approximately from 0,14 to 0,19 percentage points. We also find a slightly higher effect of firms' investment activity on abnormal returns with the subsample of Not-fully equity financed buybacks compared to Completed buybacks and the Full sample. Like before, we also find a negative relation between firms' investment opportunities and abnormal returns, and a positive relation between capex change and abnormal returns. The last significant coefficient we obtain with regression performed on a subsample of Not-fully

equity financed buybacks is liquidity, again positive but has a very small effect. None of the models for Equity and Not-fully equity financed buybacks is overall statistically significant.

When trying to explain abnormal returns of Leveraged buybacks (Table 17) by only testing for the three most common hypotheses (Model 1), we do not obtain any statistically significant coefficients and cannot confirm any hypotheses. However, when adding variables for size and the firm's investment activity, the leverage coefficient becomes statistically significant but again loses significance when other controlling variables are added (Model 3). Anyhow, we do find evidence for the capital structuring hypothesis with a subsample of Leveraged buybacks, which has the largest effect on abnormal returns among all subsamples and the Full sample. Namely, if leverage increases by one percentage point, the 3-day CARs of Leveraged buybacks, on average, *ceteris paribus*, decrease by 0,13 percentage points. With this subsample, we also find a negative relation between investment opportunities and abnormal returns and a surprisingly positive relation between firms' size and abnormal returns. This means that larger firms that initiate Leveraged buybacks exhibit higher abnormal returns at the announcements. The result contradicts our expectations and the existing literature, but the effect is practically zero since the obtained Size coefficients of 0,03 for both Model 2 and Model 3 need to be multiplied by 0,00432 in order to obtain a percentage increase, as this corresponds to a one percent increase in total assets when using $\log_{10}$ transformation, as we do in this variable. The results of Mixed buybacks are also summarized in Table 17, where we can again find evidence for the signalling hypothesis for the short-term undervaluation, in the same range of magnitude as for the sample of Not-fully equity financed buybacks, as well as a positive relation between capex change and abnormal returns. For the rest of the variables, we do not obtain statistically significant coefficients. The overall models of these two subsamples are all statistically insignificant.

Cross-sectional regression by subsamples is performed with the purpose of detecting the differences in underlying factors influencing the abnormal returns among different forms of buybacks. Unfortunately, we are not able to elaborate much on our findings since only a few estimated coefficients of the included variables are statistically significant. However, we do find that the signalling effect is the strongest for companies initiating Mixed buybacks, whereas we cannot confirm the signalling effect for the ones initiating Equity and Leveraged buybacks. The stronger signalling effect on abnormal returns is also observed among companies that do not complete the buyback program in comparison to the ones that do. Leverage is found to influence abnormal returns at announcements of Non-completed buybacks and Leveraged buybacks only, where for the latter we observe a higher effect. Capital structuring hypothesis is thus supported but very limited to specific subsamples. We cannot confirm the free cash flow hypothesis that buyback announcements are made to lower agency costs, which is reflected in higher abnormal returns, because all coefficients for cash and FCF are statistically insignificant. McNally (1999) argues that it is unexpected that abnormal returns around announcements of Open market share repurchases would be observed due to the reduction of agency costs because the Open market share repurchases

Table 17: OLS cross-sectional results for Leveraged and Mixed subsamples

Results from OLS cross-sectional regression						
Dependent variable: 3-day CAR [-1,+1]	Leveraged			Mixed		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Independent variables	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)	Coef. Estimates (t-statistics)
Intercept	0,0268 (1,1350)	-0,1668 (-2,0950) *	-0,1990 (-1,7350)	-0,0138 (-0,6710)	0,0126 (0,1490)	-0,0912 (-0,8740)
Size		0,0303 (2,5040)	0,0327 (2,0700)		-0,0030 (-0,2340)	0,0115 (0,7270)
MTB	-0,0004 (-0,5830)	0,0000 (-0,0550)	0,0002 (0,2700)	-0,0002 (-0,1280)	-0,0004 (-0,3600)	0,0009 (0,4350)
Prior CAR	-0,0715 (-0,5370)	-0,1145 (-0,9170)	-0,0687 (-0,4370)	-0,1442 (-1,7760)	-0,1900 (-2,1960) *	-0,1669 (-1,8770)
Cash	-0,0715 (-0,7450)	-0,0048 (-0,0490)	-0,0285 (-0,2470)	0,0379 (0,5030)	-0,0017 (-0,0210)	0,0000 (0,0000)
FCF	0,1037 (0,7160)	0,1038 (0,7580)	0,0957 (0,6330)	0,0106 (0,0980)	0,0359 (0,3270)	0,0421 (0,3790)
Investment		0,1325 (0,7150)	0,2170 (0,8890)		-0,1003 (-0,4130)	-0,0234 (-0,0930)
Inv.Opp.		-0,1249 (-2,4250) *	-0,1129 (-1,3320)		-0,0297 (-0,9690)	-0,0372 (-1,1850)
Capex change		0,0126 (0,9280)	0,0134 (0,8690)		0,0195 (1,9810)	0,0190 (1,9010)
Leverage	-0,0819 (-1,1570)	-0,1305 (-1,9410)	-0,1152 (-1,3740)	0,0676 (1,1710)	0,0598 (0,9900)	0,0875 (1,3400)
ROE			-0,0341 (-0,5180)			-0,0471 (-0,7600)
EPS			0,0017 (0,3590)			0,0009 (0,4190)
Liquidity			0,0042 (0,3180)			0,0051 (1,5820)
Dividend dummy			0,0014 (0,0600)			-0,0197 (-0,9090)
Buyback size			0,0281 (0,2350)			-0,0106 (-0,1380)
Completion rate						
No. of observations	36	36	36	94	94	94
Residual standard error	0,0521 on 30 DF	0,0473 on 26 DF	0,0518 on 21 DF	0,0821 on 88 DF	0,0818 on 84 DF	0,0823 on 79 DF
Multiple R-squared	0,08833	0,3499	0,37	0,05089	0,09969	0,1425
Adjusted R-squared	-0,06361	0,1249	-0,05001	-0,00303	0,003227	-0,009444
F-statistic	0,581 on 5 and 30 DF	1,555 on 9 and 26 DF	0,881 on 14 and 21 DF	0,944 on 5 and 88 DF	1,033 on 9 and 84 DF	0,938 on 14 and 79 DF

