Actual Share Repurchases, Price Efficiency, and the Information Content of Stock Prices*

Pascal Busch[†] Stefan Obernberger[‡]

October 26, 2015

Abstract

We examine the impact of actual share repurchases on stock prices using several measures of price efficiency and manually collected data on U.S. repurchases. We find that share repurchases make prices more efficient and reduce idiosyncratic risk. Further analyses reveal that the effects are driven by repurchases in down markets. We conclude that share repurchases help to maintain accurate stock prices by providing price support at fundamental values. We find no evidence that managers use share repurchases to manipulate stock prices when selling their equity holdings or stock options.

Keywords: Share repurchases, market efficiency, price efficiency

JEL classifications: G10, G30, G35

*We would like to thank Jacopo Bizzotto, Dion Bongaerts, Thomas Boulton, Philipp Geiler, Alexander Hillert, Thomas Keusch, Olga Lebedeva, Mike Mao, Stefan Ruenzi, Christoph Schneider, Michael Ungeheuer, and Patrick Verwijmeren for advice on this project and seminar participants at the 12th Corporate Finance Day, 12th International Paris Finance Meeting, Erasmus University Rotterdam, German Finance Association Conference 2014, Georgia State University, IFABS Oxford Corporate Finance Conference 2015, and University of Mannheim for fruitful discussions and helpful comments. We are especially grateful to Ernst Maug for many valuable comments and suggestions. Pascal Busch received financial support from the Rudolph von Bennigsen-Foerder-Foundation.

†University of Mannheim, 68131 Mannheim, Germany. Email: busch@corporate-finance-mannheim.de, Phone: +49 (0)621 181 1979.

‡Erasmus University Rotterdam, 3000DR Rotterdam, The Netherlands. Email: obernberger@ese.eur.nl, Phone: +31 (0)10 4081329.

1 Introduction

Share repurchases have become the dominant form to pay out cash in the United States.[1] Roughly 90% of total repurchase volume is acquired in the open market. On average, open market repurchases represent 6.8% of monthly trading volume and every tenth repurchase amounts to at least 16.5% of monthly trading volume. These numbers suggest that share repurchases can substantially impact stock prices. In line with this presumption, numerous articles in the business press have criticized buybacks for being used by managers as a costly tool of manipulating the stock price to boost their equity based compensation.[2] The Harvard Business Review recently condensed this concern proclaiming that "*trillions of dollars that could have been spent on innovation and job creation [..] have instead been used to buy back shares for what is effectively stock-price manipulation*".[3]

This paper investigates whether open market share repurchases distort market prices and undermine price efficiency. We approach this question by examining the impact of share repurchases on price efficiency and the information content of stock prices. We define "information content" as the amount of information incorporated into the stock price and "price efficiency" as the degree to which all *available* information is incorporated into the stock price. We formulate two alternative hypotheses and test them using a unique, hand-collected data set of U.S. repurchase programs, which allows us to precisely measure repurchase activity and to construct credible instruments.[4] Contrary to the public opinion, our main result is that share repurchases make prices more efficient.

[1]Cf., for example, Skinner (2008) and Grullon and Michaely (2004). Based on hand-collected data from SEC-filings and data from CRSP, we estimate the total payout between 2004 and 2010 to amount to $4.3 trillion, of which approximately 58% were distributed via share repurchases.

[2]E.g., "The Buyback Boondoggle" on BloombergBusiness (http://www.bloomberg.com/bw/magazine/content/09_34/b4144096907029.htm), "Why Stock Buybacks are more harmful than you think" in MoneyMorning (http://moneymorning.com/2013/01/23/why-stock-buybacks-are-more-harmful-than-you-think/).

[3]See "Profits without prosperity" by William Lazonick in the Harvard Business Review, September 2014 Issue.

[4]In 2003, the Securities and Exchange Commission adopted amendments to Rule 10b-18 that mandate the publication of monthly share repurchases under the quarterly filings with the SEC. Before 2004, studies analyzing actual U.S. stock repurchases had to use proxies for the number of shares bought back derived from CRSP and Compustat, for example, Stephens and Weisbach (1998) and Dittmar (2000). See Banyi, Dyl, and Kahle (2008) for an exhaustive overview on studies using proxies from CRSP and Compustat and the reliability of these measures.

Our baseline hypothesis is motivated by the business press and postulates that share repurchases increase the stock price beyond its fundamental value and consequently reduce the information content in stock prices. Managers have a strong incentive to use share repurchases to intentionally increase the stock price beyond its fundamental value, i.e., to manipulate the stock price, because their compensation is at least partly based on equity. Recent empirical evidence is consistent with the notion that managers deliberately attempt to influence the stock price to increase their compensation. For example, studies show that CEOs strategically time corporate news releases (Edmans, Goncalves-Pinto, Wang, and Xu, 2014) and firm advertising (Lou, 2014) to temporarily increase stock prices in months in which their equity vests. Further studies suggest that share repurchases might be used for the same purpose. Bonaimé and Ryngaert (2013) find that the probability of a share repurchase is highest in quarters with net insider selling. Furthermore, Fenn and Liang (2001) document a positive relationship between share repurchases and the management's stock options and Babenko (2009) find that firms are more likely to initiate share repurchases when their employees hold a large stake in the firm.

Even if managers are not able to influence their compensation via buybacks directly, increasing the stock price might still be in their interest because their performance is also assessed on their ability to create shareholder value. In other words, managers might use share repurchases to keep shareholders content. Finally, many firms have large repurchase programs which they have to execute within a certain period of time to reach payout targets. Thus, share repurchases might unintentionally increase the noise in stock prices because of their price impact. If repurchases increase the stock price beyond fundamental values, the information content in stock prices will decrease and the incorporation of market- and firm-specific information will be delayed; idiosyncratic risk will increase and price efficiency will decrease.

Our alternative hypothesis postulates that share repurchases make prices more efficient by increasing either the speed or the accuracy with which available information is incorporated into the stock price. A distinctive feature of share repurchases is that they can only incorporate positive information into the stock price because firms participate in the market as buyers of their stock. Therefore, firms can either initiate a trade by placing a market order and thereby directly incorporate positive information or submit a limit order and thereby provide a lower bound for the stock price. These two alternatives provide two distinct channels via which share repurchases may increase price efficiency.

According to the first channel, share repurchases will improve the speed with which positive information is incorporated into the stock price if firms actively trade on positive information that is not yet reflected in the stock price. This argument builds on Hou and Moskowitz (2005) who reason that some stocks are less efficiently priced because they are less visible or neglected by investors. Firms engaging as investors in their own stock can react to other investors' inattention and improve price efficiency by repurchasing shares.

According to the second channel, share repurchases will improve the accuracy of the stock price if firms provide price support at fundamental values. The notion of share repurchases being used to provide price support is in line with both how CFOs claim to execute their repurchase programs and empirical evidence. According to personal accounts from CFOs, at least some firms provide brokers with specific instructions that include exact price ranges and repurchase volumes. In a survey by Brav, Graham, Harvey, and Michaely (2005), CFOs name buying back at low stock prices the most popular reason to conduct share repurchases. Several empirical studies confirm the notion that valuation plays an important role in the repurchase decision (e.g., Stephens and Weisbach, 1998; Dittmar, 2000).

