# DOES THE INTEREST RATE ENVIRONMENT MATTER?

## EVIDENCE FROM SHARE REPURCHASE ANNOUNCEMENTS

**JESSICA DECKERT**

**SIGNE KARKLINA**

Master Thesis

Stockholm School of Economics

2019

**Does the interest rate environment matter? Evidence from share repurchase announcements**

Abstract:

This paper investigates how the interest rate environment affects cumulative abnormal returns around share repurchase announcements. Even though previous findings regarding this relationship are limited, anecdotal evidence claims that the low interest rate environment is the driver behind the increased amounts of share repurchase programs in recent years. To test this relationship, we use a two-step methodology for a sample of US listed companies. Firstly, we determine cumulative abnormal returns (CAR) for 3 event windows. Secondly, we perform regression analysis to quantify the interest rate environment effect on estimated abnormal returns. The results of our analysis are mixed. While a low interest rate environment is associated with lower CAR for a 3-day (-1, 0, 1) event window, the low interest rate has an insignificant effect for 7-day (-3, 0, 3) CAR and a strong positive impact on 61-day (-30, 0, 30) CAR. We propose that the findings can be explained by higher market expectations of share repurchase announcements in a low interest rate environment. However, the positive relationship between the low interest rate environment and 61-day CAR indicates a market learning process through information signaled by share repurchases when interest rates are low. Despite the plausible explanation provided, the results present an empirical puzzle that requires further research.

Keywords:

Share repurchases, buybacks, interest rates, event study, cumulative abnormal returns

Authors:

Jessica Deckert (41353)
Signe Karklina (41356)

Tutor:

Kenth Skogsvik, Professor, Department of Accounting

Master Thesis
Master Program in Accounting, Valuation and Financial Management
Stockholm School of Economics

**Acknowledgments**

We would like to thank Kenth Skogsvik, our supervisor, for the valuable advice and the productive and insightful meetings we had during the past four months. We would also like to express our gratitude to Antonio Vazquez for his advice on statistical and econometric issues, as well as to Mariya Ivanova for giving valuable comments in early stages of writing this thesis. Further, we thank Peter Aleksziev for attending our thesis meetings with Kenth and for his advice.

Jessica Deckert Signe Karklina

December 9, 2019

# Contents


**1. INTRODUCTION ..... 5**

**2. LITERATURE REVIEW ..... 6**

**2.1. Overview of share repurchases and the market response ..... 6**

**2.2. Relevant theories ..... 7**

2.2.1. Modigliani and Miller propositions ..... 7
2.2.2. Signaling theory ..... 9
2.2.3. Agency cost theory and Free cash flow theory ..... 10
2.2.4. Tax clienteles ..... 11
2.2.5. Institutional clienteles ..... 11
2.2.6. Summary of share repurchase literature ..... 12

**3. ANECDOTAL EVIDENCE ..... 14**

**4. HYPOTHESES ..... 14**

**5. METHODOLOGY ..... 15**

**5.1. Event study ..... 16**

**5.2. Pooled OLS regression analysis ..... 18**

**5.3. Model inputs ..... 19**

5.3.1. Treatment variable: interest rate environment ..... 19
5.3.2. Alternative variable: interest rate trend ..... 20
5.3.3. Control variables ..... 21

**6. DATA SAMPLE ..... 29**

**7. RESULTS ..... 31**

**7.1. Event study results - discussion of dependent variable ..... 31**

**7.2. Pooled OLS results ..... 33**

7.2.1. Model specification ..... 33
7.2.2. Market reaction to share repurchase announcements and interest rate environment ..... 35
7.2.3. Market reaction to share repurchase announcements and interest rate trends ..... 38

**8. ROBUSTNESS CHECKS ..... 39**

**9. DISCUSSION ..... 41**

**9.1. Market reaction to share repurchases ..... 41**

9.1.1. Comparison with prior research ..... 41
9.1.2. Downward trend before repurchase announcement ..... 42

9.1.3. Response after share repurchase announcement ....43
**9.2. Interest rate environment: short term impact .... 43**
**9.3. Interest rate environment: medium term impact .... 44**
**9.4. Interest rate trend .... 44**
**9.5. Control variables - comparison to prior studies .... 45**
**10. CONCLUSIONS .... 46**
10.1. Empirical findings ....46
10.2. Research contribution ....47
10.3. Implications of the findings ....47
10.4. Limitations and suggestions for further research ....48
**11. REFERENCES .... 49**
**12. APPENDICES .... 52**
**Appendix A .... 52**
**Appendix B .... 53**
**Appendix C .... 53**
**Appendix D .... 54**
**Appendix E .... 55**
**Appendix F .... 56**

# 1. Introduction

> "Everyone's got an opinion on buybacks, from executives and politicians to Twitter users. Now, in a year when it was once thought they'd reach $1 trillion, a louder voice is being heard: the markets." (Ponczek, 2019)

This quote encapsulates the ongoing discussion among finance professionals and various market participants about the increase in share repurchase activity. According to Grullon and Michaely (2004), the year 2000 was the first time in history when industrial organizations paid out more cash through share repurchases than through dividends. This trend has only continued: while S&P 500 companies spent $480 billion on share buybacks in 2013, this amount reached $806 billion in 2018 (Kerber, 2015; Wigglesworth, 2019; Light, 2019).

The theoretical explanations behind this development are scarce. In general, different streams of research have previously discussed various aspects of share repurchases. While most studies conclude that the market reacts positively to share repurchase announcements and hence abnormal returns can be generated, findings regarding the motivation behind share buybacks differ. Some of the results suggest management payoffs as a driving factor, whereas others support the signaling of undervaluation or the reduction of agency costs. While empirical research on the recent share repurchase activity has been limited, industry professionals have suggested that the interest rate environment has a significant effect on the company's intentions to repurchase previously issued shares (Light, 2019). This alleged relationship is an outcome of the U.S. Central Bank expansionary monetary policy that implies decreased interest rates resulting in lower borrowing costs for companies. The anecdotal evidence claims that the decrease in cost of debt has fueled the share buyback activity.

So far, no research has been done to directly investigate the relationship between the interest rate environment and the market response to share repurchase programs. We propose an integrated approach to study this relationship: first, we investigate whether the market reaction to share repurchase announcements has changed over time and whether previous findings still hold. Subsequently, we examine whether the low interest rate environment affects the market response to share repurchase announcements. Hence, the goal of this thesis is to answer the following research question:

> What is the effect of the interest rate environment on abnormal returns around share repurchase announcements?

To answer the above-mentioned research question, we perform an event study on share repurchase announcements for US listed companies in the years 1984-2018. We estimate the market reaction for three different event windows using three different methodologies. After obtaining abnormal returns, regression analysis is used to test the proposed relationship between the interest rate environment and share repurchases.

Our results indicate that cumulative abnormal returns associated with share repurchase announcements differ based on the prevailing interest environment and this difference is economically significant. Furthermore, we also find that the cumulative abnormal returns have declined over time. However, the results regarding the impact of the interest rate environment on the market reaction to share repurchase announcements are mixed: while

for a 3-day event window, low interest rate environment has a negative and statistically significant effect on cumulative abnormal returns, there is no significant effect on 7-day cumulative abnormal returns. When the event window is extended to 61 days, a low interest rate environment has a positive effect on abnormal returns around share repurchase announcement dates. While the obtained results for the impact of the current interest rate environment are puzzling, the trend in interest rates seems to have no effect on the market reaction to share buyback announcements.
The rest of this thesis is structured as follows: Section 2 summarizes previous findings and relevant theories that provide a background for our research. Section 3 presents anecdotal evidence for our study. In Section 4, we propose hypotheses that are tested in this thesis. Section 5 describes the methodology employed in this study, and Section 6 elaborates on our data sample. While the results are presented in Section 7, Section 8 discusses their robustness. In Section 9, results are discussed and in Section 10, conclusions and suggestions for further research are presented

# 2. Literature review

## 2.1. Overview of share repurchases and the market response

Share repurchases are one of the tools used by companies to return capital to their shareholders. Even though the concept of buying back previously issued shares is straightforward, share repurchases can be done in four different ways: (1) the fixed-price tender offer, (2) the dutch-auction tender offer, (3) the open market repurchase program, and (4) privately-negotiated share repurchases (Grullon & Ikenberry, 2000; Atkins et al., 2013).
In a fixed-price tender offer a company offers to pay a fixed price for a specific number of shares to all shareholders. The tender offer is usually valid for a specific time period from 3 weeks up to 1 month (Vermaelen, 1984). However, the company does not necessarily have to execute the repurchase if less than a specified minimum number of stocks is offered by the market (Grullon & Ikenberry, 2000).
The dutch-auction tender is similar to the fixed-price tender offer. However, to determine the share price, the management of the repurchasing firm announces a range of acceptable prices. Then each shareholder offers to sell their shares for a specific price within that range. Finally, the repurchasing company executes all bids from the lowest to the highest price until the number of shares repurchased is equal to the size of share repurchase program (Grullon & Ikenberry, 2000).
In contrast to Dutch auction and fixed price tender offers, in privately negotiated share repurchases, the company can negotiate repurchase agreements with individual shareholders. This is the most efficient way in which a sizeable number of shares can be repurchased in a relatively short period of time. Although the above-mentioned techniques are very efficient because companies can purchase large amounts of shares over relatively short time spans, they are not as popular among managers as open market share repurchase programs (Grullon & Ikenberry, 2000).
Open market share repurchase programs imply that the company buys its shares in the open market either directly or through a subsidiary. In the US, open market repurchases are regulated by law (SEC rule 10b-18 ("Safe Harbor")) and treated as a material event. Hence, the programs have to be approved by the company's board and have to be publicly

announced to the market. Usually, open market share repurchases do not have a restricted size or execution period. However, Grullon and Ikenberry (2000) state that on average, open market share repurchase programs include approximately 5% of the outstanding share base and take around 3 years to complete.
Previous researches have mostly selected and studied one specific share repurchase type. For example, Bonaimé (2012) and Grullon and Michaely (2002) studied the market reaction only to open share repurchase programs, while Lakonishok and Vermaelen (1990) studied fixed price tenders. Moreover, Comment and Jarrel (1991) compared the three most prominent types of share repurchases. For the purpose of this study, we use a sample that consists of all share repurchase types.
The type of the share repurchase program contains information that might affect the market response to the announcement. For example, open market share repurchase programs are not a binding commitment and are more flexible, hence, the expected market response is smaller. Comment and Jarrel (1991) finds that fixed-price tender offers result in an abnormal return of about 11%, compared to less than 8% for Dutch auctions, and around 2% for open-market repurchase programs. Furthermore, Masulis (1980) finds abnormal two-day-returns of 17% after announcements of tender offer share repurchase programs. In more recent studies, Ikenberry, Lakonishok and Vermaelen (1995) find a positive long-term price reaction to open market share repurchase announcements.
Despite the discussed differences across share repurchase types, for the purpose of this research, we do not distinguish between share repurchase types and proceed the research by including all methods in our sample as the aim of this paper is to investigate whether the interest rate environment affects market response to share repurchases as a whole with no regard to technique type.

## 2.2. Relevant theories

Share repurchases as a part of corporate payout policy have been a prominent research topic in both corporate finance and financial analysis literature. In order to establish a common ground for our study, in this section we discuss previous findings of capital structure and payout policy studies to highlight the driving factors behind companies' decisions to authorize share repurchase programs. Afterwards we provide reasoning as to why the market response to share repurchases might depend on the interest rate environment.

### 2.2.1. Modigliani and Miller propositions

Share repurchases are a vital part of companies' payout policies that are a result of capital structure decisions. Hence, most research on share repurchase, dividend and capital structure decisions build on the propositions developed by Modigliani and Miller.

**Leverage irrelevance proposition**
Share repurchases are a cash outflow for the company causing changes in the capital structure. Moreover, as share repurchases can be financed either with cash or debt, the decision of how to fund a share repurchase program further affects the capital structure of a company. Modigliani and Miller (1958) addresses the capital structure impact on company valuation of capital structure decisions by suggesting leverage irrelevance in their Proposition I. The leverage irrelevance theory states that with given production-

investment decisions, the market value of a firm is invariant to its capital structure. In other words, Modigliani and Miller (1958) argues that the market value of a levered firm equals the market value of an unlevered firm if both have the same business risk. The leverage irrelevance proposition is based on the assumptions of a perfect capital market[1]. The Proposition I implies that share repurchases per se do not create value to the company's shareholders because changes in capital structure that are an outcome of share repurchases do not affect company value. Hence, according to the leverage irrelevance theory, share repurchase announcements should not yield abnormal returns.
Furthermore, Modigliani and Miller (1958) also add Proposition II that states that the cost of capital of levered firm ($r_E$) is equal to the cost of equity of unlevered firm ($r_U$) plus a premium that is proportional to the leverage of the firm measured as market value-based debt to equity ratio. This relationship is illustrated in figure 1. The Proposition II indicates that the cost of capital for a levered firm is sensitive to its borrowing cost. Hence, even though leverage of the company does not matter, the cost of debt matters.

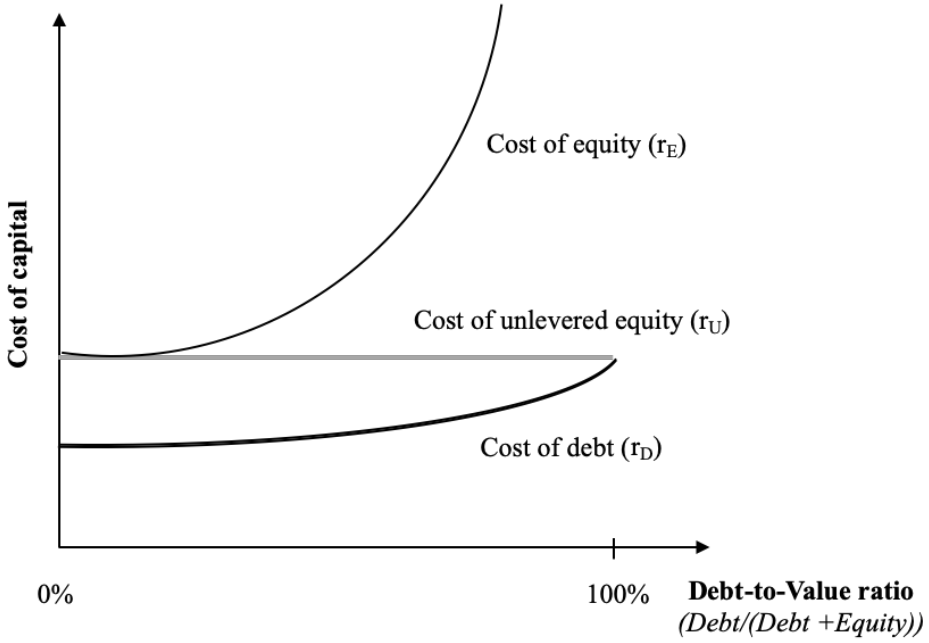



**Figure 1**. The cost of capital in perfect capital markets (Berk, DeMarzo & Harford, 2015)

### Dividend irrelevance theory

Furthermore, Modigliani and Miller (1961) develops the dividend irrelevance theory that is also based on perfect capital market assumptions and implies that a firm's dividend policy has no impact on its valuation or shareholder returns. Furthermore, the scholars argue that dividends and share buybacks are perfect substitutes as investors are indifferent between capital gains and dividends payments. Hence, repurchase announcements should

[1] A perfect capital market assumes: (i) equal and costless information available to all market participants; (ii) there are no taxes; (iii) there are no transaction costs; (iv) all investors are rational, and all agents are price takers; (v) there are no agency costs.

not yield abnormal returns also according to the dividend irrelevance proposition (Modigliani & Miller, 1961; Berk, DeMarzo & Harford, 2015).