The Table represents results of cross-sectional regression by sub/samples where 3-days CARs are regressed against chosen firm characteristics. The firms' characteristics data (independent variables) are gathered at the last day a year before buyback program is announced where: **Size** is log10 of total assets; **MTB** is market value of equity (number of shares outstanding * share price) divided by book value of equity; **Prior CAR** is 21-days cumulative abnormal return of the firm (sum of stock's returns minus returns on value weighted S&P500 index) from 31 days to 11 days prior to the buyback announcement; **Cash** is cash divided by total assets; **FCF** is free cash flows divided by total assets; **Investment** is capital expenditure divided by total assets; **Inv. opp.** (Investment opportunity) is annual change in total sales ($Sales_{t+1} - Sales_t / Sales_t$ where $t = 0$ is year of announcement); **Capex change** is yearly change in capital expenditure ($Capex_{t+1} - Capex_t / Capex_t$ where $t = 0$ is year of announcement); **Leverage** is total debt divided by total assets; **ROE** (return on equity) is a measure of operating performance and is calculated as net income divided by total equity; **EPS** is earnings per share measurement obtained from Capital IQ Pro; **Liquidity** is quick ratio (cash, cash equivalents and short-term receivables divided by total current liabilities); **Dividend dummy** equals 1 if dividends are paid to shareholder and 0 otherwise; **Buyback size** is the amount of shares company announces to repurchase in value terms divided by total assets; **Completion rate** is amount of shares bought back in value terms divided by buyback size.

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and . denotes significance at 10%

Source: own work

do not reduce cash and FCF as much as or more than Fixed price tender offers. Commonly, the free cash flow hypothesis is supported by papers examining announcements of Fixed price tender offers, including that of Nohel and Tarhan (1998); hence the McNally's argument seems reasonable. Investment activity seems to have a slight effect on abnormal returns among the companies that complete buyback programs and finance them with debt or both, own resources and debt, whereas for companies initiating Equity buybacks or the ones that do not complete the program, the investment activity does not influence the abnormal returns.

5.4 Results from the binary model

As already stated, we present only results from the logit model but as a side control probit model is performed as well, whereby we obtain virtually the same results as with the logit model, which is a common practice in the existing literature. As already explained in Section 3.4, with these models, we search for differences in firms' characteristics at the announcement that make buyback programs more or less likely to be carried out in a specific

way, as broken down with our subsamples. Like with OLS cross-sectional analysis, we gradually add independent variables to the model.

Firstly, we examine the differences between Non-completed and Completed buybacks, findings of which are presented in Table 18. We find that if the firm is less undervalued in the short-term prior to buyback announcement (exhibiting higher Prior CAR), the higher the likelihood that the buyback program will be completed. More precisely, an increase in Prior CAR by one percentage point, on average, *ceteris paribus*, increases the probability of buyback being completed by 0,41 percentage points. However, we can confirm this only with Model 1, whereas adding additional independent variables to the model results in a loss of significance in the Prior CAR coefficient. The results could imply that the firms that initiate Completed buybacks do not intentionally increase their short-term undervaluation, whereas the ones initiating Non-completed buybacks might increase their short-term undervaluation to exhibit short-term announcement effects and do not tend to complete the program. We also find that larger firms are more likely to complete the buyback program. To be exact, an increase in Size by one percentage point, on average, *ceteris paribus*, increases the probability of buyback being completed by 0,09 percentage points (obtained marginal effects multiplied by 0,0043 due to $\log_{10}$ transformation). This finding is in line with the existing literature, as commonly argued, larger firms are usually more mature and with fewer investment opportunities. Furthermore, our results show that the higher the level of leverage the firm has prior to the buyback announcement, the less likely it is that the firm will complete the buyback program. Namely, an increase in Leverage by one percentage point, on average, *ceteris paribus*, decreases the probability of buyback being completed by 0,19 percentage points based on Model 1 or 0,35 percentage points based on Model 2 and Model 3, all of which are statistically significant. This could imply that Completers are less prone to overleveraging themselves throughout the buyback program or that Non-completers might stop their programs due to overleveraging. Lastly, we present supporting evidence for buybacks being substitutes rather than supplements to dividends. To be exact, we find that if the firm pays out dividends before the announcement, it is 9% less likely that the buyback will be completed compared to firms that do not pay out dividends. Based on residual deviance and Akaike information criterion (hereinafter “AIC”) score, measures of model fit, the model that best predicts the outcome of buyback being completed or not is Model 2. All three models predict that 54% of buybacks in the sample will be completed, which is exactly what we observe in the actual data set in our Full sample, with 54% of buybacks classified as Completed. The models correctly predict values of the independent variable between 56% and 65% of the time, calculation of which is shown in Appendix 3. Although the explanatory power of the models is quite low, the best one is obtained with the most explanatory variables, Model 3, which exhibits a Pseudo R-squared of 9%, another measure of goodness of fit.

