M.Sc. Thesis - Financial Economics

The influence of actual share repurchases on price efficiency in the United States

Lex Croes

Student ID number: 410090

Date final version: August 19, 2019

Supervisor: Dr. S. Obernberger

Second assessor: t.b.a.

Abstract

This paper examines the influence of share repurchases in the United States on the efficiency of stock prices for firms listed on the NYSE and NASDAQ. I find that actual share repurchases increase the price efficiency and information content of the stock prices when firms provide price support below or at the intrinsic value during periods with negative market news. Furthermore, I find that share repurchases by NYSE-listed firms increase the efficiency of the stock price significantly more than NASDAQ-listed during down market periods. I attribute this finding to better market timing abilities of NYSE-listed firms and their more extensive adoption of repurchases to provide price support. Moreover, I obtain evidence that firms on the NYSE manipulate stock prices by intentionally increasing stock prices above their intrinsic value during periods containing positive market news. I find that particularly repurchasing firms where corporate insiders have most to gain have a detrimental effect on the efficiency of stock prices. Finally, I provide evidence that analyst EPS forecast-driven repurchases have a harmful impact on the efficiency and the information content of stock prices.

Keywords: Actual share repurchases, idiosyncratic risk, information content, payout policy, price efficiency | *JEL classification*: G10, G30, G35

Table of contents

Table of tables

1 Introduction

Share repurchases have become an increasingly popular payout policy for firms in the United States (US). Skinner (2008) documents the development of dividends and net repurchases for US industrial firms over time and reports that aggregate share repurchases amount to $223 billion in 2004. This surge in repurchases sparked the debate in the business press and academic literature whether share repurchases are an efficient use of the firm's funds. Various studies find that management and employee stock options influence the manager's decision to repurchase shares (Fenn & Liang, 2001; Kahle, 2002; Babenko, 2009). These findings raise the concern whether managers repurchase shares for their own benefit. Busch and Obernberger (2016) address these concerns by using a novel approach to directly determine the influence of actual share repurchases on the price efficiency and the information content of a stock. To determine the efficiency and information content of stock prices they use measures of price delay and firm-specific risk. They find that share repurchases increase the efficiency and information content of stock prices by providing price support at the intrinsic value. Therefore, their evidence is not in line with the view that share repurchases manipulate stock prices.

Aggregate share repurchases in the US have recovered from their drop during the financial crisis and have risen to an all-time high recently. The Standard & Poor's Dow Jones Indices report that share repurchases by S&P 500 firms amounted to an annual record of $806 billion dollar in 2018 of which Apple alone was good for $74 billion[1]. The recent surge in share repurchases has reinvigorated the concerns of their influence on the US economy. Several papers find that the unprecedented spending on corporate payout in combination with decreasing aggregate investments on R&D and capital expenditures are warning signs for the US economy (Floyd, Li & skinner, 2015; Kahle & Stulz, 2017). The Tax Cut and Jobs Act (TCJA) of 2017 provides a one-off discount on the tax for US corporations to repatriate profits hoarded overseas and reduced the corporate tax rate from 35% to 21% as of 2018. The TCJA was introduced to boost the US economy and create jobs, but the record spending of US firms on share repurchases in 2018 has led to the growing scrutiny of the TCJA and share repurchases amongst politicians, legislators and academics. Several politicians propose they want to limit the conditions under which firms are allowed to repurchase stock, while others suggest raising the tax rate on capital gains to make repurchases less attractive for firms. Proponents of repurchases argue no action is required, since they claim that shares repurchases are an efficient way to redistribute excess capital to shareholders when firms lack profitable investment opportunities. Moreover, respected research institutions and legislators propose regulatory reforms for share repurchases as their research and professional judgement imply that share

[1]Source: press release (03/25/2019) by S&P Down Jones Indices, obtained from: https://www.spindices.com/documents/index-news-and-announcements/20190325-sp-500-buybacks-2018-q4-pr.pdf

repurchases manipulate stock prices[1]. The academic literature finds evidence that management has incentives to manipulate stock prices for their own capital gain (Bonaimé & Ryngaert, 2013; Ben-Rephael, Oded & Wohl, 2014; Cheng, Harford & Zhang, 2015; Almeida, 2018). The tax reforms, growing scrutiny of share buybacks, and record breaking levels of share repurchases in the US make it desirable from a legal, a social, and an academic perspective to investigate the influence of share repurchases on the efficiency of stock prices.

Therefore, I will use the research of Busch and Obernberger (2016) as my benchmark paper to analyse the following research question[2]:

Do share repurchases in the United States increase the efficiency of stock prices?

Following the research design of the benchmark paper, I address this research question by analysing the influence of stock buybacks on the efficiency and the information content of stock prices. In accordance with the benchmark paper, I use measures of price delay and measures of firm-specific risk of to determine the efficiency and information content of stock prices. In order to compose a well-founded answer to my research question, I test the following hypotheses throughout my empirical analysis. The first hypothesis is based on the literature finding evidence that managers intentionally use share repurchases to manipulate stock prices. For instance, Kahle (2002) finds that firms are more likely to announce repurchase programs when corporate insiders have many options outstanding or when employees have many stock options exercisable. Moreover, Ben-Rephael, Oded, and Wohl (2014) document that firms repurchase more shares in periods with high net insider selling and Bozanic (2010) reports that managers repurchases shares to meet certain EPS targets. Therefore, the first hypothesis assumes that share repurchases decrease the information content of stock prices by increasing the stock price above its intrinsic value as proposed by Busch and Obernberger (2016).

In contrast with the belief that buybacks manipulate stock prices, Busch and Obernberger (2016) find that stock buybacks increase the efficiency and information content of stock prices. As proposed by the benchmark paper, I hypothesize that share repurchases increase the speed and precision by which public news is reflected into the stock price. This are the two main hypotheses of my empirical analysis, which form the basis of my answer to the research question. Building on the second hypothesis, the benchmark paper argues that share repurchases solely allow firms to incorporate positive news into the stock price, since firms make a transaction on the market from the buyside perspective. Busch and Obernberger (2016) suggest that share repurchases can increase the efficiency of stock prices via two alternative channels according to this argument.

[1]e.g., “Stock Buybacks: Background and Reform Proposals” by the Congressional Research Service Legal Sidebar, obtained from: https://fas.org/sgp/crs/misc/LSB10266.pdf

[2]Busch and Obernberger (2016) and the term ‘benchmark paper’ are used interchangeably throughout this thesis to refer to this study

Hou and Moskowitz (2005) find that share repurchases allow firms to correct the mispricing of their stock due to investor neglect or reduced visibility in the market. Based on this notion, Busch and Obernberger (2016) assume that share repurchases increase the speed with which positive market news is incorporated into the stock price. In accordance with the benchmark paper, I hypothesize that this is the first channel how repurchases increase the stock price efficiency. Hong, Wang, and Yu (2008) find that the variance of short-term stock returns is lower for firms with adequate funds to repurchase shares, since they are able to prevent their stock price from overreacting in the event of negative market news. Based on this argument, Busch and Obernberger (2016) reason that stock buybacks increase the precision with which negative market news is reflected into the stock price. In line with the benchmark paper, I postulate that this is the second channel how share repurchases increase the efficiency of stock prices.

Cook, Krigman & Leach (2003b) investigate the managerial market timing of actual share repurchases and find that firms on the NYSE repurchase shares at a relatively lower cost than firms on the NASDAQ. Furthermore, they find that firms listed on the NYSE provide more price support through limit orders when the stock price drops below its intrinsic value compared to firms listed on the NASDAQ. These findings may be of considerable importance for my research, since the benchmark paper finds that share repurchases mainly increase the efficiency of stock prices by providing price support at the intrinsic value. Although the price support argument of Busch and Obernberger (2016) does not directly imply managerial timing ability, their finding that firms improve the efficiency of stock prices by repurchasing shares below or at the intrinsic value is to some degree consistent with the managerial timing ability. Based on the results of Cook, Krigman & Leach (2003b) and Busch and Obernberger (2016), I hypothesize that NYSE-listed firms increase the price efficiency of stocks by more than NASDAQ-listed firms by repurchasing shares. Furthermore, I assume that repurchasing shares by NYSE-listed firms decreases the firm-specific risk of stocks more than repurchasing shares by NASDAQ-listed firms. Various studies find that meeting or beating the analyst EPS forecast influences a firm's decision to repurchase shares (Hribar, Jenkins & Johnson, 2006; Almeida, Fos & Kronlund, 2016). Based on their findings, I hypothesize that analyst EPS forecast-driven share repurchases reduce the efficiency and the information content of stock prices.

I empirically test the hypotheses by constructing a dataset of 2,756 US firms covering 120,406 firm-quarters over a period from begin 2004 till the end of 2018. The 120,406 firm quarters over the entire period consist of 62,131 quarters with repurchase activity. The firms included in the sample trade on two major US exchanges, the NYSE or NASDAQ. I find that share repurchases reduce the delay and the firm-specific risk of stock prices during quarters containing negative market news. This corresponds with the main finding of the benchmark paper that share repurchases increase the efficiency of stock prices by providing price support at the intrinsic value. Analysis of the volatility of stock returns in up and down markets provides further evidence in favor of the price support argument.

Moreover, I find that providing price support at the intrinsic value increases the information content of stock prices significantly more for NYSE-listed firms than NASDAQ-listed firms. This is consistent with other research documenting better managerial market timing abilities for firms listed on the NYSE than firms listed on the NASDAQ (Cook, Krigman & Leach, 2003b). However, I also obtain evidence that share repurchases on the NYSE during markets containing positive news reduce the efficiency and information content of stock prices. This is in line with the notion that managers intentionally manipulate stock prices by repurchasing shares to boost their equity-based remuneration (Bonaimé & Ryngaert, 2013; Ben-Rephael, Oded & Wohl, 2014). Further inspection zooming in on potentially harmful share repurchases reveals that particularly share repurchases with which corporate insiders have most to gain, are detrimental to the efficiency of the stock prices. Moreover, I find analyst EPS forecast-driven share repurchases decrease the efficiency and the information content of stock prices. This is in accordance with the literature finding that managers are more likely to repurchase shares when they are about to miss the analyst EPS forecast (Hribar, Jenkins & Johnson, 2006; Almeida, Fos & Kronlund, 2016). Overall, I find that share repurchases primarily increase the efficiency of stock prices by providing price support at the intrinsic value. Nevertheless, I also obtain evidence that a specific group of share repurchases decreases the efficiency of stock prices.

My paper contributes to the existing academic literature in three ways. Firstly, I contribute to the literature that investigates the impact of actual share repurchases on the efficiency of stock prices. Busch and Obernberger (2016) were the first to directly analyse the impact of actual repurchases on the efficiency and information content of stock prices by using a novel research design in the context of share repurchases. Their main finding is that share repurchases increase the efficiency of stock prices by providing price support at the intrinsic value. The recent debate whether share repurchases are an efficient use of corporate funds questions the findings of their research. I shed new light on this debate by providing evidence that the main findings of Busch and Obernberger (2016) hold for a more recent period and on a quarterly basis, while my support for the price manipulation argument for some repurchases in this setting contradicts their findings. The discrepancy in findings on the price manipulation argument are best explained by changed manager's incentives to repurchase shares due to the more intensive use of stock options recently. Moreover, I complement the work of Busch and Obernberger (2016) by documenting that repurchases by NYSE-listed firms increase the efficiency of stock prices more than NASDAQ-listed firms. I attribute this difference in impact on the efficiency of stock prices between exchanges to the finding that NYSE-listed firms are better in timing the market with share repurchases than NASDAQ-listed firms and that NYSE-listed firms repurchase shares more to provide price support than NASDAQ-listed firms (Cook, Krigman & Leach, 2003b). This is consistent with the evidence that firms primarily increase the efficiency of stock prices by providing price support at the intrinsic value provided by Busch and Obernberger (2016). Second, I contribute to the field of research that investigates whether particular types of investors, like short sellers, institutional traders, and corporate insiders influence the efficiency and the information content of stock prices[1]. In contrast with the benchmark paper, I find that short sellers, institutional traders, and corporate insiders may have a detrimental influence on efficiency of stock prices. Thirdly, I contribute to the body of literature analysing the effects of earnings management and analyst forecasts by documenting that analyst EPS forecast-driven repurchases reduce the efficiency and information content of stock prices[2].

I find that share repurchases primarily increase the efficiency of stock prices when firms provide price support at the intrinsic value. This evidence could inform politicians and regulators proposing to completely ban open market share repurchases that this is not an efficient solution for the concerns regarding share repurchases. However, the support I find for the price manipulation argument for a specific group of repurchases suggests that a reform of the law of open market share repurchases is required to curb their potentially detrimental effects on the US economy. My research could inspire the academic literature to provide further compelling evidence on the manipulative nature of a certain group of share repurchases. This would strengthen the case of politicians and legislators proposing a reform of the current laws on open market share repurchases. Moreover, my research informs shareholders that not all share repurchases are in their best interest.

The rest of my thesis is structured as follows. Chapter 2 outlines the theoretical framework, which provides an overview of the basics of share repurchases, the regulatory background, relevant academic literature, and the development of my hypotheses. Subsequently, chapter 3 discusses the collection of the data, sample construction, and manipulation of the data. Chapter 4 describes the methodology employed at the empirical analysis and discusses the descriptive statistics of all variables used. Next, chapter 5 reports the empirical results, tests my hypotheses,

[1]For instance, Bris, Goetzmann & Zhu (2007), Boehmer, Jones & Zhang (2008), Boehmer & Kelley (2009), Phillips (2011), Saffi & Sigurdsson (2011), Boehmer & Wu (2012), and An & Zhang (2013).
[2]For example, Bens, Nagar, Skinner & Wong (2003), Hribar, Jenkins & Johnson (2006), Young & Yang (2011), Cheng, Harford & Zhang (2015), and Almeida, Fos & Kronlund (2016).

and relates my findings to prior research. Lastly, chapter 6 draws a conclusion from my findings, discusses the limitations of my research, and proposes certain recommendations for future research.

2 Theoretical framework

In this section, I briefly summarize the basics of share repurchases and the corresponding regulatory background. Subsequently, I provide an overview of the relevant academic literature on share repurchases along with their findings. Lastly, I relate these arguments and findings to the development of my hypotheses.

2.1 The fundamentals of share repurchases

A company can return wealth to its investors by repurchasing shares. The firm can repurchase its own shares on the market to decrease the number of shares outstanding[1]. The reduction of shares outstanding increases the relative ownership in the firm of the remaining shareholders and therefore their claim on future earnings of the firm. Although the literature on the basics of share repurchases is inconsistent on the number of share repurchase methods, I identify the following five methods: open market share repurchases, accelerated repurchases, fixed price tender offers, Dutch auction tender offers or privately negotiated repurchases (Grullon & Ikenberry, 2000; Vermaelen, 2005; Bargeron, Kulchania & Thomas, 2011)[2].

Approximately 90% of the volume repurchased in the US is acquired through open market share repurchases (Busch and Obernberger, 2016). This validates my use of quarterly common shares repurchased as a proxy for open market share repurchases. An open market repurchase program contains the firm's announcement to buy back a predetermined number of shares or dollar volume within a certain period. However, a firm is not required by US law to repurchase the total number of shares announced in the repurchase program or to complete the repurchase within the stated timeframe. Firms are allowed to alter the announced repurchase period or intended repurchase volume, while they may also decide to terminate a repurchase program prematurely. These program characteristics portray the flexible nature of open market share repurchases. The flexibility of this acquisition method enables managers to only repurchase shares when they believe their stock is undervalued or to use their funds on new profitable investment opportunities when these arise in the future.

An accelerated share repurchase program enables a firm to repurchase vast amounts of their shares outstanding on an expedited basis through an investment bank. The firms pay the

[1]Source: 'Share repurchase' by Investopedia, obtained from:
https://www.investopedia.com/terms/s/sharerepurchase.asp
[2]Source: 'Accelerated share repurchase/buyback' by WallStreetMojo, obtained from:
https://www.wallstreetmojo.com/accelerated-share-repurchase-buybacks/

investment bank in advance and enter into a forward contract with the cooperating party. Subsequently, the investment bank uses its network to quickly borrow the firm’s shares from their clients or lenders. They immediately deliver these shares to the firm, while they return the borrowed shares to their clients or lenders over time by repurchasing shares in the open market. This method allows a firm to decrease the number of shares outstanding at a faster rate, while they also transfer the risk to the investment bank for a predetermined premium. The use of accelerated share repurchases has risen drastically over the years and is linked by a growing body of literature to earnings management (Bargeron, Kulchania & Thomas, 2011; Michel, Oded & Shaked, 2010; Bonaimé, Hankins & Jordan, 2016).

A fixed price tender offer determines the repurchase price, sought number of shares and duration of the offer in advance. The price offered to shareholders to repurchase shares exceeds the stock’s current market price. Interested shareholders submit the number of shares they are willing to sell at the offered repurchase price. If the total number of shares tendered by the shareholders exceeds the sought number of shares by the company, the firm buys back the number of shares sought on a pro-rata basis. The firm may decide to extend the duration of the offer when insufficient shares are tendered. Furthermore, they may specify a minimum amount of shares tendered for the offer to go through. An important advantage of this acquisition method is that it provides certainty to the repurchasing firm on the number of shares that can be repurchased at a specific price before they will have to actually buy back their shares. However, this method is relatively expensive compared to open market repurchases, since the offered repurchase price is generally higher than the current market price.

A Dutch auction tender offer specifies a price range for which the firm is willing to repurchase shares. Shareholders are free to decide how many shares they wish to tender at a certain price within the price range. The firm then determines at what repurchase price within the range the total amount of shares tendered by the shareholders exceeds the number of shares sought by the firm. The shares tendered below or at this repurchase price are bought back by the firm for the repurchase price at this threshold. If the total number of shares tendered at or below the repurchase price exceeds the number of shares sought, then the number of shares sought are bought back at a pro-rata basis from this group of tendered shares. The firm may decide to cancel the offer or buy back all tendered shares at the maximum price when not insufficient are tendered.

In a privately negotiated repurchase firms directly approach a large shareholder to buy back a vast amount of shares. Privately negotiated repurchases are interesting to firms that want to substantially reduce their shares outstanding quickly and off the radar, since the firm usually only deals with one or a few parties. However, there is also a more infamous example of privately negotiated repurchases called ‘greenmail’. This is when a firm privately repurchases its shares at a substantial premium from a major shareholder in the threat of a hostile takeover. The US Federal Tax Treatment of greenmail gains, which imposes a 50% tax on greenmail profits, has substantially reduced greenmailing practices since the 1990s. Furthermore, privately negotiated repurchases do not count towards a firm’s daily trading volume restrictions imposed by the safe harbour rule 10b-18. Therefore, this method allows a firm to repurchase a significant amount of shares through a privately negotiated deal, while they simultaneously buy back shares on the open market.

2.2 Regulatory background

I use the work of Cook, Krigman, and Leach (2003a) and Vermaelen (2005) to provide an overview of the development of US law on share repurchases over time. The Securities Exchange Act of 1934 (SEA) was one of the first policies in the US attempting to regulate securities transactions on the secondary market, like the NYSE. Section 9(a)(2) of this act prohibited various forms of stock price manipulation. However, the complexity to precisely define manipulative conduct in a law complicated its implementation. Therefore, until the 1980s US firms were deterred from adopting repurchase programs on a large scale by the threat of facing manipulation charges. The Securities and Exchange Commission (SEC[1]) implemented Rule 10b-18 in 1982, which provides a safe harbor for firms that comply with the prescribed code of conduct when they repurchase shares. The code of conduct states that firms may use one broker or dealer per day to repurchase stock and imposes certain timing restrictions regarding the opening and closing minutes of a trading day. Furthermore, it dictates that the repurchase price may not exceed the highest independent bid or last transaction price quoted. Finally, the act limits the maximal daily repurchase volume to for firms to 25% of their average daily trading volume. The implementation of the safe harbor rules ended the legally grey area around repurchases and therewith sparked the adoption of repurchase programs by firms in the US.

The amendment of Rule 10b-18 in 2003 by the SEC required publicly listed firms to disclose more comprehensive information of their monthly repurchase activity on a quarterly basis starting the second quarter of 2004. This new rule prescribes firms to disclose the number of shares repurchased in the previous quarter, the average repurchase price, the number of shares repurchases in the previous quarter as part of a repurchase program, and the remaining

[1]Definition SEC: An independent federal agency that oversees and regulates the securities industry in the United States and enforces securities laws, obtained from: https://financial-dictionary.thefreedictionary.com/SEC

volume of this repurchase program in their quarterly public filings. This rule had a major impact on the transparency of the repurchase activity of firms in the US and is responsible for the availability of my quarterly repurchase data in Compustat. Furthermore, Rule 10b-5 and section 10(b) impose restrictions on insider trading related to share repurchases. These rules prohibit corporate insiders from trading securities on crucial non-public information with respect to share repurchases

Finally, the Tax Cut and Jobs Act (TJCA) of 2017 boosted US share repurchases in 2018 and is expected to give additional impulse to share repurchases in the near future. This act contains a discounted one-off levy on profits hoarded overseas to stimulate the repatriation of these funds. US firms were estimated to have hoarded approximately 2.8 trillion dollar worth of profits overseas[1]. Approximately $900 billion dollar of these profits hoarded overseas has been repatriated since the tax overhaul was implemented[2]. These figures emphasize the effect this law may potentially have on the share repurchases and US economy in the future.

2.3 Literature review

In this section, I will discuss the existing literature on share repurchases related to my research. Since I investigate the impact of actual share repurchases on the efficiency and information content of stock prices, I consider the literature on the managerial timing ability of share repurchases most closely related to my study. Subsequently, I will discuss the literature on the management incentive hypothesis, because the recent surge in share repurchases in the US has resulted in a growing body of literature questioning managers' motives for share repurchases.