Our price support argument builds on Hong, Wang, and Yu (2008) who extent the model of Grossman and Miller (1988) to allow firms to intervene when the stock price drops below fundamental value due to an exogenous demand shock. In their model, firms with sufficiently large funds for share repurchases will be able to prevent the stock price from overshooting and firms will have a lower short-horizon return variance. Taking the argument of Hong, Wang, and Yu (2008) one step further, the price adjustment to new information will be less noisy because the stock price response to new, negative systematic information will be bounded from below at the stock's fundamental value. Thus, the repurchasing firm's stock will be more efficiently priced and the idiosyncratic risk in the stock price will be lower. Note that this argument critically depends on the timing of the price support. If price support is provided above fundamental values, share repurchases will increase both price delay and idiosyncratic risk. The evidence would be consistent with the price manipulation hypothesis. Our two hypotheses are mutually exclusive but each hypothesis might be valid for some time or some firms.

For the empirical analysis, we collect data on monthly repurchase activity from SEC-filings to exploit the time-series variation in actual share repurchases. We obtain the exact numbers of monthly repurchase volumes and repurchase prices for all firms within our sample period. Our unique data set covers 6,537 repurchase programs of 2,930 U.S. firms in the period 2004–2010. Repurchase programs extend over 87,614 firm-months including 38,155 repurchase months. In our baseline analysis, we construct a panel of monthly observations and regress a measure of the information content of stock prices on a measure of repurchases and a set of control variables.

We rely on two groups of measures of the information content of stock prices, which have been applied in the context of short selling (cf. Morck, Yeung, and Yu, 2000, Bris, Goetzmann, and Zhu, 2007, Boehmer and Wu, 2013, Saffi and Sigurdsson, 2011, Phillips, 2011). In several ways, share repurchases resemble short sales, just with opposite signs. Both groups of traders, firms and short sellers, are likely to be better informed and trade large amounts of stock. Like short sales, share repurchases are deemed to distort prices at the expense of market efficiency.

The first group of measures determines the delay with which prices respond to new information as proposed by Hou and Moskowitz (2005). These measures compare the explanatory power of a simple market model regression to an extended market model regression. The extended market model additionally includes five lags of the market return as explanatory variables. The intuition behind these measures is that the higher the explanatory power of the lagged market returns in the extended market model, the higher is the delay until new information is fully incorporated into prices. Hou and Moskowitz (2005) demonstrate that stocks with the highest delay face a significant return premium, which can best be explained by investor neglect or inattention. If share repurchases improve speed and/or accuracy of stock prices, price delay should decrease.

The second group of measures analyzes the amount of idiosyncratic risk incorporated into the stock price. Roll (1988) points out that the extent to which a stock moves together with the market depends on the relative amounts of systematic and idiosyncratic information incorporated into the stock price. In line with Morck, Yeung, and Yu (2000) and Bris, Goetzmann, and Zhu (2007), we use the R-squared of a market model and the correlation between stock and market returns to determine the amount of idiosyncratic risk incorporated in the stock price. If share repurchases incorporate idiosyncratic information or noise (systematic information) into the stock price, the R-squared and the cross-correlation should decrease (increase).[5]

We use two distinct measures of repurchase activity, the number of shares repurchased scaled by shares outstanding and the remaining volume that can be repurchased under the currently open repurchase program. The latter measure precisely captures a firm's repurchase ability, which offers a novel way to proxy for repurchase activity: The lower the remaining repurchase volume, the lower a firm's ability to intervene when the stock price drops below its fundamental value. As this measure is predetermined in the sense that it is fixed before the period over which we compute our efficiency measures, it allows us to exclude reverse causality.

We furthermore use firm fixed effects and time fixed effects to ensure that the results are neither driven by unobserved heterogeneity in the cross-section nor by unobserved macroeconomic factors. In addition, we use instruments derived from program characteristics as suggested by Hillert, Maug, and Obernberger (2015) to isolate the exogenous variation. These instruments represent the size and the month of the program and allow us to prescribe the

[5]Notably, we can infer from these measures whether the idiosyncratic or the systematic component of the stock price is affected by share repurchases. If the idiosyncratic component is affected, this might be due to private information or public, firm-specific information, but also price manipulation (noise) will increase idiosyncratic risk.

execution of a program at its beginning to the future. Thereby, we ensure that predicted repurchases are entirely unrelated to future levels of price efficiency, once again eliminating reverse causality concerns.

We find that share repurchases unequivocally decrease the delay with which prices respond to new market wide information and conclude that share repurchases make prices more efficient. Furthermore, our analysis of the R-squared and the correlation with the market reveals that share repurchases increase the synchronicity of the repurchasing firm's stock with the market. This result implies that the relative amount of idiosyncratic risk in stock prices is lower when repurchases are higher. Therefore, the evidence is not consistent with the notion that share repurchases increase the noise in stock returns. All of these results hold irrespective of how we measure repurchase activity.

Next, we refine our analysis to learn more about the channels via which repurchases increase price efficiency. We use market returns to indicate whether positive or negative, systematic information comes to the market and split repurchase activity in months where the stock market goes up and months where the market goes down. This approach reflects our dependent variable that examines the speed and accuracy with which lagged market returns are incorporated into the stock price and builds on the insight that share repurchases decrease idiosyncratic risk.The latter finding suggests that firm-specific news play a smaller role for the execution of actual share repurchases than overall market conditions. We find that repurchases increase price efficiency and decrease idiosyncratic risk in particular in months where the market goes down, i.e., when there is new negative information. We conclude that share repurchases increase the information content of stock prices by providing price support at fundamental values.

Return moment distributions strongly support the notion that firms use share repurchases to support prices at fundamental values. As argued above, if firms provide price support at fundamental values, the adjustment process to new, negative information should be less noisy and we should see fewer extreme returns. Our finding that repurchases reduce return volatility and kurtosis is in line with this presumption.

We conduct several additional tests to identify repurchases that are detrimental to price efficiency. We identify repurchases that take place while or before insiders sell portions of their equity holdings in the company. We also distinguish between repurchase programs where insider ownership, outstanding stock options, or exercised stock options are high. In none of these instances, we find a detrimental effect of share repurchases on price efficiency. There is also no evidence that share repurchases that are motivated by large cash-holdings harm price efficiency.

The question of whether share repurchases use and incorporate private information in the stock price is not directly addressed in this paper. However, the results are not in line with the notion that share repurchases incorporate private, firm-specific information because we observe a decrease in idiosyncratic risk, rather than an increase.