The second subsamples that we try to differentiate are Equity and Not-fully equity financed buybacks. The results of these logit models are shown in Table 19 and reveal that the size of

Table 18: Logit model results for Completed vs Non-completed subsamples

Results from logit model												
Completed vs Non-completed buybacks												
y=1 if Completed y=0 if Non-completed												
	Model 1				Model 2				Model 3			
Independent variables	Coef. Estimates (z-value)	Odds ratios		Marginal effects	Coef. Estimates (z-value)	Odds ratios		Marginal effects	Coef. Estimates (z-value)	Odds ratios		Marginal effects
Intercept	0,5212 (2,7240)	***	1,6841	0,1274	-5,0824 (-5,8900)	***	0,0062	-1,1206	-5,2777 (-5,7050)	***	0,0051	-1,1515
Size					0,9127 (6,7010)	***	2,4910	0,2012	0,9794 (6,6630)	***	2,6628	0,2137
MTB	-0,0047 (-0,5600)		0,9953	-0,0012	-0,0069 (-0,7260)		0,9932	-0,0015	-0,0251 (-1,4220)		0,9752	-0,0055
Prior CAR	1,6782 (2,0470)	*	5,3559	0,4102	0,8466 (0,9690)		2,3316	0,1867	0,9271 (1,0490)		2,5272	0,2023
Cash	-1,0884 (-1,3480)		0,3367	-0,2660	0,3277 (0,3580)		1,3878	0,0723	0,2965 (0,3130)		1,3451	0,0647
FCF	0,9807 (0,8540)		2,6664	0,2397	1,1970 (0,9620)		3,3100	0,2639	1,3674 (1,0870)		3,9253	0,2984
Investment					-1,5985 (-0,6450)		0,2022	-0,3525	-1,4307 (-0,5680)		0,2391	-0,3122
Inv.Opp.					-0,2179 (-0,6980)		0,8042	-0,0480	-0,3204 (-0,9850)		0,7259	-0,0699
Capex change					0,1672 (1,5860)		1,1820	0,0369	0,1618 (1,5080)		1,1756	0,0353
Leverage	-0,7856 (-1,6690)	.	0,4559	-0,1920	-1,6049 (-2,8690)	**	0,2009	-0,3539	-1,6027 (-2,8080)	**	0,2014	-0,3497
ROE									0,4406 (1,2040)		1,5536	0,0961
EPS									0,0017 (0,1670)		1,0017	0,0004
Liquidity									-0,0162 (-0,3350)		0,9840	-0,0035
Dividend dummy									-0,4336 (-2,0430)	*	0,6482	-0,0946
Buyback size									0,2303 (0,3720)		1,2590	0,0502
No. of observations	527				527				527			
Null deviance	727,06 on 526 degrees of freedom				727,06 on 526 degrees of freedom				727,06 on 526 degrees of freedom			
Residual deviance	718,64 on 521 degrees of freedom				664,19 on 517 degrees of freedom				658,71 on 512 degrees of freedom			
AIC	730,64				684,19				688,71			
Mean predicted prob.	0,5408				0,5408				0,5408			
Correctly pred. values	0,5560				0,6414				0,6528			
Pseudo R-squared	0,0116				0,0865				0,0940			

The Table represents results of logit model. The firms' characteristics data (independent variables) are gathered at the last day a year before buyback program is announced where: **Size** is $\log_{10}$ of total assets; **MTB** is market value of equity (number of shares outstanding * share price) divided by book value of equity; **Prior CAR** is 21-days cumulative abnormal return of the firm (sum of stock's returns minus returns on value weighted S&P500 index) from 31 days to 11 days prior to the buyback announcement; **Cash** is cash divided by total assets; **FCF** is free cash flows divided by total assets; **Investment** is capital expenditure divided by total assets; **Inv. opp.** (Investment opportunity) is annual change in total sales ($Sales_{t+1} - Sales_{t-2} / Sales_{t-2}$ where $t = 0$ is year of announcement); **Capex change** is yearly change in capital expenditure ($Capex_{t+1} - Capex_{t-2} / Capex_{t-2}$ where $t = 0$ is year of announcement); **Leverage** is total debt divided by total assets; **ROE** (return on equity) is a measure of operating performance and is calculated as net income divided by total equity; **EPS** is earnings per share measurement obtained from Capital IQ Pro; **Liquidity** is quick ratio (cash, cash equivalents and short-term receivables divided by total current liabilities); **Dividend dummy** equals 1 if dividends are paid to shareholder and 0 otherwise; **Buyback size** is the amount of shares company announces to repurchase in value terms divided by total assets.