2.3.1 Managerial timing ability

An extensive survey of a widespread sample of approximately 400 financial executives covering 250 firms reports that undervaluation is the primary reason for management to repurchase shares (Brav, Graham, Campbell & Michaely, 2005). In subsequent interviews about half of the financial executives state their firms keeps records of their repurchase timing and claim they can beat the market. Furthermore, they declare that share repurchases are initiated or accelerated when they consider the repurchase price low relative to prior stock prices. The literature directly investigating the timing ability of managers on share repurchases is scarce, since firms were not required to disclose detailed information on their repurchase activity till 2004. Therefore, most studies examining share repurchases prior to this period had to use data from repurchase program announcements or use alternative proxies. Various studies

[1]Source: "Why The Tax Cuts And Jobs Act (TCJA) Led To Buybacks Rather Than Investment" by Forbes, obtained from: https://www.forbes.com/sites/annemarieknott/2019/02/21/why-the-tax-cuts-and-jobs-act-tcja-led-to-buybacks-rather-than-investment/#54d93baf37fb
[2]Source: "U.S. Companies Brought Home More Profits From Overseas" by The Wall Street Journal, obtained from: https://www.wsj.com/articles/u-s-companies-transferred-more-profits-from-overseas-in-2018-than-estimated-11561044921

using repurchase announcements provide indirect evidence for the managerial timing ability of repurchases, since they find that the announcement of fixed price tender offers is followed abnormal stock returns (Vermaelen, 1981; Comment & Jarrell 1991). Others find that the announcement of open market repurchase programs are followed by long-term abnormal returns and argue that the evidence is most in line undervaluation hypothesis (Ikenberry, Lakonishok & Vermaelen, 1995; Chan, Ikenberry & Lee, 2007). The undervaluation hypothesis postulates that managers repurchase shares when they perceive their stock to be undervalued. The authors conclude that their findings are most in line with the notion that managers repurchase shares when they believe their stock is undervalued by the market.

The following studies use actual share repurchases instead of program announcement data and therefore provide more direct evidence on the managerial timing ability of share repurchases. Various studies find that share repurchases are negatively related to prior stock returns and other work report that the amount of share repurchases increases after negative stock returns (Stephens and Weisbach, 1998; Cook, Krigman, and Leach, 2003b; Bozanic 2010). These results using actual share repurchases provide additional evidence that undervaluation is an important motive for share repurchases. More recent papers confirm the findings that managers can time the market with actual share repurchases. De Cesari, Espenlaub, Khurshed, and Simkovic (2012) find firms with low insider ownership better time the market than firms with high insider ownership, while they also document that high institutional ownership is negatively related to management's ability to time the market. Dittmar and Field (2015) report that firms with high net insider buying, negative prior stock returns, and a lower repurchase frequency buy back shares prices significantly lower than market prices. Ben-Rephael, Oded, and Wohl (2014) document that their results are more pronounced for smaller and growth firms compared relative to large value firms. Contrarily to prior studies, these findings indicate that the ability of managers to time the market for actual share repurchases is related to the firm's net insider selling and degree of institutional ownership.

2.3.2 Management incentive

The increasing popularity of share repurchases in the US led to a growing body of literature that questions whether the signalling of undervaluation or redistribution of excessive cash is truly management's motive to repurchase shares. The management incentive argument presumes that managers are incentivized to repurchase shares to boost their equity-based remuneration. Stock options have become increasingly more dominant form of executive compensation over time and are supposed to align incentives of a firm's management and

[1]Source: "Nasdaq vs NYSE: Top 7 Differences Traders Should Know" by DAILYFX, obtained from: https://www.dailyfx.com/nas-100/NASDAQ-vs-NYSE.html

[2]Definition blue chip by Investopedia: A nationally recognized, well-established, and financially sound company. Blue chips generally sell high-quality, widely accepted products and services, obtained from: https://www.investopedia.com/terms/b/bluechip.asp

shareholders (Mehran, 1995). However, various studies have found that these changes in executive compensation have resulted in the increased popularity of share repurchases in the US and incentivised management to maximize their own wealth at the expense of outside shareholders. Fenn and Liang (2001) corroborate this notion as they find that management stock options have a negative impact on dividends and a positive impact on share repurchases. They reason that the combination of the relationship of stock options with repurchases and dividends may transfer wealth from outside shareholders to management. Several other studies find that firms are more likely to initiate share repurchases when employees have a large stake in the firm or a lot of stock options exercisable (Kahle, 2002; Babenko, 2009). Bonaimé and Ryngaert (2013) find that share repurchases are most likely in quarters with high net insider selling. These findings suggest that share repurchases are conducted to maximize the capital gain of corporate insiders.

Another increasingly popular field of research examines the effect of performance measures, like EPS, on share repurchases. Basic EPS simply subtracts preferred dividends from net income and divides this number by the weighted average of common shares outstanding. Dilutive EPS additionally takes all convertible securities in consideration. Common forms of convertible securities are stock options, convertible preferred stock and convertible bonds. Bens, Nagar, Skinner, and Wong (2003) find that managers repurchase shares to mitigate the dilutive effect of employee stock options on diluted EPS and to manipulate the EPS growth rate upwards. Hribar, Jenkins & Johnson (2006) confirm the importance of EPS as a motive for repurchases from another angle by documenting that firms are much more likely to repurchase shares when they would marginally miss the analyst EPS forecast. Other studies also report how management benefits from these repurchases by documenting that firms are more likely to repurchase shares when the CEO's bonus is tied to an EPS target (Young & Yang, 2011; Cheng, Harford & Zhang, 2015). Contrarily to previous work on market timing, Cheng, Harford, and Zhang (2015) additionally find that EPS-bonus driven repurchases do not exhibit positive long turn abnormal returns, which suggests the manipulative nature of these repurchases. Almeida, Fos, and Kronlund (2016) confirm earlier findings analyst EPS that firms are more likely to repurchase shares if they would barely miss the analyst EPS forecast. Furthermore, they extend previous findings by documenting the eagerness of firms to meet financial reporting targets is associated with reductions in cash holdings, investments, and employment. Overall, these results provide ample evidence that management's incentives to repurchase shares may have shifted from the signalling undervaluation and the distribution of excessive cash towards more manipulative and self-interested motivations over time.

[1]Source: "Nasdaq vs NYSE: Top 7 Differences Traders Should Know" by DAILYFX, obtained from: https://www.dailyfx.com/nas-100/NASDAQ-vs-NYSE.html

[2]Definition blue chip by Investopedia: A nationally recognized, well-established, and financially sound company. Blue chips generally sell high-quality, widely accepted products and services, obtained from: https://www.investopedia.com/terms/b/bluechip.asp

2.4 Hypothesis Development

In this section, I describe how the findings of relevant literature on share repurchases lead to the development of the hypotheses in my research. Evaluating these hypotheses will aid me to compose a well-founded answer to the main research question of this paper.

Several studies find that managers intentionally manipulate stock prices for the benefit of corporate insiders, employees, and to meet analyst EPS forecasts at the expense of outside shareholders and real long term investment decisions (Kahle, 2002, Bonaimé & Ryngaert, 2013; Almeida, Fos, and Kronlund, 2016). Busch and Obernberger (2016) argue that firms reduce the information content of stock prices when they manipulate stock prices, because this deliberately increases the stock price above its intrinsic value. Analogous to the benchmark paper and based on the corresponding literature, I postulate the following hypothesis:

H1: Share repurchases decrease the information content of stock prices by increasing the stock price above its intrinsic value

As addressed in the introduction, information content is defined as the amount of information that reflected into the stock price and price efficiency as the proportion to which all public information is incorporated into the stock price. The information content is represented by the amount of firm-specific risk incorporated into the stock price. Following the benchmark paper, I assume that increasing the stock price above its intrinsic value decreases the price efficiency and reduces the firm-specific risk of a stock.

Contrarily to the findings of the academic literature in line with the management incentive argument, Busch and Obernberger (2016) find no evidence that open market share repurchases manipulate stock prices. In the benchmark paper, they argue that share repurchases can only incorporate positive news into the stock price as firms engage from the buyside of the market. They reason that firms can improve stock price efficiency by placing a market order or a limit order. A market order is a request of the firm to buy back its shares at the best available current market price and is considered the fastest way to enter a position in a trade. Therefore, this channel of repurchasing shares allows the firm to directly incorporate the new positive information. A limit order is a request of the firm to buy back its shares, while specifying the maximum price the firm is willing to pay to repurchase its stock. By setting the maximum price they are willing to repurchase shares for, the firm reveals to their investors what they perceive to be the lower bound of their stock price. A limit order is not as fast as market order in taking a position in a trade depending on the liquidity of the stock but does offer the firm more control of the transaction.

[1]Source: "Nasdaq vs NYSE: Top 7 Differences Traders Should Know" by DAILYFX, obtained from: https://www.dailyfx.com/nas-100/NASDAQ-vs-NYSE.html

[2]Definition blue chip by Investopedia: A nationally recognized, well-established, and financially sound company. Blue chips generally sell high-quality, widely accepted products and services, obtained from: https://www.investopedia.com/terms/b/bluechip.asp

As proposed by the benchmark paper, I deduce the following hypothesis:

H2: Share repurchases increase the speed and precision by which public news is reflected into the stock price

These alternative hypotheses (H1 and H2) form the basis of my research as they describe the main effect of share repurchases on the efficiency of stock prices.

The benchmark paper argues that there are two distinct ways share repurchases can improve the stock price efficiency of firm's stock. The first channel postulates that share repurchases increase the speed with which positive market news is reflected into the stock price by placing a market order. Busch and Obernberger (2016) base their argument on the notion that the efficiency of stock prices is lower for firms that are neglected by investors or less observable in the market (Hou & Moskowitz, 2005). The positive information incorporation argument in the benchmark paper assumes that firms repurchase shares to incorporate new positive public information into the stock. According to this argument, I should observe increases in stock price efficiency during quarters containing positive market news. Busch and Obernberger (2016) initially find weak evidence in favor of the positive information incorporation argument. They refute the evidence by analysing the impact of share repurchases on stock return moment distributions in up and down markets.

The second channel proposes that share repurchases will improve stock price efficiency when firms provide price support at the intrinsic value of its stock according to the benchmark paper. The price support notion supposes that negative market news is incorporated more accurately into the stock price if firms set a lower bound at the intrinsic value of their stock by repurchasing shares. This argument is based on the notion that firms with adequate capital can prevent stock prices from overreacting to negative market news by repurchasing shares and thus reduce the short-term variance of their stock (Hong, Wang & Yu, 2008). In line with the price support argument, the existing literature appointing undervaluation as a motive for share repurchases is rich. Several studies on the motives for share repurchases and managerial timing ability of repurchases provide evidence in line with the undervaluation argument (Stephens & Weisbach, 1998; Cook, Krigman, Leach, 2003b; Bozanic, 2010; De Cesari, Espenlaub, Khurshed & Simkovic, 2012; Ben-Rephael, Oded & Wohl, 2014). Other papers have found that announcements of repurchase programs are followed by abnormal price increases and long-term abnormal returns (Vermaelen, 1981; Comment & Jarrell, 1991; Ikenberry, Lakonishok & Vermaelen, 1995; Chan, Ikenberry & Lee, 2007). These results may indirectly imply that firms initiate repurchase programs when management perceives their stock to be undervalued. The evidence in the benchmark paper that firms prevent stock prices from dropping below their

[1]Source: "Nasdaq vs NYSE: Top 7 Differences Traders Should Know" by DAILYFX, obtained from: https://www.dailyfx.com/nas-100/NASDAQ-vs-NYSE.html

[2]Definition blue chip by Investopedia: A nationally recognized, well-established, and financially sound company. Blue chips generally sell high-quality, widely accepted products and services, obtained from: https://www.investopedia.com/terms/b/bluechip.asp

intrinsic value provides strong support for the price support argument. Consequently, share repurchases improve stock price efficiency and increase the information content during periods containing negative market news. As proposed by benchmark paper and based on the discussed literature, I formulate the following hypotheses:

H3(a): Share repurchases increase the speed with which positive market news is incorporated into the stock price

H3(b): Share repurchases increase the precision with which negative market news is incorporated into the stock price

These hypotheses are mutually exclusive for a specific firm in a particular period, but each hypothesis could still hold for the same firm during a different period.

I extend the benchmark paper by splitting the impact of share repurchases on the efficiency and information content of stock prices for two major stock exchanges in the US, the NYSE and the NASDAQ. I use the same research design as in the rest of my empirical analysis, but I allow for the interaction of the proxies for repurchase activity and the controls with variables indicating the exchange listing of the firm. To the best of my knowledge, no academic research has compared the impact of share repurchases on the efficiency of stock prices for firms listed on the NYSE relative to firms listed on the NASDAQ. The NYSE and the NASDAQ are the largest exchanges in the world, but there are some key differences between both exchanges that might impact the influence of share repurchases on the efficiency of stock prices[1]. The stocks of firms trading on the NASDAQ are perceived to be more volatile than stocks trading on the NYSE. This is in line with the notion that the NYSE mainly contains blue chip and industrial firms, which are considered more mature and stable in times of adversity[2]. The firms listed on the NASDAQ are primarily considered high tech firms, which are perceived to have more growth potential in general. This is in accordance with the notion that NYSE firms usually have a higher market capitalization. Moreover, the daily trading volume is mainly higher for firms listed on the NASDAQ. Further, there are some differences in listing requirements and exchange costs. The maximum entree fee and yearly fee for firms on the NYSE is considerably higher than for firms on the NASDAQ, which corresponds with the notion that the NYSE contains more mature and bigger firms. Firms listed on the NYSE must have a minimum 1,100,000 shares outstanding owned by at least 400 shareholders and with a minimum share price of $4. Contrarily, firms listed on the NASDAQ are required to minimally have 1,250,000 shares outstanding with at least three dealers for its stocks. Although the cross-sectional differences not captured by the control variables are picked up by the firm fixed

[1]Source: "Nasdaq vs NYSE: Top 7 Differences Traders Should Know" by DAILYFX, obtained from: https://www.dailyfx.com/nas-100/NASDAQ-vs-NYSE.html

[2]Definition blue chip by Investopedia: A nationally recognized, well-established, and financially sound company. Blue chips generally sell high-quality, widely accepted products and services, obtained from: https://www.investopedia.com/terms/b/bluechip.asp

effects, the control variables might be more representative in a regression model that specifies the controls per exchange.

Cook, Krigman and Leach (2003b) investigate the market timing of open market share repurchases for firms listed on the NYSE and NASDAQ. They find that the larger NYSE-listed firms repurchase shares at a lower cost than the generally smaller NASDAQ-listed firms. Further, Cook, Krigman and Leach (2003b) report that primarily firms on the NYSE provide price support by placing limit orders after the stock price has dropped below its intrinsic value, while substantially less open market share repurchases are executed by the use of limit orders on the NASDAQ. If managers are able to time the market, they systematically buy back shares at a price below the average quarterly stock price. Therefore, repurchasing shares will drive stock prices to their intrinsic value. This is consistent with the price support argument from Busch and Obernberger (2016), although they address that the price support argument does not directly imply managerial timing ability. The benchmark paper finds that share repurchases mainly increase the efficiency and information content of stock prices by providing price support at the intrinsic value. Based on the findings of Busch and Obernberger (2016) and Cook, Krigman, and Leach (2003b), I expect that share repurchases by NYSE-listed firms increase the efficiency of stock prices more than NASDAQ-listed firms. Furthermore, Cook, Krigman and Leach (2003b) find that contemporaneous stock returns, lagged stock returns and trading volume influence the daily repurchase volume on the NYSE, while the daily repurchase volume on the NASDAQ is unrelated to contemporaneous and lagged stock returns. The discrepancy between the determinants of repurchase volume on each exchange provides another reason to expect different results on the impact of repurchases on the efficiency of stock repurchases for both exchanges. Moreover, they document that share repurchases on the NASDAQ substantially improve the stock's liquidity relative to the period before the announcement of the repurchase announcement.

Other studies find that the trading costs are substantially higher for NASDAQ-listed firms listed than NYSE-listed firms, which could influence the way firms execute their repurchase programs (Huang & Stoll, 1996; Bessembinder & Kaufman, 1997). A more recent paper reports that trading costs of the NASDAQ remain higher even after a mandatory reform by the SEC on the order-handling at the NASDAQ (Bessembinder, 1999). Another study finds that the NYSE provides low trading costs for small stocks with a low daily trading volume, while the NASDAQ offers low trading costs for large stocks with a high daily trading volume (Chung, Van Ness & Van Ness, 2004). Even though the higher trading costs for NASDAQ-listed firms probably have a small impact on the influence of repurchases on the efficiency of stock prices, this does provide an additional motive to expect a bigger effect on price efficiency of stocks for NYSE-listed firms. In accordance with this reasoning, I postulate the following hypotheses:

H4(a): Share repurchases by NYSE-listed firms increase the price efficiency of stocks more than repurchases by NASDAQ-listed firms

H4(b): Share repurchases by NYSE-listed firms reduce the firm-specific risk of stock prices more than repurchases by NASDAQ-listed firms

The hypotheses, both considering a different component of the efficiency of stock prices, allow me to separately tests for differences in these components of price efficiency for both exchanges.

The academic literature provides evidence that the performance measure EPS influence the decision of managers to repurchase shares. EPS measures a firm’s profitability by dividing its earnings by the weighted average of common shares outstanding for a given quarter. The quarterly earnings of a firm are computed by subtracting the preferred dividends from the net income in the corresponding quarter. EPS is increasingly scrutinized by the business press, because this measure can easily be manipulated by managers[1]. For instance, firms can strategically repurchase shares to decrease their number of common shares outstanding, which artificially increases EPS due to construction of the performance measure. Several academic studies document that managers are more likely to conduct share repurchases when the bonus in the executive compensation contract is linked to an EPS target and therefore maximize their own wealth through repurchases (Young & Yang, 2011; Cheng, Harford & Zhang, 2015). Hribar, Jenkins & Johnson (2006) provide evidence that the probability of share repurchases is higher when firms are about to miss the analyst EPS forecast, while Almeida, Fos, and Kronlund (2016) additionally report that firms are willing to trade off investments, employment and cash holdings to meet their forecast. These results imply that managers repurchase shares for their own personal benefit instead of in the best interest of the shareholders and the firm. Therefore, I expect that analyst EPS forecast motivated share repurchases have a detrimental effect on the efficiency of stock prices and I develop the following hypothesis:

H5: Analyst EPS forecast-driven share repurchases reduce the efficiency and information content of stock prices.

By applying the benchmark’s novel research design in the context of analyst EPS forecast driven repurchases I aim to shed new light on the potentially detrimental effects of repurchases.

[1]For instance, “The Limitations of Earnings Per Share” by Morningstar, obtained from: http://www.morningstar.co.uk/uk/news/105269/the-limitations-of-earnings-per-share.aspx and “The repurchase revolution; Share buy-backs” by The Economist, obtained from: https://search.proquest.com/docview/1561998745/5B77708A25004D5EPQ/3?accountid=13598

3 Data

In this section, I describe data collection and the required transformations to obtain an empirically workable dataset.

3.1 Sample construction

The dataset was compiled and manipulated in accordance with the methods used in the benchmark paper with several adjustments made in the collection and manipulation process. Publicly traded firms in the US are obliged to report details on their repurchase activity on a quarterly basis as of 2004 due to new disclosure requirements. Hence, monthly stock data from CRSP from January 2004 till December 2018 form the master file. I transform the monthly stock data to quarterly data, since I examine share repurchases on a quarterly basis. This initially results in a master file with 15,106 firms and 456,457 firm-quarters over the entire sample period. My baseline data consists CRSP monthly stock data, Compustat quarterly fundamental data, Compustat annual fundamental data, CRSP daily stock data and IBES analyst data. Firm-quarters with missing baseline data were dropped. Table A1 in the Appendix provides an overview of the number of firms and firm-quarters after each merge.

Initially, I obtain all share types trading on every exchange in the US from CRSP. This results in a dataset consisting of 15,106 firms and 1,353,575 firm-months. Transforming the monthly stock data to the quarterly stock data converts the firm-months into 456,457 firm-quarters. Subsequently, I merge the Compustat quarterly fundamental data to the master file after dropping all firms without at least one repurchase-quarter over the entire research period. Besides the quarterly firm fundamentals, this dataset contains the repurchase activity data. Banyi, Dyl and Kahle (2008) justify my use of Compustat's quarterly purchases of common stock as a proxy of open market repurchases, since they report that this is the most accurate estimate of actual repurchases. A closer inspection of Compustat's average repurchase price and the quarterly average of CRSP's daily stock price indicates that CRSP's quarterly average of the daily stock price contains less outliers and missing values for my dataset. Therefore, I decide to use CRSP's quarterly average repurchase price to compute the quarterly repurchase volume as this variable allows me to preserve more firm-quarters. Besides, my research does not examine the market timing of actual repurchases, so it will be off little influence for the results. Next, I merged the Compustat annual fundamental data and the CRSP daily stock data to the master file respectively. The CRSP daily stock data was transformed to quarterly data before the merger. A careful examination of the quarterly sum of CRSP's daily trading volume and Compustat's quarterly common shares traded pointed out that the quarterly sum of CRSP's daily trading volume contained more outliers. I check these outliers by comparing these values to the corresponding common shares outstanding and by looking at values in surrounding quarters per firm. Based on the analysis, I choose to use Compustat's quarterly common shares traded and I supplement missing values with the quarterly sum of CRSP's daily trading volume. Subsequently, I merge the IBES analyst data to the master file after transforming the monthly analyst data to quarterly data. Hereafter, I drop all firms without at least one firm-quarter of analyst data and zero analysts were assumed for firm-quarters with missing analyst data. Finally, I merge Compustat short interest data, Thomson Reuters Institutional Holdings data, Thomson Reuters Institutional Filings, ThomsonOne target and acquiror data, and IBES analyst EPS forecast data to the baseline dataset. Eventually, this results in a final dataset consisting of 2,756 firms and 120,406 firm-quarters as reported in Table A1 in the Appendix.