We contribute to the literature in at least two ways. First, ours is the first study to examine the impact of open market share repurchases on the informational efficiency of stock prices. Hong, Wang, and Yu (2008) show that firms with higher ability to intervene when the stock price drops below fundamental value, have lower return variances. To the best of our knowledge, there is no other study that takes a closer look at this topic. We therefore provide a novel approach to assessing the direct effects of actual share repurchases on the stock market. Second, we contribute to a growing literature that tries to understand how specific groups of investors, such as institutional traders, corporate insiders, and short sellers, affect the efficiency and information content of prices.[6]

2 Theoretical considerations

In this paper, we examine the question of whether share repurchases distort or improve market prices by looking at the impact of share repurchases on price efficiency. Price efficiency denotes the degree to which *available* information is incorporated in the stock price. In

[6]See, for example, Fishman and Hagerty (1992), Sias and Starks (1997), Piotroski and Roulstone (2004), Saffi and Sigurdsson (2011), Bris, Goetzmann, and Zhu (2007), Boehmer and Kelley (2009), Phillips (2011), Boehmer and Wu (2013).

a semi-strong efficient capital market, public information is considered to be available and should be incorporated into the stock price. Trading on private information does not affect the degree to which public information is incorporated into the stock price. Our study is, therefore, not tailored towards the question of whether share repurchases are based on private information. There is a longstanding literature on this question with respect to both repurchase announcements (cf. Vermaelen, 1981, Dann, 1981, Ikenberry, Lakonishok, and Vermaelen, 1995, 2000, Peyer and Vermaelen (2009), and Fu and Huang (2015)) and actual repurchases (cf. Ben-Rephael, Oded, and Wohl, 2013, and Dittmar and Field, 2015). In the following paragraphs, we discuss the implications of our study on the question of whether share repurchases use and incorporate private information. We also blend this discussion with the empirical evidence presented in studies on the managerial timing ability of share repurchases. Our overall conclusion is that our results align well with the existing literature.

Firms will incorporate private information into the stock price when their repurchase trades reveal information to the market. In this case, we would expect that the idiosyncratic risk (market correlation) in the stock price increases (decreases) because a firm's private information will be firm-specific, i.e. idiosyncratic. Accordingly, the finding that share repurchases decrease (increase) idiosyncratic risk (market correlation), would be hard to reconcile with the notion of share repurchases incorporating private information. The existing literature does neither confirm nor reject the notion that share repurchases incorporate private information into the stock price. Ben-Rephael, Oded, and Wohl (2013) conclude that private information does not get revealed until the repurchase activity is published in the quarterly filings. Following their argument, share repurchases should incorporate little to no private information into the stock price. Dittmar and Field (2015) document positive abnormal returns in the three months following the repurchase. However, it remains unclear whether private information is incorporated into the stock price during the repurchase itself.

The literature on managerial timing ability of actual share repurchases unanimously finds that firms buy back at prices below average market prices (cf., e.g., Ben-Rephael, Oded, and Wohl, 2013, and Dittmar and Field, 2015). The price support argument in this study suggests that share repurchase buy back after declines in the stock price and stabilize prices by providing a lower bound for the stock price. When firms only buy back at the lower bound of the stock price, average market prices computed over a month have to be higher than the average repurchase price in the same month. The empirical result that repurchase prices are on average lower than market prices is, therefore, consistent with the price support argument.

The price support argument does also not presume the use of private information. As argued above, the argument builds on the idea that firms react to a decline in the stock price and establish a lower bound for the stock price. In the model of Hong, Wang, and Yu (2008), firms react to an exogenous demand shock without having private information. In a similar spirit, Hou and Moskowitz (2005) argue that some stocks are less efficient because they are less visible or neglected by investors. As a result, publicly available information is not adequately incorporated into the stock price and prices are more noisy. Firms reacting to this neglect by repurchasing shares will improve price efficiency regardless of whether they have private information or not.

Finally, the price support argument does not imply managerial timing ability either. Since price support is provided after the stock price has declined, repurchase prices will be lower than preceding stock prices. However, timing ability will still depend on whether firms buy back above or below fundamental values. If firms provide price support above fundamental values, repurchases will manipulate prices and will be followed by negative abnormal returns. If firms buy back when the stock price equals its fundamental value, repurchases will not be followed by abnormal returns. Eventually, if firms are able to buy back when the stock price drops below its fundamental value, firms command timing ability and repurchases will be followed by positive abnormal returns. Our results suggest that firms either keep prices at or bring prices towards their fundamental values, which implies that firms buy back either at or below fundamental values. Therefore, our results are consistent with both the presence and the lack of managerial timing ability, but not with price manipulation.

3 Data and methodology

In this section, we describe the construction of the data set, our methodology, and the variables used.

3.1 Sample construction

New disclosure rules require firms publicly traded in the U.S. to publish monthly accounts of their share repurchase activity under the newly created items 2(e) of Form 10–Q and 5(c) of Form 10–K respectively. The requirement applies to all periods ending on or after March 15, 2004, but most firms already started to publish detailed accounts of their repurchase activity for the last quarter of 2003. Firms need to report the total number of shares purchased, the average price paid per share, the number of shares purchased under specific repurchase programs, and either the maximum dollar amount or the maximum number of shares that may still be purchased under these programs. Additionally, firms also have to indicate the method of repurchase (e.g., open market repurchase, accelerated share repurchase, private transaction, tender offer). We analyze shares repurchased under an open market repurchase program, which sometimes differs slightly from the total number of shares repurchased. There are several reasons for why this difference may arise. For example, shares may be delivered back to the issuer for the payment of taxes resulting from the vesting of restricted stock units or the exercise of stock options by employees and directors requires firms to acquire shares.

As a starting point, we obtain all ordinary shares (share codes 10 and 11) that are traded on the NYSE, AMEX, and NASDAQ (exchange codes 1, 2, and 3) from CRSP. This gives us 6,504 firms over the period from January 2004 to December 2010. We omit 18 firms that are not available in Compustat and drop 171 firms with missing data on the central index key (cik) which is the main identifier of the SEC's online platform Edgar. Eventually, we arrive at 6,315 firms that can be found on CRSP, Compustat, and Edgar.

We use web crawlers to download all 10-Q and 10-K filings that were filed between January 1, 2004 and March 31, 2011. In total we obtain 96,203 10-Qs and 34,589 10-Ks and use textual analysis programs to extract the repurchase data from these filings. To ensure the quality of our data, we manually check and correct all observations. Eventually, we are left with 376,843 firm-month observations including more than 20,000 firm-months with missing CRSP data because firms are no longer or not yet listed on AMEX, NASDAQ, or NYSE at the time of the repurchase.

The initial data set includes 9,100 repurchase programs. We drop 167 programs with unknown announcement date, 1,587 programs, which were started before 2004, and a further 50, which were announced after 2010. Next, we exclude 144 programs, because they are not executed in the open-market, and a further 615 programs with an unlimited or variable volume, because program size is one of our instruments and needs to be determined. After these screening procedures we end up with 6,537 repurchase programs, of which half remain active until they have been completed, i.e. they have no fixed expiration date.[7]

In the last step, we add data from I/B/E/S and TAQ and eliminate all firms that do not have an open repurchase program in at least one month between 2004 and 2010. After deleting all observations for which the variables used in the baseline analysis are not available, we end up with a final data set including 2,930 repurchasing firms and 158,471 firm months. These firms have 6,537 programs which extend over 87,614 firm-months and firms conduct share repurchases in 38,155 of these firm-months.