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and . denotes significance at 10%

Note: Mean predicted prob. = Mean predicted probabilities; Correctly pred. values = Correctly predicted values or accuracy

Source: own work

the firm is again the factor differentiating the subsamples. Namely, larger firms are more likely to exhibit Equity buybacks, which is contrary to the findings of existing literature. Larger firms may be able to borrow money more easily than smaller firms, which could be spent on buyback financing, so our results are a bit contradictory, but the observed effect is very small, close to 0, since the obtained marginal effects need to be adjusted for $\log_{10}$ transformation. We also find differences in the amount of cash the firm has prior to buyback, depending on the later choice of source of funding. Firms with more cash are less likely to engage in Equity buybacks. More precisely, an increase in Cash by one percentage point, on average, ceteris paribus, decreases the probability of buyback being fully financed from the firm's own resources by 0,67 percentage points based on Model 1, 0,52 percentage points based on Model 2 or 0,36 percentage points based on Model 3, all of which are statistically significant. The results are the opposite of what existing literature has found so far and to our expectations, since the ability of firms to finance the buyback from their own resources is higher for firms with more resources, including cash, than those with less. But this may

go hand in hand with firms' other activities, including investments, which is the last differentiation we are able to detect. We find that firms with more investments are less likely to engage in Equity buybacks. To be exact, an increase in Investment by one percentage point, on average, ceteris paribus, decreases the probability of buyback being fully financed from the firm's own resources by 1,95 percentage points based on Model 2 or 2,29 percentage points based on Model 3, again, both are statistically significant. The results are in line with existing literature and our expectations, since the more resources the firms spend on investments, the less is left for the financing of the buyback programs.

Table 19: Logit model results for Equity vs Not-fully equity financed subsamples

Results from logit model										
Equity vs Not-fully equity financed buybacks										
Independent variables	Coef. Estimates (z-value)	Model 1 Odds ratios	Marginal effects	Coef. Estimates (z-value)	Model 2 Odds ratios	Marginal effects	Coef. Estimates (z-value)	Model 3 Odds ratios	Marginal effects	
Intercept	0,3973 (1,3430)	1,4878	0,0949	-2,2363 (-1,8670)	· 0,1069	-0,5098	-1,3429 (-0,9620)	0,2611	-0,2975	
Size				0,2007 (2,5620)	* 1,2223	0,0458	0,3577 (1,7410)	1,4300	0,0792	
MTB	-0,0074 (-0,6770)	0,9926	-0,0018	-0,0082 (-0,7120)	0,9918	-0,0019	-0,0325 (-1,2930)	0,9680	-0,0072	
Prior CAR	0,4538 (0,3630)	1,5742	0,1084	0,0182 (0,0140)	1,0184	0,0041	-0,4833 (-0,3640)	0,6167	-0,1071	
Cash	-2,8136 (-2,1680)	* 0,0600	-0,6720	-2,2879 (-1,6650)	· 0,1015	-0,5216	-1,6376 (-1,1030)	0,1945	-0,3628	
FCF	2,2484 (1,1680)	9,4722	0,5370	2,1284 (1,0690)	8,4012	0,4852	1,7695 (0,8670)	5,8680	0,3920	
Investment				-8,5501 (-2,1800)	* 0,0002	-1,9492	-10,3460 (-2,5340)	* 0,0000	-2,2920	
Inv. Opp.				0,4513 (0,8870)	1,5703	0,1029	0,5711 (1,0560)	1,7703	0,1265	
Capex change				-0,0018 (-0,0110)	0,9982	-0,0004	0,0050 (0,0270)	1,0050	0,0011	
Leverage	0,6927 (0,8660)	1,9991	0,1654	0,2331 (0,2790)	1,2626	0,0531	0,1196 (0,1370)	1,1271	0,0265	
ROE							0,6293 (1,1910)	1,8762	0,1394	
EPS							-0,0534 (-1,1500)	0,9480	-0,0118	
Liquidity							-0,1308 (-1,5400)	0,8774	-0,0290	
Dividend dummy							0,2506 (0,8730)	1,2847	0,0555	
Buyback size							0,4050 (0,4400)	1,4993	0,0897	
No. of observations	285			285			285			
Null deviance	392,90 on 284 degrees of freedom			392,90 on 284 degrees of freedom			392,90 on 284 degrees of freedom			
Residual deviance	382,11 on 279 degrees of freedom			368,9 on 275 degrees of freedom			360,61 on 270 degrees of freedom			
AIC	394,11			388,9			390,61			
Mean predicted prob.	0,5439			0,5439			0,5439			
Correctly pred. values	0,5965			0,6070			0,6456			
Pseudo R-squared	0,0275			0,0611			0,0822			

The Table represents results of logit model. The firms' characteristics data (independent variables) are gathered at the last day a year before buyback program is announced where: **Size** is log10 of total assets; **MTB** is market value of equity (number of shares outstanding * share price) divided by book value of equity; **Prior CAR** is 21-days cumulative abnormal return of the firm (sum of stock's returns minus returns on value weighted S&P500 index) from 31 days to 11 days prior to the buyback announcement; **Cash** is cash divided by total assets; **FCF** is free cash flows divided by total assets; **Investment** is capital expenditure divided by total assets; **Inv. opp.** (Investment opportunity) is annual change in total sales ($Sales_{t+1} - Sales_{t-2} / Sales_{t-2}$ where $t = 0$ is year of announcement); **Capex change** is yearly change in capital expenditure ($Capex_{t+1} - Capex_{t-2} / Capex_{t-2}$ where $t = 0$ is year of announcement); **Leverage** is total debt divided by total assets; **ROE** (return on equity) is a measure of operating performance and is calculated as net income divided by total equity; **EPS** is earnings per share measurement obtained from Capital IQ Pro; **Liquidity** is quick ratio (cash, cash equivalents and short-term receivables divided by total current liabilities); **Dividend dummy** equals 1 if dividends are paid to shareholder and 0 otherwise; **Buyback size** is the amount of shares company announces to repurchase in value terms divided by total assets.