I use ThomsonOne data to indicate whether a firm is a target of acquiror in a merger or acquisition during my sample period. Deals are included in the sample if they meet the following criteria. First, the deal status is completed, intended, pending or partially completed. Second, the deal type is a disclosed or an undisclosed transaction for a majority stake, leveraged buyout, tender offer, transaction for a minority stake or an acquisition of remaining interest. I use the quarterly actual reported EPS figures in IBES instead of Compustat's quarterly EPS for my EPS analysis, since the actual EPS in IBES corresponds better with the average analyst EPS forecast from IBES. Various studies document that Compustat updates quarterly earnings figures to reflect restated values and uses the GAAP accounting principles, while most analysts use "street" measures of earnings (Livnat & Mendenhall, 2006; Abarbanell & Lehavy, 2003). Contrarily to the benchmark paper, I use the CRSP daily closing bid and ask prices instead of TAQ intraday stock data to compute the relative spread due to database license restrictions.

I drop firm-quarters with higher values for common shares repurchased than common shares traded in a certain quarter as these appear to be errors in the repurchase data. Furthermore, I exclude all firms listed on different exchanges than the NYSE and NASDAQ, since these alternative exchanges were too thinly represented in my sample to conduct a meaningful analysis for these exchanges. In accordance with the benchmark paper, I drop all share types other than ordinary shares. Using quarterly repurchases of common stock as a proxy for actual repurchases, I assume that firms with less than 5 repurchase-quarters over the entire research period do not accurately represent firms with an active open market repurchase program. If this would primarily concern firms at the end of my research period, this may impair my results as mainly exclude firms that recently initiated a repurchase program. However, closer inspection of this concern reveals this is not the case, so I drop these firms from my sample. Finally, I exclude all firm-quarters in 2003, since this year has solely been included to prevent the loss of firm-quarters due to the creation of lagged variables.

4 Methodology

In this section, I describe the employed empirical analysis used to obtain the results to answer my main research question. In the baseline analysis, I regress a measure of price efficiency or firm-specific risk on lagged repurchase intensity and a set of control variables in accordance with the benchmark paper. I do not use the two instrumental variables proposed by Hillert, Maug, and Obernberger (2016) to predict exogenous repurchase intensity or the predetermined remaining volume as proxies for repurchase activity. The availability and quality of the repurchase data required for these methods is insufficient for the data sources I have at my disposal.

4.1 Price efficiency and firm-specific risk

Following the research design of the benchmark paper, I regress a measure of price efficiency or information content on lagged repurchase intensity and a set of control variables. The ordinary least squares (OLS) regressions in my baseline analysis generally use the following equations:

$$Price\ Eff_{i,t} = \alpha + \delta Price\ Eff_{i,t-1} + \beta Rep_{i,t-1} + \sum_{l=1}^{l=k} y_l\, Control_{i,l,t} + \mu_i + \eta_t + u_{i,t} \tag{1}$$

$$Firm\text{-Specific}_{i,t} = \delta Firm\text{-Specific}_{i,t-1} + \beta Rep_{i,t-1} + \sum_{l=1}^{l=k} y_l\, Control_{i,l,t} + \mu_i \tag{2}$$

Where *Price Eff* represents a measure of price efficiency, delay or coefficient-based delay, and *Firm-specific* denotes a measure of firm-specific risk, R-squared or absolute market correlation. $Rep_{i,t-1}$ stands for lagged repurchase intensity and *Control* refers to a set of control variables. Furthermore, μ_i and η_i denote a time-invariant firm fixed effect and a quarter fixed effect respectively.

Busch and Obernberger (2016) address potential reverse causality and endogeneity concerns with respect to repurchase intensity. Repurchase intensity is supposed to measure a firm's buyback activity of their stock. However, if a firm provides price support to prevent a mispricing of their stock, contemporaneous repurchase intensity may be endogenously affected by the unnoticed initial degree of mispricing of the stock. Therefore, contemporaneous repurchase intensity will not accurately represent a buyback activity on the stock market. They provide three solutions to circumvent these potential endogeneity and reverse causality concerns in the benchmark paper. Firstly, Busch and Obernberger (2016) propose to estimate exogenous repurchase intensity with a generalized method of moments (GMM) regression using two instruments suggested by Hillert, Maug, and Obernberger (2016). The proposed instruments are announced program size and program quarter. Program size specifies how many shares can maximally be repurchased under a certain repurchase program and program quarter denotes the difference between the current quarter and the initiation quarter of a specific repurchase program. Secondly, they suggest using the predetermined remaining volume as a proxy for repurchase intensity, because this variable is less likely to be affected by reversed causality due to its more exogenous nature. Remaining volume uses the size of a repurchase program to compute the remaining volume that can be repurchased at the beginning of each quarter. However, I do not possess qualitative data on repurchase programs due to limitations in the data sources at my disposal. Therefore, I am not able construct an empirically workable data sample containing variables as program size, program quarter and remaining volume, which are required to implement these methods.

Thirdly, they propose to circumvent potential reverse causality concerns by lagging repurchase intensity by one period. I proxy repurchase activity with lagged repurchase intensity in all the specifications throughout my empirical analysis due to previously addressed limitations with regard to the two alternative methods. Therefore, I should be cautious for reverse causality driving my results, but I expect that a thorough comparison between my results and those in the benchmark paper in combination with several robustness checks can reasonably abate these concerns. Analogous to the benchmark paper, I incorporate firm fixed effects and time fixed effects to prevent the results from being affected by undetected heterogeneity in the cross-section and undetected macroeconomic factors. Finally, I include lagged dependent variables to account for decision-making dependent on the current level of the respective dependent variable.

4.2 Price delay measures

In line with the benchmark paper, I estimate price efficiency by using two alternative measures of delay proposed by Hou and Moskowitz (2005). The delay measures estimate the speed and precision by which new information is incorporated into the stock price. Using daily stock and market returns, I regress a basic market model and an extended market model including up to five lags of market returns (Boehmer & Wu, 2012; Phillips, 2011). I define market return as a value-weighted market portfolio (including distributions). The basic market model and extended market model are presented by equation (3) and (4), respectively:

$$r_{i,t} = \alpha_i + \beta_i^0 r_{m,t} + \varepsilon_{i,t} \tag{3}$$

$$r_{i,t} = a_i + \beta_i^0 r_{m,t} + \sum_{n=1}^{5} \beta_i^n \, r_{m,t-n} + \varepsilon_{i,t} \tag{4}$$

Where $r_{i,t}$ represents the return of firm i on day t, $r_{m,t}$ reflects the market return on day t and $r_{m,t-n}$ denotes the market return n days preceding day t. The intuition behind both models in this setting is as follows: if all new market news was directly reflected into a firm's share price, β_i^0 would be converging to one and β_i^n would be converging to zero. Contrarily, if the incorporation of new market news into a firm's stock price is delayed, β_i^n will be different from zero and β_i^0 will converge to zero instead depending on the degree of delay. Slower incorporation of new information into the stock price will results in a higher explanatory power of the extended market model relative to the basic market model and thus a higher R-squared.

Analogous to Hou and Moskowitz (2005), the first delay measure compares the explanatory power, which is represented by R-squared, of the basic market model to the extended market model:

$$Delay = 1 - \frac{R^2_{basic}}{R^2_{extended}} \tag{5}$$

The faster new market news is reflected into a firm's stock price, the lower the explanatory power of the extended market model will be. According to the equation above, this will lead to a lower delay measure indicating a higher degree of price efficiency.

The second delay measure uses the absolute coefficients of both market models scaled by their corresponding standard errors. More specifically, this delay measure is the lag-weighted sum of the scaled absolute coefficients of the lagged market returns relative to the sum of all scaled coefficients:

$$Coefficient\text{-}based\ delay = \frac{\sum_{n=1}^{5} n \times \frac{abs(\beta_i^n)}{se(\beta_i^n)}}{\frac{abs(\beta_i^0)}{se(\beta_i^0)} + \sum_{n=1}^{5} \frac{abs(\beta_i^n)}{se(\beta_i^n)}} \tag{6}$$

Where β_i^0 denotes the coefficient of the market return and β_i^n represents for the coefficient of the corresponding lagged market return according to the extended market model in equation (3). The abbreviations abs and se stand for absolute value and standard error, respectively. The interpretation of coefficient-based delay is similar to the first delay measure, higher coefficient-based delay indicates higher stock price efficiency.

4.3 Firm-specific risk measures

I estimate the degree of firm-specific risk of a firm's stock by determining the correlated movement of the firm's stock returns and the market return. Analogous to Bris, Goetzmann, and Zhu (2007) and Morck, Yeung, and Yu (2000), I measure firm-specific risk with the R-squared of the basic market model (equation 3) and the absolute market correlation between stock and market returns. A higher R-squared and absolute market correlation of a firm's stock indicate lower firm-specific risk and therefore higher information content of a stock.

4.4 Liquidity and EPS measures

Busch and Obernberger (2016) use intraday transaction data from the NYSE TAQ database to estimate the relative spread. Due to license restrictions regarding the NYSE TAQ database, I use the CRSP daily closing bid and ask prices proportionate to the quote midpoint price to compute the relative spread:

$$Relative\ Spread = \frac{ask - bid}{(ask + bid)/2} \quad (7)$$

More liquid stocks have a higher daily trading volume than illiquid stocks. Generally, this increased buy and sell side interaction for a stock results in converging bid and ask prices. Therefore, the relative spread is negatively related to the liquidity of a stock.

I extend the benchmark paper by examining the potentially detrimental impact of share repurchases on price efficiency and firm-specific risk for firms that slightly beat their average analyst EPS forecast in a repurchase-quarter (section 5.6). Based on research of Hribar, Jenkins, and Johnson (2006) and Almeida, Fos, and Kronlund (2016), I compute a variable that measures the difference between the quarterly average analyst EPS forecast and the corresponding actual reported EPS. Subsequently, I create a dummy variable that identifies firms, whose actual reported EPS beats the average analyst EPS forecast by 0.05 or less in a certain quarter, while they contemporaneously repurchase shares. The threshold of 0.05 is the median difference by which firms beat the average analyst EPS forecast with conditional that the firm beats the EPS forecast. The variable measuring the difference between the analyst EPS forecast and the actual EPS is called 'EPS forecast difference' and the previously described dummy is named 'EPS slightly beats forecast'. An EPS forecast difference of zero is assumed for firm-quarters with missing values if firms have at least one firm-quarter of EPS data.

4.5 Descriptive statistics

The descriptive statistics for all variables used in my empirical analysis are provided in Table 1 and Table A2 in the Appendix reports the definitions of all these variables. The sample contains 120,406 firm quarters of which 62,131 quarters contain repurchase activity, so around half of the firm quarters in my sample contain repurchase activity. This is relatively high compared to the benchmark paper, since approximately a quarter of their firm months contain repurchase activity. If only one month in a quarter contains repurchase activity, the firm-quarter is identified as a repurchase quarter. This difference in research design might explain the higher rate of repurchase quarters to firm quarters in my sample. My descriptive statistics seem reasonable and fairly in line with the benchmark paper except for some minor differences.

The two delay measures, delay and coefficient-based delay range from 0 to 1 and 0.09 to 3.67 respectively. The mean and median of both delay measures are slightly lower than the mean and median in the benchmark paper, which I expected to due to the research design on a quarterly basis. I suppose that computing delay on a quarterly instead of monthly basis slightly averages down the delay as delay is computed over a longer period. Additionally, I expect that the higher proportion of repurchase quarters in my sample relative to the benchmark paper results in lower mean and median delay, since I assume that share repurchases decrease delay. The median of the delay measures is somewhat lower than the mean, which indicates this variable is lightly skewed to the left. Both firm-specific risk measures, R-squared and absolute market correlation, are defined between 0 and 1 and have similar means and medians.

For a total of 62,131 repurchase quarters the average repurchase volume amounts 111.2 million, which corresponds to buying back 1.06% of the common shares outstanding or 3.20% of the quarterly trading volume. The median repurchase volume of 6.5 million is the equivalent of buying back 0.51% of common shares outstanding and 1.33% of the trading volume in a quarter. The higher mean and median repurchase intensity relative to the benchmark paper are in line with my expectations, since the quarterly amount of shares repurchases is generally higher than the monthly equivalent. Scaling the number of shares repurchased by common shares outstanding instead of total shares outstanding might also result in a slightly higher repurchase intensity. The mean and median repurchase intensity (TV) are fairly low compared to the corresponding mean and median in the benchmark paper. This is in line with my expectations, since the quarterly number of shares repurchased does not necessarily need to be higher than the monthly number of shares repurchased, while the quarterly trading volume usually is higher than the monthly equivalent.

Table 1: Descriptive statistics

	Mean	Median	SD	SD(within)	1st Perc.	99th Perc.	N
Dependent variables							
Delay	0.308	0.208	0.274	0.214	0.013	0.997	120,406
Coefficient-based delay	1.563	1.507	0.577	0.477	0.460	2.992	120,406
R-squared	25.87%	23.07%	19.34%	15.46%	0.02%	75.80%	120,406
|Market correlation|	0.462	0.480	0.214	0.163	0.015	0.871	120,406
Repurchase Measures							
Repurchase volume (mill.)	57.4	0.0	360.0	275.3	0.0	1132.8	120,406
Repurchase intensity	0.55%	0.00%	1.38%	1.29%	0.00%	5.94%	120,406
Repurchase intensity (TV)	1.65%	0.00%	4.69%	4.26%	0.00%	21.30%	120,406
Repurchase measures in repurchase quarters							
Repurchase volume (mill.)	111.2	6.5	495.1	332.8	0.0	1834.9	62,131
Repurchase intensity	1.06%	0.51%	1.77%	1.59%	0.00%	7.76%	62,131
Repurchase intensity (TV)	3.20%	1.33%	6.14%	4.90%	0.00%	30.70%	62,131
Control variables							
Acquiror dummy	0.162	0	0.369	0.329	0	1	120,406
Analysts	22.934	16	23.083	9.700	0	94	120,406
Book to market	0.566	0.481	0.439	0.290	-0.295	2.415	120,406
Cash to assets	15.5%	8.4%	17.6%	7.9%	0.1%	75.8%	120,406
Change in short interest	0.2%	0.0%	4.4%	4.4%	-15.1%	17.3%	116,250
Deviation price from 30$	23.8	16.5	53.1	32.8	0.3	168.5	120,406
Dividends to assets	1.3%	0.2%	2.5%	1.6%	0.0%	15.3%	120,406
EBITDA to assets	0.028	0.027	0.033	0.023	-0.075	0.123	120,406
Institutional ownership	72.5%	79.9%	26.5%	13.6%	1.8%	100.0%	120,406
Leverage	0.424	0.370	0.274	0.099	0.025	0.959	120,406
Market cap (mill.)	7,437.6	1,110.5	29,298.3	13,683.1	21.2	129,941.9	120,406
Net insider trading	-0.17%	0.00%	0.79%	0.75%	-4.78%	0.88%	115,046
Options exercised	0.08%	0.00%	0.20%	0.19%	0.00%	1.26%	120,406
Options outstanding	5.19%	3.60%	5.57%	3.49%	0.00%	25.39%	120,406
Relative spread	0.41%	0.11%	1.06%	0.73%	0.01%	5.06%	120,406
Return	0.010	0.010	0.072	0.072	-0.182	0.209	120,406
Target dummy	0.010	0	0.101	0.097	0	1	120,406
Total assets (mill.)	13,236.2	1,457.8	93,648.9	24,346.4	26.1	182,075.0	120,406
Trading volume	0.526	0.403	0.464	0.296	0.020	2.547	120,406
Volatility	0.025	0.021	0.016	0.014	0.008	0.086	120,406

This table contains descriptive statistics for dependent variables, repurchase variables and control variables for firms that repurchases share on the open market between 2004-2018. Furthermore, the table gives information on the repurchase variables in repurchase quarters and of all quarters in the sample period. The mean, median, standard deviation (SD), within-firm standard deviation (SD within), the 1st percentile, the 99th percentile, and the number of observations is presented for each variable. The within-firm standard deviation is determined with a regression of the relevant variable on firm fixed effects.

The descriptive statistics for the control variables are in line with those of the existing literature and benchmark paper. However, my sample represents firms with a higher market capitalization and total assets than those of the benchmark paper according to my descriptive statistics. This may be the result of the loss of small firms due to differences in sample construction. The mean and median of trading volume are higher by almost a factor of three, which corresponds to the fact that a quarter consists out of three months. Yet, the value of 99th percentile is substantially higher than the corresponding value in the benchmark paper. I reduce the impact of potentially spurious outliers by transforming the extreme values for several control variables. Hence, I winsorize book to market, change in short interest, dividends to assets, EBITDA to assets, net insider trading, options exercised, options outstanding, and trading volume at one percent at the left tail, right tail, or both tails depending on the distribution of the extreme values for the respective variable. Finally, I transform institutional ownership by limiting the maximal ratio to 100%, since a higher stake in a firm is impossible.

5 Empirical analysis

In this section, I begin my analysis by examining the determinants of repurchase intensity. Subsequently, I will test my hypotheses by analysing the impact of share repurchases on price efficiency and firm-specific risk. Next, I use the same research design to inspect the influence of share repurchases in up-markets and down-markets. I extend the benchmark paper by also conducting the aforementioned analysis using a research design that allows me to compare the results for two major US exchanges, NYSE and NASDAQ. For convenience purposes I will refer to the specifications that splits the effects of repurchase intensity and the control variables for both exchanges as the exchange models or specifications throughout my analysis (model 2 and 4 if applicable). Finally, I try to identify potentially detrimental repurchases by focussing on several subsets of repurchases proposed by the existing literature.

5.1 Examination of determinants of share repurchases

In this section, I examine if lagged repurchase intensity is an adequate proxy for contemporaneous repurchase intensity. Moreover, I assess drivers of actual share repurchases. Table 2 presents the results of repurchase intensity regressed on a set of control variables.

In model (3), I include lagged repurchase intensity to determine its suitability as a proxy for contemporaneous repurchase intensity. As addressed in the benchmark paper, a noisy proxy of repurchase activity would bias the coefficient estimate towards zero and therefore complicate the determination of significant relationships. The coefficient of lagged repurchase intensity is 0.18 and strongly significant with t-value of 15.75. This indicates that lagged repurchase intensity is highly economically significant, since the firm fixed effects capture the average effect of repurchase intensity already.

Table 2: Examination of determinants of repurchase activity

Dependent variable:	Repurchase intensity					
Exchange:		NYSE	NASDAQ		NYSE	NASDAQ
Model:	(1)	(2)	(2)	(3)	(4)	(4)
Repurchase intensity$_{t-1}$				0.1762***	0.1784***	0.1726***
				(15.75)	(12.77)	(10.02)
Options exercised$_t$	-0.0075	0.1163**	-0.0759**	-0.0214	0.0905*	-0.0845***
	(-0.28)	(2.31)	(-2.35)	(-0.80)	(1.82)	(-2.65)
Net insider trading$_t$	-0.0760***	-0.0703***	-0.0820***	-0.0801***	-0.0722***	-0.0874***
	(-5.64)	(-4.31)	(-4.00)	(-6.02)	(-4.46)	(-4.34)
Options outstanding$_t$	0.0094***	0.0101***	0.0093***	0.0079***	0.0080***	0.0082***
	(4.49)	(2.89)	(3.90)	(4.41)	(2.72)	(3.96)
Return$_{t-1}$ > 0 t-1	-0.0093***	-0.0089***	-0.0093***	-0.0077***	-0.0072***	-0.0079***
	(-10.69)	(-6.43)	(-8.63)	(-9.33)	(-5.49)	(-7.61)
Return$_{t-1}$ < 0 t-1	-0.0002	-0.0009	-0.0002	-0.0006	-0.0012	-0.0006
	(-0.12)	(-0.47)	(-0.15)	(-0.46)	(-0.64)	(-0.40)
Book to market$_{t-1}$	0.0018***	0.0022***	0.0015***	0.0016***	0.0021***	0.0013***
	(7.19)	(4.90)	(5.44)	(7.31)	(5.21)	(5.39)
Total assets$_{t-1}$ (ln)	0.0011***	0.0008***	0.0014***	0.0013***	0.0010***	0.0016***
	(4.89)	(3.00)	(5.45)	(6.50)	(4.26)	(6.89)
Cash to assets$_{t-1}$	0.0053***	0.0081***	0.0047***	0.0058***	0.0088***	0.0051***
	(6.30)	(5.05)	(5.08)	(7.61)	(6.13)	(6.05)
EBITDA to assets$_{t-1}$	0.0051**	0.0090**	0.0023	0.0020	0.0048	0.0001
	(2.08)	(2.10)	(0.80)	(0.94)	(1.26)	(0.03)
Dividends to assets$_{t-1}$	-0.0105***	-0.0139**	-0.0082**	-0.0098***	-0.0131***	-0.0077**
	(-3.16)	(-2.50)	(-2.06)	(-3.44)	(-2.71)	(-2.24)
Leverage$_{t-1}$	-0.0086***	-0.0102***	-0.0064***	-0.0089***	-0.0103***	-0.0071***
	(-10.04)	(-8.62)	(-5.78)	(-11.67)	(-9.68)	(-7.30)
Acquiror$_t$	-0.0007***	-0.0007***	-0.0008***	-0.0007***	-0.0006***	-0.0008***
	(-5.44)	(-3.28)	(-4.98)	(-5.61)	(-3.40)	(-5.21)
Target$_t$	-0.0018***	-0.0022**	-0.0015*	-0.0015**	-0.0017*	-0.0012
	(-2.93)	(-2.18)	(-1.88)	(-2.37)	(-1.71)	(-1.58)
Relative spread$_{t-1}$ (ln)	-0.0006***	-0.0010***	-0.0003*	-0.0003***	-0.0007***	-0.0001
	(-4.28)	(-5.29)	(-1.78)	(-2.62)	(-4.04)	(-0.41)
Constant	-0.0078***	-0.0085***		-0.0070***	-0.0075***	
	(-5.60)	(-5.99)		(-5.73)	(-6.04)	
R^2(within firm)	0.029	0.030		0.059	0.060	
Observations	115,046	115,046		114,645	114,645	
Firms	2,734	2,734		2,734	2,734	
Firm FE and quarter FE	Y	Y		Y	Y	

This table reports OLS regressions of repurchase intensity on lagged repurchase intensity, stock returns and a set of control variables. Standard errors are clustered at firm level. Table A2 in the Appendix provides the definitions of all variables. The standard errors are clustered at the firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. Please note that both model (2) and (4) are one regression model presented in two columns. Each column reports the coefficients of the corresponding variable interacted with the firms' exchange listing (NYSE or NASDAQ).