3.2 Research design and definition of variables

Our generic specifications regress a measure of price efficiency or information content on a measure of repurchase activity and a range of controls:

[7] There are no regulatory rules that require a repurchase program to expire. Stephens and Weisbach (1998) report average program completion rates of 54.10%, 68.70%, and 73.80% one, two, and three years after the program announcement. Bonaimé (2012) finds an average completion rate of 72.57% eight quarters after the quarter of the program announcement. The average completion rates in our sample are 45.53%, 53.17%, and 59.31%. The lower average completion rates in our sample are partly attributable to the decline in repurchase activity during the financial crisis. Pre-crisis completion rates are four to eight percentage points higher.

$$
\begin{aligned}
Efficicency_{i,t} &= \alpha + \delta Efficiency_{i,t-1} + \beta Rep_{i,t} + \sum_{l=1}^{l=K} \gamma_l Control_{i,l,t} \qquad (1) \\
&\quad + \mu_i + \eta_t + u_{i,t} \\
IdiosyncraticRisk_{i,t} &= \alpha + \delta IdiosyncraticRisk_{i,t-1} + \beta Rep_{i,t} + \sum_{l=1}^{l=K} \gamma_l Control_{i,l,t} \qquad (2) \\
&\quad + \mu_i + \eta_t + u_{i,t}
\end{aligned}
$$

Here, *Efficiency* is a measure of price delay and *IdiosyncraticRisk* denotes *R-Squared* or *Market Correlation*. *Rep* denotes either *Repurchase Intensity* or *Remaining Volume*. *Repurchase Intensity* is defined as the number of shares repurchased in a month divided by the number of shares outstanding at the end of the previous month. *Remaining Volume* is defined as the number of shares that can still be bought under the current program at the beginning of month t scaled by shares outstanding at the beginning of the program. *Control* refers to the control variables, μ is a time-invariant firm fixed effect and η is a month fixed effect.

Repurchase Intensity captures the activity of firms in the stock market precisely. However, *Repurchase Intensity* might also be the outcome of current, partly unobserved market conditions. For example, if firms step in to prevent a mispricing of their stock, we will only observe the outcome of the firm's effort to prevent the mispricing. A realistic outcome of the firm's trading activity, therefore, is, that the observed price efficiency is kept at a level similar to the one in previous months. In this setting, *Repurchase Intensity* will be endogenously determined by the unobserved counterfactual level of price efficiency, i.e., the level of mispricing in absence of share repurchases. Meanwhile, the actual effect of share repurchases on price efficiency is reflected in the difference between the observed outcome and the unobserved counterfactual outcome. As a consequence, contemporaneous *Repurchase Intensity* and observed price efficiency will not be correlated or they will even be negatively correlated if repurchases cannot fully prevent a mispricing of the stock. Therefore, concerns of endogeneity and reverse causality are high when firms provide price support to prevent a mispricing of their stock.

We tackle this problem from three different angles. In our first specification, we predict exogenous *Repurchase Intensity* using two instruments proposed by Hillert, Maug, and Obernberger (2015): The announced program size and the distance between the current month and the program starting month. *Program Size* denotes the maximal number of shares that may be purchased under a particular program and is scaled by the number of shares outstanding. If the program volume is reported in US Dollars we divide the maximal Dollar volume that may be repurchased under the program by the firm's market capitalization. The size of the program is fixed before the execution begins in order to ensure that the size of the program is exogenous with respect to future variations in our dependent variables. We can use neither the realized size of the program nor the remaining portion of the program as instruments, because both depend on firms' actual repurchase behavior and are therefore endogenously determined. Hillert, Maug, and Obernberger (2015) show that *Program Size* has a positive impact on repurchases. *Program Month* denotes the number of calendar months since the announcement of the repurchase program. The motivation is that the period for which the program has been active is not influenced by the subsequent within-firm variation of our dependent variables. Hillert, Maug, and Obernberger (2015) demonstrate that firms front-load the execution of their programs, hence *Program Month* has a negative impact on realized repurchases. Taken together, these program characteristics allow us to prescribe the execution of a program at its beginning to the future. Thereby, we ensure that predicted repurchases are not related to future levels of price efficiency, which is critical to our identification strategy.

In our second specification, we lag *Repurchase Intensity* by one period and thereby circumvent the reverse causality problem. In our third specification, we use *Remaining Volume* as a measure of the ability to conduct repurchases. The advantage of *Remaining Volume* over *Repurchase Intensity* is that it is predetermined and therefore not potentially driven by reverse causality: Price efficiency and returns over month t cannot affect the remaining repurchase volume at the beginning of month t. Meanwhile, the remaining repurchase volume should proxy very well for a firm's ability to buy back amounts of shares that are large enough to put information into prices. Also note that *Remaining Volume* is not driven by prior returns (cf. Table 3).

By including firm fixed effects, time fixed effects, and lagged dependent variables, we exclude that our results are driven by unobserved heterogeneity in the cross-section, macro-factors, and between-month "efficiency-timing". Even if the start of a repurchase program depended on the current efficiency of the stock, the lagged dependent variable would control for currently high or low levels of efficiency. To ensure that the results are not driven by announcement effects, we additionally control for the month in which the repurchase program begins.

3.2.1 Measures of price delay and idiosyncratic risk

To measure price efficiency, we use two variants of the delay measure suggested by Hou and Moskowitz (2005). The delay measure quantifies how fast and how accurately new information is incorporated into prices by assessing the explanatory power of lagged returns in an extended market model relative to a simple market model. We estimate the measures as in Boehmer and Wu (2013) or Phillips (2011) using daily returns. Therefore we estimate the following models for each firm and each month:

$$r_{i,t} = \alpha_i + \beta_i^0 r_{m,t} + \varepsilon_{i,t} \text{ (Base model)} \tag{3}$$

$$r_{i,t} = \alpha_i + \beta_i^0 r_{m,t} + \sum_{n=1}^{5} \beta_i^n r_{m,t-n} + \varepsilon_{i,t} \text{ (Extended market model)} \tag{4}$$

Here $r_{i,t}$ denotes the return of firm i on day t, $r_{m,t}$ denotes the market return on day t, and $r_{m,t-n}$ denotes the market return n days prior to day t. If all new information is immediately incorporated into a firm's stock price, this will be reflected in the coefficient for the contemporaneous market return β_i^0 while the coefficients for the lagged market returns β_i^n will be equal to zero. However, if the incorporation of new information into prices is delayed then the coefficients for the lagged market returns β_i^n will be different from zero and the extended market model will consequently have a higher explanatory power than the base model. We use five lags to include all trading days within one week.