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and · denotes significance at 10%
Note: Mean predicted prob. = Mean predicted probabilities; Correctly pred. values = Correctly predicted values or accuracy

Source: own work

Based on measures of model fit, the best model explaining the likelihood of whether a firm initiates Equity or Not-fully equity financed buybacks is Model 3. This model also predicts that 54% of Completed buybacks will be fully financed with equity, which is exactly what we observe in the actual data set in our sample, with 54% of Completed buybacks classified as Equity buybacks. Model 3 also correctly predicts the value of the independent variable

65% of the time, calculation of which is shown in Appendix 3, and exhibits a Pseudo R-squared of 8%.

As you can see from Table 20, we are not able to find any variable that would affect the likelihood of firms engaging in Leveraged or Mixed buybacks since all the obtained coefficients of independent variables from logit models are statistically insignificant.

Table 20: Logit model results for Leveraged vs Mixed subsamples

Results from logit model									
Leveraged vs Mixed buybacks									
y=1 if Leveraged y=0 if Mixed									
Independent variables	Coef. Estimates (z-value)	Model 1		Marginal effects	Coef. Estimates (z-value)	Model 2		Coef. Estimates (z-value)	Marginal effects
		Odds ratios				Odds ratios			
Intercept	-0,8436 (-1,7440)	0,4302		-0,1602	-2,8975 (-1,4310)	0,0552		-1,1129 (-0,4650)	-0,1997
Size					0,1319 (0,9940)	1,1410		0,1426 (0,3930)	0,0256
MTB	0,0408 (1,3000)	1,0417		0,0078	0,0462 (1,2200)	1,0473		0,0346 (0,9200)	0,0062
Prior CAR	2,6631 (1,2230)	14,3405		0,5058	2,5723 (1,1230)	13,0958		2,0331 (0,8570)	0,3649
Cash	-1,5777 (-0,8090)	0,2064		-0,2997	-1,1064 (-0,5170)	0,3307		-0,6599 (-0,2930)	-0,1184
FCF	-1,6980 (-0,6070)	0,1830		-0,3225	-1,2569 (-0,4400)	0,2845		-1,2289 (-0,4080)	-0,2205
Investment					5,3427 (1,0520)	209,0673		3,2375 (0,6010)	0,5810
Inv.Opp.					-0,9269 (-0,8970)	0,3958		-0,9437 (-0,8200)	-0,1693
Capex change					0,0472 (0,1940)	1,0484		0,0558 (0,2140)	0,0100
Leverage	0,4700 (0,3500)	1,5999		0,0893	-0,1590 (-0,1070)	0,8530		-1,3563 (-0,7900)	-0,2434
ROE								1,6907 (1,0160)	5,4231
EPS								-0,0507 (-0,6350)	0,9506
Liquidity								-0,1294 (-0,8950)	-0,0232
Dividend dummy								0,1546 (0,3160)	1,1671
Buyback size								-3,1744 (-1,2540)	0,0418
No. of observations	130				130			130	
Null deviance	153,41 on 129 degrees of freedom				153,41 on 129 degrees of freedom			153,41 on 129 degrees of freedom	
Residual deviance	146,65 on 124 degrees of freedom				143,94 on 120 degrees of freedom			139,13 on 115 degrees of freedom	
AIC	158,65				163,94			169,13	
Mean predicted prob.	0,2769				0,2769			0,2769	
Correctly pred. values	0,7308				0,7462			0,7231	
Pseudo R-squared	0,0440				0,0617			0,0931	

The Table represents results of logit model. The firms' characteristics data (independent variables) are gathered at the last day a year before buyback program is announced where: **Size** is $\log_{10}$ of total assets; **MTB** is market value of equity (number of shares outstanding * share price) divided by book value of equity; **Prior CAR** is 21-days cumulative abnormal return of the firm (sum of stock's returns minus returns on value weighted S&P500 index) from 31 days to 11 days prior to the buyback announcement; **Cash** is cash divided by total assets; **FCF** is free cash flows divided by total assets; **Investment** is capital expenditure divided by total assets; **Inv. opp.** (Investment opportunity) is annual change in total sales ($Sales_{t+1} - Sales_{t-2} / Sales_{t-2}$ where $t = 0$ is year of announcement); **Capex change** is yearly change in capital expenditure ($Capex_{t+1} - Capex_{t-2} / Capex_{t-2}$ where $t = 0$ is year of announcement); **Leverage** is total debt divided by total assets; **ROE** (return on equity) is a measure of operating performance and is calculated as net income divided by total equity; **EPS** is earnings per share measurement obtained from Capital IQ Pro; **Liquidity** is quick ratio (cash, cash equivalents and short-term receivables divided by total current liabilities); **Dividend dummy** equals 1 if dividends are paid to shareholder and 0 otherwise; **Buyback size** is the amount of shares company announces to repurchase in value terms divided by total assets.