Moreover, the within-firm R-squared increases from 2.9% (model 1) to 5.9% (model 3), which reflects the increase in explanatory power after lagged repurchase intensity has been included.

The majority of the control variables are in accordance with the sign and statistical significance of those presented in the existing literature. However, the coefficient of options exercised does not come with the expected sign or statistical significance in model (1) and (3). The models examining the determinants of repurchase intensity per exchange (2 and 4) reveal the issue. Options exercised by corporate insiders on the NYSE have the expected positive impact on share repurchases, while the NASDAQ equivalent has a negative impact on share repurchases. The opposing effects of options exercised on share repurchases on the exchanges probably drive the lack of significance in the specifications excluding the exchange split (model 1 and 2). The significantly positive coefficient in both models of options exercised on share repurchases on the NYSE is in line with the results of Babenko (2009). Net insider trading and options outstanding both have a positive impact on share repurchases in all specifications, which is in accordance with earlier findings of management and employee compensation on repurchases (Fenn & Liang, 2001; Kahle, 2002; Bonaimé & Ryngaert, 2013). I do not find a relation between lagged negative returns and share repurchases, which is in contrast to the extant literature that finds that share repurchases are negatively related to prior stock returns (Bozanic, 2010; De Cesari, Espenlaub, Khurshed & Simkovic, 2012; Ben-Rephael, Oded & Wohl, 2014). However, the negative impact of lagged positive results on share repurchases in all specifications is in accordance with this literature. Congruent with the literature documenting that undervaluation is an important motive for management to conduct repurchases, book to market is positively related to share repurchases in all specifications (Comment & Jarrell, 1991; Dittmar, 2000). The significantly positive coefficient of the natural logarithm of total assets is in accordance with the findings that larger incumbent firms are more probable to conduct share repurchases (Dittmar, 2000). I find that cash to assets has a positive impact on share repurchases in all specifications, while EBITDA to assets becomes insignificant when lagged repurchase intensity is controlled for in model (3) and (4). The results on cash to assets are in line with notion that firms repurchase more shares when their cash flows increase either expectedly or unexpectedly (Stephens & Weisbach, 1998). Moreover, various other studies document that the likelihood of share repurchases increase when a firm has excess cash holdings, operating cash flows, and/or investing cash flows (Li & McNally, 2003; Oswald & Young, 2008).

Some studies argue that dividends and share repurchases are complementary, which is in line with the flexibility hypothesis (Jagannathan, Stephens and Weisbach, 2000). This theory postulates that firms repurchase stock following negative returns and increase dividends following positive returns. Dividends are linked to firms with higher and steadier operating cash flows, while share repurchases are associated with firms with incidental non-operating cash flows, asserting the flexible nature of share repurchases. However, the negative and significant coefficient of dividends to assets in all specifications is more in accordance with the dividend substitution hypothesis. This theory argues that firms have been substituting dividends for repurchases in the US over time (Grullon and Michaely, 2002; Skinner, 2008; Jiang, Kim, Lie and Yang, 2013). The negative relation between leverage and share repurchases is in line with the notion that firms use open market share repurchases to increase their debt-to-equity ratio (Dittmar, 2000; Maxwell & Stephens, 2003). Several studies find that open market share repurchases can serve as a takeover defence (Bagnoli, Gordon and Lipman, 1989; Bagwell, 1991; Sinha, 1991; Billett and Xue, 2007). In contrast with prior research, I find that being the target in a potential takeover has a negative influence on share repurchases as indicated by the target coefficient. I find it difficult to interpret this negative significant coefficient as I would have expected a different sign. However, after the inclusion of lagged repurchase intensity the target dummy drops in significance and becomes even insignificant for the coefficient of the NASDAQ interaction variable. The negative relation between the acquiror dummy and repurchases is easier to comprehend as it appears more intuitive that an acquiring firm in a potential takeover would not contemporaneously initiate a share buyback. An increasing relative spread means the bid ask quotes of a firm's stock are diverging, which indicates the stock is becoming more illiquid. The negative impact of the lagged relative spread on repurchase intensity confirms the notion that firms tend repurchase stock when liquidity is high to reduce transaction costs (Brockman, Howe and Mortal, 2008; Hillert, Maug & Obernberger, 2016). The impact of liquidity is solely present for repurchases on the NYSE when lagged repurchase intensity is included.

5.2 Share repurchases and price efficiency

In this section, I discuss the influence of share repurchases on price efficiency. Model (1) and (2) present the results on the delay measure, while model (3) and (4) report the results on the coefficient-based delay measure. Model (2) and (4) split the effects of share repurchases on delay measures per exchange, NYSE or NASDAQ.

Most of the results indicate that share repurchases reduce delay. However, I do not find that share repurchases on the NASDAQ decrease coefficient-based delay, while the NYSE equivalent is marginally significant (Model 4). Increasing repurchase intensity by one within-firm standard deviation reduces delay by 0.0023 percentage points, which coincides with 1.11% of median delay or a decrease of delay by 0.011 standard deviations[1].

[1]Computations in their respective order: 0.0023 = 0.0159 × -0.1427, where 0.0159 is the within-firm standard deviation of repurchase intensity in repurchase quarters from Table 1 and -0.1427 is the coefficient of lagged repurchase intensity in Table 4 model (1). 0.0111 = 0.0023 / 0.208, where 0.208 is median delay in Table 1. 0.011 = 0.0023 / 0.214, where 0.214 is the within-firm standard deviation of delay from Table 1.

Table 3: The impact of share repurchases on price delay

Dependent variable:	Delay			Coefficient-based delay		
Exchange:		NYSE	NASDAQ		NYSE	NASDAQ
Model:	(1)	(2)	(2)	(3)	(4)	(4)
Repurchase intensity$_{t-1}$	-0.1427***	-0.1418**	-0.1607**	-0.2226**	-0.2693*	-0.2214
	(-2.86)	(-2.16)	(-2.20)	(-2.04)	(-1.84)	(-1.40)
Delay$_{t-1}$	0.1641***	0.1534***	0.1580***			
	(33.89)	(22.62)	(27.21)			
Coefficient-based delay$_{t-1}$				0.0965***	0.0923***	0.0931***
				(26.92)	(18.36)	(20.31)
Return$_{t-1}$ > 0	-0.1106***	-0.1501***	-0.0713***	-0.1774***	-0.2680***	-0.1028**
	(-7.02)	(-7.24)	(-3.54)	(-5.22)	(-5.34)	(-2.46)
Return$_{t-1}$ < 0	-0.1547***	-0.1389***	-0.1790***	-0.2998***	-0.2389***	-0.3584***
	(-7.30)	(-4.85)	(-6.34)	(-6.38)	(-3.41)	(-6.03)
Market cap$_{t-1}$ (ln)	-0.0451***	-0.0458***	-0.0373***	-0.0902***	-0.0918***	-0.0780***
	(-16.38)	(-16.40)	(-13.06)	(-16.25)	(-16.14)	(-13.52)
Book to market$_{t-1}$	0.0111***	-0.0014	0.0227***	0.0176**	-0.0105	0.0398***
	(2.89)	(-0.27)	(4.75)	(2.31)	(-1.07)	(4.20)
Volatility$_{t-1}$ (ln)	-0.0367***	-0.0192***	-0.0537***	-0.0555***	-0.0421***	-0.0733***
	(-11.68)	(-4.71)	(-13.41)	(-8.78)	(-4.83)	(-9.28)
Analysts$_{t-1}$ (ln)	-0.0038**	-0.0002	-0.0058***	-0.0077**	0.0025	-0.0144***
	(-2.56)	(-0.13)	(-2.95)	(-2.53)	(0.60)	(-3.66)
Relative spread$_{t-1}$ (ln)	0.0380***	0.0121***	0.0633***	0.0775***	0.0417***	0.1126***
	(18.32)	(4.43)	(21.29)	(18.12)	(7.58)	(18.70)
Deviation price from 30$$_{t-1}$	0.0002***	0.0001**	0.0002***	0.0003***	0.0002**	0.0003***
	(3.62)	(2.06)	(2.67)	(4.02)	(2.21)	(3.17)
Trading volume$_{t-1}$	0.0174***	0.0200***	0.0271***	0.0312***	0.0387***	0.0471***
	(5.47)	(4.64)	(6.07)	(4.67)	(4.06)	(5.07)
Change in short interest$_{t-1}$	0.0168	0.0597***	-0.0221	0.0899***	0.1753***	0.0116
	(1.15)	(2.94)	(-1.13)	(2.80)	(3.81)	(0.27)
Institutional ownership$_{t-1}$	-0.0326***	-0.0606***	-0.0124	-0.0599***	-0.1319***	-0.0153
	(-4.36)	(-6.34)	(-1.36)	(-3.98)	(-6.44)	(-0.84)
Constant	1.3235***	1.2443***		3.6186***	3.4992***	
	(25.18)	(23.76)		(34.26)	(33.16)	
R^2(within firm)	0.195	0.199		0.173	0.175	
Observations	115,734	115,734		115,726	115,726	
Firms	2,645	2,645		2,645	2,645	
Firm FE and quarter FE	Y	Y		Y	Y	
Wald test of repurchase intensity$_{t-1}$ interacted with:						
NYSE - NASDAQ (test)		0.04			0.05	
NYSE - NASDAQ (p-value)		84.62%			82.34%	

This table reports OLS regressions of delay and coefficient-based delay on repurchase intensity and a set of control variables. Model (1) and (2) present the results for delay and model (3) and (4) provide the results for coefficient-based delay. Please note that both model (2) and (4) are one regression model presented in two columns. Each column reports the coefficients of the corresponding variable interacted with the firms' exchange listing (NYSE or NASDAQ). The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic tests for differences between the coefficients of repurchases by NYSE-listed firms and NASDAQ-listed firms in model (2) and (4). The corresponding test statistics and p-values are presented for each Wald test.

Correspondingly, increasing repurchase intensity by one within-firm standard deviation decreases coefficient-based delay by 0.0036 percentage in a similar manner. This corresponds with 0.23% of median coefficient-based delay or a reduction of coefficient-based delay by 0.007 standard deviations. These figures imply that coefficient-based delay is a slightly noisier measure of price efficiency than delay. Furthermore, the coefficients on lagged repurchase intensity for delay and coefficient-based delay are lower than the corresponding coefficients of Busch and Obernberger (2016) by a factor 4.4 and 5.5 respectively.

This indicates that lagged repurchase intensity is a relatively noisier proxy for contemporaneous repurchase intensity, which suggests that the estimation of the coefficients in my sample suffer more from attenuation bias. I expect that differences in data sources used, repurchase data, sample construction and data manipulation drive these differences. Moreover, Busch and Obernberger (2016) argue that lagged repurchase intensity might not be an accurate proxy for contemporaneous repurchase activity if firms repurchase shares sporadically over time. However, around 76% of firm-quarters containing repurchase activity are followed by a quarter in which shares are repurchased in my sample, so this is not the reason for the noisiness of my proxy for repurchase activity. The use of less noisy proxies for repurchase activity as proposed in the benchmark paper could mitigate the attenuation concerns, but limitations in the availability and quality of the required repurchase data to construct these proxies restricted me to do so for my sample. Additionally, I do not find striking differences in the specifications splitting the impact of repurchases on delay per exchange (model 2 and 4). The corresponding Wald tests at the bottom of the table confirm this finding, since the test statistics report that the coefficients of share repurchases on the NYSE and NASDAQ are not statistically different from each other in both exchange models.

Overall, my results provide evidence that share repurchases increase the speed and precision by which market news is reflected into the stock price and therefore I accept hypothesis 2. In line with the benchmark paper, this implies that stock buybacks increase the stock price efficiency and the information content of stock prices. My results are therefore not in accordance with the price manipulation argument, since this notion presumes that share repurchases decrease the efficiency of stock prices (hypothesis 1). Furthermore, I do not find any evidence that share repurchases by NYSE-listed firms reduce price delay more than NASDAQ-listed firms (hypothesis 4a). Although, I do not find a statistically significant relation between share repurchases on the NASDAQ and coefficient-based delay, there are no notable differences in sign and magnitude between the coefficients of NYSE and NASDAQ repurchases in both models (2 and 4).

Most of the control variables come with the expected sign and significance documented by the existing literature. Market capitalization has a negative impact on both delay measures in all models, which indicates that price delay decreases with the size of a firm (Phillips, 2011; Saffi & Sigurdsson, 2011). This is in line with the notion that larger and incumbent firms suffer less from investor neglect. Analogous to Busch and Obernberger (2016), I find that higher valued firms experience less stock price delay, since the coefficient of book to market is significantly positive. However, I only find this positive relation between valuation and delay for repurchases conducted on the NASDAQ (2 and 4). The coefficient of book to market for repurchases on the NYSE is statistically insignificant and even comes with the wrong sign. Volatility has a negative impact on delay in all specifications, which is congruent with earlier findings that more volatile firms incur less price delay (Busch & Obernberger, 2016). In line with other studies, I find that firms with higher analyst coverage have less price delay (Brennan & Subrahmanyam, 1995; Boehmer & Wu, 2012). However, I only find this relation between analyst coverage and price delay for firms listed on the NYSE, since the coefficients of repurchases on the NASDAQ are insignificant in both specifications (2 and 4). The statistically positive coefficients in all specifications of the relative spread indicates that more illiquid stocks have higher delay. This is in line with the notion that liquidity increases price efficiency by stimulating arbitrage activity (Chordia, Roll & Subrahmanyam, 2008; Chung & Hrazdil, 2010).

Further, I find that the corresponding coefficients of the relative spread for firms listed on the NASDAQ are around twice as large as the NYSE equivalents, indicating that the impact of liquidity on delay is larger on the NASDAQ. Similar to Busch and Obernberger (2016), I find that trading volume has a positive impact on delay in all models, while a negative relation as observed by Boehmer and Wu (2012) was expected. In Panel A of Table 3 in the Appendix, I reveal that trading volume actually has the expected negative relation with delay, but switches sign when I control for other liquidity measures. My results on change in short interest are ambiguous. For the specifications not including a firm’s exchange listing, I find that short interest has a positive impact on coefficient-based delay (model 3). The corresponding coefficients of the exchange models indicate that short interest is only positively related to delay for firms listed on the NYSE. I find these results difficult to interpret, because Boehmer and Wu (2012) document that short interest is negatively related to price delay. In Panel A of Table A4 in the Appendix, I document that short interest changes sign when I control for firm fixed effects. Finally, institutional ownership is negatively related to price delay in both models excluding exchange effects (1 and 3). This is in line with the finding that institutional ownership and trading improves stock price efficiency (Boehmer, Jones & Zhang, 2008; Boehmer and

Kelley, 2009). However, specification (2) and (4) indicate that this relation is primarily driven by institutional ownership of firms listed on the NYSE, since this coefficient is statistically significant at one percent, while the corresponding NASDAQ equivalent is insignificant. The different results for various control variables on price delay for firms listed on the NYSE and NASDAQ indicate that the distinct firm characteristics per exchange might influence certain findings. This suggests that a firm's exchange listing could also impact the effect of share repurchases on price delay and firm-specific risk.

5.3 Share repurchases and firm-specific risk

In this section, I will examine the influence of share repurchases on firm-specific risk. Firm-specific risk covers the uncertainties, potential concerns and investment risk inherent to a specific company's stock or industry. This type of risk can be reduced by diversification, contrarily to systematic risk. Firm-specific risk of a stock increases when firms manipulate prices or incorporate firm-specific news, while providing price support below or at the intrinsic value reduces this risk (Hong, Wang & Yu, 2008; Busch & Obernberger, 2016). Table 4 presents the results of the impact of repurchases on firm-specific risk, measured by R-squared and absolute market correlation. Repurchase activity is proxied by lagged repurchase intensity in all specifications similar to section 5.2. The impact of repurchases on R-squared is examined in model (1) and (2) and on market correlation in model (3) and (4). Model (2) and (4) analyse the impact of share repurchases on their respective firm-specific risk measure separately for the NYSE and NASDAQ.

The results unequivocally report that share repurchases reduce firm-specific risk, reflected by an increase in R-squared and market correlation. R-squared increases by 0.0021 percentage points when repurchase intensity increases by one within-firm standard deviation. This is the equivalent of 0.92% of median R-squared or an increase of R-squared by 0.014 standard deviations[1]. Increasing repurchase intensity by one within-firm standard deviation increases market correlation by 0.0022 percentage points in similar fashion, which corresponds to 0.46% of median market correlation or an increase of market correlation by 0.013 standard deviations. The coefficients are lower than the corresponding results for lagged repurchase intensity in the benchmark paper, which indicate their lower economic significance due to the same attenuation concerns addressed in the previous section. Furthermore, the higher coefficients in both exchange models (2 and 4) for share repurchases on the NASDAQ suggests that share repurchases on this exchange may reduce firm-specific risk slightly more than repurchases on the NYSE.

[1]Computations in their respective order: 0.0021 = 0.0159 × 0.1334, where 0.0159 is the within-firm standard deviation of repurchase intensity in Table 1 and 0.1334 is the coefficient of lagged repurchase intensity in model (1) of Table 5. 0.91 = 0.0021 / 0.2307, where 0.2307 is the median R-squared in Table 1. 0.014 = 0.0021 / 0.1546, where 0.1546 is the within-firm standard deviation of R-squared in Table 1.

Table 4: The impact of share repurchases on R-squared and absolute market correlation

Dependent variable:	R-squared			|Market correlation|		
Exchange:		NYSE	NASDAQ		NYSE	NASDAQ
Model:	(1)	(2)	(2)	(3)	(4)	(4)
Repurchase intensity$_{t-1}$	0.1334***	0.1074**	0.1689***	0.1396***	0.1245***	0.1662***
	(4.31)	(2.32)	(4.02)	(4.18)	(2.61)	(3.55)
R-squared$_{t-1}$	0.2488***	0.2461***	0.2440***			
	(58.28)	(48.28)	(44.24)			
|Market correlation|$_{t-1}$				0.2534***	0.2437***	0.2515***
				(53.46)	(42.95)	(42.68)
Market cap$_{t-1}$ (ln)	0.0232***	0.0231***	0.0218***	0.0286***	0.0297***	0.0243***
	(14.88)	(14.26)	(13.34)	(15.88)	(15.91)	(12.89)
Book to market$_{t-1}$	-0.0110***	0.0035	-0.0209***	-0.0113***	0.0024	-0.0211***
	(-5.18)	(1.16)	(-8.21)	(-4.49)	(0.69)	(-6.88)
Analysts$_{t-1}$ (ln)	0.0010	-0.0002	0.0018*	0.0016	-0.0003	0.0028**
	(1.19)	(-0.18)	(1.67)	(1.59)	(-0.22)	(2.17)
Relative spread$_{t-1}$ (ln)	-0.0157***	-0.0110***	-0.0201***	-0.0211***	-0.0107***	-0.0310***
	(-13.70)	(-6.92)	(-13.87)	(-15.89)	(-5.93)	(-17.83)
Deviation price from 30$$_{t-1}$	-0.0000	-0.0000	-0.0000	-0.0001**	-0.0000*	-0.0000
	(-1.49)	(-1.22)	(-0.43)	(-2.51)	(-1.90)	(-1.19)
Trading volume$_{t-1}$	0.0014	0.0005	-0.0030	0.0012	-0.0047*	-0.0014
	(0.84)	(0.19)	(-1.45)	(0.61)	(-1.73)	(-0.57)
Change in short interest$_{t-1}$	-0.0490***	-0.0637***	-0.0364***	-0.0355***	-0.0550***	-0.0175
	(-5.75)	(-5.12)	(-3.24)	(-3.67)	(-4.05)	(-1.35)
Institutional ownership$_{t-1}$	0.0114***	0.0304***	0.0006	0.0179***	0.0391***	0.0050
	(2.97)	(5.08)	(0.14)	(3.77)	(5.94)	(0.85)
Constant	-0.4339***	-0.4187***		-0.4245***	-0.3875***	
	(-14.98)	(-14.26)		(-12.51)	(-11.36)	
R^2(within firm)	0.413	0.414		0.371	0.373	
Observations	115,734	115,734		115,734	115,734	
Firms	2,645	2,645		2,645	2,645	
Firm FE and quarter FE	Y	Y		Y	Y	
Wald test of repurchase intensity$_t$ interacted with:						
NYSE - NASDAQ (test)		0.96			0.39	
NYSE - NASDAQ (p-value)		32.66%			53.30%	

This table reports OLS regressions of R-squared and absolute market correlation on lagged repurchase intensity and a set of control variables. Model (1) and (2) present the results for R-squared and model (3) and (4) provide the results for market correlation measure. Please note that both model (2) and (4) are one regression model presented in two columns. Each column reports the coefficients of the corresponding variable interacted with the firms' exchange listing (NYSE or NASDAQ). The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic tests for differences between the coefficients of repurchases by NYSE-listed firms and NASDAQ-listed firms in model (2) and (4). The corresponding test statistics and p-values are presented for each Wald test.

The corresponding Wald tests at the bottom of the table corroborate this result, since the test statistics hint that the impact of share repurchases on firm-specific risk differs for NYSE-listed firms and NASDAQ-listed firms although the coefficients are not statistically significantly different at a 10% level.

The results provide strong evidence that share repurchases increase the correlated movement between stock and market returns, since they unequivocally increase the R-squared and market correlation of a stock (hypothesis 2). None of the obtained results is in line with the notion that share repurchases incorporate private information into the stock price or that repurchases increase the amount of misinformation of a stock. Moreover, I find weak evidence that repurchases by NASDAQ-listed firms reduce the firm-specific risk of stock prices more than NYSE-listed firms, which is not in line with hypothesis 4b. However, this notion requires further analysis before I deduce any conclusions from the results.