**Leverage irrelevance and corporate taxation**

However, the perfect capital market assumptions do not hold in reality. Thus, in their 1963 paper, Modigliani and Miller relax one of the perfect capital market assumptions and introduce corporate taxes. As interest expenses are tax deductible, levered firms benefit from an interest tax shield. Hence, the authors conclude that with taxation, their leverage irrelevance proposition does not hold: the market value of a levered firm will exceed the market value of an unlevered firm if both have the same business risk by the present value of the interest tax shields (Modigliani & Miller, 1963). Subsequently, the valuation of the firm is not only affected by the borrowing costs of the firm, but also by the capital structure choices. Given everything else equal, investors prefer normal interest rates over low interest rates because of the higher tax shields. Taking this into account, share repurchases not only per se affect company valuation, but also the choice of funding, as well as respective borrowing costs, can directly affect the value of the firm. Hence, differences in market reaction to share repurchase announcements could be expected depending on the prevailing interest rates.

### 2.2.2. Signaling theory

Signaling theory proposes that corporate decisions, including share repurchases, can convey inside information to external investors. The information signaled can range from future earnings prospects to over-/undervaluation of the company, to maturity of the firm and/or intended changes of a company's business model, to entrenchment problems and the intentions to solve them.

Following the original signaling equilibrium model developed by Spence (1979), many scholars have developed signaling models in which they acknowledge the presence of asymmetric information. For example, Bhattacharya (1979) developed a signaling model in which dividends function as signals for expected future cash flows. The author identifies the cost of raising new capital as a signaling cost if the firm has to raise external capital to meet the dividend commitments (Bhattacharya, 1979). Miller & Rock (1985) also propose a model in which dividends signal expected future earnings to investors. However, Miller & Rock (1985) identifies reduction of investments below a firm's optimal investment level in order to maintain previously decided dividend levels as signaling cost. Despite the differences in signaling costs, in both models inside information about future cash flows and earnings prospects is externalized, information asymmetries are reduced, and capital market prices are adjusted accordingly.

Similar to dividends, also share repurchases can be used to convey different signals to the market. Penman (2012) suggests that management should initiate share repurchase programs when their shares are undervalued. This argument is based on the assumption that when the market receives a signal of undervaluation, the stock price is adjusted to the signaling firm's intrinsic value. However, Rau and Vermaelen (2002) critically discuss that under the assumption of efficient markets in the semi-strong form, the stock price would adjust immediately after the announcement of a repurchase program, implying that it would be impossible for any company to actually repurchase undervalued stock).

Another potential signal that can be sent through payout decisions is the existence of entrenchment problems and the intention of management to solve them (Jensen and

Meckling, 1976). Entrenchment problems occur when managers hold too little equity stake in the firm they manage for their interests to be aligned with the interests of the firm's owners. As an alternative to traditional corporate governance techniques that limit opportunistic management behavior, share repurchases can also reduce entrenchment problems: by reducing cash available for management for misappropriate use. Hence, share repurchases signal to the market that management itself intends to reduce agency costs.

A multitude of signaling hypotheses have been tested empirically in the context of share repurchase programs. A leading study was conducted by Vermaelen (1981). The study investigates the market reaction to both open market and tender offer share repurchases. Evidence strongly supports signaling effects in tender offer share repurchase programs: firms repurchase shares at a premium when the outlook of future earnings is positive. However, the evidence found is less conclusive in the case of open market share repurchases. Vermaelen (1981) suggests that open market repurchases might be a tool to compensate managers by transferring shares from outsiders to insiders rather than to signal positive earnings outlooks to the market. In another study, Vermaelen (1984) also investigates various signaling effects of tender offer share repurchases. The author finds that the size of the share repurchase program, insider holdings and the premium paid for repurchased shares are perceived as positive signals by the market.

### 2.2.3. Agency cost theory and Free cash flow theory

Agency cost theory builds on a misalignment of interests between managers and shareholders. More specifically, according to agency cost theory, managers of firms with excess cash flows and scarce investment opportunities might invest in projects that are value destroying for the shareholders as their compensation is tied to the company's performance (Berk, DeMarzo and Harford, 2015). Free cash flow (FCF) theory addresses this issue by suggesting that payout policy reduces excess cash available to managers, which consequently reduces agency costs. This theory was first introduced by Easterbrook (1984) and Jensen (1986) and since then has been tested in empirical share repurchase research.

Grullon and Michaely (2004) compare open market repurchase programs, dividend payouts and fixed price tender offers. The authors find that repurchasing firms reduce their capital expenditure and research and development expenses, as well as significantly decrease their cash reserves compared to their non-repurchasing peers. Hence, the authors argue that share repurchase programs reduce agency costs. Further, Grullon and Michaely (2004) find evidence for the market reaction being stronger for firms that are more likely to invest in negative net present value projects. Therefore, the empirical findings of Grullon and Michaely (2004) are in line with the Free cash flow theory.

The implied narrative of those empirical findings is as follows: When firms move from a growth to a more mature phase in their lifecycle and their investment opportunity set becomes smaller, the proportion of existing assets to their total valuation increases. As assets in place are less risky than growth opportunities, the total systematic risk of those companies declines, which leads to a decrease in their cost of equity. Due to the contraction of growth opportunities, companies invest less, which leads to higher free cash flows. The probability of overinvestments, or more specifically investments in unprofitable projects, increases. In this situation, a decision to pay out cash through a share repurchase program reduces agency problems, especially in mature firms with

lower growth opportunities and higher free cash flows. For example, Lee and Suh (2011) find temporary and substantial cash increases before firms authorize share repurchase programs. These results provide support for Agency cost theory as firms distribute excess cash to reduce the agency conflicts. However, Howe et al. (1992) find no support for the Free cash flow hypothesis when investigating the market reaction to tender offer share repurchases.
The already existing empirical evidence shows that share repurchase programs address agency costs by reducing cash available for investing. Hence, the market response to share repurchase announcements can vary depending on the severity of agency problems and on the quality of investment opportunities of a company. Furthermore, Bernanke and Gertler (1989) argue that agency costs fluctuate through the business cycles and hence, the economic environments. This link provides intuitive evidence that the market response to share repurchase announcements might be time dependent.

### 2.2.4. Tax clienteles

Since tax rates significantly affect the after-tax returns of investors, the taxation of capital gains and cash payouts can impact capital allocation decisions of individual investors. These tax effects have been investigated by Bagwell and Shoven (1989) who perform an empirical study investigating the impact of taxation on cash payouts to shareholders. The authors focus on the *Tax Reform Act 1986*, which increased the taxation of realized capital gains relative to dividend income in the US. The results show that, contrary to the scholar's expectation, the number of share repurchases accelerated in the two years following the tax reform.

Also, Blouin et al. (2011) find evidence for a tax clientele effect in their study. The authors investigate investors' and firms' reactions to the *Jobs and Growth Tax Relief Reconciliation Act 2003* considering portfolio allocation choices between dividend and share repurchase oriented firms. The authors find support regarding tax clientele theory and how investor portfolio allocation changed as a response to taxation changes. Furthermore, Blouin et al. (2011) also find that firms with large individual ownership changed their payout structure towards more dividend payments and reduced their share repurchases. Hence, the study shows that the prevailing tax regime has an impact on corporate payout decisions, as companies follow the goal to accommodate payout preferences of their investors.

### 2.2.5. Institutional clienteles

Similarly, as for dividend payments, institutional theory states that institutions prefer companies that do share repurchases. Bodnaruk and Östberg (2013) look at the relationship between companies' payout policies and their shareholder base. The authors ground their research on institutional theory that implies that the shareholder base affects the payout policy and the cost of external financing of the firm. Results of Bodnaruk and Östberg (2013) study show that share repurchases significantly reduce the size of the shareholder base. That being the case, share repurchases are less likely to be undertaken by smaller companies.
These findings suggest that the market response to share repurchase announcements can be affected by the shareholder base of the company. O'Brien and Bhushan (1990) state

that analyst coverage is higher for companies with large institutional ownership, which provides support for differences in market response to share repurchase announcements.

### 2.2.6. Summary of share repurchase literature

The previously discussed findings provide evidence that the market reacts positively to share repurchase announcements and consequently abnormal returns can be generated. Furthermore, the theories summarized in Table 1 indicate that the market response of the share buybacks can depend on various factors. We extend this view by proposing that the market response to share repurchase announcements can be time varying and that the interest rate environment can be used to explain this variation.

**Table 1.** Summary of share repurchase studies

| Theory | Key studies | Summary |
|---|---|---|
| Leverage irrelevance theory | Modigliani and Miller (1958) | In perfect capital markets, company's value is not affected by the leverage. Therefore, share repurchases should not create value for shareholders. That being the case, no abnormal returns should be observed around repurchase announcements. |
| Dividend irrelevance theory | Modigliani and Miller (1961) | Dividends and share buybacks are perfect substitutes in perfect and efficient markets. Hence, the choice of share repurchases over other payout methods should not create value to investors implying to abnormal returns around share repurchase announcements. |
| Signaling theory | Bhattacharya (1979); Miller & Rock (1985); Penman (2012); Vermaelen (1981) | Share repurchases are means to signal inside information to the external agents. If the information signaled is positive, a positive market reaction to the announcements of share repurchases can be expected and vice versa. |
| Agency theory and Free cash flow theory | Easterbrook (1984); Jensen (1986); Grullon and Michaely (2004) | Share repurchases, by decreasing excess cash or by increasing leverage, signal to the market that management is making an attempt to reduce agency problems. This information can generate abnormal returns around share repurchase announcements. |
| Tax clienteles | Bagwell and Shoven (1989) Rau and Vermaelen (2002) | Different tax regimes affect payout preferences of specific investor groups. Also, the preferences of major investor groups affect payout policies, including the decision to engage in share repurchases. |
| Institutional clienteles | Bodnaruk and Östberg (2013) | The shareholder base affects company's payout policy and therefore company decisions regarding share repurchases. |

# 3. Anecdotal evidence

Anecdotal evidence provides views of finance practitioners as to how the prevailing interest rate environment affects share repurchases. They explain the rise of share repurchases by a significant increase in leverage driven by low borrowing costs:

> "Companies are tapping the debt markets to fund buybacks, spurred by persistently low interest rates. Rating agencies have taken a dim view, arguing that share repurchases are a poor use of debt."

(Henderson, 2019)

The reasoning why companies decide to finance their share repurchases by debt is explained by following quote:

> "If you look at the cost of equity versus the cost of debt, the incentive to issue debt and buy back equity has never been higher."

(Rao,2019)

This argumentation provides a time-varying and interest rate-dependent view on share repurchase programs authorized by companies. To test this view, we investigate market reactions to share repurchase announcements, taking into account the interest rate environment. Building on this connotation, our goal is to test whether the interest rate environment has an effect on the market reaction to share repurchase announcements.

# 4. Hypotheses

An extensive body of literature shows that corporate payout decisions signal information about future profitability and cash flow generation to investors (Bhattacharya, 1979; Miller & Rock, 1985; Vermaelen, 1984; Ikenberry, Lakonishok & Vermaelen, 1995; Masulis, 1980). Another stream of research argues that payout policy, especially the announcement of share repurchase programs, can signal the intention of management to reduce agency costs (Easterbrook, 1984; Jensen, 1986; Grullon & Michaely, 2004; Lee & Suh, 2011). We conclude that, although the underlying reason of initiating buyback programs might differ across companies, the announcement of share repurchase decisions should lead to a positive market reaction. Therefore, we establish our first hypothesis as follows:

**H1:** The market reaction to share repurchase announcements is positive.

Moving forward, we develop hypotheses regarding the relationship between interest rate environments and capital structure decisions. According to the leverage irrelevance theory proposed by Modigliani and Miller (1958), share repurchases should not create value to the shareholders under the assumption of a perfect capital market. However, as

those assumptions do not hold in real life, share repurchases can create value to shareholders.
As presented in Section 3, in a low interest rate environment, companies increase their leverage to perform share repurchases because of artificially low interest rates. This economic paradigm can be incorporated in Modigliani and Miller (1958) propositions even when the perfect capital market assumption of no taxes is relaxed (Appendix A). Government subsidized interest rates decrease the weighted average cost of capital of the firm under the assumption that cost of equity stays the same given the same risk level and investor preferences regarding risk. That allows us to observe that prevailing central-bank-subsidized risk-free rate is not the equilibrium rate, meaning that it is not the rate investors demand.
Hence, given that the abovementioned relationship holds, when borrowing costs are low and share repurchases are considered a value creating event (if hypothesis 1 is approved), the market should react to buyback announcements more positively because the value can be generated at a lower expense. Taking that into account, we formulate our second hypothesis as follows:

> **H2:** The market response to share repurchase announcements is higher in times of low interest rates as compared to normal/high interest rates.

Furthermore, we assume that investors follow a martingale approach, meaning that when interest rates are declining (rising), they expect them to decline (rise) further, when forming their expectations about the future development of interest rates. Under this assumption, investor preference for share repurchases might be affected by investor expectations regarding the future development of the interest rate environment. Thus, we propose that the market response to share repurchase announcements is higher in times of declining interest rates compared to increasing interest rates, which leads us to our third hypothesis:

> **H3:** The market response to share repurchase announcements is higher in times of declining interest rates compared to increasing interest rates.

In order to test these hypotheses, we develop a methodology and present it in the next section. The data sample used in this study is described in Section 6.

# 5. Methodology

In order to analyze the effect of the interest rate environment on market preference for share repurchases, we proceed in two steps. First, we perform an event study to measure cumulative abnormal returns (CAR) around share repurchase announcement dates. Second, we use regression analysis to determine the impact of the interest rate environment on CAR.

## 5.1. Event study

The usefulness of an event study relies on its timing. An event study measures the impact of one specific event on the value of a firm (MacKinlay, 1997). Given an efficient capital market with rational investors, the effect of any event is immediately reflected in security prices (MacKinlay, 1997). Hence this methodology builds on the assumption of efficient capital markets in a semi-strong form.
According to MacKinlay (1997), event studies are a common tool to measure the impact of capital structure changes on firm valuation. For the purpose of our study, we define an estimation window of 100 days. Over this period the normal return parameters of our sample companies are measured. On the basis of those normal return parameters, abnormal returns during the event window are calculated. Although according to MacKinlay (1997) a gap between the estimation and the event window is not necessarily needed, we define a gap of 70 trading days to ensure that returns in the estimation window are not impacted by the event itself, or by developments prior to the event (Grullon & Michaely, 2004). We also define 3 event windows that are of interest for our research: 3-day (-1, 0, 1), 7-day (-3, 0, 3), and 61-day (-30, 0, 30) (see Figure 2).

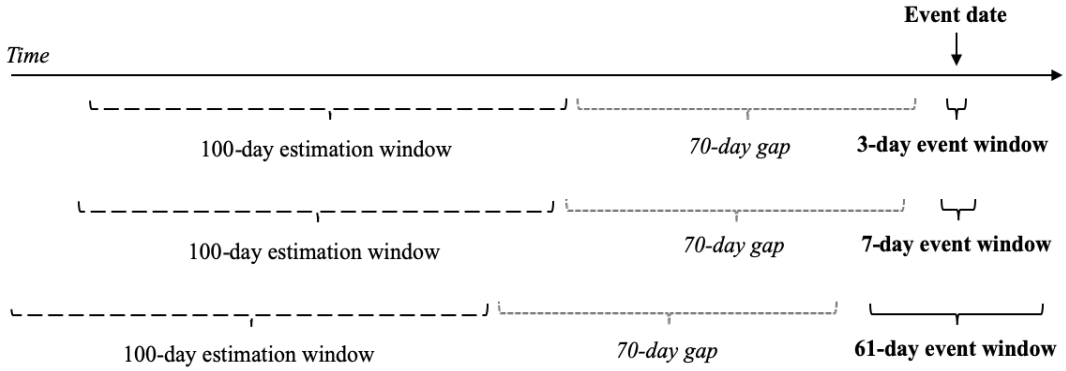



**Figure 2.** Illustration for event study

According to MacKinlay (1997), the definition of the exact event date is critical to any event study. We are interested in market reactions to the information that a certain company authorized a share repurchase program. Since companies are required by law to immediately disclose decisions of this kind to the capital market, we assume that the event date is equal to the date in which the program was authorized. The board authorization dates are collected from SDC Platinum.
We perform an event study using the *Event Study by WRDS* tool where three risk models are offered: Market model, Fama-French 3 Factor model and Fama-French Plus Momentum model. The differences across models lies in the underlying asset pricing model used to estimate the returns. While the Market model uses the Capital asset pricing model (CAPM), the Fama-French 3 Factor model and the Fama-French Plus Momentum model are multiple factor models. Regarding the models, there is an ongoing discussion in corporate finance literature about whether additional factor models yield superior results (MacKinlay, 1997).