Significance levels: *** denotes significance at 0,1%, ** denotes significance at 1%, * denotes significance at 5% and . denotes significance at 10%
Note: Mean predicted prob. = Mean predicted probabilities; Correctly pred. values = Correctly predicted values or accuracy

Source: own work

6 CONCLUSION

By the use of event study methodology, we examine the abnormal returns around buyback announcements made in the United States between and including years 2000 and 2019. The most common form of a buyback is Open market share repurchase (hereinafter referred to only as “buyback” or “share repurchase”), where a company buys back its outstanding shares

from the market at the current market price, usually over a prespecified period of months or years. A company can use its own resources, or it can borrow the funds to finance the buyback program. It also has an option not to complete the announced program. However, the mere announcement of the program represents new information, which is reflected in the stock's prices. Existing literature primarily reports positive abnormal returns around buyback announcements, which means that they are, in general, perceived as good news by market participants. When searching for answers why abnormal returns are observed, one can find evidence for all three commonly studied hypothesis in existing literature: (i) signalling hypothesis, which tries to explain abnormal returns as consequence of companies signal of undervaluation and higher future profitability than expected by the market, (ii) agency or free cash flow hypothesis, which reasons that abnormal returns are observed because funds are distributed to the shareholders instead of wasted by the management and (iii) capital structuring hypothesis, which suggests that buybacks help underleveraged firms to reach the optimal capital structure and these is reflected in abnormal returns. Besides detecting abnormal returns around buyback announcements and trying to explain what influences them, we also search for the differences in abnormal returns based on how the program is carried out and differences in companies' characteristics among these groups.

Our Full sample consists of 527 buyback announcements, one per firm. We define a buyback program as Completed, if the completion rate (calculated by dividing the total value of repurchased shares by the planned value of shares to be bought back at the announcement) is equal to or above 99%; otherwise, as Non-completed. We further divide Completed buyback to: (i) Equity buyback – if the levered free cash flow (shorter “LFCF”) during the buyback period is higher than the amount of buyback itself, meaning that the company self-funds the program, (ii) Leveraged buyback – if the firm borrows more than 50% of the planned buyback amount during the buyback period, as substantial cash has been raised, possibly for the buyback and (iii) Mixed buyback – if the buyback cannot be classified as Equity or Leveraged. Leveraged buyback and Equity buyback are together referred to as Not-fully equity financed buybacks. Our Full sample consists of 242 Non-completed and 285 Completed buybacks, among which 155 are classified as Equity, 94 as Mixed and 36 as Leveraged buybacks. We can hence conclude that it is quite common for companies to just announce the buyback programs but not to complete them, since only 54% of companies actually complete the intended share repurchase programs. Among the Completed buybacks, we observe that companies funding the buybacks from their own resources prevail, but a mixture of self-funded programs and funded by borrowed money is quite common as well, whereas Leveraged buybacks are relatively rare.

We find that companies that complete the announced buyback program (hereinafter “Completers”) plan to repurchase more shares (in value terms), start repurchasing sooner after the announcements and repurchase in a shorter time period than companies that do not complete the buyback program (hereinafter “Non-completers”). We also observe the highest values of buybacks among the Equity buybacks and the lowest for Leveraged buybacks.

Analysed companies are quite large with a mean value of assets equalling 8,2 billion USD and ranging from as low as 1,6 million USD to as high as 647,8 billion USD, but Completers are on average larger than Non-completers. We also find that Completers have lower MTB ratios, fewer investment opportunities, payout less dividends, have lower levels of leverage and have fewer liquid assets than Non-completers. But Completers have higher financial distress risk although they have better operating performance, whereas the levels of cash of Completers and Non-completers are almost the same. We also detect some differences among the Completers, namely, firms initiating Leveraged buybacks and Equity buybacks are larger than the ones initiating Mixed buybacks. MTB ratio is the lowest for the subsample of Equity buybacks and the highest for the subsample of Leveraged buybacks, while the subsample of Mixed buybacks has the highest levels of cash. The highest level of leverage and also the highest financial distress risk is recorded for companies initiating Equity buybacks but the ones conducting Leveraged buybacks are right behind them. Operating performance is better, and liquidity is higher for companies that do not fully finance buybacks from their own resources in comparison to those that do. No differences are found in terms of investment opportunities and the amount of dividends paid among the subsamples of Completers.

Consistent with existing literature, we detect positive abnormal returns ranging between 0,16% and 2,55% among different sub/samples and different days around the event (different event windows). Except on the day of the event, the market reacts most favourably to buyback announcements made by firms that are able to finance the program completely from their own resources with abnormal returns ranging from 0,85% to 2,55%, which remain statistically significant also over longer, five- and twenty-one-day, event windows. Non-completers have the highest abnormal return on the day of the event (0,88%) and have also higher abnormal return for a two-day event window than Completers, but abnormal returns of Non-completers decrease and become statistically insignificant over the longer event windows, whereas abnormal returns of Completers increase and remain significant. Abnormal returns for five - and twenty-one-day event windows for Completers amount to 1,71% and 2,09%, respectively. Hence, we can conclude that the market reacts more favourably to buyback announcements made by Completers than Non-completers. Abnormal performance around the announcements made by companies initiating Leveraged and Mixed buybacks cannot be confirmed because we obtain statistically insignificant results for all tested event windows. We obtain statistically significant abnormal returns only for two- and five-day event windows for a sample of Not-fully equity financed buybacks, which are much lower in comparison to Equity buybacks, namely 1,07% and 1,20%, respectively. We observe positive market reactions also when the assumption of normality in the distribution of abnormal returns is dropped, where we come to similar conclusions. In particular, markets react more favourably to buyback announcements made by Completers in comparison to Non-completers, but this time abnormal returns of Non-completers remain statistically significant also over longer event windows. Most favourable market reaction is again observed for firms initiating Equity buybacks, while abnormal returns for all forms of Not-

fully equity financed buybacks cannot be confirmed, with the exception of abnormal returns for a two-day event window. But again, the abnormal performance is much lower than the one observed by companies funding the program from their own resources. Based on the presented abnormal returns, we can conclude that the market reacts differently to buyback announcements depending on how the program is carried out.