Most of the results of my control variables are in line with the findings reported by the existing literature. The significantly positive coefficient of market capitalization in all specifications supports the notion that larger firms have lower firm-specific risk (Malkiel & Xu, 1997; Ferreira & Laux, 2007; Fu, 2009; Lee & Faff, 2009). The literature is inconclusive on the impact of valuation on firm-specific risk (Ali, Hwang & Trombley, 2003; Fu, 2009; Hutton, Marcus & Tehranian, 2009). In both models excluding exchange effects (1 and 3), I find that book to market is negatively related to R-squared and market correlation, which indicates that valuation has a positive impact on firm-specific risk. I find this result difficult to interpret. Further inspection reveals that this negative relation is only obtained for firms listed on the NASDAQ, since the corresponding coefficient significantly negative, while the coefficient of the NYSE equivalent is insignificantly positive. These results suggest that valuation might have a different effect on firm-specific risk for firms listed on the NYSE and NASDAQ. The statistically negative coefficients of relative spread in all specifications are in line with other studies documenting that liquidity is negatively related to firm-specific risk (Spiegel & Wang, 2005; Fu, 2009). However, I do not obtain this negative relation for my other liquidity measure, trading volume. In Panel B of Table A3, I show that trading volume initially has the expected impact on R-squared, but switches sign when the other liquidity control is included in the specification. I find that short interest has a negative impact on R-squared and market correlation, which is in accordance with the finding that short interest is negatively related to firm-specific risk (Au, Doukas & Onayev, 2009; Duan, Hu & McLean, 2010). In Panel B of Table A4 in the Appendix, I document that the sign and significance of the coefficient of short interest is not distorted by the inclusion of firm fixed effects or other control variables. In the models excluding effects, I find that institutional ownership has a positive impact on R-squared and market correlation. This is in line with other papers documenting that institutional ownership is negatively related to firm-specific risk (Ferreira & Laux, 2007; An & Zhang, 2013). Further examination shows that this relation for institutional ownership is primarily driven by institutional investors having a stake in firms listed on the NYSE, since the coefficient of the NASDAQ equivalent is insignificant for both the R-squared and the market correlation specifications. Similar to those with delay, the results of several control variables indicate that some established relationships with firm-specific risk are to a certain degree dependent on a firm's exchange listing.

5.4 Share repurchases in up and down markets

In this section, I attempt to determine through which channel share repurchases increase stock price efficiency and reduce a stock's firm-specific risk. Busch and Obernberger (2016) propose two distinct channels through which this share repurchases can have this effect. First, firms can act upon new public information not processed into the stock price yet. Firms believe that their shares should be worth more based on this new information and repurchase shares until the stock price reaches the enhanced intrinsic value. According to this channel, I should primarily perceive an increase in price efficiency in quarters when positive news comes to the market. The second channel postulates that stock buybacks increase the precision with which negative public news is reflected into the stock price. Firms can prevent stock prices from overreacting to the negative public information by setting a lower bound at the intrinsic value. This way I should mainly observe increases in price efficiency in quarters containing negative news. Analogous to the benchmark paper, I use the contemporary market return to identify quarters with positive and negative market news. Subsequently, I split repurchase intensity in up and down market quarters. I extend this research design by additionally allowing for interaction between repurchase intensity and the exchange a firm is listed on. This allows me to examine whether I also observe different effects per exchange besides the market condition. I use the same set of control variables as in Table 3 and Table 4. The results of the impact of share repurchases on price delay in up and down markets are provided in Panel A of Table 5.

I obtain significantly negative coefficients for all down market quarters for the delay and coefficient-based delay measure, while the coefficients for up market quarters are statistically insignificant and smaller in magnitude for all specifications. The down market coefficients of delay and coefficient-based delay (column 1 and 3) increase by a factor of 2.4 and 3 respectively relative to their corresponding coefficients of lagged repurchase intensity in Table 3 (column 1 and 3)[1].

[1]Computation in their respective order: 2.4 = -0.3388 / -0.1427, where -0.3388 is the coefficient of the down market repurchase interaction term of Table 5A column (1) and -0.1427 is the coefficient of lagged repurchase intensity of Table 3 model (1). 3.0 = -0.6677 / -0.2226, where -0.6677 is the coefficient of the down market repurchase interaction term of Table 5A column (3) and -0.2226 is the coefficient of lagged repurchase intensity of Table 3 model (3).

Table 5a: The impact of share repurchases on delay in up and down markets

Dependent variable:	Delay		Coefficient-based delay	
Model:	(1)	(2)	(3)	(4)
Repurchase intensity$_{t-1}$	-0.0208		0.0540	
× Up market$_t$	(-0.32)		(0.37)	
Repurchase intensity$_{t-1}$	-0.3388***		-0.6677***	
× Down market$_t$	(-4.67)		(-4.17)	
Repurchase intensity$_{t-1}$		-0.0187		-0.0140
× Up market$_t$ × NYSE		(-0.22)		(-0.16)
Repurchase intensity$_{t-1}$		-0.0504		-0.0363
× Up market$_t$ × NASDAQ		(-0.54)		(-0.38)
Repurchase intensity$_{t-1}$		-0.3442***		-0.3239***
× Down market$_t$ × NYSE		(-3.88)		(-3.57)
Repurchase intensity$_{t-1}$		-0.3348***		-0.3221***
× Down market$_t$ × NASDAQ		(-3.12)		(-2.93)
R^2(within firm)	0.195	0.199	0.173	0.192
Observations	115,734	115,734	115,726	115,726
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Wald tests of repurchase intensity$_{t-1}$ interacted with:				
Up$_t$ - Down$_t$ (test)	11.71		11.34	
Up$_t$ - Down$_t$ (p-value)	0.06%		0.08%	
Up$_t$ × NYSE - Down$_t$ × NYSE (test)		8.24		7.36
Up$_t$ × NYSE - Down$_t$ × NYSE (p-value)		0.41%		0.67%
Up$_t$ × NASDAQ - Down$_t$ × NASDAQ (test)		4.33		4.21
Up$_t$ × NASDAQ - Down$_t$ × NASDAQ (p-value)		3.75%		4.02%
Up$_t$ × NYSE - Up$_t$ × NASDAQ (test)		0.06		0.03
Up$_t$ × NYSE - Up$_t$ × NASDAQ (p-value)		79.91%		86.02%
Down$_t$ × NYSE - Down$_t$ × NASDAQ (test)		0.00		0.00
Down$_t$ × NYSE - Down$_t$ × NASDAQ (p-value)		94.52%		98.95%

This table reports OLS regressions of delay and coefficient-based delay on lagged repurchase intensity interacted with dummy variables indicating up and down markets and a set of control variables in model (1) and (3) (untabulated). Model (2) and (4) additionally interact lagged repurchase intensity with a dummy variable indicating the firm's exchange listing (NYSE or NASDAQ) besides the dummy variable indicating up and down markets. The control variables are similar to those in Table 3. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic in model (1) and (3) tests for differences between the coefficients of repurchases in up and down markets. The Wald statistic in model (2) and (4) tests for differences of various combinations of repurchases in up and down markets by NYSE-listed firms and NASDAQ-listed firms. The corresponding test statistics and p-values are presented for each Wald test.

Increasing repurchase intensity by one within-firm standard deviation in a down-market quarter reduces delay by 0.0054 percentage points, which coincides with 2.60% of median delay and a reduction of delay by 0.025 standard deviations[1]. These figures indicate the higher economic significance of the results when market conditions are included in the specification relatively to the corresponding economic significance of the coefficients obtained in section 5.2. In line with the benchmark paper, my results indicate that share repurchases primarily increase the

[1]Computations in their respective order: 0.0054 = 0.0159 × -0.3388, where 0.0159 is the within-firm standard deviation of repurchase intensity in Table 1 and -0.3388 is the coefficient of lagged repurchase intensity interaction with down market in Table 5A column (1). 0.0260 = 0.0054 / 0.208, where 0.208 is median delay from Table 1. 0.025 = 0.0054 / 0.214, where 0.215 is the within-firm standard deviation of delay in Table 1.

price efficiency of a stock during periods when negative news comes to the market. However, I do not obtain any results that indicate that share repurchases increase stock price efficiency during up market quarters which is in contrast with the benchmark paper. The Wald tests at the bottom of column (1) and (3) corroborate this notion by reporting that the difference of the up and down market coefficients is statistically significant at a one percent level. Further inspection of the exchange models (2 and 4) confirms the notion that share repurchases solely improve price efficiency during quarters containing negative market information. Similar to my corresponding findings in section 5.2, I do not find any striking differences between share repurchases on the NYSE and NASDAQ during down market quarters. The corresponding Wald tests support this finding, since the statistics report that the difference of the coefficients is not statistically significant for both delay and coefficient-based delay.

Table 5B reports the results of the impact of share repurchases on R-squared and market correlation in up-markets and down-markets. In the specifications not including exchange effects, I obtain significantly positive coefficients for the R-squared and the market correlation measure during down market quarters, while the coefficients in up markets are statistically insignificant and smaller in magnitude. The down market coefficients of R-squared and market correlation (column 1 and 3) increase by around a factor 2.5 relative to their corresponding coefficients of lagged repurchase intensity in Table 4 (column 1 and 3). Increasing repurchase intensity by one within-firm standard deviation in a down-market quarter increases R-squared by 0.0060 percentage points, which coincides with 2.60% of median R-squared and a decrease of R-squared by 0.039 standard deviations[1]. These statistics point out the increased economic significance of the results when up and down markets are incorporated in the specifications in a similar fashion as with delay. In accordance with the benchmark paper, my results indicate that share repurchases mainly reduce firm-specific risk of a stock during market periods with negative information. The statistics of the Wald tests at the bottom of column (1) and (3) substantiate this finding by documenting that the difference of the up and down market coefficients is statistically significant at a one percent level.

Further examination of the exchange models (2 and 4) corroborates the notion that share repurchases reduce firm-specific risk during quarters with negative market news. The coefficient of share repurchases during down markets for the NYSE is around twice as large as the coefficient of the NASDAQ equivalent for both specifications, which indicates that repurchases on NYSE have a relatively bigger impact on firm-specific risk.

[1]Computations in their respective order: 0.0060 = 0.0159 × 0.3791, where 0.0159 is the within-firm standard deviation of repurchase intensity in Table 1 and 0.3791 is the coefficient of lagged repurchase intensity in a down market in Table 5b column (1). 0.0260 = 0.0060 / 0.2307, where 0.2307 is median R-squared from Table 1. 0.039 = 0.0060 / 0.1546, where 0.1546 is the within-firm standard deviation of R-squared in Table 1.

Table 5b: The impact of share repurchases on R-squared and absolute market correlation in up and down markets

Dependent variable:	R-squared		|Market correlation|	
Model:	(1)	(2)	(3)	(4)
Repurchase intensity$_{t-1}$	-0.0192		0.0016	
× Up market$_t$	(-0.52)		(0.04)	
Repurchase intensity$_{t-1}$	0.3791***		0.3618***	
× Down market$_t$	(7.42)		(7.00)	
Repurchase intensity$_{t-1}$		-0.1531***		-0.0694
× Up market$_t$ × NYSE		(-2.62)		(-1.13)
Repurchase intensity$_{t-1}$		0.1256**		0.0885
× Up market$_t$ × NASDAQ		(2.49)		(1.52)
Repurchase intensity$_{t-1}$		0.5314***		0.4412***
× Down market$_t$ × NYSE		(6.88)		(6.14)
Repurchase intensity$_{t-1}$		0.2422***		0.2913***
× Down market$_t$ × NASDAQ		(3.74)		(4.18)
R^2(within firm)	0.413	0.415	0.371	0.373
Observations	115,734	115,734	115,734	115,734
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Wald tests of repurchase intensity$_{t-1}$ interacted with:				
Up$_t$ - Down$_t$ (test)	43.99		31.75	
Up$_t$ - Down$_t$ (p-value)	0.00%		0.00%	
Up$_t$ × NYSE - Down$_t$ × NYSE (test)		59.62		34.36
Up$_t$ × NYSE - Down$_t$ × NYSE (p-value)		0.00%		0.00%
Up$_t$ × NASDAQ - Down$_t$ × NASDAQ (test)		2.27		5.52
Up$_t$ × NASDAQ - Down$_t$ × NASDAQ (p-value)		13.21%		1.89%
Up$_t$ × NYSE - Up$_t$ × NASDAQ (test)		13.07		3.54
Up$_t$ × NYSE - Up$_t$ × NASDAQ (p-value)		0.03%		5.99%
Down$_t$ × NYSE - Down$_t$ × NASDAQ (test)		8.53		2.35
Down$_t$ × NYSE - Down$_t$ × NASDAQ (p-value)		0.35%		12.55%

This table reports OLS regressions of R-squared and absolute market correlation on lagged repurchase intensity interacted with dummy variables indicating up and down markets and a set of control variables in model (1) and (3) (untabulated). Model (2) and (4) additionally interact lagged repurchase intensity with a dummy variable indicating the firm's exchange listing (NYSE or NASDAQ) besides the dummy variable indicating up and down markets. The control variables are similar to those in Table 4. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic in model (1) and (3) tests for differences between the coefficients of repurchases in up and down markets. The Wald statistic in model (2) and (4) tests for differences of various combinations of repurchases in up and down markets by NYSE-listed firms and NASDAQ-listed firms. The corresponding test statistics and p-values are presented for each Wald test.

The statistically significant difference of the corresponding coefficients reported by the Wald test supports this finding. Furthermore, I obtain notable results for quarters with positive market news for both the R-squared and market correlation specifications.

In column (2), the coefficient for share repurchases on the NYSE during up market quarters is significantly negative, while the coefficient of the NASDAQ equivalent is significantly positive. The corresponding results for market correlation in column (4) are marginally insignificant but do have the same sign. Although the coefficients are substantially smaller than the corresponding down market coefficients in both models, the results indicate that share repurchases on the NYSE during up markets increase firm-specific risk, while the NASDAQ equivalent reduces firm-specific risk. The opposing effects on firm-specific risk from share repurchases on the NYSE and NASDAQ during up markets are supported by the strong statistically significant difference of the corresponding coefficients reported by the Wald test for both models. Moreover, the Wald test documents that the difference of the coefficients for repurchases on the NYSE in up and down markets is strongly statistically significant, which further confirms the opposing effects of share repurchases on the NYSE for both market conditions. The difference of the coefficients for repurchases on the NASDAQ in up and down markets is marginally insignificant, which corresponds to the finding that repurchases on the NASDAQ reduce firm-specific risk in both market conditions.

Overall, the results provide strong evidence in favor of the price support argument, since the coefficients for repurchases during up markets are strongly significant and positive in all specifications. However, I also obtain weak evidence in favor of the positive information incorporation argument for share repurchases on the NASDAQ (hypothesis 3a). Therefore, I accept hypothesis 3b and I cannot reject hypothesis 3a. The result that share repurchases on the NYSE during up markets increase firm-specific risk indicates that firm-specific information is incorporated into the stock price or the noise increases through these repurchases. Although price delay does not increase by these repurchases, this provides weak support for the price manipulation argument (hypothesis 1). I obtain no evidence that share repurchases by NYSE-listed firms increase the price efficiency of stock more than NASDAQ-listed firms and therefore I reject hypothesis 4a. The results on the impact of share repurchases by NYSE-listed firms on the firm-specific risk are mixed for up and down markets, which complicates the evaluation of hypothesis 4b. However, the results for share repurchases by both NYSE-listed firms and NASDAQ-listed firms during up markets are considered weak from an economic and statistical point of view relative to their down market equivalents. Therefore, I put more emphasis on the finding that share repurchases by NYSE-listed firms reduce the firm-specific risk more than NASDAQ-listed firms during down markets and I accept hypothesis 4b. The discrepancy between the results on whether share repurchases reduce the firm-specific risk of a stock through the incorporation of positive information or by providing price supports necessitates further analysis and academic corroboration.

5.4.1 Share repurchases and stock return moment distributions

In this section, I analyse the impact of share repurchases on stock return moment distributions to further examine the inconsistency of the results with respect to the price support argument and the positive information incorporation argument. I measure the stock return moment distributions with the average quarterly volatility and kurtosis of daily stock returns. My results so far provide the strongest evidence for the price support argument, which postulates that firms prevent prices from dropping below their intrinsic values. Therefore, I should observe severe negative returns less frequently when firms repurchase shares, indicating that the volatility and kurtosis of a stock decrease. Table A5 in the Appendix presents the results the impact of share repurchases on volatility and kurtosis using the same set of control variables as in Table 4. The significantly negative coefficients of lagged repurchase intensity in the volatility specifications (model 1 and 2) corroborate the price support hypothesis. The corresponding coefficient for the kurtosis specification in model (3) comes with the right sign but lacks statistical and economical significance. Further inspection of the exchange model (4) reveals that the corresponding NYSE coefficient is insignificantly positive, while the NASDAQ coefficient is insignificantly negative for lagged repurchase intensity. These opposing effects might reveal why the coefficient of lagged repurchase intensity in model (3) lacks in significance.

Since I use a similar research design as the benchmark paper, I cannot exclude price support as a potential driver for the positive impact of share repurchases on the NASDAQ on the R-squared during periods with positive markets news. I use the quarterly average of monthly market returns to identify up-markets and down-markets, while I use daily returns to compute my firm-specific risk measures. An up market quarter might contain a short period of negative market news during which firms can provide price support. Busch and Obernberger (2016) postulate that providing price support during short negative news periods in up market quarters decreases volatility, since the improvement of the precision with which negative information is incorporated into the stock price will result in less severe negative stock returns. On the other hand, if the incorporation of positive information drives my results in up markets, volatility will increase during up market quarters, since the incorporation of positive news results in more extreme positive stock returns. To analyse this matter in more detail, I examine the impact of share repurchases on volatility in up-markets and down-markets using the same research design as in Table 5.

Table 6: The impact of share repurchases on volatility up and down markets

Dependent variable:	Volatility (ln)	
Model:	(1)	(2)
Repurchase intensity$_{t-1}$ × Up market$_t$	-0.8502*** (-9.27)	
Repurchase intensity$_{t-1}$ × Down market$_t$	-0.8787*** (-8.84)	
Repurchase intensity$_{t-1}$ × Up market$_t$ × NYSE		-0.9865*** (-7.66)
Repurchase intensity$_{t-1}$ × Up market$_t$ × NASDAQ		-0.7268*** (-5.73)
Repurchase intensity$_{t-1}$ × Down market$_t$ × NYSE		-0.4475*** (-3.56)
Repurchase intensity$_{t-1}$ × Down market$_t$ × NASDAQ		-1.2877*** (-8.67)
R^2(within firm)	0.624	0.625
Observations	115,734	115,734
Firms	2,645	2,645
Firm FE and quarter FE	Y	Y
Controls	Y	Y
Wald tests of repurchase intensity$_{t-1}$ interacted with:		
Up$_t$ - Down$_t$ (test)	0.05	
Up$_t$ - Down$_t$ (p-value)	82.43%	
Up$_t$ × NYSE - Down$_t$ × NYSE (test)		10.47
Up$_t$ × NYSE - Down$_t$ × NYSE (p-value)		0.12%
Up$_t$ × NASDAQ - Down$_t$ × NASDAQ (test)		9.94
Up$_t$ × NASDAQ - Down$_t$ × NASDAQ (p-value)		0.16%
Up$_t$ × NYSE - Up$_t$ × NASDAQ (test)		2.12
Up$_t$ × NYSE - Up$_t$ × NASDAQ (p-value)		14.51%
Down$_t$ × NYSE - Down$_t$ × NASDAQ (test)		19.7
Down$_t$ × NYSE - Down$_t$ × NASDAQ (p-value)		0.00%

This table reports OLS regressions of volatility and kurtosis on lagged repurchase intensity on lagged repurchase intensity interacted with dummy variables indicating up and down markets and a set of control variables (untabulated). Model (2) additionally interact lagged repurchase intensity with a dummy variable indicating the firm’s exchange listing (NYSE or NASDAQ) besides the dummy variable indicating up and down markets. The control variables are similar to those in Table 3. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic in model (1) tests for differences between the coefficients of repurchases in up and down markets. The Wald statistic in model (2) tests for differences of various combinations of repurchases in up and down markets by NYSE-listed firms and NASDAQ-listed firms. The corresponding test statistics and p-values are presented for each Wald test.

The results are presented in Table 6 for which I use the same set of control variables as in table 4. The statistically negative coefficients of lagged repurchase intensity during up markets in model (1) are in line with the findings that firms provide price support in up market periods as well in the benchmark paper. The difference of the coefficients for repurchases in up and down markets is not statistically significant according the corresponding Wald test, which corroborates this notion. All the coefficients in the exchange model (2) are significantly negative too, providing further evidence in favour of the price support argument.

Overall, the analysis of share repurchases in up and down markets provides strong evidence that share repurchases increase the efficiency of stocks by providing price support at the intrinsic value when negative news comes to the market (hypothesis 3b). The evidence in favor of the positive information incorporation argument is only observed for a small subset of share repurchases on the NASDAQ during positive market news periods and is considered weak from an economic and statistical point of view. Moreover, share repurchases decrease the volatility of stock returns in both periods containing positive and negative market news, which provides further evidence in favor of the price support argument. Although I cannot reject the hypothesis that firms incorporate positive information into the stock price during up market periods (hypothesis 3a), additional analysis of stock return moment distributions reveals that my results are more in accordance with the price support hypothesis (hypothesis 3b). Furthermore, I find modest support that share repurchases by NYSE-listed firms reduce firm-specific risk more than NASDAQ-listed firms (hypothesis 4b). The corresponding evidence during down markets in line with hypothesis 4b is strong from an economic and statistical perspective, while the contradicting evidence during up markets is ambiguous. Finally, I find weak evidence from an economic and statistical point of view that share repurchases on the NYSE during periods with positive market increase the firm-specific risk of a stock, which weakly supports the price manipulation argument (hypothesis 1). This finding requires further examination in the subsequent sections.

5.5 Contemporaneous repurchases

In this section, I examine the effects of current repurchase activity on price efficiency and firm-specific risk. The current repurchase activity is measured by contemporaneous repurchase intensity and a contemporaneous repurchase dummy, which identifies quarters containing repurchase activity. As addressed in section 4.1, the coefficients of contemporaneous repurchase intensity will be biased upwards, since I have documented that firms provide price support. Busch and Obernberger (2016) postulate that the contemporaneous repurchase dummy is expected to be less positively correlated to the delay measures, since this variable only indicates whether a repurchase takes place instead of also accounting for the repurchase size. Table 7 reports the impact of current repurchase activity on the price efficiency and firm-specific risk of a stock.