Despite the discussion about the relevance of additional factors, the theoretical and empirical validity of the CAPM has been criticized by scholars since the early 1950s. Most of the criticism is devoted to the underlying assumptions of the CAPM. On the theoretical side, Allais and Roy (1953) and Roy (1952) criticize the assumption that investors maximize their expected utility. Furthermore, Kahneman and Tversky (1992) showed with their Prospect Theory (Cumulative Prospect Theory) that individuals behave in contradiction to what is predicted by expected utility theory. Their criticism focuses especially on the shape of the preference curve (Kahneman and Tversky, 1979).

Further, a broad range of researchers (Friedman and Savage, 1948, Markowitz, 1952, Swalm, 1966, Levy, 1969, Kahneman and Tversky, 1979) criticizes the risk aversion assumption. They argue that typical preference must include both risk-averse and risk-seeking aspects, wherefore the variance, as used in the CAPM, is not a suitable index for risk. On the empirical side, the normal distribution assumption of rates of return is rejected in most studies that test if the actual distribution of rates of return assimilates a normal distribution. Further, when the CAPM is tested directly in empirical studies, only minimal support for the linear risk-return relationship implied by the CAPM is found. Moreover, those studies show that the beta alone has almost no explanatory power of the variation in mean returns (Levy, 2010).

Carhart (1997) argues that the addition of a fourth factor to the original Fama-French 3 factor model, which captures the one-year momentum anomaly of stocks as developed by Jegadeesh and Titman (1993), substantially improves on the average pricing errors of the CAPM and the 3-factor model (Carhart, 1997).

We follow Carhart (1997) and use the Fama -French Plus Momentum model (3 & 6) as our benchmark model to calculate normal returns. Further, we test for robustness of our results comparing the obtained CAR to the cumulative abnormal returns we obtain when we use the Market Model (1 & 4) and Fama-French 3factor model (2 & 5). According to MacKinlay (1995), the results should be fairly robust across models. The returns for three models are estimated as follows:

$$R_{it} = \alpha_i + \beta_{1,i} R_{mt} + \varepsilon_{it} \quad (1)$$

$$R_{it} = \alpha_i + \beta_{1,i} R_{mt} + \beta_{2,i} SMB_i + \beta_{3,i} HML_i + \varepsilon_{it} \quad (2)$$

$$R_{it} = \alpha_i + \beta_{1,i} R_{mt} + \beta_{2,i} SMB_i + \beta_{3,i} HML_i + \beta_{4,i} MOM_i + \varepsilon_{it} \quad (3)$$

where $R_{it}$is the return on the individual stock; $R_{mt}$ is the return in excess of the risk-free rate on a well-diversified market index (in our case S&P 500 / CRSP value weighted index; $SMB_i$is the size premium (small minus big); $HML_i$the value premium (high B/M minus low B/M) and $MOM_i$the one year momentum in returns for the stock.

After returns for individual stocks are obtained, the abnormal returns are calculated as follows:

$$\widehat{AR}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_{1,i} R_{mt} \quad (4)$$

$$\widehat{AR}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_{1,i} R_{mt} - \hat{\beta}_{2,i} SMB_i - \hat{\beta}_{3,i} HML_i \quad (5)$$

$$\widehat{AR}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_{1,i} R_{mt} - \hat{\beta}_{2,i} SMB_i - \hat{\beta}_{3,i} HML_i - \hat{\beta}_{4,i} MOM_i \quad (6)$$

where: $\widehat{AR}_{it}$ is the abnormal return measured for stock i at time t.

The cumulative abnormal returns are calculated by summing abnormal returns over the chosen event window.

$$\widehat{CAR}_i(\tau_1,\tau_2) = \sum_{\tau=\tau_1}^{\tau_2} \widehat{AR}_{i\tau} \quad (7)$$

After obtaining the CAR values, we proceed with the regression analysis, which is discussed in the next section of this paper.

## 5.2. Pooled OLS regression analysis

Next, we test potential explanatory factors for the market reaction around announcement dates of share repurchase programs using pooled ordinary least square (OLS) regressions. The advantage of pooled regressions is that the dataset can include a large sample of companies and multiple observations per firm. Moreover, a pooled cross-sectional regression approach is in line with the methodology used in other share repurchase studies (Grullon & Michaely, 2002; Grullon & Michaely, 2004; Bonaimé, 2012).

In our model, the cumulative abnormal returns (CAR) obtained in the event study are the dependent variable in the regression, while the interest rate environment (*IRE*[2]) and trend in interest rates (*TREND*[3]), both included as dummy variables, are our treatment variables. Hence, pooled OLS regression allows us to capture the effect of the interest rate environment and of the interest rate trend on CAR in two distinct coefficients. However, previous literature shows that abnormal returns are difficult to explain as the findings are not conclusive. Therefore, we include 13 control variables, which were identified in the previously discussed findings of other empirical research or relate to theories deliberated upon in Section 2. Hence, our regression models are as follows:

$$CAR_i(\tau_1\tau_2) = \alpha + \beta_1 IRE_i + \sum \beta_j CONTROL + \varepsilon_i \quad (8)$$
$$CAR_i(\tau_1\tau_2) = \alpha + \beta_1 TREND_i + \sum \beta_j CONTROL + \varepsilon_i \quad (9)$$

where: $CAR_i(\tau_1\tau_2)$ is a dependent variable; $IRE_i$ is a treatment variable; $TREND_i$ a is a variable which effect we are interested in observing.

In order to limit the bias in the obtained results, we use fixed effects in our regression models. In general, fixed effects allow to control for omitted variable bias that arises due

[2] IRE is defined as a dummy variable that takes the value of 1 if the real interest rate being below 0. See further in section 5.3.1.

[3] TREND is defined as a dummy variable that proxies trend in interest rate between the event year and year prior share repurchase announcement. See further in section 5.3.2.

to unobserved heterogeneity when this heterogeneity is constant over time. More specifically, we use industry fixed effects as one could argue that business models of companies tend to be homogenous across firms in the same industry, but heterogenous across industries. Industry fixed effects help to account for these differences across industries by creating a common intercept for all firms in the same industry. This common intercept captures otherwise unobserved heterogeneity when industry fixed effects are not used.

Furthermore, to test robustness of the results we also use firm fixed effects. Firm fixed effects account for firm specific characteristics that do not change over time but are not captured by the other control variables included in the regression. Even though one could argue that firm fixed effects are stricter than industry fixed effects, the firm fixed effects limit the parsimoniousness of the model given the large number of dummy variables created in relation to total observations included in the regression. Hence, the firm fixed effects are used only as a robustness check.

We also address the possible multicollinearity by estimating variance inflation factors (VIF). VIF quantifies the extent of correlation between two independent variables in the regression. The most common rule of thumb says that if VIF is above 10, then it is a sign of multicollinearity issue in the model. Some researchers argue that an acceptable tolerance level is 4, however, in our case, we use a threshold of 10 and gradually eliminate variables for which VIF is larger than 10 (Garcia et al., 2015).

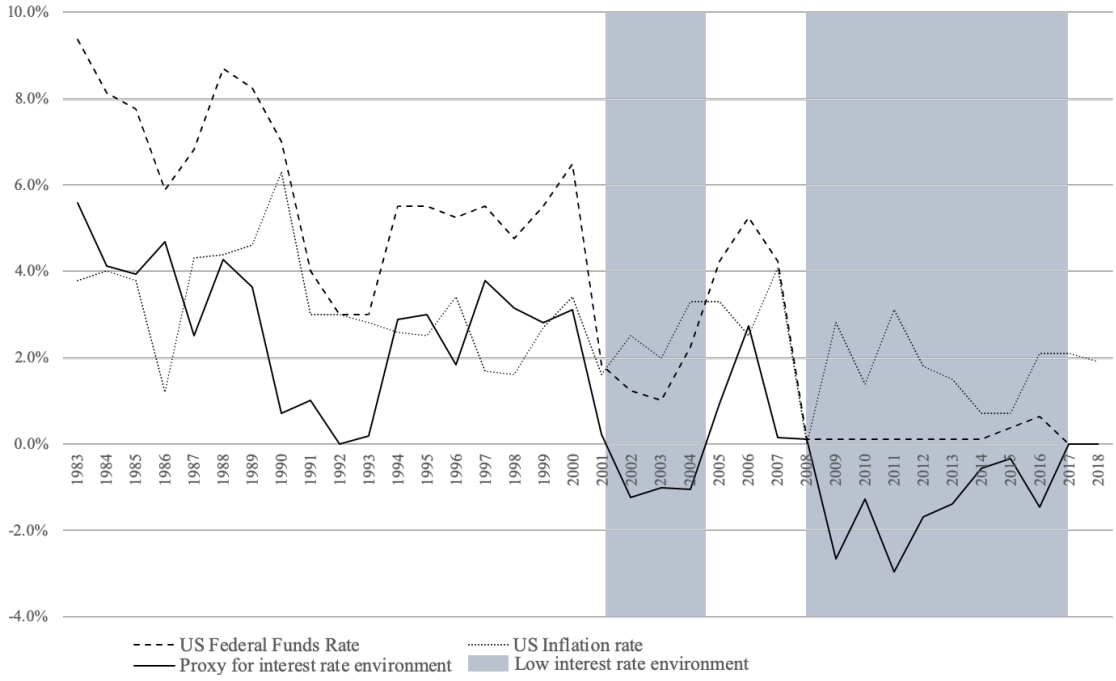
Furthermore, to also account for heteroscedasticity, we cluster standard errors. The clustering of standard errors is important because the correlation among residuals can lead to significant underestimation of standard errors and hence to an over-rejection of the null hypothesis that implies that the slope in the linear regression is equal to zero (Cameron, Gelbach, & Miller, 2011). The current literature proposes a range of methods for estimating standard errors where correlation across residuals is taken into account. We follow the method discussed by Petersen (2009) that suggests comparing the standard errors obtained when different clustering approaches are used. Hence, we compare three error clustering methods: (i) using sandwich estimator of variance ("robust" standard errors), (ii) at the firm level and (iii) at the firm, industry and year level. Petersen (2009) states that when the standard errors clustered at the firm level are three to four times larger than the "robust" standard errors, it is an indicator of the firm effects being present in the data. Furthermore, when the standard errors clustered by several dimensions are much larger than the standard errors clustered by only one dimension, it indicates several effects in the data. Following this logic, we compare the standard errors estimated using three clustering types and select one that is most appropriate for our data sample. Finally, after specifying the regression model, two-tailed t-tests are used to reject the null hypothesis at the 1%, 5% or 10% significance levels.

## 5.3. Model inputs

### 5.3.1. Treatment variable: interest rate environment

Our goal is to find an answer to the question whether the interest rate environment has an effect on CAR around share repurchase announcement dates. Hence, the interest rate

environment is the treatment variable. We use the US Central Bank Policy Rate[4] (federal funds rate) from Thomson Reuters and adjust it for yearly inflation rates to determine real interest rates. On the basis of inflation-adjusted interest rates, we divide our sample into two groups: the interest rate environment is considered as low when the real interest rate is negative or equal to zero, while normal interest rate environment refers to the situation when the real interest rate is higher than zero (see Figure 3).




*Note:* In total 12 years have been classified as low interest rate environment, while the rest is considered as normal.

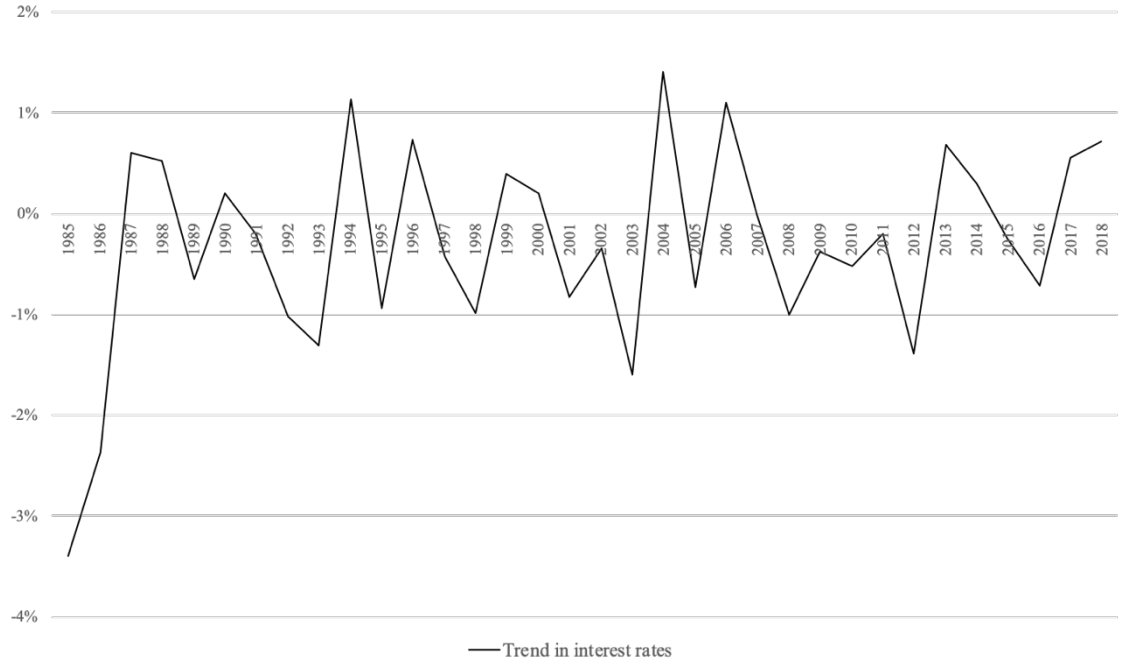
**Figure 3.** Interest rate environment over time

The interest rate environment is represented by a dummy variable that takes the value of 0 (1) if the announcement has been made in a normal (low) interest rate environment. When the dummy is activated (1), we expect the coefficient for *IRE* to be positive, meaning CAR to be higher, as explained in Section 4 We expect a positive coefficient of our treatment variable.

### 5.3.2. Alternative variable: interest rate trend

Most corporate valuation models discount future cash flows by discount rates to derive the present value of a company. Hence, expectations regarding the future development of the interest rate environment might also impact the CAR measured around repurchase announcements. Therefore, we run the regression models also with an alternative variable.

[4] Rate at which banks lend federal funds at the Federal Reserve overnight (Thomson Reuters)




*Note:* In the sample 21 years are considered as declining interest rate trend, while 13 are regarded as increasing interest rate trend.

**Figure 4.** Interest rate trend over time

We estimate interest rate trend as the difference between 10-year US bond rates in June of every year compared to the previous year's rates. Similar to our first treatment variable interest rate environment, we create a dummy variable for the interest rate trend, which takes the value of 0 if the interest rates are declining and value 1 if interest rates are rising (Figure 4). Following the reasoning above, we expect a positive relationship between CAR and the interest rate trend, meaning that when interest rates are declining, CAR around repurchase announcements are higher.

### 5.3.3. Control variables

In regression models, we include the following control variables: firm size, excess profitability, non-operating income to sales ratio, capital expenditures, research and development expense, cash, tax regimes, book-to-market ratio, leverage, change in leverage, sales growth, size of share repurchase program and time trend. In the following text, we discuss why these specific variables are included in the regression. We also present our expectations regarding the coefficients of those variables. An overview of the variables and their definitions is provided in Table 2.

**Firm size**

According to Ikenberry et al. (1995), firm size is a valid proxy for information asymmetries. Because smaller firms are less covered by analysts, an announcement of a share buyback should create a larger surprise effect in the capital market. We control for

differences in firm size by including in our regressions a proxy for the company size (*SIZE*) that is defined as natural logarithm of the opening balance of total assets in the year in which the repurchase program was announced. We use the natural logarithm to improve the scale of the variables, which allows us to estimate a more robust regression coefficient. Additionally, using the logarithm of positive real values keeps results interpretable. Based on the abovementioned surprise effect, we expect a negative coefficient for *SIZE.*

**Excess profitability**

Signaling theory also states that share repurchases can send a positive signal about a firm's future profitability to the market. We introduce a variable *PROF* to control for disparities in excess company profitability that is measured as the difference between company's return on equity and its cost of equity. The return on equity is calculated by dividing the net income of the year prior to the repurchase announcement by the opening balance of owner's equity of that year. The cost of equity is calculated using the 10-year US government bond rate as the risk-free rate and market risk premium obtained from Damodaran data base [5]. The company-specific equity betas are gathered from Compustat. Furthermore, we winsorize the beta values below -2 to -2 and values above 3 to 3[6] to ensure reasonability of our dataset.