The first delay measure suggested in Hou and Moskowitz (2005) is the ratio of the R-squared estimates of the two models:

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

The higher the price efficiency of stock and consequently the faster new information is incorporated into prices, the smaller is the difference in explanatory power between base model and extended market model. Thus, as price efficiency increases the *Delay* measure decreases.

The second delay measure is based on the coefficients of the two regressions. This delay measure is constructed as the ratio of the lag-weighted sum of the absolute coefficients of the lagged market returns relative to the sum of all coefficients, scaled by the standard errors of the coefficients:

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

As for *Delay, Coefficient-based Delay* also decreases with higher degrees of price efficiency, i.e. faster information incorporation, as the explanatory power of the coefficients of the lagged market returns decreases.

To measure the amount of idiosyncratic information incorporated into stock prices we determine the degree of co-movement (synchronicity) of individual stock returns with the market return. In line with Morck, Yeung, and Yu (2000) and Bris, Goetzmann, and Zhu (2007), we use the R-squared of a market model and the correlation between stock and market returns. We estimate *R-squared* and *Market Correlation* using daily returns for each month. We use the R-squared of the model in equation 3.

3.2.2 Further variables

For a measure of the relative spread, we use the NYSE TAQ database to extract the necessary intraday transaction data. For each trade we assign the prevailing bid and ask quotes that are valid at least one second before the trade took place. If there is more than one transaction in a given second, the same bid and ask quotes are matched to all of these transactions. If there is more than one bid and ask quote in a given second, we assume that the last quote in the respective second is the prevailing quote.[8] We only consider the NBBO (National Best Bid and Offer) quotes.[9] We calculate the quote midpoint as the average of the prevailing bid and ask quotes. *Relative spread* is defined as time-weighted average of the difference between the prevailing ask and the prevailing bid quote divided by the quote midpoint price.

3.3 Descriptive statistics

Table 2 provides descriptive statistics for all variables used in the analysis. As we exclusively analyze within-firm variation in repurchases, we exclude non-repurchasing firms. Our sample covers 158,471 firm months including 38,155 repurchase months.

Both measures of price delay exhibit similar means and medians, which indicates that both variables are not skewed. *Delay* is strictly defined between 0 and 1 and *Coefficient-based Delay* ranges between 0 and 5. In both cases, mean and median are close to the midpoint of these ranges. *R-squared* and the *Market Correlation* are also defined between 0 and 1. Both measures exhibit similar means and medians. We use the absolute values of *Market Correlation* in all of our analyses.

The average *Repurchase Volume* over 38,155 repurchase months is \$49.3 million. This is equivalent to buying back 0.68% of shares outstanding or 6.81% of monthly trading volume. The median repurchase volume is 0.38% of shares outstanding or 3.33% of trading volume. The median remaining repurchase volume is 2.05% of shares outstanding at the beginning of

[8]Henker and Wang (2006) consider this procedure to be more appropriate compared to the classical Lee and Ready (1991) five-second rule. Bessembinder (2003) tries zero to thirty-second delays in increments of five seconds and does not find any differences in the results.

[9]http://wrds-web.wharton.upenn.edu/wrds/research/applications/microstructure/NBBO%20derivation/

the program. Average (median) program size in our sample is 6.59% (5.27%) of the shares outstanding.

4 Empirical analysis

We start the empirical analysis with a discussion of the determinants of our repurchase variables, *Repurchase Intensity* and *Remaining Volume*. In the following sections, we test our main hypotheses and examine the robustness of our results.

4.1 Analysis of share repurchase variables

The purpose of the analysis of our repurchase variables, *Repurchase Intensity* and *Remaining Volume,* is threefold. First, we establish the relevance of our instruments, *Program Month* and *Program Size.* Second, we discuss whether lagged *Repurchase Intensity* is a good proxy for contemporaneous *Repurchase Intensity.* Third, we examine further drivers of repurchase activity.[10] To analyze repurchase activity, we use specifications similar to the ones presented in Section 3.2 and regress a measure of repurchase activity on program characteristics and control variables. The results are reported in Table 3.

In column (1) and column (2), we analyze *Repurchase Intensity.* The program characteristics *Program Month* and *Program Size*, which we use as instruments for repurchases, are highly significant and in line with Hillert, Maug, and Obernberger (2015). The coefficient on *Program Month* is negative indicating that repurchase activity is highest at the beginning of the program. The positive coefficient on *Program Size* is also in line with what one would expect: *Repurchase Intensity* is higher when program size is larger.

In column (2), we add the lagged dependent variable to assess its fit for use as a proxy for repurchase activity. Using a noisy measure of an independent variable causes attenuation, which biases the coefficient estimate towards zero. Thus, if lagged *Repurchase Intensity* was

[10]Note also that the determinants of actual share repurchases are related to but not equivalent to the determinants of repurchase program announcements. For example, liquidity will play a much bigger role in executing repurchase programs than in deciding upon a repurchase program.

a weak proxy for contemporaneous *Repurchase Intensity*, it would be harder for us to obtain significant results. In the regression analysis of *Repurchase Intensity* depicted in column (2), the lagged dependent variable has a positive coefficient of 0.2. As we control for firm fixed effects that already pick up the average effect *of Repurchase Intensity*, the impact of lagged *Repurchase Intensity* appears to be economically highly significant. In line with this observation, the explanatory power of the model (excluding the variation already explained by the fixed effects) increases from 6% to 10% when including the lagged dependent variable. We conclude hat lagged *Repurchase Intensity* is the best predictor we have at our disposal.

For *Repurchase Intensity*, the results on the controls match well with the results from the existing literature. Our results confirm earlier studies on the relation between compensation of employees and executives and actual share repurchases (Fenn and Liang, 2001, Babenko, 2009, and Bonaimé and Ryngaert, 2013): *Options Exercised* has a positive impact on repurchases. Furthermore, repurchases are higher when corporate insiders sell their stock (see *Net Insider Trading*) or when employees hold many stock options in the firm (see *Options Outstanding*). In line with earlier literature (cf., e.g., Stephens and Weisbach, 1998 and Dittmar, 2000) we find that *Repurchase Intensity* is driven by lagged negative returns, whereas lagged positive returns have no statistically significant impact. Firms also buy back more when their book-to-market ratio is higher suggesting that valuation is factored in the repurchase decision. This result is in line with the notion that managers buy back when they consider the firm's stock price to be low. Jensen (1986) and Stephens and Weisbach (1998) find that firms tend to repurchase more shares if they have stronger cash flows. Coefficients on *EBITDA to Assets* come in with the right sign, but lack statistical significance. Once *Cash to Assets* has been controlled for*, EBITDA to Assets* does not impact share repurchases. Dividends seem to have no impact on repurchases, which is consistent with the notion that firms view repurchases as complements to dividends rather than as substitutes. Dittmar (2000) shows that firms use repurchases to increase leverage, which is consistent with our result that firms with higher leverage conduct fewer repurchases. The dummy variable *Acquiror* indicates acquiror status in a takeover and has a negative impact on repurchases. The dummy variable