Table 7: The impact of current repurchase activity on price efficiency and firm-specific risk

A. Contemporaneous repurchase intensity

Dependent Variable:	Delay	Coefficient-based delay	R-squared	|Market correlation|
Model:	(1)	(2)	(3)	(4)
Repurchase intensity$_t$	0.2226***	0.4965***	-0.2102***	-0.2190***
	(4.23)	(4.25)	(-6.65)	(-6.88)
R^2(within firm)	0.195	0.173	0.413	0.410
Observations	115,797	115,789	115,797	115,797
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
B. Contemporaneous repurchase dummy				
Repurchase dummy$_t$	-0.0003	0.0024	0.0013	0.0014
	(-0.19)	(0.66)	(1.28)	(1.40)
R^2(within firm)	0.194	0.173	0.413	0.409
Observations	115,797	115,789	115,797	115,797
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
C. Contemporaneous repurchase dummy in up and down markets				
Repurchase dummy$_t$	0.0020	0.0118***	-0.0045***	-0.0040***
× Up market$_t$	(1.02)	(2.90)	(-3.92)	(-3.48)
Repurchase dummy$_t$	-0.0057**	-0.0201***	0.0151***	0.0145***
× Down market$_t$	(-2.49)	(-3.82)	(9.12)	(8.72)
R^2(within firm)	0.194	0.173	0.414	0.410
Observations	115,797	115,789	115,797	115,797
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
D. Contemporaneous repurchase dummy in up and down markets interacted with NYSE and NASDAQ				
Repurchase dummy$_t$	0.0049**	0.0185***	-0.0077***	-0.0069***
× Up market$_t$ × NYSE	(1.96)	(3.35)	(-4.45)	(-3.93)
Repurchase dummy$_t$	-0.0009	0.0044	-0.0004	-0.0002
× Up market$_t$ × NASDAQ	(-0.36)	(0.81)	(-0.27)	(-0.10)
Repurchase dummy$_t$	-0.0081***	-0.0322***	0.0266***	0.0257***
× Down market$_t$ × NYSE	(-2.95)	(-4.74)	(11.96)	(11.52)
Repurchase dummy$_t$	-0.0027	-0.0069	0.0033	0.0028
× Down market$_t$ × NASDAQ	(-0.88)	(-1.03)	(1.54)	(1.32)
R^2(within firm)	0.195	0.173	0.415	0.411
Observations	115,797	115,789	115,797	115,797
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y

This table reports OLS regressions of delay, coefficient-based delay, R-squared, and absolute market correlation on contemporaneous repurchase activity in column (1), (2), (3) and (4) respectively. The results on repurchase intensity, the repurchase dummy, the repurchase dummy in up and down markets, and the repurchase dummy in up and down markets for NYSE-listed firms and NASDAQ-listed firms are presented in Panel A, Panel B, Panel C, and Panel D, respectively. The set of control variables are similar to those in Table 3 and Table 4. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively.

Panel A presents the results of contemporaneous repurchase intensity, Panel B considers the contemporaneous repurchase dummy, Panel C examines the contemporaneous repurchase dummy in up and down markets, and Panel D analyses the contemporaneous repurchase dummy in up and down markets interacted with the NYSE-listing or NASDAQ-listing of a firm.

The results regarding contemporaneous repurchase intensity in Panel A confirm the positive bias of the coefficients due to the previously addressed endogeneity concerns when firms provide price support. The coefficients for delay and coefficient-based delay switch sign and become positive, while the coefficients for R-squared and market correlation switch sign and become negative. In contrast with the benchmark paper, I do find statistically significant relations for contemporaneous repurchase intensity in all specifications. The results on the contemporaneous repurchase dummy corroborate the notion that the coefficients of this proxy for current repurchase activity suffer less from the positive bias relative to contemporaneous repurchase intensity due to its more exogenous nature. Most of the coefficients come in with the expected sign according to my previous results in Table 3 and 4, but in contrast with the benchmark paper they are not statistically significant. Conversely to the benchmark paper, I do not obtain any significant results for the repurchase dummy in Panel B. However, the coefficients for R-squared and market correlation come with the right sign, but lack significance.

When I interact the repurchase dummy with up and down markets in Panel C, I obtain more significant and bigger coefficients in all specifications. The coefficients during down market are negative for the delay measures and positive for the firm-specific risk measures, providing further evidence for the price support argument (hypothesis 3b). Although smaller in size and less significant, the opposite signs for the coefficients in up market provide further evidence for the price manipulation argument (hypothesis 1). The results in Panel D reveal that the positive impact of share repurchases on price delay and firm-specific risk during up markets are primarily driven by NYSE-listed firms, since the coefficients of repurchases during up markets by NASDAQ-listed firms are strongly insignificant. This provides further support for my earlier finding that share repurchases on the NYSE during up market periods decrease information content of stock prices. However, I also find that share repurchases on the NYSE during down market periods provide most support for price support argument, since the coefficients of the NASDAQ equivalent are marginally insignificant at the 10% level.

5.6 Harmful repurchases, delay, and R-squared

My results so far provide strong evidence for the price support argument, weak evidence for the price manipulation argument, and weak evidence for the positive information incorporation argument. Congruent with the benchmark paper, I have limited my analysis to influence of within-firm variation in repurchases on price efficiency and firm-specific risk. Additionally, I used regression specifications that recognize exogenous variation in share repurchases and ascertain its influence on price efficiency and firm-specific risk. This research design may have been too strict to find more compelling evidence for the price manipulation argument.

Therefore, I alter three aspects of my research design as proposed by Busch and Obernberger (2016) to reduce the previously described restrictions and zoom in on potentially detrimental repurchases. First, I use contemporaneous repurchase intensity like in Panel A of Table 8 to allow for potentially endogenous variation. Second, I do not include firm fixed effects in the regression specifications, which permits cross-sectional heterogeneity to drive my results. Third, I create interaction variables between repurchase intensity and dummy variables that specify subgroups of potentially harmful repurchases. In each specification, I aim to isolate the detrimental effect of the expected harmful subset of repurchases by using the following two interaction terms: “repurchase intensity × interaction variable” and “repurchase intensity × (1 – interaction variable)”. I use the same set of control variables for the delay and R-squared specification as in Table 4 and 5, respectively. The results of the potentially detrimental repurchases on delay are provided in Panel A of Table 8 and the results for R-squared in Panel B of Table 8.

In column (1) to (3), I distinguish share repurchases with corporate insiders that would benefit from stock price manipulation the most. Column (4) identifies repurchasing firms with relatively high proportions of cash to assets. These firms may be incentivized to return these abundant funds to the firm’s shareholders through share repurchases. However, compulsory and sizeable share repurchases within a short time frame could be detrimental to the firm and therefore harm price efficiency. Column (5) extends the benchmark paper by identifying firms that slightly beat the average EPS forecast in a given quarter. Management is incentivized to manipulate stock prices if they have any type of bonuses or stock options linked to realizing certain EPS forecasts. Repurchase intensity is interacted with net insider selling, which is a dummy variable that equals one if net insider trading is negative and zero otherwise (column 1). Furthermore, repurchase intensity is interacted with the respective dummy variable that indicates whether options outstanding (column 2), options exercised (column 3), or options exercised (column 4) is below or above the median at the implied repurchase program initiation.

Table 8: Detrimental share repurchases

A. Influence on delay

Dependent variable:	Delay				
Model:	(1)	(2)	(3)	(4)	(5)
Interaction variable:	Net insider selling	High options outstanding	High options exercised	High cash to assets	EPS slightly beats forecast
Interaction variable$_t$:	-0.0081***	0.0160***	-0.0036	0.0133***	-0.0164***
	(-4.24)	(5.36)	(-1.25)	(4.87)	(-7.83)
Repurchase intensity$_t$	0.4938***	0.3905***	0.4742***	0.3337***	0.6778***
× Interaction variable$_t$	(7.00)	(6.06)	(6.08)	(4.61)	(4.58)
Repurchase intensity$_t$	0.2402***	0.1971*	0.2708***	0.3711***	0.3334***
× (1 - Interaction variable$_t$)	(2.84)	(1.83)	(3.36)	(4.27)	(5.81)
R-squared	0.441	0.442	0.441	0.441	0.441
Observations	110,813	115,797	115,797	115,797	115,797
Firms	2,625	2,645	2,645	2,645	2,645
Firm FE	N	N	N	N	N
Quarter FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Wald test of repurchase intensity$_t$ interacted with:					
Int. var$_t$. - (1 - Int. var$_t$.) (test)	5.87	2.42	3.31	0.11	5.10
Int. var$_t$. - (1 - Int. var$_t$.) (p-value)	1.54%	12.03%	6.92%	74.02%	2.40%

B. The impact on R-squared

Dependent variable:	R-squared				
Model:	(1)	(2)	(3)	(4)	(5)
Interaction variable:	Net insider selling	High options outstanding	High options exercised	High cash to assets	EPS slightly beats forecast
Interaction variable$_t$:	0.0037***	-0.0097***	0.0033*	-0.0110***	0.0072***
	(3.25)	(-5.12)	(1.84)	(-6.17)	(5.36)
Repurchase intensity$_t$	-0.3411***	-0.3396***	-0.3141***	-0.2752***	-0.4841***
× Interaction variable$_t$	(-7.56)	(-8.74)	(-6.32)	(-6.28)	(-5.51)
Repurchase intensity$_t$	-0.2805***	-0.1668**	-0.3217***	-0.3293***	-0.2920***
× (1 - Interaction variable$_t$)	(-5.73)	(-2.32)	(-6.95)	(-6.10)	(-8.13)
R-squared	0.563	0.564	0.563	0.564	0.563
Observations	110,813	115,797	115,797	115,797	115,797
Firms	2,625	2,645	2,645	2,645	2,645
Firm FE	N	N	N	N	N
Quarter FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Wald test of repurchase intensity$_t$ interacted with:					
Int. var$_t$. - (1 - Int. var$_t$.) (test)	0.92	4.50	0.01	0.61	4.36
Int. var$_t$. - (1 - Int. var$_t$.) (p-value)	33.87%	3.40%	91.03%	43.52%	3.68%

This table report OLS regressions of delay (Panel A) and R-squared (Panel B) on dummy variables, contemporaneous repurchase intensity interacted with the dummy variables, and a set of control variables (untabulated). The control variables in Panel A and Panel B are similar to those in Table 3 and Table 4, respectively. Net insider selling is a dummy variable specifying net insider selling in the respective quarter. High options outstanding, high options exercised, and high cash to assets are dummy variables indicating firms with above median values at the implied program initiation (aggregated values over whole sample period for options exercised). EPS slightly beats forecast is a dummy variable indicating firms that beat their respective average EPS forecast by 0.1133 during a given quarter, while they contemporaneously repurchase shares. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic tests for differences between the coefficients of repurchases interacted with the respective interaction variable or not. The corresponding test statistics and p-values are presented for each Wald test.

In column (5), I allow for interaction between repurchase intensity and a variable that identifies share repurchases that beat the average EPS forecast by 0.05 during a quarter, while they contemporaneously repurchase shares. I chose a threshold of 0.05, because this is the median difference by which firms beat the average EPS forecast if they beat the EPS forecast. Panel A analyses the impact of detrimental repurchases on delay, while Panel B examines the impact on R-squared.

Panel A reports the results of the impact of detrimental repurchases on delay. Contrary to the benchmark paper, I obtain significant coefficients for the interaction variable and repurchase intensity interacted with the interaction variable in all specifications. The coefficients of lagged repurchase intensity not interacted with the interaction variable come with opposite signs in all models compared to the corresponding results in Table 3 and Table 4 due previously described endogeneity concerns when firms provide price support, which biases the coefficients. Therefore, I do not interpret the direct impact of these coefficients on price delay, but instead I compare the size of the coefficients of repurchase intensity not interacted with the interaction variable to the size of the corresponding coefficient interacted with the interaction variable. If the size of coefficient of repurchase intensity interacted with the interaction variable is bigger in proportion to the not interacted coefficient, this indicates that its impact on price efficiency is more detrimental when both coefficients suffer from the same bias due to the endogeneity concerns. Subsequently, I test whether the corresponding difference of the coefficients is statistically significant with the Wald test. The bias of the coefficients does not allow me to directly determine the negative impact of the potentially detrimental subsets of repurchases on the price efficiency of stocks, while I simultaneously capture the positive impact of the baseline set of repurchases on the price efficiency of stocks. However, a comparison of the size of the coefficients for both groups does indicate which subset of share repurchases is relatively more harmful to the price efficiency of stocks.

Column (1) reports a coefficient approximately twice as large for repurchase intensity interacted with net insider selling relative relatively to the coefficient of repurchase intensity interacted with net insider buying. The Wald test reports that the difference of the coefficients is statistically significant at a five percent level. This supports the notion that share repurchases with high net insider selling decrease price delay relatively less than repurchases with net insider buying. The results in column (2) indicate that repurchases of firms with relatively more options outstanding are more detrimental to stock price efficiency, since the corresponding coefficient is approximately twice as large as the coefficient for firms with less options outstanding. The difference of these coefficients is marginally insignificant at a 10% level. In column (3), I find that repurchases of firms with relatively high options exercised throughout the sample period are more harmful to price efficiency than firms with lower options exercised. The difference of the corresponding coefficients is statistically significant at a 10 percent level. These results support the notion that repurchases in which corporate insiders have most to gain are most detrimental to stock price efficiency. The results in column (3) do not indicate that share repurchases of firms with high cash are more harmful to stock price efficiency. The coefficient of firms that slightly beat the average EPS forecast is more than twice as large as the coefficient for firms that did not (column 5). The difference between the coefficients is statistically significant at a five percent level. This supports the notion that repurchases driven by management's desire to meet EPS targets are more detrimental to stock price efficiency. In Panel B of Table 8, I only find that share repurchases of firms with high options outstanding and firms that slightly beat the EPS forecast have a more harmful impact on the firm-specific risk of stock prices. The coefficients of firms with high options outstanding is twice as large as the coefficient of firms with low options outstanding and the difference of these coefficients is strongly statistically significant. I observe the same results for firms that slightly beat the EPS forecast.

In Panel A of Table A6 in the Appendix, I analyse the impact of detrimental repurchases in delay using a similar research design as in Table 8, but I replace contemporaneous repurchase intensity by the more exogenous repurchase dummy. Due to the more exogenous nature, the coefficients suffer less from the positive bias, which makes it easier to interpret the coefficients. I obtain significantly positive coefficients of repurchase intensity interacted with net insider selling, high options exercised, and the EPS dummy. The differences of the corresponding coefficients in column (1), column (3), and column (5) are strongly statistically significant. These results support the notion that share repurchases of firms with net insider selling, high options exercised, and firms that slightly beat the EPS forecast decrease the price efficiency of a stock. The results in Panel B provide further evidence that share repurchases by firms with high options outstanding and firms that slightly beat the EPS forecast increase the firm-specific risk. Although the corresponding coefficients itself lack significance, the difference between the coefficients is strongly statistically significant for both models (2 and 5). In Table A7 in the Appendix, I use the same specifications as in Table 8, but I additionally control for firm fixed effects. The results in Panel A on delay and in Panel B on R-squared mostly confirm my findings on the detrimental impact of share repurchases for firms with net insider selling, high options outstanding, high options exercised, and firms that slightly beat their EPS forecast.

I find the evidence of the detrimental effect of share repurchases on stock price efficiency most compelling for firms with net insider selling, high options outstanding, high options exercised, and firms that slightly beat their average analyst EPS forecast. Moreover, I obtain the strongest evidence that share repurchases increase the firm-specific risk of a stock for firms with high options outstanding and firms that slightly beat their average analyst EPS forecast. Therefore, repurchasing firms with net insider selling, high options outstanding, high options exercised, and firms that slight beat their average analyst EPS forecast have a more detrimental impact on the efficiency and the information content of stock prices. Based on all the evidence in the detrimental repurchase analysis and my results for repurchases by NYSE-listed firms during up markets (section 5.4.1), I accept the price manipulation hypothesis (hypothesis 1) and the EPS hypothesis (hypothesis 5) for these subsets of share repurchases.

5.7 Robustness tests

In this section, I will assess the validity of my results by examining an alternative measure of firm-specific risk, excluding the financial crisis from my sample, and the impact of prior levels of price efficiency.

5.7.1 Alternative measure of firm-specific risk

I use an alternative measure of firm-specific risk to determine whether the association I established between share repurchases and firm-specific risk still holds. Various studies use idiosyncratic volatility as a measure of firm-specific risk (Bali & Cakici, 2008; Ang, Hodrick, Xing & Zhang, 2009). Analogous to the benchmark paper, I define idiosyncratic volatility as the variance of the residual of a basic market model regression (equation 3) using daily returns. Table A8 in the Appendix reports the results for idiosyncratic volatility using the same specification as Table 5. The significant negative coefficient of lagged repurchase intensity affirm my findings that that share repurchases reduce firm-specific risk.

5.7.2 Share Repurchases and prior levels of efficiency

Busch and Obernberger (2016) find that the impact of share repurchases on the price efficiency and firm-specific risk of a stock is less prominent when the prior degree of efficiency is higher of a stock. To examine whether the impact of share repurchases on the efficiency of a stock depends on prior levels of efficiency of the stock for a firm I use the following research design. First, I compute the average delay, coefficient-based delay, R-squared, and absolute market correlation for each quarter over my entire sample. Subsequently, I determine the top and bottom quintile for every efficiency measure in all quarters. Next, I use a dummy variable to identify firms belonging to the top and bottom quintile in the previous quarter by the comparing the lagged value of the efficiency measure of a firm to the corresponding top and bottom quintiles of that quarter. This research design allows me to split contemporaneous repurchase activity in with high prior values of the corresponding efficiency measure, low prior values of the corresponding efficiency measure, and a baseline group. I present the results in Table A9 in the Appendix. In line with the benchmark paper, I find that buying back shares by firms in the best efficiency quintile does not further improve the efficiency of their stock prices. In Table A10 in the Appendix, I use the same research design, but I also include up and down market interaction terms in the specifications. The results mostly corroborate my findings for both market conditions.

5.8 Price support and the financial crisis

In Table 5, I find that share repurchases primarily increase the efficiency of a stock by providing price support below or at the intrinsic value when negative news comes to the market. In this section, I verify whether the evidence in favour of the price support argument is not driven by the financial market crisis. Therefore, I redo the analysis of section 5.4 after I exclude all observations from the third quarter of 2008 up to and including the first quarter of 2009. The results in Table A11 of the Appendix validate that the evidence in favor of the price support argument is not driven by the financial market crisis.

6 Conclusion

In this thesis, I investigate whether share repurchases in the United States increase the efficiency of stock prices. I address this question by analysing the influence of stock buybacks on the efficiency and information content of stock prices. I estimate the price efficiency of stocks with two measures of price delay and I determine the information content of stock prices with two measures of firm-specific risk. I employ a research design that additionally allows me to compare the impact of share repurchases of the efficiency of a stock price between firms listed on the NYSE and firms listed on the NASDAQ.

My results provide strong evidence that share repurchases in the US increase the speed and precision by which new market information is incorporated into the stock price. Specifically, I find strong support that firms increase the efficiency of their stock price by providing price support at the intrinsic value when negative news comes to the market. This is in line with the findings of the benchmark paper (Busch and Obernberger, 2016). Moreover, I find that firms providing price support on the NYSE increase the information content of their stock price significantly more than firms relative to firms providing price support on the NASDAQ. Therefore, I conclude that providing price support during period with negative market news improves the efficiency of a stock for both the NYSE and NASDAQ, but to a greater extent for firms listed on the NYSE.

However, my results also provide evidence that firms repurchasing shares on the NYSE during markets containing positive news reduce the efficiency of their stock price, since these repurchases decrease both efficiency and information content of their stock price. These findings support the price manipulation hypothesis, which states that management intentionally increases the firm's stock price above its intrinsic value to boost their equity-based compensation. Further analysis zooming in on share repurchases whereof corporate insiders have most to gain, provides additional support for the price manipulation argument. I find that share repurchases by firms with net insider selling, high options outstanding, and high options exercised have a detrimental effect on the efficiency of the stock price. Furthermore, I find that share repurchases driven by management's desire to beat the analyst EPS forecast reduce the efficiency of a stock price. Therefore, I conclude that share repurchases on the NYSE during periods with positive news decrease the efficiency of a stock price, particularly for firms where corporate insiders have most to gain from stock price manipulation. Consequently, the evidence in my thesis is not congruent with the notion that share repurchases incorporate positive information into the stock price. Finally, I conclude that share repurchases primarily increase the efficiency of stock prices, since the overall evidence is most profound for the price support argument. However, I deduce that a particular group of share repurchases reduce the efficiency of stock prices from evidence of share repurchases in markets with positive news and the detrimental share repurchases analysis.

My paper contributes to the existing academic literature in three ways. First, I contribute to the bibliography that investigates the impact of actual share repurchases on the efficiency of stock prices. My work complements Busch and Obernberger (2016) by providing evidence that their findings in line with the price support argument still hold for a more recent period, while my support for the price manipulation argument for a particular group of share repurchases is inconsistent with their findings. I ascribe this discrepancy in our findings to the intensified use of stock options recently, which incentivizes managers to manipulate stock prices for their own capital gain. Furthermore, I augment the research of the benchmark paper by reporting that repurchases by NYSE-listed firms increase the efficiency of stock prices more than NASDAQ-listed firms. This difference is best explained by the better managerial timing ability of NYSE-listed firms and more extensive use of repurchases to provide price support by NYSE-listed firms relative to NASDAQ-listed firms (Cook, Krigman & Leach, 2003b). Second, I contribute to the body of literature that examines if specific types of investors, like institutional traders, short sellers, and corporate insiders impact the efficiency of stock prices[1]. Conversely to Busch and Obernberger (2016), I do document that institutional traders, short sellers, and corporate insiders may have a detrimental impact on stock efficiency of stock prices. Third, I contribute to the literature on earnings management and analyst forecasts by reporting that analyst EPS forecast-driven repurchases reduce efficiency of stock prices[2].