The expectations regarding the relationship between excess profitability and CAR are disputable. Building on FCF theory, a firm with high excess profitability and restricted investment opportunities would reduce excess cash flow by distributing cash back to the shareholders. In this situation, the market reaction to the share repurchase announcements should be positive as managers are not destroying shareholder wealth by investing in unprofitable projects. However, if the investment opportunities are not scarce, the market reaction to share repurchase announcements should be negative.

**Non-operating income to sales ratio**

Besides profitability, some scholars propose that share repurchases are a way to pay out unexpected non-operating income to shareholders (Jagannathan, Stephens, & Weisbach, 2000). We include the control variable *NOI*, calculated as the ratio of non-operating income to sales of the year preceding the repurchase announcement. We expect a positive coefficient for *NOI*, as the payout of non-operating income should signal that the company has good outlooks in terms of future cash flows and hence does not need its non-operating income to finance operations.

**Capex to assets ratio**

According to FCF theory, firms repurchase stock to reduce agency costs related to negative net present value investments by management when overall investment opportunities for the company are scarce. Therefore, we introduce a variable *CAPEX*, calculated as capital expenditures during the year prior to the announcement divided by the opening balance of total assets in that year. If FCF theory is driving the decision to announce share repurchase, and the investment opportunity set of the company is indeed

[5] The equity risk premiums are collected for US market from the website http://pages.stern.nyu.edu/~adamodar/

[6] The equity beta values range from -3,34 to 4,96.

restricted, then high level of CAPEX means that unprofitable investments are undertaken. In that case, investors should prefer the payout of cash through a repurchase program. Therefore, CAPEX should have a positive coefficient. However, if the intention to signal a reduction in agency costs caused by unprofitable investments is not driving the repurchase decision, an opposite relationship can be expected.

**R&D to assets ratio**

Similar as for CAPEX, we control for investments in research and development (RD). The control variable *RD* reflects R&D expenses of the year prior to the repurchase announcement divided by the opening balance of total assets of that year. As both *CAPEX* and *RD* are similar in their nature, the expected relationship is similar.

**Cash to assets ratio**

Since FCF and agency cost theories build on the presence of cash available for investments, it is important for us to control for the cash levels of our sample firms. Therefore, we introduce the control variable *CASH* that is calculated as the level of cash in relation to total assets in the opening balance of the year in which the repurchase program was announced. We expect a positive coefficient for this variable as higher cash implies potentially higher agency costs that are reduced by share buybacks.

**Tax regimes**

Further, we acknowledge the argument of clientele theories that implies the prevalent tax regime can impact shareholder preference for debt vs. equity with regard to capital structure and for repurchases vs. dividends with regard to payout policy. Thus, we develop control variable *TAX*. The variable is calculated according to Graham (2003):

$$TAX = \frac{1-T_p^D}{1-T_p^E} \tag{10}$$

where *TAX:* a nominal tax ratio that is a proxy for tax regime, $T_p^D$*:* a personal tax rate on interest income[7], $T_p^E$*:* a personal tax rate on capital gains[8].

According to Masulis (1980), a stock repurchase is generally taxed as a capital gain or loss, while a dividend is taxed as ordinary income. That being the case, the personal tax rate on interest income is a tax rate applicable to dividends and the personal tax rate on capital gains applies to share repurchases. Hence, in the case of tax rates on capital gains being lower than tax rates on dividend income, the *TAX* ratio is expected to be below one. We call this a low tax regime. The lower the tax regime, the more positive market response to share repurchase announcements is expected according to the tax clientele theory. Hence, we expect a negative coefficient for the *TAX* variable.

[7] The personal tax rate on interest income is proxied as the nominal personal income tax.

[8] The tax rate on capital gains is proxied as the nominal capital gains on capital gains.

**Book-to-market ratio**

Further, we include a book-to-market ratio (*BMR*) to control for differences in under-/overvaluation across firms, as well as to account for entrenchment of the cash available for the firm. To obtain *BMR*, we calculate the market capitalization of our sample companies by multiplying the number of common shares outstanding in the beginning of the fiscal year in which the repurchase program is announced with the closing price at that point in time. Then, we calculate the control variable *BMR* as follows:

$$BMR = \log\left(1 + \frac{BV(E)}{MV(E)}\right) \tag{11}$$

where *BV(E):* book value of equity as opening balance of the financial year when share repurchases were announced; *MV(E):* market value of equity (calculated as previously described).

Building on Penman (2012), who argues that repurchases should be done when companies are undervalued, we expect that, when the signaling of undervaluation drives the repurchase decision, a positive coefficient for the *BMR* variable.

Furthermore, based on the entrenchment hypothesis, a high book-to-market ratio implies that the company is underperforming because its book value of equity is high compared to the market valuation. That being the case, the market would react positively to share repurchase announcements as cash is distributed back to the shareholders instead of investing in an unprofitable business. Hence, also here a positive coefficient for *BMR* can be expected.

**Leverage**

Further, we control for differences in leverage. The variable *LEVE* is calculated as total outstanding debt divided by the market capitalization using opening figures of the financial year at which the announcement was made. Alternatively, we compile a net leverage variable, which divides the difference between total debt and cash holdings by total assets in the beginning of the announcement year. However, since net leverage is highly correlated with *CASH* holdings, we ultimately use *LEVE* as our primary control variable for which we expect a positive relationship with the abnormal returns around share repurchase announcements. This expectation is derived from agency theory, which implies that debt disciplines the management of a company with scares investment opportunities and available cash, therefore increase in leverage could be seen as a positive sign to the market.

**Change in leverage**

We also introduce a variable *LEV_CH,* that proxies the financing used to perform the share repurchases[9]. The variable is calculated as follows:

[9] The data from SDC provides a variable for the funding of the share repurchase program. However, the number of observations for which the funding method was disclosed was limited, hence, we use change in leverage as proxy for funding.

$$\frac{LEVERAGE_{(t+2)}}{LEVERAGE_{(t-1)}} - 1 \quad (12)$$

where $LEVE_{(t+2)}$*:* leverage at the end of financial year 2 years after the share repurchase announcement[10]; $LEVE_{(t-1)}$*:* leverage at the beginning of the financial year when the share repurchase program was announced.

We expect a positive coefficient for *LEV_CH*, arguing that similar logics as for the *LEVE* variable should apply. Agency costs are reduced when the leverage increases, hence, the market should respond positively to leverage increases, assuming that the bankruptcy probability is not significantly increased.

**Sales growth**

Further, we account for different growth levels across our sample companies by controlling for sales growth *SG*, calculated as three-year average sales growth up to the year in which the repurchase program is announced. One could expect that higher growth companies would invest more to maintain their growth instead of repurchasing the shares. Hence, the coefficient of *SG* would be negative. However, there could also be a surprise effect, when a growing company signals to the market that although high required investments in growth, it still manages to repurchase shares. In that case, a positive coefficient can be expected.

**Percentage of shares authorized to repurchase**

We also control for the size of the authorized repurchase program by including a variable of percentage of shares authorized to repurchase (*AUTH)*. The variable is calculated as the number of authorized shares to repurchase divided by the number of common shares outstanding at the beginning of the financial year of the announcement. Based on the findings of Vermaelen (1981) and Ikenberry et al. (1995), we expect a positive relationship between the size of the repurchase announcement and CAR around share repurchase announcements.

**Time trend**

Lastly, we introduce the *TIME* variable as a proxy for the time trend. *TIME* is calculated as the year of the repurchase announcement minus 1984, so that for repurchases announced in the first year of our sample period, *TIME* takes the value of 1. The variable is expected to capture the effects in the regression that change over time and are not directly measurable, such as for example the learning effects of share repurchases over time among investors and company management. We expect a negative coefficient as investors learn more about share repurchases, the abnormal returns earned from announcements could decrease.

[10] We take 1-year shorter time window compared to Grullon and Ikenberry (2000) suggested 3 years of completion period for open market share repurchases due to the mix of share repurchase methods in our sample

**Table 2.** Control variables included in the regression model

| Variable | Definition | Expected relationship | Comment |
|---|---|---|---|
| *TAX* | $\frac{(1-R_D^p)}{(1-R_E^p)}$ | - | We expect the lower the tax regime, the more positive market response to share repurchase announcement according to tax clientele theory. |
| *ROE* | $\frac{NET\ INCOME_{-1}}{EQUITY_{-2}}$ | | Auxiliary variable |
| $r_e$ | $RISKFREE\ RATE_0 + \beta_0 * IMPLIED\ PREMIUM_0$ | | Auxiliary variable |
| *PROF* | $ROE - re$ | NC | When profitable firms repurchase shares, they send a positive signal about future profitability to the market. The opposite occurs when unprofitable firms or firms with scarce investment opportunities announce stock repurchases. |
| *MARKET CAP* | $CMN\ SHARES\ OUTST_{-1} * CLOSING\ PRICE_{-1}$ | | Auxiliary variable |
| *BMR* | $LOG(1 + (\frac{EQUITY_{-1}}{MARKET\ CAP_{-1}})$ | + | Mature companies with a restricted investment opportunity set are characterized by high book-to-market ratios. The announcement of a repurchase program might signal the willingness of management to reduce agency costs |
| *CAPEX* | $\frac{CAPEX_{-1}}{ASSETS_{-2}}$ | NC | Companies with high investment levels are likely to overinvest. The announcement of a repurchase program might signal the willingness of management to reduce agency costs through overinvestment. However, if management underinvests to perform share repurchases, negative effect on abnormal returns can be expected. |
| *CASH* | $\frac{CASH_{-1}}{ASSETS_{-1}}$ | + | Companies with high cash holdings have an increased risk that management overinvests. The announcement of a repurchase program might signal the willingness of management to pay out excess cash, reducing the risk of agency costs through overinvestment |
| *NOI* | $\frac{NOI_{-1}}{REVENUE_{-1}}$ | + | Repurchases might be a way for companies to distribute nonoperating income to investors |

| Variable | Definition | Expected relationship | Comment |
|---|---|---|---|
| *RD* | $\frac{R\&D\ EXPENSES_{-1}}{ASSETS_{-2}}$ | NC | Companies with high R&D expenses are likely to overinvest. The announcement of a repurchase program might signal the willingness of management to reduce agency costs through overinvestment. However, similarly to *CAPEX* opposite relationship can also be expected. |
| *SIZE* | $LOG(ASSETS_{-1})$ | - | The surprise factor might be stronger when small companies announce repurchase programs, as small firms are less covered by analysts and generally less likely to engage in repurchase programs |
| *LEVE* | $\frac{TOTAL\ DEBT_{-1}}{MARKET\ CAP_{-1}}$ | - | Debt-financed repurchase programs increase risk if company is already highly levered |
| *SG* | $(\frac{GROWTH_{-3} + GROWTH_{-2} + GROWTH_{-1}}{3})$ | NC | When growing companies repurchase shares, they signal that they can finance their growth without the cash used for the repurchase program. The market reaction should be positive. On the other hand, a negative market response could be expected when growing companies run the risk of underinvestment because of buying back their shares |
| *TIME* | $YEAR_0 - 1984$ | - | Abnormal returns should decrease as the market develops over time |
| *AUTH* | $\frac{TOTAL\ SHARES\ AUTHORIZED_0}{COMMON\ SHARES\ OUTSTANDING_{-1}}$ | + | The larger the repurchase announcement, the higher the market reaction should be |
| *LEV_CH* | $\frac{LEVERAGE_{(t+2)}}{LEVERAGE_{(t-1)}} - 1$ | + | When firms engage in repurchase programs of significant size and finance them by issuing new debt, the leverage ratio should change (this variable is only interesting for debt-financed repurchase programs) |

*Note:* NC stands for nonconclusive expectations regarding the variables' impact on abnormal returns around share repurchase announcements

# 6. Data sample

We conduct our empirical study with a focus on the US market, as this choice allows to have a large sample with good data availability. Further, the US market has experienced distinct interest rate environments over our chosen time span. Moreover, the choice of the US market allows us to compare the results with a large number of similar studies regarding market response to share repurchase announcements conducted on the US market.

To perform the study, we obtain information regarding share repurchase announcements from the SDC Platinum database. Firstly, we reduce our data sample to companies listed in one of the US stock exchanges (AMEX, NASDAQ, NYSE) over a time span from 1984[11] to 2018. Secondly, the data sample is further reduced to the events for which abnormal returns can be estimated using company ticker and event date according to the previously described methodology. Company specific financial data is gathered using the CRSP[12]/Compustat Merged database.

We compile a complete dataset by merging repurchase-specific information obtained from SDC PLATINUM with company-specific accounting data obtained from CRSP/Compustat Merged based on the common company indicators: company ticker and CUSIP, which reduces our sample size even further. Additionally, we eliminate all duplicates in our sample that are generated when calculating CAR. Further, we follow Blouin et al. (2013) and exclude financial institutions[13] from our data sample, as regulatory constraints may inhibit management from changing the payout policy. Eventually, we are left with an unbalanced panel were the number of observations varies across the event windows and the model used to estimate the abnormal returns. Descriptive statistics for control variables used in regressions where CAR is obtained using the Fama-French Plus Momentum 1-day event window is provided in Appendix B.

In the Fama-French Plus Momentum 1-day event window sample there are 14 916 observations out of which 7 783 (52%) were announced in a normal interest rate environment, while 7 133 were announced in a low interest rate environment. The repurchase announcements were performed by a total of 3 425 distinct companies, meaning that every company, on average, authorized 4.35 repurchase programs over the time span from 1984 to 2018.

As 66.5% of observations are concentrated in 4 of 16 industries, namely IT, manufacturing and other services and retail and trade, observations are not equally distributed across industries. The mean value of total assets in the year prior to the repurchase announcement amounts to 6 913 million USD, where the largest asset bases are found in investment-intensive industries such as aerospace, oil and gas,

[11] 1984 is a data point at which observations for the US listed companies start in SDC Platinum database

[12] Center for Research in Security Prices

[13] SDC Industry classification: Commercial banks, bank holding companies; Credit institutions; Insurance; Holding companies, except banks; Investment & Commodity firms, dealers, exchanges; Real estate, mortgage bankers & brokers; Savings and loans, mutual savings banks; Other financial

pharmaceuticals and utilities. The average proportion of cash holdings to total assets is 18.78% and stable across interest rate environments. Furthermore, the mean original (winsorized) beta value of our data sample is 0.94 (1.01), which indicates that data sample is well-diversified and a proxy for the market (Table 3).