Target indicates target status in a takeover attempt and equals one from the time of the announcement until the completion or cancellation of the takeover. Bagwell (1991) develops a theoretical model to show that repurchases may serve as a takeover defense and Dittmar (2000) confirms the prediction of the model empirically. However, we do not find significant results. *Repurchase Intensity* is driven by liquidity as indicated by the lagged relative spread.[11]

In column (3), we analyze *Remaining Volume*, which denotes the number of shares that can be repurchased at the beginning of the month scaled by shares outstanding as of the beginning of the program. In this specification, most of the controls remain insignificant when controlling for *Program Size* that accounts for more than 50% of the variation in *Remaining Volume*. Most importantly, the coefficients on lagged returns for *Remaining Volume,* which is determined at the beginning of the month, are insignificant. Thus, the number of shares that can still be repurchased under the currently active program is not affected by prior returns. There is no such relation because firms can always add an additional repurchase program when needed. *Remaining Volume* has therefore two major advantages over *Repurchase Intensity*. First, it is fixed at the beginning of the month allowing us to exclude reverse causality in the subsequent analyses. Second, as *Remaining Volume* is not driven by prior returns, co-movement of this variable and our measures of efficiency (which are likely to be driven by lagged returns) is much less of a concern. The coefficients on *Cash to Assets* and *Dividends to Assets* are positive and statistically significant indicating that higher cash and higher propensity to pay out dividends increase the volume that can be repurchased in the next quarter.

In Table A3 in the Internet Appendix, we check the robustness of our results by estimating a Tobit model as in Dittmar (2000). The results are qualitatively similar. In particular, the coefficients on lagged *Repurchase Intensity*, *Program Size*, and *Program Month* exhibit the correct sign and high statistical significance.

[11] For a thorough discussion of the relationship between share repurchases and stock liquidity for a U.S. sample, see Hillert, Maug, and Obernberger (2015).

4.2 Share repurchases and price efficiency

Table 4 reports the results on the impact of actual repurchases on price efficiency. We analyze *Delay* and *Coefficient-based Delay* in column (1) to column (3) and column (4) to column (6) respectively. In column (1) and column (4), we predict *Repurchase Intensity* using *Program Size* and *Program Month* as instruments. For both models, we cannot reject the overidentifying restrictions.[12] We test for underidentification by using the statistic proposed by Kleibergen and Paap (2006). Their test is for the rank of a matrix and in our case it checks the rank of the matrix of reduced-form coefficients and tests whether the instruments are sufficient to identify the endogenous variables. We can reject the null hypothesis of underidentification for all of our models. The Stock-Yogo test on the weak-instrument bias always rejects the hypothesis that the bias exceeds 5% of the bias from OLS (not tabulated). Furthermore, the instruments are statistically significantly different from zero and have the predicted signs as shown in Table 3: higher *Program Size* implies higher *Repurchase Intensity*, and a later *Program Month* implies lower *Repurchase Intensity*. We therefore conclude that the models are correctly specified. In column (2) and column (5), we proxy for *Repurchase Intensity* by using *Repurchase Intensity* of the previous month. In column (3) and (6), we use *Remaining Volume* as a measure of a firm's ability to use share repurchases to intervene in the stock market

We find that repurchases unequivocally decrease price delay—irrespective of which specification and measure of price delay we use. In column (1), an increase by one within-firm standard deviation in *Repurchase Intensity* decreases *Delay* by 0.0227 percentage points ($= 0.0081 \times -2.8020$, where -2.8020 is the coefficient on *Repurchase Intensity* from Table 4), which corresponds to 4.88% of median *Delay* ($= 0.0227/0.465$, where 0.465 is the median of Delay obtained from Table 2). Boehmer and Wu (2013) document a lower effect of shorting on price delay. In their Model 2 in Table 3, which includes time and firm fixed effects, a one standard deviation increase in shorting (0.068), reduces delay by 2.49% ($= (0.160 \times 0.068)/0.437$,

[12] The Hansen J-Statistic for the test of overidentifying restrictions cannot reject the null that the model is correctly specified.

where 0.160 is the coefficient on shorting and 0.437 is the median delay).[13] Saffi and Sigurdsson (2011) report that a "one-standard-deviation increase in lending supply is associated with a decrease in [Delay] of 0.097 standard deviations." In our case, which only considers within-firm variation, a one standard-deviation increase in *Repurchase Intensity* reduces delay by 0.090 standard deviations.

The coefficient on lagged *Repurchase Intensity* in column (2) is lower by a factor of 4.4 compared to column (1), which could indicate that lagged *Repurchase Intensity* is a more noisy measure of contemporaneous repurchases and, therefore, the coefficient estimate might suffer from an attenuation bias. In column (3), an increase by one within-firm standard deviation in *Remaining Volume* decreases *Delay* by 0.0023 percentage points ($= 0.0377 \times -0.0612$, where -0.0612 is the coefficient on *Repurchase Intensity* from Table 4), which corresponds to 0.50% of median *Delay* ($= 0.0023/0.465$, where 0.465 is the median of Delay obtained from Table 2). For *Coefficient-based Delay*, GMM-diagnostics, coefficients, test statistics, and economic significance are qualitatively similar.

In conclusion, our results suggest that share repurchases increase the speed and accuracy with which information is incorporated into the stock price. We conclude that repurchases lead to both higher price efficiency and higher information content of stock prices. The evidence is not consistent with the notion that share repurchases are used to manipulate share prices as in this case we should observe higher price delay.

The coefficients for the control variables are reasonable and mostly in line with prior literature. We observe in all specifications that *Delay* decreases with size, analyst coverage, and liquidity. This result is in line with the results of Hou and Moskowitz (2005), Saffi and Sigurdsson (2011), and Phillips (2011). The coefficient on *Book to Market* indicates that *Delay* is lower when stocks are valued higher. Phillips (2011) reports the same sign when analyzing the change in *Delay*.[14] However, his results are mostly not statistically

[13]Note that Boehmer and Wu (2013) compute "plain" standard deviations whereas we compute within-firm standard deviations. For our sample, "plain" standard deviations are about 20% larger. Therefore, the economic magnitude of our results is biased downwards relative to the one reported by Boehmer and Wu (2013).