I acknowledge that my research design is limited in its methodology to circumvent the previously mentioned endogeneity and reverse causality concerns. Hence, it is recommended that further research investigates this subject using more detailed and complete set of repurchase data to provide further compelling evidence. However, in the light of the reinvigorated debate on open market share repurchases amongst US politicians and legislators, my research provides the valuable insight that actual share repurchases mainly increase the efficiency of stock prices. However, my research recommends a reform of the law on actual repurchases to curb the harmful effects of a particular group of share repurchases to the US economy. Finally, my paper informs shareholders that share repurchases are not necessarily in their best interest.

[1]For example, Bris, Goetzmann & Zhu (2007), Boehmer, Jones & Zhang (2008), Boehmer & Kelley (2009), Phillips (2011), Saffi & Sigurdsson (2011), Boehmer & Wu (2012), and An & Zhang (2013).
[2]For instance, Bens, Nagar, Skinner & Wong (2003), Hribar, Jenkins & Johnson (2006), Young & Yang (2011), Cheng, Harford & Zhang (2015), and Almeida, Fos & Kronlund (2016).

References

Abarbanell, J., & Lehavy, R. (2003). Biased forecasts or biased earnings? The role of reported earnings in explaining apparent bias and over/underreaction in analysts' earnings forecasts. *Journal of Accounting and Economics, 36*(1-3), 105-146.

Ali, A., Hwang, L. S., & Trombley, M. A. (2003). Arbitrage risk and the book-to-market anomaly. *Journal of Financial Economics, 69*(2), 355-373.

Almeida, H. (2018). Is It Time to Get Rid of Earnings-per-Share (EPS)? *Review of Corporate Finance Studies, 8*(1), 174-206.

Almeida, H., Fos, V., & Kronlund, M. (2016). The real effects of share repurchases. *Journal of Financial Economics, 119*(1), 168-185.

An, H., & Zhang, T. (2013). Stock price synchronicity, crash risk, and institutional investors. *Journal of Corporate Finance, 21*, 1-15.

Ang, A., Hodrick, R. J., Xing, Y., & Zhang, X. (2009). High idiosyncratic volatility and low returns: International and further US evidence. *Journal of Financial Economics, 91*(1), 1-23.

Au, A. S., Doukas, J. A., & Onayev, Z. (2009). Daily short interest, idiosyncratic risk, and stock returns. *Journal of Financial Markets, 12*(2), 290-316.

Babenko, I. (2009). Share repurchases and pay-performance sensitivity of employee compensation contracts. *The Journal of Finance, 64*(1), 117-150.

Bagnoli, M., Gordon, R., & Lipman, B. L. (1989). Stock repurchase as a takeover defense. *The Review of Financial Studies, 2*(3), 423-443.

Bagwell, L. S. (1991). Share repurchase and takeover deterrence. *The Rand journal of economics*, 72-88.

Bali, T. G., & Cakici, N. (2008). Idiosyncratic volatility and the cross section of expected returns. *Journal of Financial and Quantitative Analysis, 43*(1), 29-58.

Banyi, M. L., Dyl, E. A., & Kahle, K. M. (2008). Errors in estimating share repurchases. *Journal of Corporate Finance, 14*(4), 460-474.

Bargeron, L., Kulchania, M., & Thomas, S. (2011). Accelerated share repurchases. *Journal of Financial Economics, 101*(1), 69-89.

Ben-Rephael, A., Oded, J., & Wohl, A. (2014). Do firms buy their stock at bargain prices? Evidence from actual stock repurchase disclosures. *Review of Finance, 18*(4), 1299-1340.

Bens, D. A., Nagar, V., Skinner, D. J., & & Wong, M. F. (2003). Employee stock options, EPS dilution, and stock repurchases. *Journal of Accounting and Economics, 36*(1-3), 51-90.

Bessembinder, H. (1999). Trade execution costs on Nasdaq and the NYSE: A post-reform comparison. *Journal of Financial and Quantitative Analysis, 34*(3), 387-407.

Bessembinder, H., & Kaufman, H. M. (1997). A comparison of trade execution costs for NYSE and NASDAQ-listed stocks. *Journal of Financial and Quantitative Analysis, 32*(3), 287-310.

Billett, M. T., & Xue, H. (2007). The takeover deterrent effect of open market share repurchases. *The Journal of finance, 62*(4), 1827-1850.

Boehmer, E., & Kelley, E. K. (2009). Institutional investors and the informational efficiency of prices. *The Review of Financial Studies, 22*(9), 3563-3594.

Boehmer, E., & Wu, J. (2012). Short selling and the price discovery process. *The Review of Financial Studies, 26*(2), 287-322.

Boehmer, E., Jones, C. M., & Zhang, X. (2008). Which shorts are informed? *The Journal of Finance, 63*(2), 491-527.

Bonaimé, A. A., & Ryngaert, M. D. (2013). Insider trading and share repurchases: Do insiders and firms trade in the same direction? *Journal of Corporate Finance, 22*, 35-53.

Bonaimé, A. A., Hankins, K. W., & Jordan, B. D. (2016). The cost of financial flexibility: Evidence from share repurchases. *Journal of Corporate Finance, 38*, 345-362.

Bozanic, Z. (2010). Managerial motivation and timing of open market share repurchases. *Review of Quantitative Finance and Accounting, 34*(4), 517-531.

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

Brennan, M. J., & Subrahmanyam, A. (1995). Investment analysis and price formation in securities markets. *Journal of financial economics, 38*(3), 361-381.

Bris, A., Goetzmann, W. N., & Zhu, N. (2007). Efficiency and the bear: Short sales and markets around the world. *The Journal of Finance, 62*(3), 1029-1079.

Brockman, P., Howe, J. S., & Mortal, S. (2008). Stock market liquidity and the decision to repurchase. *Journal of Corporate Finance, 14*(4), 446-459.

Busch, P., & Obernberger, S. (2016). Actual share repurchases, price efficiency, and the information content of stock prices. *The review of financial studies, 30*(1), 324-362.

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

Cheng, Y., Harford, J., & Zhang, T. T. (2015). Bonus-driven repurchases. *Journal of Financial and Quantitative Analysis, 50*(3), 447-475.

Chordia, T., Roll, R., & Subrahmanyam, A. (2008). Liquidity and market efficiency. *Journal of Financial Economics, 87*(2), 249-268.

Chung, D., & Hrazdil, K. (2010). Liquidity and market efficiency: A large sample study. *Journal of Banking & Finance, 34*(10), 2346-2357.

Chung, K. H., Van Ness, B. F., & Van Ness, R. A. (2004). Trading costs and quote clustering on the NYSE and NASDAQ after decimalization. *Journal of Financial Research, 27*(3), 309-328.

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

Cook, D. O., Krigman, L., & Leach, J. C. (2003a). An analysis of SEC guidelines for executing open market repurchases. *The Journal of Business, 76*(2), 289-315.

Cook, D. O., Krigman, L., & Leach, J. C. (2003b). On the timing and execution of open market repurchases. *The Review of Financial Studies, 17*(2), 463-498.

De Cesari, A., Espenlaub, S., Khurshed, A., & Simkovic, M. (2012). The effects of ownership and stock liquidity on the timing of repurchase transactions. *Journal of Corporate Finance, 18*(5), 1023-1050.

Dittmar, A. K. (2000). Why do firms repurchase stock. *The Journal of Business, 73*(3), 331-355.

Dittmar, A., & Field, L. C. (2015). Can managers time the market? Evidence using repurchase price data. *Journal of Financial Economics, 115*(2), 261-282.

Duan, Y., Hu, G., & McLean, R. D. (2010). Costly arbitrage and idiosyncratic risk: Evidence from short sellers. *Journal of Financial Intermediation, 19*(4), 564-579.

Fenn, G. W., & Liang, N. (2001). Corporate payout policy and managerial stock incentives. *Journal of financial economics, 60*(1), 45-72.

Ferreira, M. A., & Laux, P. A. (2007). Corporate governance, idiosyncratic risk, and information flow. *The Journal of Finance, 62*(2), 951-989.

Floyd, E., Li, N., & Skinner, D. J. (2015). Payout policy through the financial crisis: The growth of repurchases and the resilience of dividends. *Journal of Financial Economics, 118*(2), 299-316.

Fu, F. (2009). Idiosyncratic risk and the cross-section of expected stock returns. *Journal of financial Economics, 91*(1), 24-37.

Grullon, G., & Ikenberry, D. L. (2000). What do we know about stock repurchases? *Journal of Applied Corporate Finance, 13*(1), 31-51.

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

Hillert, A., Maug, E., & Obernberger, S. (2016). Stock repurchases and liquidity. *Journal of financial economics, 119*(1), 186-209.

Hong, H., Wang, J., & Yu, J. (2008). Firms as buyers of last resort. *Journal of Financial Economics, 88*(1), 119-145.

Hou, K., & Moskowitz, T. J. (2005). Market frictions, price delay, and the cross-section of expected returns. *The Review of Financial Studies, 18*(3), 981-1020.

Hribar, P., Jenkins, N. T., & Johnson, W. B. (2006). Stock repurchases as an earnings management device. *Journal of Accounting and Economics, 41*(1-2), 3-27.

Huang, R. D., & Stoll, H. R. (1996). Dealer versus auction markets: A paired comparison of execution costs on NASDAQ and the NYSE. *Journal of Financial economics, 41*(3), 313-357.

Hutton, A. P., Marcus, A. J., & Tehranian, H. (2009). Opaque financial reports, R2, and crash risk. *Journal of financial Economics, 94*(1), 67-86.

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.

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

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

Kahle, K. M., & Stuhlz, R. M. (2017). Is the US public corporation in trouble? *Journal of Economic Perspectives, 31*(3), 67-88.

Lee, D. D., & Faff, R. W. (2009). Corporate sustainability performance and idiosyncratic risk: A global perspective. *Financial Review, 44*(2), 231-237.

Li, K., & McNally, W. (2003). The decision to repurchase, announcement returns and insider holdings: A conditional event study. *The ICFAI Journal of Applied Finance*, *9*(6), 55-70.

Livnat, J., & Mendenhall, R. R. (2006). Comparing the post–earnings announcement drift for surprises calculated from analyst and time series forecasts. *Journal of accounting research, 44*(1), 177-205.

Malkiel, B. G., & Xu, Y. (1997). Risk and return revisited. *Journal of Portfolio Management, 23*(3), 9-14.

Maxwell, W. F., & Stephens, C. P. (2003). The wealth effects of repurchases on bondholders. *The Journal of Finance*, *58*(2), 895-919.

Mehran, H. (1995). Executive compensation structure, ownership, and firm performance. *Journal of financial economics, 38*(2), 163-184.

Michel, A., Oded, J., & Shaked, I. (2010). Not all buybacks are created equal: The case of accelerated stock repurchases. *Financial Analysts Journal*, *66*(6), 55-72.

Morck, R., Yeung, B., & Yu, W. (2000). The information content of stock markets: why do emerging markets have synchronous stock price movements? *Journal of financial economics, 58*(1-2), 215-260.

Oswald, D., & Young, S. (2008). Share reacquisitions, surplus cash, and agency problems. *Journal of Banking & Finance, 32*(5), 795-806.

Phillips, B. (2011). Options, short-sale constraints and market efficiency: A new perspective. *Journal of Banking & Finance, 35*(2), 430-442.

Saffi, P. A., & Sigurdsson, K. (2010). Price efficiency and short selling. *The Review of Financial Studies*, *24*(3), 821-852.

Sinha, S. (1991). Share repurchase as a takeover defense. *Journal of Financial and Quantitative Analysis*, *26*(2), 233-244.

Skinner, D. J. (2008). The evolving relation between earnings, dividends, and stock repurchases. *Journal of financial economics, 87*(3), 582-609.

Spiegel, M. I., & Wang, X. (2005). Cross-sectional variation in stock returns: Liquidity and idiosyncratic risk.

Stephens, C. P., & Weisbach, M. S. (1998). Actual share reacquisitions in open-market repurchase programs. *The Journal of finance, 53*(1), 313-333.

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

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

Young, S., & Yang, J. (2011). Stock repurchases and executive compensation contract design: The role of earnings per share performance conditions. *The Accounting Review*, *86*(2), 703-733.

Appendix

Table A1: Overview of the number of firms and firm-quarters after each merge

	Firms	Firm-quarters
CRSP monthly stock data	15,106	456,457
Compustat quarterly fundamentals	5,486	228,429
Compustat annual fundamentals	5,475	224,733
CRSP daily stock data	5,474	224,072
IBES analyst data	4,893	205,025
Missing baseline data and data manipulation	(2,137)	(84,619)
Final dataset	2,756	120,406

This table provides an overview of the number of firms and firm-quarters after each dataset merger. Missing baseline data and data manipulation report the number of firms and firm-quarters lost due to missing baseline data and data preparation. The parenthesis denote negative values.

Table A2: Description of variables

Name	Definition	Source	Unit
Acquiror	1 if the firm is currently bidding for another firm	ThomsonOne	Binary
Analysts	Quarterly sum of the monthly number of analysts(ln)	IBES	Unit
Book to market	Book value of equity / market cap, winsorized at 1%	Compustat	Ratio
Book value of equity	Ordinary equity (ceqq)	Compustat	Million
Cash	Cash and short-term investments (cheq)	Compustat	Million
Change in short interest	Change of short interest at quarter end scaled by common shares outstanding	Compustat	Ratio
Coefficient-based delay	Price efficiency measure computed as the lag-weighted sum of the scaled absolute coefficients of the lagged market returns relative to the sum of all scaled coefficients. All coefficients are scaled by their corresponding standard errors.	CRSP	Ratio
Common shares outstanding	Number of common shares outstanding at the last trading day of the quarter (cshoq)	Compustat	Million
Delay	Price efficiency measure computed by the proportion of the R^2 of the basic market model to the R^2 of the extended market model	CRSP	Ratio
Deviation price from $30	Absolute difference between $30 and the stock price (ln)	CRSP	Unit
Dividends	Total dividends (dvt)	Compustat	Million
EBITDA	Operating income before depreciation (oibdpq)	Compustat	Unit
EPS difference	Difference between the average analyst EPS forecast in a quarter and the corresponding actual reported EPS	IBES	Ratio
EPS slightly beats forecast	1 if the firm EPS difference is greater than zero and no greater than 0.05 in a quarter, while the firm contemporaneously repurchases shares	IBES	Binary
Idiosyncratic volatility	Variance of the residual of the basic market model regression (equation 3) for each quarter using daily returns (ln)	CRSP	Unit
Institutional ownership	Shares held by institutions scaled by shares outstanding	TR Inst. Hold.	Ratio

(Continued)

Table A2 (continued)

Name	Definition	Source	Unit
Kurtosis	Measures how much the tails of the distribution of stock returns differ from the tails of a normal distribution over one quarter (ln)	CRSP	Unit
Leverage	(Total asset – book value of equity) / (total asset – book value of equity + market cap)	Compustat / CRSP	Ratio
Market capitalization	Common shares outstanding times price	Compustat / CRSP	Million
Market correlation	Correlation between daily stock return and contemporaneous market return	CRSP	Unit
Market return	Quarterly average of a monthly value-weighted market portfolio (including distributions)	CRSP	Unit
NASDAQ	1 if firm is listed on the NASDAQ	CRSP	Binary
Net insider trading	Insider buying minus insider selling scaled by market cap	TR Inst. Filings	Ratio
NYSE	1 if firm is listed on the NYSE	CRSP	Binary
Options exercised	Number of shares obtained by option exercises of corporate insiders in the respective quarter scaled by common shares outstanding	TR. Inst. Filings	Ratio
Options outstanding	Outstanding options scaled by common shares outstanding	Compustat	Ratio
Price	Quarterly average of the daily stock price	CRSP	Unit
Relative spread	Quarterly average of the daily relative spread (ln)	CRSP	Ratio
Repurchase dummy	1 if a firm repurchases shares	Compustat	Binary
Repurchase intensity	Number of shares repurchased during the quarter divided by the number of common shares outstanding in the previous quarter	Compustat	Ratio
Repurchase intensity (TV)	Number of shares repurchased during the quarter divided by the number of shares repurchased over the current quarter	Compustat	Ratio
Repurchase volume	Number of shares repurchased during the quarter times price	Compustat / CRSP	Million
Return	Quarterly average of monthly stock return	CRSP	Unit
Return > 0	Return if positive, otherwise zero	CRSP	Unit
Return < 0	Return if negative, otherwise zero	CRSP	Unit
R-squared	R-squared estimate of the market model regressions (equation 3 and 4) using daily returns	CRSP	Ratio
Target	1 if the firm is currently a target of another firm	ThomsonOne	Binary
Total assets	Total assets (ln) – (atq)	Compustat	Million
Trading volume	Quarterly number of common shares traded minus shares repurchased over the quarter scaled by common shares outstanding	Compustat	Ratio
Volatility	Standard deviation of daily returns over one quarter (ln)	CRSP	Unit

This table outlines the dependent variables, the repurchase variables, and the control variables used in my empirical analysis. The table report the definition, the data source, and the unit of measurement for each variable. Several variables from Compustat contain the mnemonic within parenthesis at the end of their definition. Furthermore, variables denoted with (ln) in the definition are expressed as natural logarithms.

Table A3: Trading volume
A. The influence on delay

Dependent variable:	Delay			
Model:	(1)	(2)	(3)	(4)
Trading volume$_{t-1}$	-0.0901***	-0.0181***	0.0366***	0.0174***
	(-13.76)	(-6.76)	(12.55)	(5.47)
Delay$_{t-1}$		0.3992***	0.3321***	0.1641***
		(79.59)	(66.93)	(33.89)
Repurchase intensity$_{t-1}$		-0.0899*	0.0631	-0.1427***
		(-1.74)	(1.20)	(-2.86)
Return$_{t-1}$ > 0 t-1		-0.1883***	-0.1432***	-0.1106***
		(-10.58)	(-8.80)	(-7.02)
Return$_{t-1}$ < 0 t-1		-0.0917***	-0.1730***	-0.1547***
		(-3.78)	(-7.70)	(-7.30)
Market cap$_{t-1}$ (ln)		-0.0400***	-0.0114***	-0.0451***
		(-35.91)	(-9.18)	(-16.38)
Book to market$_{t-1}$		0.0095***	-0.0071**	0.0111***
		(2.97)	(-2.41)	(2.89)
Volatility$_{t-1}$ (ln)			-0.0438***	-0.0367***
			(-14.38)	(-11.68)
Analysts$_{t-1}$ (ln)			-0.0008	-0.0038**
			(-0.80)	(-2.56)
Relative spread$_{t-1}$ (ln)			0.0692***	0.0380***
			(36.43)	(18.32)
Deviation price from 30$$_{t-1}$			0.0001**	0.0002***
			(2.52)	(3.62)
Change in short interest$_{t-1}$			-0.0210	0.0168
			(-1.46)	(1.15)
Institutional ownership$_{t-1}$			-0.0430***	-0.0326***
			(-7.26)	(-4.36)
Constant	0.3898***	1.0392***	0.7350***	1.3235***
	(51.12)	(42.46)	(32.30)	(25.18)
R-squared	0.097	0.409	0.440	0.195
Observations	120,406	119,945	115,734	115,734
Firms	2,756	2,756	2,645	2,645
Firm FE	N	N	N	Y
Quarter FE	Y	Y	Y	Y

(Continued)

Table A3: Trading volume
B. The impact on R-squared

Dependent variable:	R-squared			
Model:	(1)	(2)	(3)	(4)
Trading volume$_{t-1}$	0.0343***	-0.0001	0.0053***	0.0014
	(8.37)	(-0.05)	(3.42)	(0.84)
R-squared$_{t-1}$		0.4930***	0.2552***	0.2488***
		(98.34)	(60.63)	(58.28)
Repurchase intensity$_{t-1}$		0.0701**	0.1540***	0.1334***
		(2.11)	(5.17)	(4.31)
Market cap$_{t-1}$ (ln)		0.0239***	0.0341***	0.0232***
		(36.18)	(26.94)	(14.88)
Book to market$_{t-1}$		0.0027	-0.0123***	-0.0110***
		(1.60)	(-5.95)	(-5.18)
Analysts$_{t-1}$ (ln)				0.0010
				(1.19)
Relative spread$_{t-1}$ (ln)				-0.0157***
				(-13.70)
Deviation price from 30$$_{t-1}$				-0.0000
				(-1.49)
Change in short interest$_{t-1}$				-0.0490***
				(-5.75)
Institutional ownership$_{t-1}$				0.0114***
				(2.97)
Constant	0.1788***	-0.3959***	-0.5565***	-0.4339***
	(44.30)	(-30.73)	(-21.05)	(-14.98)
R-squared	0.224	0.553	0.413	0.413
Observations	120,406	119,945	119,945	115,734
Firms	2,756	2,756	2,756	2,645
Firm FE	N	N	Y	Y
Quarter FE	Y	Y	Y	Y

This table presents OLS regressions of delay (Panel A) and R-squared (Panel B) on trading volume, lagged repurchase intensity, and a set of control variables. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively.