**Table 3.** Summary of observations across industries

| Industry | Obs. | % | Assets | Beta | Cash (%) |
|---|---|---|---|---|---|
| Aerospace | 131 | 0.9% | 22 128 | 1.03 | 8.34% |
| Agriculture | 60 | 0.4% | 3 728 | 1.00 | 12.68% |
| Chemicals | 712 | 4.8% | 4 117 | 1,05 | 10.42% |
| IT | 2 523 | 16.9% | 9 496 | 1.17 | 33.50% |
| Manufacturing | 3 290 | 22.1% | 5 826 | 0.93 | 15.85% |
| Mining | 494 | 3.3% | 3 559 | 1.10 | 10.49% |
| Oil & gas | 437 | 2.9% | 12 497 | 1.17 | 9.10% |
| Other services | 1 993 | 13.4% | 2 787 | 1.02 | 23.41% |
| Pharmaceuticals | 894 | 6.0% | 10 147 | 0.88 | 23.75% |
| Public admin. | 11 | 0.1% | 1 088 | 0.58 | 12.68% |
| Real estate | 244 | 1.6% | 2 094 | 1.22 | 10.50% |
| Retail & trade | 2 121 | 14.2% | 6 374 | 0.91 | 11.25% |
| Telecommunications | 1 017 | 6.8% | 9 162 | 1.03 | 19.86% |
| Tourism | 237 | 1.6% | 5 210 | 1.04 | 8.19% |
| Transport | 517 | 3.5% | 8 253 | 1.06 | 12.86% |
| Utilities | 234 | 1.6% | 14 424 | 0.76 | 4.64% |
| Total | 14 916 | 100.0% | 6 913 | 1.01 | 18.78% |

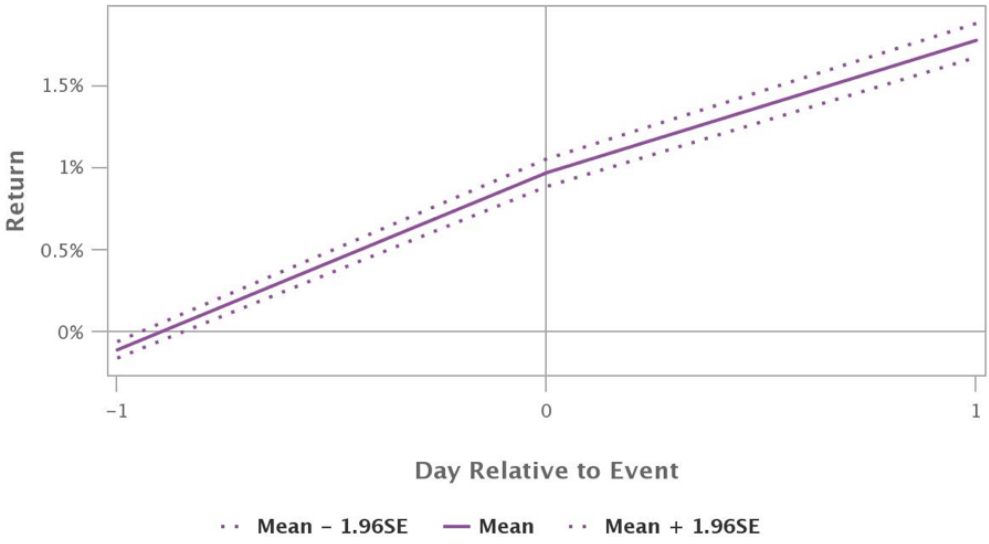
When considering the share repurchase size, companies authorized on average 24.5% of their outstanding equity in low interest rate environment, while they authorized 32.4% in a normal interest rate environment. With regard to the repurchase technique, 91.9% of repurchase programs announced in our sample were authorized as open market share repurchase programs[14]. This is in line with Vermaelen (1981) who recognizes that open market repurchases outnumber self-tender offers by approximately ten to one (Vermaelen, 1981).

[14] SDC Platinum Technique Codes OP, OPNG, OPOL (open market, open market/negotiated, open market/odd lot)

# 7. Results

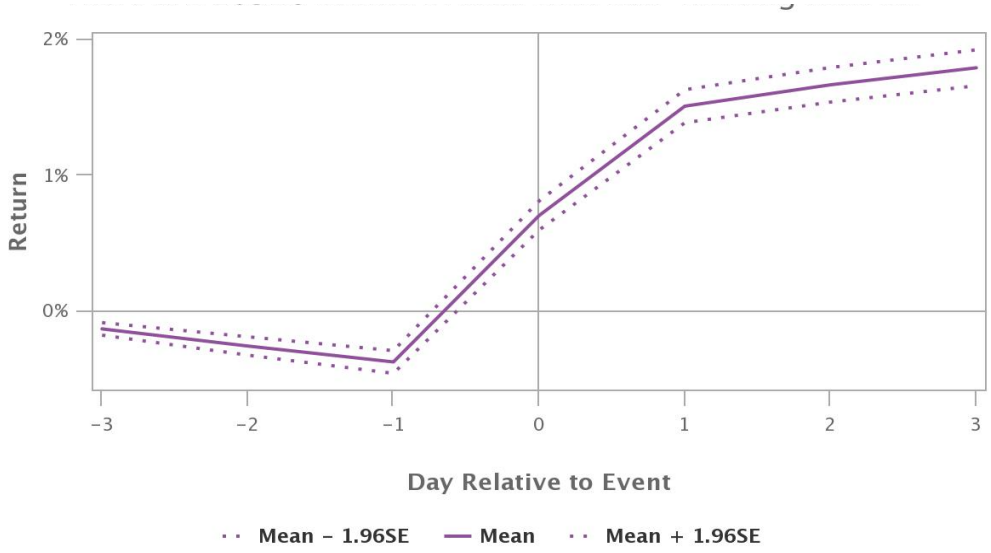
## 7.1. Event study results - discussion of dependent variable

The results for event studies with 3 different event windows are presented in Figures 5, 6 and 7. The results allow us to observe a positive and statistically significant market response to share repurchase announcements.



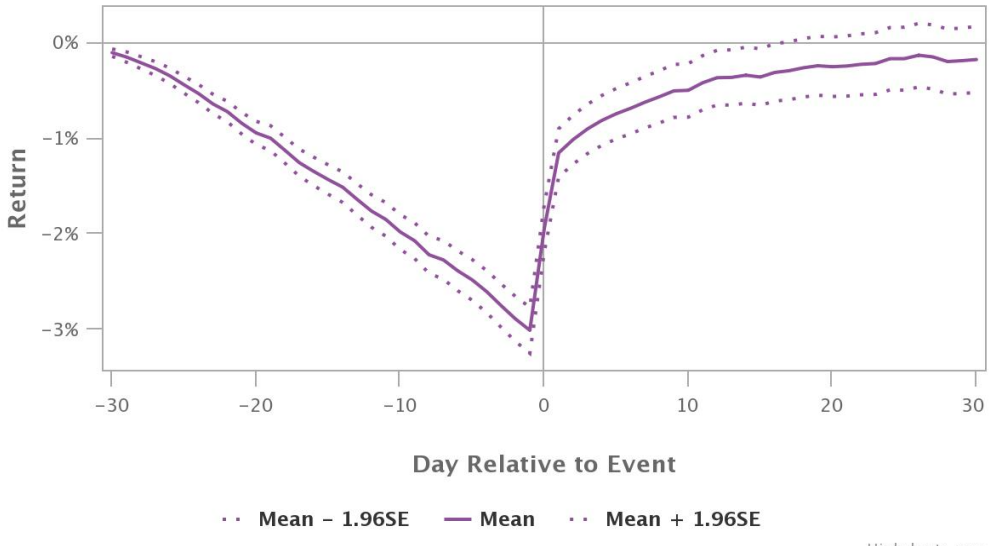

*Note:* The returns are obtained for 20 358 events using the Fama-French Plus Momentum model.

**Figure 5.** Cumulative abnormal return for 3-day event window




*Note:* The returns are obtained for 20 528 events using the Fama-French Plus Momentum model

**Figure 6.** Cumulative abnormal return for 7-day event window




*Note:* The returns are obtained for 20 303 events using the Fama-French Plus Momentum model

**Figure 7.** Cumulative abnormal return for 61-day event window

Over a 3-day (-1, 0, 1) event window, using the FFPM model as benchmark model, we observe positive abnormal returns of 1.77% (mean). Furthermore, when dividing the sample based on the prevailing interest rate environment, the mean CAR over the event window is 2.33% in a normal interest rate environment, compared to 1.16% in a low interest rate environment. Moreover, the average CAR measure weighted for number of observations differs across repurchase techniques: For open market repurchase programs the mean CAR over a 3-day event window is 1.63%, while it is 3.45% for non-open market repurchase programs (see Appendix C).

Extending the event window to seven days (-3, 0, 3), we get mean CAR of 1.19% and 2.22% for the low and the normal interest rate environment, respectively. We further extend the event window to 61 days (-30, 0, 30), and find mean CAR of -0.48%. In order to determine the significance of our results, we perform two-tailed t-tests. We find that the results for all event window are significant at the 1% level regardless of the model used.

Further, to test for the robustness of our results, we perform the same event studies using two other models to obtain market response to share repurchase announcements: The Market Model and the Fama-French 3 Factor Model. In the table below, you can see that our results are relatively stable across model specifications (Table 4).

**Table 4.** Summary of CAR across models

| Model | 3 day | | 7 day | | 61 day | |
|---|---|---|---|---|---|---|
| Int.env. | Low | Normal | Low | Normal | Low | Normal |
| MM | 1.18% | 2.28% | 1.24% | 2.13% | -0.30% | -1.19% |
| FF3F | 1.16% | 2.30% | 1.22% | 2.14% | -0.20% | -0.97% |
| FFPM | 1.16% | 2.33% | 1.19% | 2.22% | -0.30% | -0.65% |

*Note:* MM refers to Market model, FF3F refers to Fama-French 3 Factor Model, and FFPM refers to Fama-French Plus Momentum model.

## 7.2. Pooled OLS results

To test our proposed hypotheses 2 and 3, we have performed a regression analysis. To find the most optimal model, we run 8 regression models: 4 use the interest rate environment as treatment variable and the other 4 test whether the trend in interest rates can explain cumulative abnormal returns around share repurchase announcements (Table 5). The models use industry fixed effects and 3 different error clustering ways (Eicker-Huber-White-robust, at the firm level and at the firm, industry and year level).

### 7.2.1. Model specification

To test hypothesis 2, we test regression models 1, 3, 5, and 7 (Table 5). Firstly, to assess the fit of our econometric models, we obtain variance inflation factors.

**Table 5.** Specification of the models tested

| Model | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 |
|---|---|---|---|---|---|---|---|---|
| IRE | • | | • | | • | | • | |
| TREND | | • | | • | | • | | • |
| SIZE | • | • | • | • | • | • | • | • |
| BMR | • | • | • | • | • | • | • | • |
| LEVE | • | • | • | • | • | • | • | • |
| CAPEX | • | • | • | • | • | • | • | • |
| CASH | • | • | • | • | • | • | • | • |
| NOI | • | • | • | • | • | • | • | • |
| RD | • | • | • | • | • | • | • | • |
| PROF | • | • | • | • | • | • | • | • |
| SG | • | • | • | • | • | • | • | • |
| AUTH | • | • | • | • | • | • | | |
| LEVE_CH | • | • | • | • | | | | |
| TAX | • | • | • | • | | | | |
| TIME | • | • | | | | | | |

In model 1, obtained VIF values were larger than 10 for *TAX* (35.01), *TIME* (23.23) and *SIZE* (20.27). Hence, to address the multicollinearity issue, we eliminate the *TIME* variable in the model 3. In a similar approach, we also obtain VIF for model 3. The values for *TAX* (29.37) and *SIZE* (18.50) are above the chosen threshold of 10, hence, in model 5 we exclude *TAX.*

Furthermore, in model 5 we also exclude the change in leverage (*LEVE_CH*) as in the first models it is found insignificant and it is an ex-post event. In model 7, the AUTH variable is excluded as our sample mostly consists of open share repurchases and according to Comment and Jarrel (1991) the information content in authorized open market share repurchase amount is limited. Hence, we also test a model without controlling for the amount of shares authorized. Taking into account the previously mentioned aspects, model 5 and 7 are further considered as the best fit for data across all event windows tested, therefore we proceed on our analysis with these two models.

To verify hypothesis 3 about how cumulative abnormal returns around share repurchase dates change with the trend in interest rates, we run regression models 2, 4, 6, and 8. In order to control for multicollinearity, we obtain VIF values and adjust the models by excluding the same variables (*TIME, TAX, LEVE_CH* and *AUTH*) to obtain regression models 6 and 8 similarly to models 5 and 7.

After determining the variables in the regression models, we compare the estimated standard errors as suggested by Petersen (2009), when three different clustering approaches are used. Firstly, we compare the standard errors estimated for model 5 when the methods "robust" and clustering by firms are used. The results show that there is no significant difference between the size of standard errors. That indicates that residuals are not correlated across firms. Hence, Newey-West standard errors can be used.

We also compare the estimated standard errors that are clustered by firm and by firm, industry and year. The regression outcome points out that there are distinct differences in the size of estimated standard errors. When multidimensional clustering is applied in

model 5 when CAR is estimated based on the Fama-French Plus Momentum model, the errors are substantially higher for most variables compared to the ones obtained when simply clustered by firm. According to Petersen (2009), this serves as an indication of time and industry effects within data. We find similar results for other regression models using other CAR estimation techniques. Hence, the rest of the paper presents regression results using clustering by firm, industry and year.

### 7.2.2. Market reaction to share repurchase announcements and interest rate environment

**Fama-French Plus Momentum 3-day event window (-1, 0, 1) results**

Table 6 summarizes the regression results when cumulative abnormal returns are obtained using the Fama-French Plus Momentum model for a 3-day event window (-1, 0, 1) and clustering errors by firm, industry and year.

**Table 6.** Regression results for interest rate environment using industry fixed effects

| **Model** | **1** | **3** | **5** | **7** |
|---|---|---|---|---|
| No of obs. | 8 128 | 8 128 | 12 067 | 12 067 |
| $R^2$ | 26.22% | 26.21% | 24.64% | 24.64% |
| Adj. $R^2$ | 9.58% | 9.59% | 9.00% | 9.01% |
| Error clustering | Firm, industry and year | Firm, industry and year | Firm, industry and year | Firm, industry and year |
| *IRE* | -.0012205 | -.0004369 | -.003636** | -.0036441** |
| | (0.311) | (0.730) | (0.029) | (0.028) |
| *TAX* | -.0562062* | -.0645231* | | |
| | (0.088) | (0.060) | | |
| *PROF* | .0009016* | .0009206* | -.0000944 | -.0000974 |
| | (0.071) | (0.064) | (0.715) | (0.706) |
| *BMR* | .0224584*** | .021906*** | .0312824*** | .0312403*** |
| | (0.005) | (0.008) | (0.000) | (0.000) |
| *CAPEX* | .0235886 | .021584 | .009239 | .0092096 |
| | (0.405) | (0.437) | (0.669) | (0.671) |
| *CASH* | -.0028487 | -.0020933 | .001607 | .0014892 |
| | (0.760) | (0.821) | (0.887) | (0.896) |
| *NOI* | -.0149767*** | -.0149962*** | -.0135261*** | -.0135141*** |
| | (0.000) | (0.000) | (0.002) | (0.002) |
| *RD* | .0514946 | .0526629 | .0635819 | .0638031 |
| | (0.245) | (0.234) | (0.110) | (0.110) |
| *SIZE* | -.0079389*** | -.0069798*** | -.0038858*** | -.003852*** |
| | (0.000) | (0.000) | (0.001) | (0.001) |
| *LEVE* | .0029988* | .0029769* | .0016316 | .0016108 |
| | (0.052) | (0.054) | (0.315) | (0.323) |
| *SG* | .0000211*** | .0000208*** | .000023* | .0000231** |
| | (0.007) | (0.006) | (0.055) | (0.022) |
| *TIME* | .0002005 | | | |
| | (0.339) | | | |
| *AUTH* | -.0031162 | -.0030785 | -.0019064 | |
| | (0.190) | (0.191) | (0.511) | |
| *LEV_CH* | -3.02e-07 | -2.93e-07 | | |
| | (0.808) | (0.813) | | |

*Note:* This table reports regressions with industry fixed effects when CAR is obtained using the Fama-French Plus Momentum model and a 3-day event window. It should be noted that the number of observations varies due to impact of an unbalanced panel on the degrees of freedom. Numbers in the parentheses are p values obtained from two tailed t-tests where ***p<0.01; **p<0.05; *p<0.1

The results obtained in the regressions 5 and 7 contradict hypothesis 2. The coefficients obtained for the interest rate environment are negative and significant at the 5% significance level. That implies that the cumulative abnormal returns are higher in a normal interest rate environment compared to a low interest rate environment. The results are also economically significant, meaning that when the interest rate environment is low, the CAR is approximately 0.4% lower compared to a normal interest rate environment.

When considering findings regarding control variables, BMR and SIZE are significant at 1% significance level. While the coefficient of the book-to-market ratio is positive, the coefficient for company size is negative, implying an inverse relationship between the asset base of the company and CAR around share repurchase announcement dates.

Furthermore, *NOI* and *SG* are found to be significant at the 99% and 90% (95% in model 7) confidence levels, respectively.