[14]Phillips (2011), Table 3 and Table 4 respectively.

different from zero. For the dummy variable indicating the initiation month, the coefficient is significantly positive. This is plausible considering that the initiation of a repurchase program is associated with abnormal returns (cf., e.g., Peyer and Vermaelen (2009)). We observe that *Delay* decreases with higher *Volatility*. Phillips (2011) reports a similar result for an analysis of the change in delay. Again, his results are not statistically different from zero. An increase in short interest decreases Delay, which is, for example, documented in Boehmer and Wu (2013). Surprisingly, we are not able to document a statistically significant relationship between changes in short interest and price delay. In Table A4 in the Internet Appendix, we investigate this observation in further detail. We find that statistical significance depends on whether we control for firm-fixed effects. The coefficient on *Trading Volume* is positive and statistically significant but we would have expected a negative coefficient as reported by Boehmer and Wu (2013). In Table A5 in the Internet Appendix, we demonstrate that this result is driven by the other liquidity controls. We obtain the expected coefficient when we exclude all other liquidity controls and conclude that the variation in *Trading Volume* that is positively associated with delay is already picked up by these other liquidity controls. Finally, higher institutional ownership is associated with lower price delay as documented in Boehmer and Kelley (2009).

4.3 Share repurchases and idiosyncratic risk

In the previous section we have looked at the speed with which information is incorporated into stock prices. In this section, we take another perspective and analyze the impact of share repurchases on the relative amounts of idiosyncratic risk and systematic risk. If firms manipulate prices or incorporate firm-specific information, idiosyncratic risk should go up. If firms provide price support as suggested in Hong, Wang, and Yu (2008), idiosyncratic risk should go down. We use the same research design as in Section 4.2 and analyze *R-squared* and *Market Correlation* in column (1) to column (3) and column (4) to column (6) of Table 5 respectively.

In column (1), we estimate a GMM-IV model of *R-squared* using *Program Size* and

Program Month as instruments. As in the previous analysis, we can reject the hypothesis of underidentification, that the instruments are weak, and that the bias exceeds the OLS bias by more than 5%. The results corroborate that share repurchases decrease idiosyncratic risk: An increase by one within-firm standard deviation in *Repurchase Intensity* increases *R-squared* by 0.0141 points ($= 0.0081 \times 1.7350$, where 1.7350 is the coefficient on *Repurchase Intensity* from column (1) in Table 5) which corresponds to 6.34% of median *R-squared* ($= 0.0141/0.2217$, where 0.2217 is the median of *R-squared* obtained from Table 2).

We confirm this result in column (2), where we again use a predetermined variable instead of a contemporaneous instrumented one. For the reasons discussed above, the coefficients are, however, again much lower. For *Remaining Volume*, the impact is qualitatively the same but much less pronounced. For a within-firm standard deviation increase in *Remaining Volume*, *R-squared* is higher by 0.0019 points ($= 0.0385 \times 0.0407$, where 0.0407 is the coefficient on *Remaining Volume* from column (2) in Table 5) which corresponds to 0.71% ($= 0.0016/0.2217$) of median *R-squared.* In column (4) to column (6), we repeat the analysis with a measure of synchronicity, *Market-Correlation.* GMM-diagnostics, coefficients, test statistics and economic significance are in the same ballpark as for *R-squared.*

Most of our controls come in with the expected sign. In line with Roll (1988), Hutton, Marcus, and Tehranian (2009), Piotroski and Roulstone (2004), and Ferreira and Laux (2007), larger firms have higher *R-squared* suggesting that noise is lower in these firms. *R-squared* also increases in the number of analysts which can be interpreted in a similar way. The results in the literature for the impact of valuation measured by *Book-to-Market* are mixed (cf. Hutton, Marcus, and Tehranian, 2009 and Ferreira and Laux, 2007). We obtain a negative coefficient, which we find difficult to interpret. Liquidity measures are in general associated with higher *R-squared* and lower idiosyncratic risk (cf. Bris, Goetzmann, and Zhu, 2007). Our results are in line with this result from the literature. For *Trading Volume*, we do not find significant results. As outlined in Section 4.2, other liquidity measures already control for the effect and removing these measures brings out significant results. Bris, Goetzmann, and Zhu (2007) find that changes in short interest reduce *R-Squared.* We cannot confirm this result for our specification but re-specifying the model as in Table A4 in the Internet Appendix delivers the qualitatively same result. Ferreira and Laux (2007) and Piotroski and Roulstone (2004) document that institutional ownership increases idiosyncratic risk. We do not obtain significant result for this variable.

Since share repurchases increase the synchronicity between the stock and the market, the evidence is not consistent with the notion that share repurchases increase the amount of noise or that share repurchases incorporate private information in the stock price.

4.4 Do firms incorporate positive information or provide price support at fundamental values?

So far, we have established that share repurchases improve the efficiency of stock prices and reduce idiosyncratic risk. There is still more we can learn about the mechanism that brings about this effect. As outlined in the Introduction, there are two ways in which share repurchases can increase price efficiency. First, firms can trade on the basis of positive public information that is not yet incorporated in the stock price. Following this argument, firms recognize that in the light of new information their shares should be worth more and, accordingly, they buy shares until prices reach fundamental values. Second, firms can improve the accuracy with which negative public information is incorporated into the stock price by using share repurchases to prevent prices from dropping below (diverging from) fundamental values.

Each of the two aforementioned mechanisms has distinct empirical predictions. If firms incorporate positive public information into the stock price, we should observe increases in price efficiency in months where there is positive news. If firms help to price negative public information more accurately by establishing a lower bound at the fundamental value, we should observe increases in price efficiency when there is negative news. For the empirical analysis, we use the market return over the current month to determine whether positive news or negative news come to the market and split our repurchase variables in months where the market goes up and months where the market goes down. This approach reflects our dependent variable that examines the speed and accuracy with which lagged market returns are incorporated into the stock price and builds on the insight that idiosyncratic risk is lower when repurchases are higher.

We use the same specification as presented in Table 4 and Table 5 with the only distinction being that we split up our repurchase variable. We interact our measure of repurchase activity with dummy variables indicating whether the stock market went up or down. We do not include level variables in this specification because they are collinear with other included variables. *Repurchase Intensity* is collinear with the vector *Repurchase Intensity* x *Up Market* and *Repurchase Intensity x Down Market*. Dummy variables for up markets or down markets are furthermore collinear with time fixed effects.

Table 6 presents the results for price delay in Panel A and idiosyncratic risk in Panel B. The coefficient estimates on the interaction terms have the same sign as in the previous analyses. In up-markets, most of the coefficient estimates are statistically insignificant or marginally significant and their size decreases by about 50%. In down markets, however, the size of the coefficient estimates increases by a factor of two to three relative to the results in Table 4 and Table 5. In Panel A column (1), a down-market repurchase of the size of median *Repurchase Intensity* decreases *Delay* by 0.0365 points, which corresponds to 7.86% of median *Delay*. In Panel B column (1), a down-market repurchase of the size of median *Repurchase Intensity* increases *R-squared* by 0.0335 points, which corresponds to 15.09% of median *R-squared*. For the latter model, we have to reject the null hypothesis that the model is correctly specified (Hansen J test) at the 10 percent level. In column (4), we cannot reject the same model for *Market Correlation*. For this model, the above results are in the same order of magnitude. The results provide a consistent picture irrespective of which measure of efficiency or specification we use: Share repurchases decrease price delay and idiosyncratic risk in months where the stock market goes down, i.e. when negative information comes to the market.