Table A4: Change in short interest

A. The impact on delay

Dependent variable:	Delay			
Model:	(1)	(2)	(3)	(4)
Change in short interest$_{t-1}$	-0.0168	-0.0095	-0.0210	0.0168
	(-1.00)	(-0.66)	(-1.46)	(1.15)
Delay$_{t-1}$		0.4025***	0.3321***	0.1641***
		(78.05)	(66.93)	(33.89)
Repurchase intensity$_{t-1}$		-0.1018*	0.0631	-0.1427***
		(-1.87)	(1.20)	(-2.86)
Return$_{t-1}$ > 0		-0.2306***	-0.1432***	-0.1106***
		(-12.18)	(-8.80)	(-7.02)
Return$_{t-1}$ < 0		-0.0237	-0.1730***	-0.1547***
		(-0.91)	(-7.70)	(-7.30)
Market cap$_{t-1}$ (ln)		-0.0412***	-0.0114***	-0.0451***
		(-35.56)	(-9.18)	(-16.38)
Book to market$_{t-1}$		0.0117***	-0.0071**	0.0111***
		(3.41)	(-2.41)	(2.89)
Volatility$_{t-1}$ (ln)			-0.0438***	-0.0367***
			(-14.38)	(-11.68)
Analysts$_{t-1}$ (ln)			-0.0008	-0.0038**
			(-0.80)	(-2.56)
Relative spread$_{t-1}$ (ln)			0.0692***	0.0380***
			(36.43)	(18.32)
Deviation price from 30$$_{t-1}$			0.0001**	0.0002***
			(2.52)	(3.62)
Trading volume$_{t-1}$			0.0366***	0.0174***
			(12.55)	(5.47)
Institutional ownership$_{t-1}$			-0.0430***	-0.0326***
			(-7.26)	(-4.36)
Constant	0.3498***	1.0570***	0.7350***	1.3235***
	(53.61)	(41.33)	(32.30)	(25.18)
R-squared	0.073	0.411	0.440	0.195
Observations	115,797	115,734	115,734	115,734
Firms	2,645	2,645	2,645	2,645
Firm FE	N	N	N	Y
Quarter FE	Y	Y	Y	Y

(continued)

Table A4: Change in short interest
B. The impact on R-squared

Dependent variable:	R-squared			
Model:	(1)	(2)	(3)	(4)
Change in short interest$_{t-1}$	-0.0574***	-0.0451***	-0.0466***	-0.0490***
	(-5.61)	(-4.93)	(-5.59)	(-5.75)
R-squared$_{t-1}$			0.2538***	0.2488***
			(59.27)	(58.28)
Repurchase intensity$_{t-1}$			0.1644***	0.1334***
			(5.28)	(4.31)
Market cap$_{t-1}$ (ln)			0.0343***	0.0232***
			(25.88)	(14.88)
Book to market$_{t-1}$			-0.0123***	-0.0110***
			(-5.63)	(-5.18)
Analysts$_{t-1}$ (ln)				0.0010
				(1.19)
Relative spread$_{t-1}$ (ln)				-0.0157***
				(-13.70)
Deviation price from 30$$_{t-1}$				-0.0000
				(-1.49)
Trading volume$_{t-1}$				0.0014
				(0.84)
Institutional ownership$_{t-1}$				0.0114***
				(2.97)
Constant	0.1941***	0.1889***	-0.5577***	-0.4339***
	(57.32)	(62.06)	(-20.14)	(-14.98)
R-squared	0.215	0.344	0.411	0.413
Observations	115,797	115,797	115,734	115,734
Firms	2,645	2,645	2,645	2,645
Firm FE	N	Y	Y	Y
Quarter FE	Y	Y	Y	Y

This table presents OLS regressions of delay (Panel A) and R-squared (Panel B) on change in short interest, lagged repurchase intensity, and a set of control variables. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively.

Table A5: The impact of share repurchases on volatility and kurtosis

Dependent variable:	Volatility (ln)			Kurtosis (ln)		
Exchange:		NYSE	NASDAQ		NYSE	NASDAQ
Model:	(1)	(2)	(2)	(3)	(4)	(4)
Repurchase intensity$_{t-1}$	-0.8611***	-0.7794***	-0.9482***	-0.0377	0.1755	-0.2473
	(-12.09)	(-8.01)	(-9.24)	(-0.27)	(0.89)	(-1.19)
Volatility$_{t-1}$ (ln)	0.4080***	0.3831***	0.4222***			
	(78.05)	(55.80)	(67.02)			
Kurtosis$_{t-1}$ (ln)				0.0297***	0.0259***	0.0320***
				(8.23)	(4.96)	(6.59)
Return$_{t-1}$ > 0	0.1925***	0.2279***	0.1651***	-0.1025**	-0.2681***	-0.0034
	(7.89)	(6.89)	(5.23)	(-2.50)	(-4.73)	(-0.06)
Return$_{t-1}$ < 0	-1.0242***	-1.1956***	-0.9064***	-0.4991***	-0.3335***	-0.6072***
	(-30.58)	(-24.87)	(-20.73)	(-8.47)	(-3.93)	(-7.99)
Market cap$_{t-1}$ (ln)	-0.0679***	-0.0735***	-0.0616***	-0.0372***	-0.0347***	-0.0424***
	(-17.27)	(-18.35)	(-14.90)	(-6.34)	(-5.79)	(-6.93)
Book to market$_{t-1}$	0.0302***	0.0224***	0.0360***	0.0262***	0.0051	0.0391***
	(5.03)	(3.22)	(4.66)	(3.06)	(0.44)	(3.78)
Analysts$_{t-1}$ (ln)	-0.0001	0.0017	-0.0016	0.0004	-0.0056	0.0051
	(-0.05)	(0.60)	(-0.66)	(0.11)	(-1.17)	(1.16)
Relative spread$_{t-1}$ (ln)	0.0233***	0.0184***	0.0274***	-0.0223***	-0.0175***	-0.0277***
	(9.44)	(5.66)	(7.86)	(-4.84)	(-2.88)	(-4.69)
Deviation price from 30$$_{t-1}$	0.0003***	0.0003***	0.0002**	-0.0001	-0.0000	-0.0001
	(3.61)	(2.76)	(2.34)	(-1.23)	(-0.43)	(-1.33)
Trading volume$_{t-1}$	0.0492***	0.0695***	0.0393***	0.0128*	0.0136	0.0166*
	(11.21)	(11.08)	(6.93)	(1.78)	(1.30)	(1.71)
Change in short interest$_{t-1}$	0.1115***	0.0341	0.1725***	-0.0644	-0.1351**	-0.0083
	(5.96)	(1.28)	(6.91)	(-1.58)	(-2.40)	(-0.15)
Institutional ownership$_{t-1}$	0.0094	0.0031	0.0125	0.0117	-0.0239	0.0301*
	(1.04)	(0.25)	(1.09)	(0.84)	(-1.02)	(1.78)
Constant	-0.8160***	-0.8490***		2.0781***	2.1172***	
	(-10.86)	(-11.13)		(18.83)	(19.14)	
R^2(within firm)	0.624	0.625		0.046	0.046	
Observations	115,734	115,734		115,734	115,734	
Firms	2,645	2,645		2,645	2,645	
Wald test of repurchase intensity$_{t-1}$ interacted with:						
NYSE - NASDAQ (test)		1.43			2.20	
NYSE - NASDAQ (p-value)		23.20%			13.83%	

This table reports OLS regressions of volatility and kurtosis on lagged repurchase intensity and a set of control variables (untabulated). Please note that both model (2) and (4) are one regression model presented in two columns. Each column reports the coefficients of the corresponding variable interacted with the firms' exchange listing (NYSE or NASDAQ). The control variables are similar to those in Table 3. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic tests for differences between the coefficients of repurchases by NYSE-listed firms and NASDAQ-listed firms in model (2) and (4). The corresponding test statistics and p-values are presented for each Wald test.

Table A6: Contemporaneous repurchase dummy and detrimental repurchases

A. The impact on price delay

Dependent variable:	Delay				
Model:	(1)	(2)	(3)	(4)	(5)
Interaction variable:	Net insider selling	High options outstanding	High options exercised	High cash to assets	EPS slightly beats forecast
Interaction variable$_t$:	-0.0099***	0.0153***	-0.0068**	0.0145***	-0.0186***
	(-4.11)	(4.45)	(-2.06)	(4.52)	(-6.30)
Repurchase dummy$_t$	0.0040*	0.0014	0.0049**	-0.0006	0.0075**
× Interaction variable$_t$	(1.85)	(0.66)	(1.99)	(-0.26)	(2.03)
Repurchase dummy$_t$	-0.0026	-0.0030	-0.0038	0.0011	-0.0002
× (1 - Interaction variable$_t$)	(-1.07)	(-0.93)	(-1.46)	(0.41)	(-0.10)
R-squared	0.440	0.441	0.440	0.441	0.441
Observations	110,813	115,797	115,797	115,797	115,797
Firms	2,625	2,645	2,645	2,645	2,645
Firm FE	N	N	N	N	N
Quarter FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Wald test of repurchase dummy$_t$ interacted with:					
Int. var$_t$. - (1 - Int. var$_t$.) (test)	5.63	1.33	6.00	0.24	4.29
Int. var$_t$. - (1 - Int. var$_t$.) (p-value)	1.77%	24.84%	1.44%	62.60%	3.84%

B. The impact on R-squared

Dependent variable:	R-squared				
Model:	(1)	(2)	(3)	(4)	(5)
Interaction variable:	Net insider selling	High options outstanding	High options exercised	High cash to assets	EPS slightly beats forecast
Interaction variable$_t$:	0.0027**	-0.0077***	0.0035*	-0.0113***	0.0090***
	(1.99)	(-3.90)	(1.86)	(-6.01)	(5.16)
Repurchase dummy$_t$	0.0014	-0.0009	0.0007	0.0014	-0.0039
× Interaction variable$_t$	(0.89)	(-0.62)	(0.39)	(0.89)	(-1.62)
Repurchase dummy$_t$	0.0005	0.0056***	0.0012	0.0010	0.0016
× (1 - Interaction variable$_t$)	(0.38)	(2.77)	(0.77)	(0.58)	(1.36)
R-squared	0.562	0.563	0.563	0.563	0.563
Observations	110,813	115,797	115,797	115,797	115,797
Firms	2,625	2,645	2,645	2,645	2,645
Firm FE	N	N	N	N	N
Quarter FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Wald test of repurchase dummy$_t$ interacted with:					
Int. var$_t$. - (1 - Int. var$_t$.) (test)	0.23	6.89	0.06	0.02	5.31
Int. var$_t$. - (1 - Int. var$_t$.) (p-value)	63.41%	0.87%	80.88%	87.58%	2.13%

This table report OLS regressions of delay (Panel A) and R-squared (Panel B) on dummy variables, contemporaneous dummy intensity interacted with the dummy variables, and a set of control variables (untabulated). The control variables in Panel A and Panel B are similar to those in Table 3 and Table 4, respectively. Net insider selling is a dummy variable specifying net insider selling in the respective quarter. High options outstanding, high options exercised, and high cash to assets are dummy variables indicating firms with above median values at the implied program initiation (aggregated values over whole sample period for options exercised). EPS slightly beats forecast is a dummy variable indicating firms that beat their respective average EPS forecast by 0.1133 during a given quarter, while they contemporaneously repurchase shares. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic tests for differences between the coefficients of repurchases interacted with the respective interaction variable or not. The corresponding test statistics and p-values are presented for each Wald test.

Table A7: Detrimental repurchases with firm fixed effects

A. The impact on delay

Dependent variable:	Delay				
Model:	(1)	(2)	(3)	(4)	(5)
Interaction variable:	Net insider selling	High options outstanding	High options exercised	High cash to assets	EPS slightly beats forecast
Interaction variable$_t$:	-0.0074***				-0.0126***
	(-4.14)				(-6.34)
Repurchase dummy$_t$	0.3096***	0.2856***	0.2446***	0.2923***	0.4077***
× Interaction variable$_t$	(4.66)	(4.73)	(3.44)	(4.26)	(2.77)
Repurchase dummy$_t$	0.1442*	0.0163	0.1984**	0.1291	0.1944***
× (1 - Interaction variable$_t$)	(1.80)	(0.16)	(2.57)	(1.64)	(3.60)
R^2(within firm)	0.194	0.195	0.195	0.195	0.195
Observations	110,813	115,797	115,797	115,797	115,797
Firms	2,625	2,645	2,645	2,645	2,645
Firm FE	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Wald test of repurchase intensity$_t$ interacted with:					
Int. var$_t$. - (1 - Int. var$_t$.) (test)	2.75	5.27	0.20	2.48	1.96
Int. var$_t$. - (1 - Int. var$_t$.) (p-value)	9.73%	2.17%	65.68%	11.51%	16.16%

B. The impact on R-squared

Dependent variable:	R-squared				
Model:	(1)	(2)	(3)	(4)	(5)
Interaction variable:	Net insider selling	High options outstanding	High options exercised	High cash to assets	EPS slightly beats forecast
Interaction variable$_t$:	0.0040***				0.0060***
	(3.88)				(4.78)
Repurchase dummy$_t$	-0.2280***	-0.2449***	-0.1788***	-0.2584***	-0.3316***
× Interaction variable$_t$	(-5.57)	(-6.80)	(-4.06)	(-6.30)	(-3.87)
Repurchase dummy$_t$	-0.1931***	-0.0969	-0.2448***	-0.1456***	-0.1918***
× (1 - Interaction variable$_t$)	(-4.08)	(-1.47)	(-5.48)	(-2.97)	(-5.79)
R^2(within firm)	0.413	0.413	0.413	0.413	0.413
Observations	110,813	115,797	115,797	115,797	115,797
Firms	2,625	2,645	2,645	2,645	2,645
Firm FE	Y	Y	Y	Y	Y
Quarter FE	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y
Wald test of repurchase intensity$_t$ interacted with:					
Int. var$_t$. - (1 - Int. var$_t$.) (test)	0.34	3.92	1.12	3.16	2.43
Int. var$_t$. - (1 - Int. var$_t$.) (p-value)	56.21%	4.79%	29.00%	7.57%	11.91%

This table report OLS regressions of delay (Panel A) and R-squared (Panel B) on dummy variables, contemporaneous dummy intensity interacted with the dummy variables, and a set of control variables (untabulated). The control variables in Panel A and Panel B are similar to those in Table 3 and Table 4, respectively. Net insider selling is a dummy variable specifying net insider selling in the respective quarter. High options outstanding, high options exercised, and high cash to assets are dummy variables indicating firms with above median values at the implied program initiation (aggregated values over whole sample period for options exercised). EPS slightly beats forecast is a dummy variable indicating firms that beat their respective average EPS forecast by 0.1133 during a given quarter, while they contemporaneously repurchase shares. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistic tests for differences between the coefficients of repurchases interacted with the respective interaction variable or not. The corresponding test statistics and p-values are presented for each Wald test.

Table A8: The impact of share repurchases on idiosyncratic volatility

Dependent variable:	Idiosyncratic volatility (ln)
Repurchase intensity$_{t-1}$	-2.0466***
	(-13.05)
Idiosyncratic volatility$_{t-1}$ (ln)	0.3896***
	(70.42)
Market cap$_{t-1}$ (ln)	-0.1793***
	(-20.24)
Book to market$_{t-1}$	0.0958***
	(7.02)
Analysts$_{t-1}$ (ln)	-0.0004
	(-0.09)
Relative spread$_{t-1}$ (ln)	0.0677***
	(12.13)
Deviation price from 30$$_{t-1}$	0.0006***
	(3.51)
Trading volume$_{t-1}$	0.1446***
	(14.60)
Change in short interest$_{t-1}$	0.3053***
	(7.32)
Institutional ownership$_{t-1}$	0.0055
	(0.27)
Constant	-0.8838***
	(-5.30)
R^2(within firm)	0.516
Observations	115,734
Firms	2,645
Firm FE and quarter FE	Y

This table reports OLS regressions of idiosyncratic volatility on lagged repurchase intensity and a set of control variables. The control variables are the same as in Table 4. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively.

Table A9: The impact of share repurchases conditional on prior levels of price efficiency and firm-specific risk

Dependent variable:	Delay	Coef. delay	R-squared	|Mrkt corr|
Model:	(1)	(2)	(3)	(4)
Repurchase $dummy_t$	0.0006	-0.0236	0.0027**	0.0005
	(0.29)	(-0.85)	(1.98)	(0.32)
Repurchase $dummy_t$ × High $past_t$	-0.0085**	-0.0080	-0.0024	-0.0012
	(-2.09)	(-1.02)	(-1.20)	(-0.61)
Repurchase $dummy_t$ × Low $past_t$	0.0035	0.0280	-0.0003	0.0048*
	(1.35)	(1.01)	(-0.16)	(1.76)
High $past_t$	0.0743***	0.1024***	0.0344***	0.0408***
	(21.00)	(16.68)	(20.15)	(22.63)
Low $past_t$	-0.0300***	-0.1730***	-0.0541***	-0.0688***
	(-13.72)	(-9.53)	(-30.23)	(-28.94)
R^2(within firm)	0.186	0.171	0.392	0.351
Observations	115,797	115,797	115,797	115,797
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Wald tests of interaction $variables_t$ and $dummies_t$:				
Rep. dum_t. X High $past_t$ - Rep. dum_t. X Low $past_t$ (test)	7.16	1.72	0.56	3.71
Rep. dum_t. X High $past_t$ - Rep. dum_t. X Low $past_t$ (p-value)	0.75%	18.99%	45.63%	5.42%
High $past_t$ - Low $past_t$ (test)	646.03	222.42	1149.97	1211.94
High $past_t$ - Low $past_t$ (p-value)	0.00%	0.00%	0.00%	0.00%

This table reports OLS regressions of delay, coefficient-based delay, R-squared, and absolute market correlation on the contemporaneous repurchase dummy, dummy variables identifying the top and bottom quintile with respect to prior quarter's average of the dependent variable, and interaction terms. The control variables are the same as in Table 3 and Table 4. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald tests report the statistics for the difference between the coefficients of repurchases interacted with low or high values of the corresponding dependent variable. Furthermore, the Wald test reports the statistics for the difference between the coefficients of high and low dummy variables of the corresponding dependent variable. The corresponding test statistics and p-values are presented for each Wald test.

Table A10: The impact of share repurchases conditional on prior levels of price efficiency and firm-specific risk in up and down markets

Dependent variables:	Delay	Coef. delay	R-squared	|Mrkt corr|
Model:	(1)	(2)	(3)	(4)
Repurchase $dummy_t$	0.0030	0.0530	-0.0072***	-0.0062***
× Up $market_t$	(1.27)	(0.88)	(-4.76)	(-3.60)
Repurchase $dummy_t$	-0.0051**	-0.0432	0.0236***	0.0150***
× Down $market_t$	(-1.99)	(-1.48)	(11.86)	(7.53)
Repurchase $dummy_t$	-0.0052	-0.0056	0.0043**	0.0042*
× Up $market_t$ × High $past_t$	(-1.06)	(-0.59)	(2.02)	(1.91)
Repurchase $dummy_t$	0.0005	-0.0416	0.0189***	0.0134***
× Up $market_t$ × Low $past_t$	(0.19)	(-0.69)	(8.25)	(4.49)
Repurchase $dummy_t$	-0.0102**	-0.0022	-0.0056*	-0.0083***
× Down $market_t$ × High $past_t$	(-2.03)	(-0.22)	(-1.78)	(-2.72)
Repurchase $dummy_t$	0.0117***	0.0279	-0.0314***	-0.0115***
× Down $market_t$ × Low $past_t$	(3.08)	(0.97)	(-10.25)	(-3.36)
High past	0.0738***	0.1005***	0.0331***	0.0399***
	(20.87)	(16.34)	(19.20)	(21.88)
Low past	-0.0296***	-0.1664***	-0.0529***	-0.0678***
	(-13.48)	(-9.16)	(-29.76)	(-28.64)
R^2(within firm)	0.186	0.171	0.394	0.352
Observations	115,797	115,797	115,797	115,797
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Wald tests of interaction $variables_t$ and dummy $variables_t$:				
Rep. dum_t. x Up_t - Rep. dum_t. x $Down_t$ (test)	7.91	2.53	202.99	93.54
Rep. dum_t. x Up_t - Rep. dum_t. x $Down_t$ (p-value)	0.49%	11.15%	0.00%	0.00%
Rep. dum_t. x Up_t x $High_t$ - Rep. dum_t. x Up_t x Low_t (test)	1.18	0.36	25.88	7.24
Rep. dum_t. x Up_t x $High_t$ - Rep. dum_t x Up_t x Low_t (p-value)	27.81%	54.82%	0.00%	0.72%
Rep. dum_t. x $Down_t$ x $High_t$ - Rep. dum_t. x $Down_t$. x Low_t (test)	14.40	1.15	42.83	0.59
Rep. dum_t. x $Down_t$ x $High_t$ - Rep. dum_t. x $Down_t$ x Low_t (p-value)	0.02%	28.29%	0.00%	44.24%
$High_t$ - Low_t (test)	632.55	208.37	1078.88	1163.96
$High_t$ - Low_t (p-value)	0.00%	0.00%	0.00%	0.00%

This table reports OLS regressions of delay, coefficient-based delay, R-squared, and absolute market correlation on the contemporaneous repurchase dummy, dummy variables identifying the top and bottom quintile with respect to prior quarter's average of the dependent variable, dummy variables identifying up and down markets, and interaction terms. The controls are similar to those in Table 3 and Table 4. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistics test for differences between the coefficients of repurchases in up and down markets interacted with low or high values of the corresponding dependent variable. Furthermore, the Wald statistics test for the difference between the coefficients high and low variables and the difference between repurchases in up and down markets. The corresponding test statistics and p-values are presented for each Wald test.

Table A11: The impact of share repurchases in up and down markets excluding the financial crisis

Dependent variable:	Delay	Coefficient-based delay	R-squared	|Market correlation|
Model:	(1)	(2)	(3)	(4)
Repurchase intensity$_t$	-0.0331	0.0290	-0.0048	0.0132
× Up market$_t$	(-0.51)	(0.20)	(-0.13)	(0.31)
Repurchase intensity$_t$	-0.3720***	-0.7603***	0.3730***	0.3678***
× Down market$_t$	(-4.32)	(-4.15)	(6.57)	(6.17)
R^2(within firm)	0.189	0.170	0.398	0.355
Observations	109,446	109,440	109,446	109,446
Firms	2,645	2,645	2,645	2,645
Firm FE and quarter FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y
Wald test of repurchase intensity$_t$ interacted with:				
Up$_t$ - Down$_t$ (test)	11.03	12.42	35.23	26.07
Up$_t$ - Down$_t$ (p-value)	0.09%	0.04%	0.00%	0.00%

This table reports OLS regressions of delay, coefficient-based delay, R-squared, and absolute market correlation on lagged repurchase intensity in up and down markets and a set of control variables. The controls are similar to those in Table 3 and Table 4. The standard errors are clustered at firm level. The t-statistics are displayed in parenthesis and the asterisks (*, ** and ***) denote significance at 10%, 5% and 1% level, respectively. The Wald statistics test for differences between the coefficients of repurchases in up and down markets. The corresponding test statistics and p-values are presented for each Wald test.