We find supporting evidence for the signalling hypothesis only with the measure of companies' short-term undervaluation. Evidence for the capital structuring hypothesis is limited to two specific subsamples, namely Non-completed and Leveraged buybacks. Whereas we cannot confirm the free cash flow hypothesis with any of our sub/samples. We are able to find some other relations of buyback and companies' characteristics with the magnitude and direction of abnormal returns. More precisely, we find that abnormal returns are higher, the lower is the companies' investment opportunity, the higher is increase in capital expenditure, the higher is companies' liquidity, the larger is the company and the smaller is the size of the buyback program. However, these relations are limited to specific subsamples, and we are also not able to differentiate these relations between the different subsamples, based on how the buyback program is carried out, because the majority of relations are statistically insignificant. Lastly, we are able to detect some firms' characteristics prior to announcement that affect the likelihood of buyback being carried out in a specific way. We find that it is more likely that the firm will engage in Completed buybacks rather than Non-completed, if it is a larger firm or less undervalued in the short-term or with a lower level of leverage. We also present supporting evidence for buybacks being substitutes for dividends rather than supplements, since the likelihood of completing the buyback program is higher for firms that do not pay out dividends prior to buyback announcement. Our results also show that larger firms or firms with less cash or with lower investments are more likely to engage in Equity buybacks rather than Not-fully equity financed buybacks. Whereas we do not find any firm's characteristics that would affect the likelihood of firms engaging in Leveraged or Mixed buybacks.

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APPENDICIES

Appendix 1: Povzetek (Summary in the Slovenian language)

V zadnjem obdobju se je število in obseg odkupa lastnih delnic močno povečalo. Le ta ne predstavlja zgolj obliko izplačila dobička ampak ga podjetja uporabljajo tudi za druge namene, kot na primer za signalizacijo, da je trenutna vrednost podjetja na trgu podcenjena, kot obrambo pred prevzemom podjetja, doseganjem višjega dobička na delnico, doseganjem optimalno kapitalsko strukturo in drugo. Ob najavi programa odkupa lastnih delnic se podjetjem običajno poveča donosnost njihovih delnic in na trgu opazimo tako imenovano abnormalno donosnost. A sama najava programa ne zavezuje podjetja k izvedbi dejanskih odkupov v načrtovanem obsegu. Prav tako njihovo financiranje v veliki meri ostane neznano, vemo pa, da vedno več podjetji odkupuje lastne delnice z dolžniškim denarjem.

V magistrski nalogi predstavimo dosedanje literaturo s področja programov odkupa lastnih delnic, kaj so njihove prednosti in slabosti, kateri faktorji vplivajo na dokončanje programa, kdaj je primerno financirati odkup z dolgom, kakšni so abnormalni donosi in zakaj le ti nastanejo, ter katere značilnosti podjetij na to vplivajo. V empiričnem delu s pomočjo študije vpliva dogodkov raziskujemo ali trg reagira drugače na najavo programov odkupa lastnih delnic glede na to kaj se s programom kasneje zgodi. Z uporabo vzorca najav programov odkupa lastnih delnic v Združenih državah Amerike v obdobju dvajsetih let od začetka leta 2000 do konca leta 2019 ugotovimo, da podjetja ob najavi programa odkupa lastnih delnic izkazujejo abnormalne donose in so le-ti različni glede na kasnejši potek programa. Najvišje abnormalne donose opazimo pri podjetjih, ki program dokončajo in le-tega financirajo z lastnimi sredstvi med tem ko abnormalne donose ob najavi programa ne moremo potrditi za podjetja, ki program financirajo z dolgom. Predstavimo tudi značilnosti analiziranih podjetji in njihove razlike med posameznimi skupinami, tvorjene glede na izvedbo programa. Opazimo, da so podjetja, ki program dokončajo v povprečju večja, imajo nižje razmerje med tržno in knjigovodsko vrednostjo podjetja in imajo manj investicijskih priložnosti, kot podjetja, ki programa ne dokončajo. Zaznamo tudi druge razlike in razlike med različnimi oblikami financiranja. V drugem delu empirične analize, potrdimo, da podjetja z najavo programa odkupa lastnih delnic signalizirajo njihovo kratkoročno podcenjenost. Najdemo tudi druge povezave med značilnostmi podjetji in višino abnormalnih donosov, medtem ko ne najdemo razlik vpliva značilnosti podjetji na abnormalne donose glede na kasnejši potek programa. V zadnjem delu empirične analize dokažemo, da nekatere značilnosti podjetij, pred najavo programa odkupa lastnih delnic, vplivajo na verjetnost kako bo potekala izvedba odkupa lastnih delnic.