**Fama-French Plus Momentum 7-day event window (-3, 0, 3) results**

We also test how expanding the event window to 7 days (-3, 0, 3) affects the results compared to 3-day event window (-1, 0, 1). For this event window, we also use models 5 and 7 with clustering errors in several dimensions. The results are presented in Table 7.

The results obtained show that the interest rate environment is an insignificant variable to explain 7-day cumulative abnormal returns around share repurchase announcement dates. Hence, hypothesis 2 is rejected. The findings contradict the findings for CAR measured over a 3-day event window, even though the obtained coefficients are qualitatively similar (negative for both event windows).

Furthermore, when evaluating results for the control variables, *BMR* and *SIZE* are, similarly to the results obtained for the 3-day (-1, 0, 1) and 7-day (-3, 0, 3) event windows, significant at the 1% level. Also, *SG* and *PROF* are found to have a positive effect on CAR, significant at the 1% level.

**Fama-French Plus Momentum 61-day event window (-30, 0, 30) results**

The 61-day event window (-30, 0, 30) allows to see a longer-term impact on CAR, however, the still reasonably short time period prior and after the event limits a possible dilution through other events. The results of the regressions with 61-day CAR are presented in Table 7.

The positive coefficients obtained for the interest rate environment proxy are statistically significant at 10% significance level. Hence, our hypothesis 2 is approved for the 61-day (-30, 0, 30) event window. However, these results contradict the findings when CAR is estimated over shorter event windows.

Furthermore, some distinct differences regarding the importance of other control variables can be noticed. While the book-to-market ratio is statistically significant at the 1% level, company size is found to be insignificant. Further, excess profitability is significant at the 5% level, and 3-year average sales growth before the share repurchase announcement date has a negative impact on 61-day CAR, which is significant at the 5% and 1% significance levels for model 5 and 7, respectively.

**Table 7.** Regression results for 7- and 31-day event windows

| Event window | 7 days | | 61 days | |
|---|---|---|---|---|
| Model | 5 | 7 | 5 | 7 |
| No of obs. | 12 063 | 12 063 | 12 003 | 12 003 |
| $R^2$ | 24.82% | 24.82% | 24.21% | 24.21% |
| Adj. $R^2$ | 9.21% | 9.22% | 8.44% | 8.45% |
| *IRE* | -.0018592 | -.0018609 | .0146893* | .0146464* |
| | (0.253) | (0.250) | (0.083) | (0.084) |
| *PROF* | .0005787** | .0005781** | .0049414** | .0049254** |
| | (0.027) | (0.011) | (0.012) | (0.012) |
| *BMR* | .0492628*** | .0492536*** | .2101765*** | .2099375*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| *CAPEX* | .0204725 | .020466 | .1046286 | .1044836 |
| | (0.557) | (0.558) | (0.176) | (0.177) |
| *CASH* | -.0034207 | -.0034466 | .0439322 | .0433184 |
| | (0.805) | (0.802) | (0.163) | (0.159) |
| *NOI* | -.0164826 | -.01648 | -.0179221 | -.0178571 |
| | (0.101) | (0.101) | (0.270) | (0.275) |
| *RD* | .0279214 | .02797 | .0919126 | .0930858 |
| | (0.457) | (0.456) | (0.364) | (0.362) |
| *SIZE* | -.0049956*** | -.0049882*** | -.0073238 | -.0071382 |
| | (0.009) | (0.010) | (0.252) | (0.269) |
| *LEVE* | .0011645 | .0011599 | .0106739 | .0105626 |
| | (0.525) | (0.522) | (0.366) | (0.371) |
| *SG* | .000073*** | .000073*** | -.0002912*** | -.0002911*** |
| | (0.000) | (0.000) | (0.000) | (0.000) |
| *AUTH* | -.0004186 | | -.010303 | |
| | (0.921) | | (0.446) | |

*Note:* This table reports regressions with industry fixed effects and with error clustering by firm, industry and year. CAR is obtained using the Fama-French Plus Momentum model. Numbers in the parentheses are p values obtained from two tailed t-tests where ***p<0.01; **p<0.05; *p<0.1

### 7.2.3. Market reaction to share repurchase announcements and interest rate trends

The results of regressions testing the impact of the interest rate trend on the market reaction to share repurchase announcements are summarized in Table 8. The results reject the hypothesis 3 as no statistically significant effect of interest rate trend has been found on 3-day (-1, 0, 1) cumulative abnormal returns in regressions 6 and 8. When the event window is extended to 7 and 61 days, hypothesis 3 is still rejected. The coefficients obtained are insignificant at 10% significance level.

**Table 8.** Regression results for interest rate trend

| | 3 days | | 7 days | | 61 days | |
|---|---|---|---|---|---|---|
| Model | 6 | 8 | 6 | 8 | 6 | 8 |
| No of obs. | 12 607 | 12 607 | 12 063 | 12 063 | 12 003 | 12 003 |
| $R^2$ | 24.62% | 24.62% | 24.82% | 24.82% | 24.17% | 24.17% |
| Adj. $R^2$ | 8.97% | 8.98% | 9.22% | 9.22% | 8.40% | 8.40% |
| *TREND* | -.0018826 | -.001874 | -.0016182 | -.001616 | .0051724 | .0052154 |
| | (0.377) | (0.379) | (0.465) | (0.465) | (0.438) | (0.430) |
| *PROF* | -.0000841 | -.0000874 | .0005855** | .0005846*** | .0049045** | .0048895** |
| | (0.741) | (0.731) | (0.023) | (0.010) | (0.011) | (0.012) |
| *BMR* | .0310701*** | .0310266*** | .0489911*** | .0489798*** | .210569*** | .2103585*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *CAPEX* | .0150078 | .014986 | .0236045 | .0235988 | .0820159 | .0819262 |
| | (0.491) | (0.493) | (0.499) | (0.499) | (0.302) | (0.303) |
| *CASH* | -.0004879 | -.0006198 | -.0046159 | -.0046501 | .0520089* | .0514236* |
| | (0.964) | (0.954) | (0.744) | (0.741) | (0.098) | (0.094) |
| *NOI* | -.013427*** | -.013414*** | -.0164385 | -.016435 | -.018342 | -.0182794 |
| | (0.003) | (0.003) | (0.102) | (0.103) | (0.257) | (0.261) |
| *RD* | .0622146 | .0624585 | .0270101 | .0270732 | .0964574 | .0975607 |
| | (0.115) | (0.114) | (0.465) | (0.465) | (0.348) | (0.347) |
| *SIZE* | -.004996*** | -.004962*** | -.005555*** | -.005546*** | -.0027985 | -.0026377 |
| | (0.000) | (0.000) | (0.001) | (0.001) | (0.581) | (0.609) |
| *LEVE* | .0019029 | .0018803 | .001324 | .0013181 | .0096403 | .0095371 |
| | (0.243) | (0.252) | (0.469) | (0.462) | (0.402) | (0.408) |
| *SG* | .0000265** | .0000265** | .0000748*** | .0000748*** | -.00031*** | -.00031*** |
| | (0.038) | (0.011) | (0.000) | (0.000) | (0.000) | (0.000) |
| *AUTH* | -.0020929 | | -.0005418 | | -.0096401 | |
| | (0.467) | | (0.896) | | (0.480) | |

*Note:* The results are obtained using industry fixed effects when errors are clustered by firm, industry and year. CAR is estimated using Fama-French Plus Momentum model. Numbers in the parentheses are p values obtained from two tailed t-tests where ***p<0.01; **p<0.05; *p<0.1

# 8. Robustness checks

To check the robustness of our findings, we test how our results are affected when different benchmark models (Market Model, Fama-French 3 Factor Model) are used, when firm-fixed effects are included instead of industry-fixed effects, and when the same regressions are performed on a sample of repurchase announcements for which the debt-to-equity ratio increased by more than 20% from the year preceding the announcement to two years after. Further, we briefly discuss the robustness of results obtained for the most important control variables.

### Market Model

When CAR is measured with the Market Model over a 3-day event window (-1,0,1), the interest rate environment coefficient is negative and statistically significant at a 10% interval. However, the interest rate environment coefficient is not significant for CAR measured over a 7-day event window (-3, 0, 3), but is statistically significant and positive at 1% significance level for CAR measured over a 61-day event window (-30, 0, 30). Hence, the results obtained when CAR is estimated using the Fama-French Plus Momentum model and Market Model are robust (Appendix D).

### Fama French 3 Factor Model

When CAR are measured using the Fama-French 3 Factor Model, the interest rate environment coefficient is negative at 5% significance level for a 3-day event window (-1, 0, 1), insignificant for a 7-day event window (-3, 0, 3), and positive at a 5% significance level for a 61-day event window (-30,0,30). Hence, we conclude that our results are robust across different models used for the estimation of abnormal returns and not dependent on the asset pricing model used (Appendix D).

### Firm fixed effects

Further, we ran our original regressions including firm fixed effects rather than industry fixed effects (Appendix E). The inclusion of firm-fixed effects adds dummy variables for all 3 425 firms in the regressions tested, which increases the unadjusted R squared of our regression to around 25%. However, the adjusted R squared, which accounts for the number of variables included in the regression, is in line with the R squared we get in other regressions. The findings are robust with respect to changes in chosen fixed effects. Results show that the interest rate environment coefficient is negative and significant at the 5% level for a 3-day event window, insignificant for 7-day event window and significantly positive at 10% level for a 61-day event window, which is in line with our original findings.

### Only debt-financed repurchases

To further understand if our findings are robust when the source of funding for the share repurchase is taken into account, we perform a robustness check on a subsample of companies for which leverage increased by at least 20% two years after the share repurchase announcement. The industry fixed effects are included in those regressions. The findings for the interest rate environment are qualitatively and quantitatively similar to previously obtained results using the whole sample of observations (Appendix F). Hence, we can argue that the results of our regression analysis are robust for also a subsample of companies that experience a significant increase in their leverage ratios after authorizing share repurchase programs, which provides insight that those buybacks are most likely financed with debt issues.

# 9. Discussion

## 9.1. Market reaction to share repurchases

### 9.1.1. Comparison with prior research

Our event study shows a positive CAR of 1.77% around a 3-day announcement period (-1, 0, 1) when the Fama-French Plus Momentum model is used. Hence, our first hypothesis is approved as the market response to share repurchase announcements is positive and statistically significant. Furthermore, this result is qualitatively in line with prior research. However, the abnormal returns estimated in our research are lower compared to other research. We propose several explanations for this difference.

Firstly, our results indicate that abnormal returns around share repurchase announcement dates have declined over our sample period (Figure 8), specifically when comparing observations prior and after 2000.

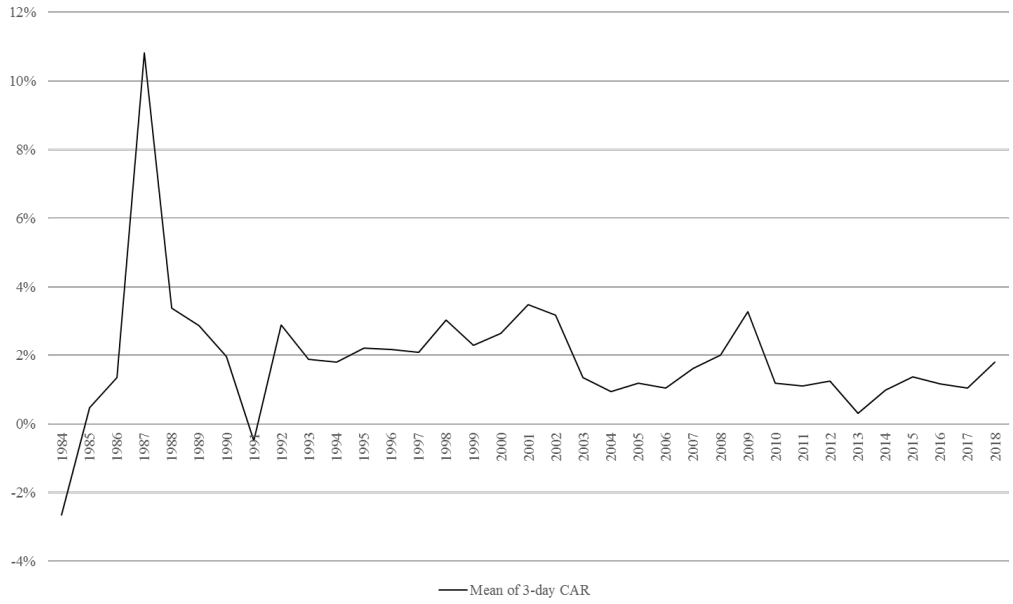



**Figure 8.** Mean 3-day CAR

However, most of the prior research on share repurchases of US listed companies study the market reaction to share repurchase announcements prior to 2000 (Comment & Jarrell, 1991; Masulis, 1980; Vermaelen, 1981; Dann, 1981; Ikenberry et al., 1995). Comparing our results to the findings of prior studies, we observe that the mean CAR for our sample is lower. The declining CAR over time is visualized in Figure 8.

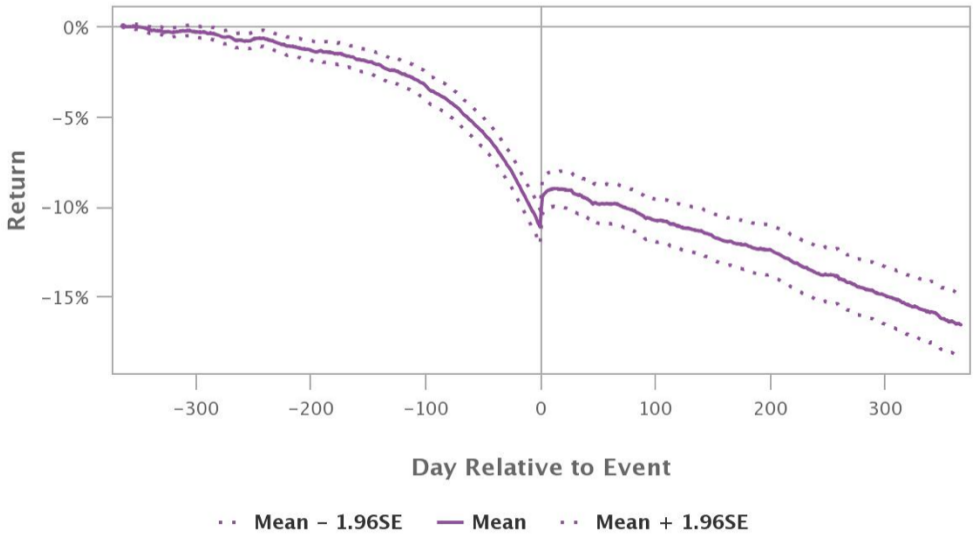
Secondly, as indicated by Comment and Jarrell (1991) and already discussed in the literature review, the market response to share repurchase announcements is sensitive to the share repurchase method. Comment and Jarrell (1991) compare CAR around announcements of open market, Dutch auction tender and self-tender repurchase offers from 1984 to 1989. The authors find excess returns of 2%, 7,7%, and 11,9% for the three repurchase techniques, respectively. Similar to their study, our results show a mean 3-day CAR of 1,63% for open market repurchase announcements. However, we obtain mean CAR of 3,45% for non-open market repurchase announcements, which is lower compared to the findings of Comment and Jarrell (1991). Furthermore, Masulis (1980) and Dann (1981) study tender price offers and find, similarly to Comment and Jarrell (1991), relatively high abnormal returns. Nevertheless, our evidence is in line with the previous findings regarding differences across share repurchase types

Thirdly, in the identified empirical studies, the Mean Return model (Masulis, 1980), Market model (Vermaelen, 1981) and Fama-French 3 Factor model (Ikenberry et al., 1995) are prevalent in prior research. In our research we use the Fama-French Plus Momentum model as benchmark model and employ the Market model and Fama-French 3 Factor model for the purpose of robustness checks. Hence, our results provide insight on whether there are significant differences across models used to estimate market reactions in an event study. Our findings show that the estimated returns are not significantly different.

### 9.1.2. Downward trend before repurchase announcement

As we test the market response to share repurchase announcements for 3 different event windows, it is possible to observe a negative share price trend prior to the share repurchase announcement. The Fama-French Plus Momentum model estimates a 29-day (-30, -2) pre-announcement CAR of -2.9%. This finding is in line with other research that finds declining stock prices prior to buyback announcements (Vermaelen, 1981; Dann, 1981; Ikenberry et al., 1995).

These results provide insights into the market timing of share repurchase announcements. In order to better understand the share price development and to get better insights regarding market timing of the announcements, we have calculated cumulative abnormal returns 365 days prior the event and the findings show negative CAR over this time horizon.




*Note:* The returns are obtained for 16 497 events using the Fama-French Plus Momentum model. The estimation window was 500 days and the gap chosen was 50 days.

**Figure 9.** Cumulative abnormal returns for 731-day event window (-365, 0, 365)

This indicates that management times the announcement and signals the market new information, for example, entrenchment of cash or that the stock is being undervalued. Hence, the market response to the announcement and obtained CAR is positive over the short time windows (Ikenberry et al., 1995).

#### 9.1.3. Response after share repurchase announcement

Regarding the abnormal returns after share repurchase announcements, we observe 0.96% CAR during the 29-day (2, 30) period immediately after the announcement. This result indicates a positive drift in the pricing effect when the event window is extended. One of the possible explanations for this lagged market response is that the market needs time to process the information conveyed by the share repurchase announcement. Furthermore, Ikenberry et al. (1995) suggests that the market under-reacts to share repurchase announcements. This proposal is in line with the undervaluation hypothesis and supports the findings of CAR being positive for 29-day (2, 30) period immediately after the announcement.

### 9.2. Interest rate environment: short term impact

Our results show that while for the 3-day event window the relationship between the interest rate environment and cumulative abnormal returns around share repurchase announcements is significant, for the 7-day event window, no significant results were found. However, in both cases the relationship between the low interest rate environment and CAR is negative, which contradicts hypothesis 2.

One possible explanation of these findings is that a macroeconomic phenomenon like extremely low interest rates might lead investors to expect corporate decisions, such as share repurchases, and hence the market reaction to such events is less pronounced. This idea is similar to an argument proposed by Comment and Jarrell (1991), who state that a management signal of insider information is more credible than macroeconomic information available in the market. This finding illustrates that the macroeconomic environment can be one of the factors influencing CAR, although it cannot explain abnormal returns per se.

Another potential reason for the negative coefficient of the low interest rate environment observed over short event windows relates to Modigliani and Miller (1958, 1963). In their 1958 paper, the authors propose that the incentive for companies to use debt financing is smaller when borrowing costs are lower, because the interest tax shields decrease (Modigliani & Miller, 1963). Following the reasoning of Modigliani and Miller, if market valuation is the main explanatory factor behind positive announcement returns around share repurchase programs (Baker, Gallagher & Morgan, 1981), one can expect a negative relationship between low interest rate environment and CAR as low rates imply lower tax shield and subsequently lower tax shields imply lower company value and lower returns.

## 9.3. Interest rate environment: medium term impact

Contrarily to our results for short event windows, the coefficient of the low interest rate environment is positive and statistically significant when CAR is measured over a 61-day event window, which confirms our hypothesis 2. One possible explanation for the difference of our results across event windows is that the market initially underreacts to the announcement and then gradually adjusts over time. This theory is supported by the development of CAR during the 29-day period after the event and by the findings of Ikenberry et al. (1995) who also suggest a post-announcement drift for open market repurchases.

Furthermore, the findings also indicate that the low borrowing costs implied by a low interest rate environment can positively affect the market response to share repurchase announcements for the 61-day event window, without regard to how particular share repurchases are financed.

## 9.4. Interest rate trend

When replacing the interest rate environment variable with a variable approximating the trend in interest rates, the respective coefficient is not significant in any regression specification. Hence, our third hypothesis is rejected. A potential explanation for the absence of a significant impact is that the trend in interest rates represents a long-term market expectation, which is publicly available information. Furthermore, as suggested by Comment and Jarrell (1991), the market assigns higher credibility to insider signals compered to superior macroeconomic information. Hence, the trend in interest rates and expectations about the potential movement in them should already be priced in and therefore should not generate abnormal returns.

## 9.5. Control variables - comparison to prior studies

In the following section, we discuss our results for control variables and compare the findings with the previous literature. Based on their significance in model 5 and 7, we discuss the following variables: book-to-market ratio, asset size, non-operating income to sales ratio, average sales growth, and excess profitability.

**Book-to-market:** the estimated relationship between the book-to-market ratio and cumulative abnormal returns is consistently positive and significant across all event windows which is in line with the proposal that valuation is an important factor, not only explaining why companies might announce share repurchases but also the subsequent market response to such events. However, the book-to-market ratio also gives an indication about firm maturity, which relates to the Free cash flow theory and the entrenchment hypothesis.

**Asset size:** the results for the statistical significance of the asset size coefficient are mixed, however, an inverse relationship between abnormal returns and *SIZE* is determined in all cases. As discussed previously, Bodnaruk and Östberg (2013) find that smaller companies are less likely to perform share repurchases. That being the case, the market surprise for smaller companies performing share repurchases can be reflected in higher abnormal returns. Furthermore, smaller companies tend to have lower analyst coverage. Because of that, information asymmetries between insiders and the external investors are larger in small firms, hence a more powerful signaling effect could have a positive impact on CAR when company size is smaller. While the surprise factor regarding share repurchase announcement can explain the significant results over short-term event windows, our results suggest that after the announcement, abnormal returns cannot be explained by the company size.

**Non-operating income to sales ratio:** the results for non-operating income to sales ratio impact on CAR are not conclusive. However, they indicate that non-operating income is negatively related with CAR generated around share repurchase announcements. According to Lee and Suh (2011), firms usually see cash increases prior to share repurchase announcements. Further, according to the Free cash flow and Agency cost theories, firms are intended to distribute excess cash back to their shareholders. However, the non-operating income to sales ratio's negative impact on CAR can be explained by market already expecting such corporate action from the company management. Another possible explanation for these findings could be that the non-operating income is actually non-cash, hence, this income does not directly affect company`s ability to perform share repurchases.

**Past years sales growth:** The results for 3-year average sales growth prior to the share repurchase announcement are mixed. While for shorter time windows of 3 and 7 days, revenue growth has a positive impact on CAR, for the 61-day event window this relationship is inverse. One of the explanations for this finding could be that the reasons for market response to share repurchase announcements are time varying. Short term positive effect of sales growth on CAR can be explained by the market surprise that a growing firm decides to buy back its outstanding shares instead of allocating the funds for investment, which supports the signaling hypothesis.

**Excess profitability:** Excess profitability (return on equity minus cost of equity) has a positive effect on CAR. However, the significance of this variable varies depending on

the event window. Nevertheless, the positive relationship is in line with Signaling theory, which states that more profitable firms use share repurchase announcements to signal a positive outlook to the market. Hence, the market reacts positively to this information.

The findings for other variables in model 5 and 7 were found either insignificant or significant when other error clustering methods are used. Overall, explaining abnormal returns is difficult due to the fact that we do not know what information has been priced in before the share repurchase announcement. Despite this issue, our results are in line with previous studies and well-established corporate finance theories can be used to explain our results.

# 10. Conclusions

Building on the ongoing public debate about share repurchases and how they are affected by low interest rates, we examine the relationship between the market reaction to share repurchase announcements and the interest rate environment. The results regarding this relationship provide new insights into a topic that has not been empirically investigated before.

## 10.1. Empirical findings

Using a sample of share repurchase announcements of the US listed companies over a period from 1984 to 2018, we find that the market reaction to share repurchase announcements is positive and statistically significant for 3-,7- and 61-day event windows. Hence, our first hypothesis is accepted. Despite the positive market announcement for share repurchase event per se, we also find that the abnormal returns decline 29 days prior to the announcement. This indicates that management times the announcement and signals new information, for example, entrenchment of cash or that the stock is being undervalued that is in line with Signaling theory.

Furthermore, when we test the relationship between the market reaction to share repurchase announcements and the interest rate environment, we find mixed results. Therefore, we neither support nor reject our second hypothesis. For 3-day CAR around the announcement date, the interest rate environment has a negative and statistically significant effect. However, for 7-day CAR, the relationship is insignificant. Furthermore, when the event window is expanded to 61 days, the interest rate environment has a positive impact on CAR. We propose that these differences can be explained by investors imply a higher likelihood of repurchase programs during a low interest rate environment resulting in a negative short-term impact on CAR, and by the market incorporating signaling effects of share repurchases in the medium term that allows to observe positive low interest rate effect on 61-day cumulative abnormal returns.

Furthermore, we also test for the effect of the interest rate trend on CAR. However, we find no significant relationship between them. This can be explained by market expectations being more of a public opinion than exclusive insider information. Hence, market expectations with regard to the interest rate should be priced into the market value on a continuous basis, and not lead to abnormal returns when a company announces a repurchase program.

## 10.2. Research contribution

The results of this thesis complement the existing literature in several ways. Firstly, the findings add to the debate presented in anecdotal evidence that states that companies are more inclined to perform share repurchases in low interest rate environment because of lower borrowing costs. We provide additional market perspective that shows that market is not as positive regarding share repurchase announcements in low interest rate environment indicating that share buybacks in short term are not as value creating when interest rates are artificially low.
Furthermore, the results add additional insights to the previous studies about the US market that mostly investigate periods prior to 2000. Our findings suggest that the abnormal returns from share repurchases have declined over the years, henceforth, indicating learning effects from share repurchases, especially when open-market share buybacks are the most common technique. Indeed, open-market share repurchases are no obligatory commitments as firms do not have to buy back all shares authorized, and not all programs announced are fully executed. Hence, declining CAR could be explained by market learning about the degree to which announced programs are completed.

Despite the declining abnormal returns, findings regarding other explanatory factors are in line with previous studies, including Signalling theory, Agency cost and Free cash flow theory.

## 10.3. Implications of the findings

The empirical evidence obtained adds not only to the ongoing debate regarding drivers behind the share repurchase trend, but also expands the existing literature by suggesting that monetary policy can affect the market response to share repurchase announcements.

The findings obtained in this paper are of interest to Central banks. The empirical evidence shows that the interest rate environment has a significantly positive effect on the market reaction to share repurchases for a 61-day event window. This suggests that the low interest rate environment can foster a short-term wealth creation for shareholders.

Furthermore, the findings of this paper have tangible implications for investors. The downward trend of abnormal returns prior the share repurchase announcement indicates that firms announce share buybacks after the stock has been underperforming. Hence, despite the positive market reaction to the share repurchase announcement itself, rational investors might not find repurchasing stocks attractive, particularly in a low interest rate environment, when returns are lower.

Additionally, the findings of this paper can be useful for company managers making decisions with regard to the payout policy of their company. Managers might be incentivized to borrow more when interest rates are low. Furthermore, in case of limited investment opportunities, managers might pay out the amount borrowed through share repurchases. However, the results indicate that the market might expect this kind of corporate decision.

### 10.4. Limitations and suggestions for further research

Nevertheless, some limitations of this paper should be discussed. First, our research is limited only to US listed companies. Expanding the research to other geographies that have different interest rate environments over time would provide additional insights.

Furthermore, expanding the period of the study could help to achieve a higher balance between years with respect to number of observations. Moreover, an increased sample size could allow to create subsamples for every share repurchase technique with a reasonable amount of observations in each subsample. The previous findings suggest that the market reaction to share repurchases differ with regard to the repurchase technique. Hence, observing possible differences between the interest rate environment and specific share repurchase techniques could provide additional insights.

Another proposal that could help to provide additional insights regarding the relationship between the interest rate environment and cumulative abnormal returns around share repurchase announcements is to use different event windows. For example, testing abnormal returns for -1/+30 days would allow to observe direct impact of event without taking into account negative abnormal return trend prior to the announcement.

Additionally, to further investigate the funding impact on share repurchase announcements, obtaining data regarding how share repurchases are financed would provide an opportunity to more specifically assess whether some financing type is prevailing in specific interest rate environment. Even though anecdotal evidence claims that leverage increases in low interest rate environment are associated with share repurchases, a further study regarding buyback financing, abnormal returns around share repurchase announcements and interest rate environment could provide empirical findings.

Furthermore, there are alternative ways to capture the interest rate trend, which might approximate market expectations better. For example, the yield curve might be a more suitable proxy for the interest rate trend. Additionally, alternative rates could be used instead of the Federal Reserve policy rate as an input to estimate the interest rate environment.

Finally, we acknowledge that the low interest rate environment spans over almost the entire period since 2008 and that there have been substantial changes in policies and structural shifts in the overall financial world. These changes might not be captured by our control variables, although they may have a significant impact on CAR. Further research could be performed by adding additional variables to control for the abovementioned issues.

# 11. References


Allais, M. (1953). Le Comportement de l'Homme Rationnel devant le Risque: Critique des Postulats et Axiomes de l'École Américaine. *The Econometric Society, 21*, 503-546.

Bagwell, L., & Shoven, J. (1989). Cash Distributions to Shareholders. *The Journal of Economic Perspectives, 3*(3), 129-140.

Baker, H. K., Gallagher, P. L., & Morgan, K. E. (1981). Mangement's view of Stock Repurchase Programs. *Journal of Financial Research, 4*, 233-247.

Berk, J., DeMarzo, P., & Harford, J. (2015). Fundamentals of Corporate Finance. *Pearson*, 3rd edition. England.

Bernanke, B., & Gertler, M. (1989). Agency Costs, Net Worth, and Business Fluctuations. *The American Economic Review, 79*(1), 14-31.

Bhattacharya, S. (1979). Imperfect Information, Dividend Policy, and "The Bird in the Hand" Fallacy. *The Bell Journal of Economics, 10*(1), 259-270.

Blouin, J., Raedy, J., & Shackelford, D. (2011). Dividends, Share Repurchases, and Tax Clienteles: Evidence from the 2003 Reductions in Shareholder Taxes. *The Accounting Review, 86*(3), 887-914.

Bodnaruk, A., & Östberg, P. (2013). The Shareholder Base and Payout Policy. *The Journal of Financial and Quantitative Analysis,48*(3), 729-760.

Bonaimé, A. (2012). Repurchases, Reputation, and Returns. *The Journal of Financial and Quantitative Analysis, 47*(2), 469-491.

Cameron, A., Gelbach, J., & Miller, D. (2011). Robust Inference with Multiway Clustering. *Journal of Business & Economic Statistics, 29*(2), 238-249.

Carhart, M.M. (1997). On Persistence in Mutual Fund Performance. *The Journal of Finance, 52*, 57-82.

Comment, R., & Jarrell, G. A. (1991). The Relative Signalling Power of Dutch-Auction and Fixed-Price Self-Tender Offers and Open-Market Share Repurchases. *The Journal of Finance, 46*, 1243-1271.

Dann, L.Y., (1981). Common stock repurchases: An analysis of returns to bondholders and stockholders. *Journal of Financial Economics, 9*(2), 113-138.

Easterbrook, F. (1984). Two agency-cost explanations of dividends. *American Economic Review, 74*, 650–659.

Garcia, C.B., Garcia, J., López Martin, M.M., & Salmeron, R. (2015). Collinearity: revisiting the variance inflation factor in ridge regression. *Journal of Applied Statistics, 42*(3), 648-661.

Graham, J. (2003). Taxes and Corporate Finance: A Review. *The Review of Financial Studies, 16*(4), 1075-1129.

Grullon, G., & Ikenberry, D. L. (2000). What do we know about Stock Repurchases? *Journal of Applied Corporate Finance, 13*, 31-51.

Grullon, G., Michaely, R. (2002). Dividends, Share Repurchases, and the Substitution Hypothesis. The Journal of Finance, 57. 1649-1684.

Grullon, G., Michaely, R. (2004). The Information Content of Share Repurchase Programs. The Journal of Finance, 59(2). 651-680.

Henderson, R. (2019). Share buybacks on course for record year. *Financial Times.* Retrieved from: https://www.ft.com/content/2151b196-a6e5-11e9-984c-fac8325aaa04

Howe, K.M., He, J., & Kao, W. K. (1992). One-Time Cash Flow Announcements and Free Cash-Flow Theory: Share Repurchases and Special Dividends. *The Journal of Finance, 47*(5), 1963-1975.

Ikenberry, D., & Lakonishok, J. (1993). Corporate Governance through the proxy Contest: Evidence and Implications. *The Journal of Business, 66*(3), 405-435.