Appendix 2: Description of key variables used in the analysis

Table A: Description of key variables used in the analysis

Description of key variables	
Variable	Definition
Buyback size	Amount of shares firm announces to repurchase (in value terms) scaled by firm's total assets in the balance sheet at the end of firm's fiscal year before the year of buyback announcement.
Capex change	Change in firm's capital expenditure (cash outflows towards purchase of plant, property and equipment by the firm) from two firm's fiscal years before the year of buyback announcement to one firm's fiscal year before the year of buyback announcement.
Cash	The firm's total cash and cash equivalents scaled by firm's total assets. All items are taken from the balance sheet at the end of firm's fiscal year before the year of buyback announcement.
Completion rate	A percentage of shares bought back (in value terms) by the firm relative to amount of shares firm announces to repurchase (in value terms).
Dividend dummy	Equals 1 if firm paid out dividends in fiscal year before the year of buyback announcement and 0 otherwise.
Dividends	Dividends paid out in the firm's fiscal year before the year of buyback announcement scaled by firm's total assets in the balance sheet at the end of firm's fiscal year before the year of buyback announcement.
EPS	Basic earnings per share at the end of firm's fiscal year before the year of buyback announcement. It is net income to common including extra items times one thousand divided by weighted average basic shares outstanding.
FCF	Firm's free cash flow in the firm's fiscal year before the year of buyback announcement. It is a sum of cash flows from operating activities, investing activities and financing activities plus foreign exchange rate adjustments and other miscellaneous cash flows.
Inv.Opp.	Change in firm's total sales from two firm's fiscal years before the year of buyback announcement to one firm's fiscal year before the year of buyback announcement.
Investment	Firm's capital expenditure (cash outflows towards purchase of plant, property and equipment by the firm) in the firm's fiscal year before the year of buyback announcement scaled by firm's total assets in the balance sheet at the end of firm's fiscal year before the year of buyback announcement.
Leverage	The firm's total debt scaled by firm's total assets. All items are taken from the balance sheet at the end of firm's fiscal year before the year of buyback announcement.
LFCE	Levered free cash flow during the time of the buyback program of a firm, starting with quarter in which the announcement was made and ending in quarter in which the program ended.
Liquidity	Current ratio - firm's total current assets as a multiple of firm's total current liabilities. All items are taken from the balance sheet at the end of firm's fiscal year before the year of buyback announcement.
MTB	Market to book ratio represent market value of firm's equity scaled by its book value at the end of firm's fiscal year before the year of buyback announcement. It is calculated by dividing firm's MVE with the firm's total equity in the balance sheet. All items are taken from the end of firm's fiscal year before the year of buyback announcement.
MVE	Number of firm's outstanding shares multiplied by the price of firm's share. All items are taken from the end of firm's fiscal year before the year of buyback announcement.
Prior CAR	Firm's cumulative average abnormal return as a sum of firm's stock returns minus returns on value weighted S&P 500 index over 31 days to 11 days prior to buyback announcement.
ROE	Firm's net income in the firm's fiscal year before the year of buyback announcement scaled by firm's total equity in the balance sheet at the end of firm's fiscal year before the year of buyback announcement.
Size	The logarithmic value of firm's total assets in the balance sheet at the end of firm's fiscal year before the year of buyback announcement.
Z-score	Measure of credit risk taking into account firm's working capital (WC), retained earnings (RE), earnings before interest and taxes (EBIT), market value of equity (MVE) and net sales (NS). All items are taken from the end of firm's fiscal year before the year of buyback announcement.

Source: adapted from Andres et al. (2018); Andriosopoulos et al. (2013); Altman (1968); Gupta and Wagner (2018); Kahle (2002); Lei & Zhang (2016); Mietzner (2017)

Appendix 3: Calculation of correctly predicted values from logit models

The accuracy of the logit models or correctly predicted values is the percentage of correctly predicted values of y with the model relative to total model predictions. The example of calculation for the Model 1 from the logit model of Completed vs Non-completed subsamples is presented in equation (42):

$$Accuracy = \frac{59+234}{59+183+51+234} = 0,556 \quad (42)$$

Table B: Calculation of correctly predicted values from the logit model of Completed vs Non-completed subsamples

Calculation of correctly predicted values - Completed vs Non-completed						
True\Predicted	Model 1		Model 2		Model 3	
	y=0	y=1	y=0	y=1	y=0	y=1
y=0	59	183	126	116	131	111
y=1	51	234	73	212	72	213
Accuracy:	0,556		0,641		0,653	

Source: own work

Table C: Calculation of correctly predicted values from the logit model of Equity vs Not-fully equity financed subsamples

Calculation of correctly predicted values Equity vs Not-fully equity						
True\Predicted	Model 1		Model 2		Model 3	
	y=0	y=1	y=0	y=1	y=0	y=1
y=0	46	84	59	71	65	65
y=1	31	124	41	114	36	119
Accuracy:	0,596		0,607		0,646	

Source: own work

Table D: Calculation of correctly predicted values from the logit model of Leveraged vs Mixed subsamples

Calculation of correctly predicted values - Leveraged vs Mixed						
True\Predicted	Model 1		Model 2		Model 3	
	y=0	y=1	y=0	y=1	y=0	y=1
y=0	93	1	94	0	92	2
y=1	34	2	33	3	34	2
Accuracy:	0,731		0,746		0,723	

Source: own work