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

Jagannathan, M., Stephens, C. P., Weisbach, M. S. (2000). Financial flexibility and the choice between dividends and stock repurchases. *Journal of Financial Economics, 57*(3), 355-384.

Jegadeesh, N., & Titman, S. (1993). Returns to Buying Winners and Selling Losers: Implications for Stock Market Efficiency. *The Journal of Finance, 48*, 65-91.

Jensen, M. (1986). Agency costs of free cash flow, corporate finance, and takeovers. *American Economic Review, 76*, 323–329.

Jiang, Z., Kim, K. A., Lie, E., & Yang, S. (2013). Share repurchases, catering, and dividend substitution. *Journal of Corporate Finance, 21*, 36-50.

Kahneman, D., Tversky, A. (1979). Prospect theory: an analysis of decision under risk. *Econometrica, 47*, 263-291.

Kerber, R. (2015). Investor Jeremy Grantham warns stock buybacks slowing growth. *Reuters.* Retrieved from: https://www.reuters.com/article/us-grantham-buybacks/investor-jeremy-grantham-warns-stock-buybacks-slowing-growth-idUSKBN0P42RO20150624

Lakonishok, J., & Vermaelen, T. (1990). Anomalous Price Behavior Around Repurchase Tender Offers. *The Journal of Finance, 45*, 455-477.

Lee, B. S., & Suh, J. (2011). Cash holdings and share repurchases: International evidence. *Journal of Corporate Finance, 17*, 1306-1329.

Levy, H. (2010). The CAPM is Alive and Well: A Review and Synthesis. *European Financial Management, 16*, 43-71.

Light, L. (2019). More than Half of All Stock Buybacks are Now Financed by Debt. Here's Why That's a Problem. *Fortune.* Retrieved from: https://fortune.com/2019/08/20/stock-buybacks-debt-financed/

MacKinlay, A.C. (1997). Event Studies in Economics and Finance. *Journal of Economic Literature, 35*, 13-39.

Masulis, R. (1980). Stock Repurchase by Tender Offer: An Analysis of Common Stock Price Changes. *Journal of Finance, 35*, 305-318.

Miller, M., & Modigliani, F. (1961). Dividend Policy, Growth, and the Valuation of Shares. *Journal of Business, 34*(4), 411-433.

Miller, M., & Rock, K. (1985). Dividend Policy under Asymmetric Information. *The Journal of Finance, 40*(4), 1031-1051.

Modigliani, F., & Miller, M. (1958). The Cost of Capital, Corporation Finance, and the Theory of Investment. *The American Economic Review, 48*, 261-297.

O'Brien, P., & Bhushan, R. (1990). Analyst Following and Institutional Ownership. *Journal of Accounting Research, 28*, 55-76.

Penman, S. (2012). Financial Statement Analysis & Security Valuation. *McGrawHill-Irwin*, 5th edition.

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of Financial Studies, 22*(1), 435-480.

Ponczek, S. (2019). Throwing Cash at Your Own Stock Isn't Enhancing Returns Anymore. *Bloomberg.* Retrieved from: https://www.bloomberg.com/news/articles/2019-08-24/throwing-cash-at-your-own-stock-isn-t-enhancing-returns-anymore

Rao, S. (2019). Share buyback juggernaut to roll on, oiled by bond yield collapse. *Reuters.* Retrieved from: https://uk.reuters.com/article/us-stocks-buybacks/share-buyback-juggernaut-to-roll-on-oiled-by-bond-yield-collapse-idUKKCN1UV0V9

Rau, P., & Vermaelen, T. (2002). Regulation, Taxes, and Share Repurchases in the United Kingdom. *The Journal of Business,75*(2), 245-282.

Roy, A.D. (1952). Safety-first and the holding of assets. *Econometrica, 20,* 431–449.

Spence, M. (1973). Job Market Signaling. *The Quarterly Journal of Economics, 87*(3), 355-374.

Vermaelen, T. (1981). Common stock repurchases and market signaling: An empirical study. *Journal of Financial Economics, 9*(2), 139-183.

Vermaelen, T. (1984). Repurchase Tender Offers, Signaling, and Managerial Incentives. *Journal of Financial and Quantitative Analysis, 19*(2), 163-181.

Wigglesworth, R. (2019). Why America's great corporate debt binge is probably not over. *Financial Times*. Retrieved from: https://www.ft.com/content/19435b4e-6c2f-11e9-80c7-60ee53e6681d

# 12. Appendices

## Appendix A

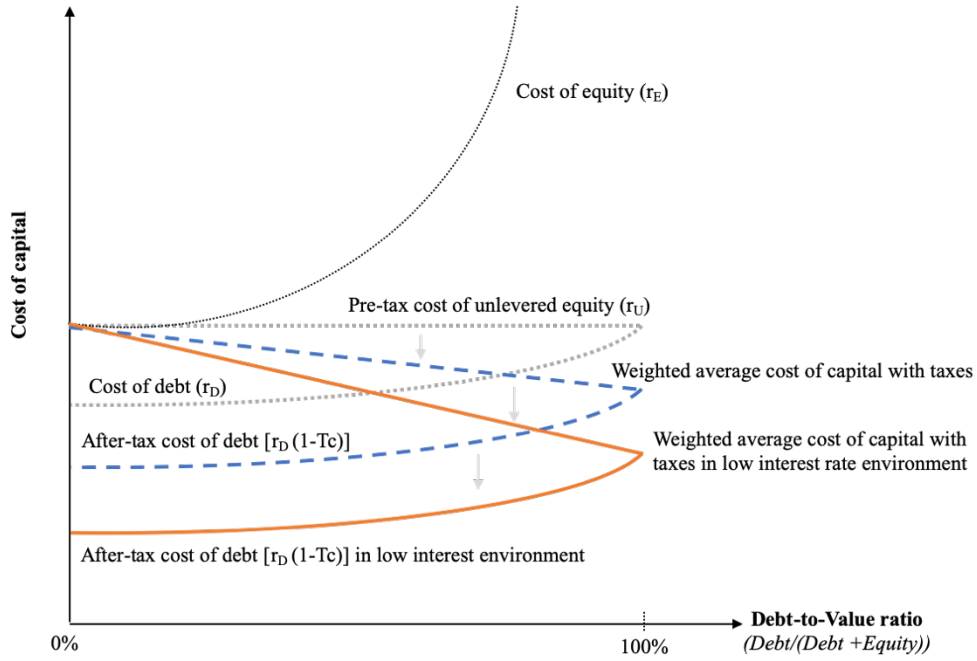



**Figure 10.** Low interest rate effect on Modigliani and Miller propositions (Berk, DeMarzo & Harford, 2015)

# Appendix B

**Table 9**. Descriptive statistics of control variables

| Variable | No. of obs. | Mean | St. dev. | Median | Quantiles | |
|---|---|---|---|---|---|---|
| | | | | | .25 | .75 |
| *SIZE* | 13 795 | 6.92 | 2.04 | 6.89 | 5.48 | 8.34 |
| *BMR* | 13 799 | 0.36 | 0.24 | 0.33 | 0.21 | 0.48 |
| *TAX* | 14 916 | 0.77 | 0.03 | 0.76 | 0.75 | 0.76 |
| *TIME* | 14 916 | 22.23 | 7.18 | 22.00 | 16.00 | 29.00 |
| *PROF* | 13 363 | 0.08 | 2.09 | 0.06 | -0.02 | 0.15 |
| *RD* | 13 364 | 0.04 | 0.07 | 0.00 | 0.00 | 0.05 |
| *AUTH* | 14 916 | 0.29 | 0.33 | 0.13 | 0.06 | 0.37 |
| *NOI* | 13 778 | 0.02 | 0.51 | 0.00 | 0.00 | 0.01 |
| *LEVE* | 13 805 | 0.29 | 0.68 | 0.12 | 0.01 | 0.32 |
| *CASH* | 13 795 | 0.19 | 0.19 | 0.12 | 0.04 | 0.28 |
| *LEVE_CH* | 9 337 | 30.65 | 703.40 | 0.10 | -0.42 | 1.11 |
| *CAPEX* | 13 364 | 0.06 | 0.08 | 0.04 | 0.02 | 0.07 |
| *SG* | 13 754 | 0.36 | 14.95 | 0.08 | 0.01 | 0.17 |

*Note:* Mean of leverage change of t=-1 and t+2 years after share repurchase announcement is affected by outliers. Hence, the mean and median values are significantly different.

# Appendix C

**Table 10**. Summary of CAR based on share repurchase type

| Repurchase technique | Obs. | % | CAR |
|---|---|---|---|
| Accelerated | 250 | 1.7% | 1.81% |
| Dutch Auction | 251 | 1.7% | 7.47% |
| Fixed price (odd lot) | 119 | 0.8% | 5.72% |
| Negotiated | 533 | 3.6% | 1.76% |
| Negotiated (odd lot) | 1 | 0.0% | -0.99% |
| Odd lot | 47 | 0.3% | 3.92% |
| Odd lot (Dutch auction) | 2 | 0.0% | 17.12% |
| Open market | 6 419 | 43.0% | 1.50% |
| Open market (negotiated) | 7 290 | 48.9% | 1.74% |
| Open market (odd lot) | 2 | 0.0% | 14.83% |
| Total | 14 916 | 100% | 1.78% |

*Note:* This table illustrates a distribution of CAR based on the share repurchase techniques. The results observed are obtained using Fama-French Plus Momentum 1-day event window. The observed CAR values can slightly change for other models depending on the number of observations included in the regression and asset pricing model used to determine CAR.

# Appendix D

**Table 11.** Robustness check results using Market and Fama-French 3 factor models

| | Market model | | | Fama-French 3 Factor model | | |
|---|---|---|---|---|---|---|
| Event window | 3 days | 7 days | 61 days | 3 days | 7 days | 61 days |
| No of obs. | 12 063 | 12 063 | 12 003 | 12 067 | 12 063 | 12 003 |
| $R^2$ | 9,15% | 9,25% | 9.31% | 9.27% | 9,47% | 8.59% |
| *IRE* | -.0033847* | -.001148 | .0176514*** | -.0032956** | -.000236 | .0177781** |
| | (0.079) | (0.572) | (0.003) | (0.043) | (0.903) | (0.039) |
| *PROF* | -.0000856 | -.0004005 | .0031189 | -.0000998 | .0005774 | .0042614** |
| | (0.746) | (0.120) | (0.017)** | (0.696) | (0.019)** | (0.012) |
| *BMR* | .0311971*** | .050823*** | .2174438*** | .0320333*** | .0502418*** | .1992401*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| *CAPEX* | -.0029052 | .0007076 | .0149936 | -.0021752 | -.003026 | .0291279 |
| | (0.902) | (0.981) | (0.813) | (0.922) | (0.917) | (0.685) |
| *CASH* | .0064311 | -.0001174 | .038479 | .001774 | -.0061084 | .034157 |
| | (0.558) | (0.992) | (0.155) | (0.873) | (0.634) | (0.237) |
| *NOI* | -.0120873** | -.0144547* | -.0154005 | -.0122955** | -.0173736* | -.0186881 |
| | (0.021) | (0.094) | (0.129) | (0.018) | (0.056) | (0.193) |
| *RD* | .0626708 | .0480155 | .0659318 | .0565438 | .0094716 | -.0122076 |
| | (0.112) | (0.222) | (0.463) | (0.157) | (0.827) | (0.908) |
| *SIZE* | -.003748*** | -.004252** | -.009281* | -.004286*** | -.006407*** | -.0120175* |
| | (0.002) | (0.030) | (0.098) | (0.005) | (0.008) | (0.063) |
| *LEVE* | .0010657 | .0014161 | .0183506 | .0010175 | .0004701 | .0156078 |
| | (0.500) | (0.671) | (0.247) | (0.506) | (0.795) | (0.187) |
| *SG* | -.0000113 | 5.07e-06 | -.000283*** | -2.08e-06 | .0000693*** | -.000317*** |
| | (0.266) | (0.478) | (0.000) | (0.841) | (0.000) | (0.000) |
| *AUTH* | -.0024586 | -.0057662 | -.0276728* | -.0011828 | -.000379 | -.0097272 |
| | (0.481) | (0.154) | (0.081) | (0.727) | (0.925) | (0.496) |

*Note:* The results are obtained using industry fixed effects when errors are clustered by firm, industry and year. The independent variable CAR is obtained for 3 event windows for both models. Numbers in the parentheses are p values obtained from two tailed t-tests where ***p<0.01; **p<0.05; *p<0.1

# Appendix E

**Table 12.** Robustness check results using firm fixed effects

| Event window | 3 days | 7 days | 61 days |
|---|---|---|---|
| Fixed effects | Firm | Firm | Firm |
| No of obs. | 12 067 | 12 063 | 12 003 |
| $R^2$ | 9,00% | 9,21% | 8.44% |
| *IRE* | -.003636** | -.0018592 | .0146893* |
| | (0.029) | (0.253) | (0.083) |
| *PROF* | -.0000944 | .0005787** | .0049414** |
| | (0.715) | (0.027) | (0.012) |
| *BMR* | .0312824*** | .0492628*** | .2101765*** |
| | (0.000) | (0.000) | (0.000) |
| *CAPEX* | .009239 | .0204725 | .1046286 |
| | (0.669) | (0.557) | (0.176) |
| *CASH* | .001607 | -.0034207 | .0439322 |
| | (0.887) | (0.805) | (0.163) |
| *NOI* | -.0135261*** | -.0164826 | -.0179221 |
| | (0.002) | (0.101) | (0.270) |
| *RD* | .0635819 | .0279214 | .0919126 |
| | (0.110) | (0.457) | (0.364) |
| *SIZE* | -.0038858*** | -.0049956*** | -.0073238 |
| | (0.001) | (0.009) | (0.252) |
| *LEVE* | .0016316 | .0011645 | .0106739 |
| | (0.315) | (0.525) | (0.336) |
| *SG* | .000023* | .000073*** | -.0002912*** |
| | (0.055) | (0.000) | (0.000) |
| *AUTH* | -.0019064 | -.0004186 | -.010303 |
| | (0.511) | (0.921) | (0.446) |

*Note:* The results are obtained using firm fixed effects when errors are clustered by firm, industry and year. The independent variable CAR is obtained for 3 event windows for both models. Numbers in the parentheses are p values obtained from two tailed t-tests where ***p<0.01; **p<0.05; *p<0.1

## Appendix F

**Table 13**. Robustness results when only companies with more than 20% leverage change are included

| Event window | 3 days | 7 days | 61 days |
|---|---|---|---|
| Fixed effects | Industry | Industry | Industry |
| No of obs. | 7 257 | 7 253 | 7 191 |
| $R^2$ | 7.85% | 8.10% | 8,38% |
| *IRE* | -.0062866** | -.003955 | .014447 |
| | (0.044) | (0.205) | (0.165) |
| *PROF* | -.0002801 | .0004106* | .0055043*** |
| | (0.127) | (0.059) | (0.005) |
| *BMR* | .0316846** | .0513167** | .2194457*** |
| | (0.019) | (0.016) | (0.000) |
| *CAPEX* | .0157345 | .0220774 | .073871 |
| | (0.649) | (0.661) | (0.486) |
| *CASH* | .0066976 | -.0032509 | .0194183 |
| | (0.580) | (0.874) | (0.684) |
| *NOI* | -.0087207 | -.0007765 | .0043269 |
| | (0.512) | (0.973) | (0.842) |
| *RD* | .1003871* | .066374 | .1606755 |
| | (0.057) | (0.234) | (0.277) |
| *SIZE* | -.0024252 | -.0025513 | -.0054734 |
| | (0.258) | (0.384) | (0.484) |
| *LEVE* | -.0044917 | -.0001366 | .0106561 |
| | (0.173) | (0.973) | (0.414) |
| *SG* | .0030216 | -.0007949 | -.0155069* |
| | (0.461) | (0.900) | (0.087) |

*Note:* The table represents regression results of model 7 when only observations for firms for which leverage 2 years after the share repurchase announcements changed more than 20%. The CAR used in the regression is estimated using Fama-French Plus Momentum model. The standard errors are clustered by firm, industry and year. Numbers in the parentheses are p values obtained from two tailed t-tests where ***p<0.01; **p<0.05; *p<0.1