In Table 7, we analyze the effect of share repurchases on stock return moment distributions (volatility and kurtosis). The empirical predictions for volatility and kurtosis are rather straightforward. According to our interpretation of the above reported results, firms prevent prices from diverging from their fundamental values. Consequently, we would expect that extreme values of stock returns become less frequent, so volatility and kurtosis should be lower when firms buy back shares. We again utilize the research design discussed above. The results strongly support the price stability argument. Volatility is lower, and kurtosis is smaller.

To further distinguish our hypothesis that firms react to market wide shocks from the hypothesis that firms react to firm-specific information, we use value-weighted SIC-2 industry returns instead of market returns to compute our dependent variables and re-do the analyses from above. The rationale here is that industry returns better reflect information that is relevant for the firm, which makes it more likely that firms actively trade and incorporate it. In the Internet Appendix in Table A6, we provide the results of these analyses. In Panel A, we replicate the analyses of Section 4.2 and 4.3 and in Panel B, we replicate the analysis of this section using SIC-2 returns as proxies for whether positive news or negative news comes to the market. While all of the results go into the same direction, they are much weaker, both from an economic and a statistical perspective. Most importantly, the coefficients on the up-market interactions do not systematically gain economic or statistical significance. We conclude that there is at best very weak evidence for the notion that firms incorporate positive information into the stock price.[15]

This section provides strong evidence for the notion that share repurchases provide price support and prevent the stock price from dropping below its fundamental value. As a consequence, share repurchases make prices more accurate and thus more efficient when new negative information arrives at the market. In line with this argument, share repurchases decrease volatility and kurtosis.

[15] In Section 4.7.3, we further investigate whether firms incorporate positive information by analyzing the post earnings announcement drift (PEAD) in the context of share repurchases. Also in this setup, we do not find evidence in this regard.

4.5 OLS results for contemporaneous repurchases

In Table 8, we estimate the OLS coefficients for contemporaneous *Repurchase Intensity* and *Repurchase Dummy*, a variable that indicates firm months with repurchase activity. As discussed in Section 3.2, we can expect that the coefficient on contemporaneous *Repurchase Intensity* has a positive bias if firms step in to prevent a mispricing of their stock. In this scenario, contemporaneous *Repurchase Intensity* might even be positively correlated with *Delay*. A variable that is more exogenous than *Repurchase Intensity* is a dummy variable indicating a month in which share repurchases take place because reverse causality will rather effect the size of the repurchase than the decision to repurchase. The results in Table 8 Panel A and Panel B confirm this conjecture. For all efficiency measures, the coefficient on *Repurchase Intensity* is not statistically significantly different from zero. Meanwhile, the coefficients on the dummy variable come in with the predicted sign and are highly statistically significant: Price efficiency is higher in months where repurchases take place.

In Panel C, we split *Repurchase Dummy* into up market and down markets as in earlier analyses. Consistent with the evidence presented earlier, the effect of repurchases on price efficiency and idiosyncratic risk is only present in down markets.

4.6 Attempts to identify repurchases that harm price efficiency or increase idiosyncratic risk

So far, we have restricted our analysis to the impact of within-firm variation in repurchase activity on price efficiency. Furthermore, we have focused on specifications that identify the exogenous variation in share repurchases and determine its impact on price efficiency. Taken together, these measures ensure that the hurdle for rejecting the null hypothesis, which states that share repurchases have no impact on price efficiency, is high. Meanwhile, one concern about our research design is that it is too strict to identify harmful effects caused by a subset of firms or repurchases.

In this section, we employ a research design that both substantially reduces the hurdle for rejecting the null hypothesis and singles out potentially harmful subsets of repurchases. We adjust our identification strategy along three dimensions. First, we use contemporaneous *Repurchase Intensity* and thereby include its potentially endogenous variation. Second, we exclude firm fixed effects to allow heterogeneity in the cross-section to drive our results. Third, we interact *Repurchase Intensity* with dummy variables indicating subsets of repurchases that are more likely to have a detrimental effect on price efficiency. Using a similar research design as in Section 4.4, we split *Repurchase Intensity* in two groups, denoted by *Repurchase Intensity * Interaction variable* and *Repurchase Intensity * (1- Interaction variable).* In this specification, we test the null hypothesis of the groups' share repurchases having no impact on our dependent variables. As pointed out in Section 4.4, we cannot include *Repurchase Intensity* as a level variable because it would be collinear with the included interaction terms.

Table 9 presents the results. In column (1) to column (4), we identify share repurchases where corporate insiders would profit most from a manipulation of the stock price. In column (1), we interact Repurchase Intensity with *Net Insider Selling*, which is equal to one if *Net Insider Trading* is negative and zero otherwise. Our coefficient of interest, the interaction of *Net Insider Selling* and *Repurchase Intensity*, is not statistically different from zero. This result also holds for defining *Net Insider Selling* over the following month or over the following three months (results not tabulated). Splitting *Repurchase Intensity* in two groups according to whether insider ownership (column 2), outstanding options (column 3), or options exercised (column 4) are above or below the median at program inception does also not produce any significant results. At the bottom of Table 9, we also test whether the effect for high and low groups are statistically significantly different from each other. We do not obtain any significant results.

If firms are forced to conduct (large) share repurchases within a short period of time, these share repurchases could harm price efficiency. For example, firms with huge piles of cash on their balance sheets might not be able to align their repurchase activity with the liquidity of their stock and therefore cause prices to increase. As a result, share repurchase trades might move prices away from fundamental values. Using a research design where we split *Research Intensity* at the median of *Cash to Assets* at the beginning of the program does, however, not provide any evidence for this conjecture (see column 5). In Table A7 of the Internet Appendix, we use *Cash to Assets* of the previous quarter as an instrument for *Repurchase Intensity* to examine this issue from a different angle. Again, an increase in *Repurchase Intensity* due to an increase in *Cash to Assets* does not significantly impact our efficiency measures.

In column (6), we group repurchases according to the quality of corporate governance measured by the Governance Index of Gompers, Ishii, and Metrick (2003). A high governance firm has an above median GIM index at the inception of the program. Once again, we do not obtain significant results.

In Table A8 of the Internet Appendix, we modify the above specifications: We use the 75th percentile to define our high and low groups in Panel A, we add firm fixed effects in Panel B, we lag *Repurchase Intensity* in Panel C, and exchange *Repurchase Intensity* for *Repurchase Dummy* in Panel D. However, none of these modifications help us to identify harmful repurchases. We conclude that, if any, only a very small subset of repurchases intentionally harm price efficiency. We only report the results for *Delay* and *R-squared* but we obtain similar results for all other measures.

4.7 Robustness tests

In this section we evaluate our results with respect to repurchase frequency, discuss alternative measures of price efficiency, examine the impact of share repurchases on the post earnings announcement drift, and present our baseline analysis excluding the financial market crisis.

4.7.1 Cross-sectional differences in repurchase frequency

Dittmar and Field (2015) point out that there is substantial heterogeneity in repurchasing frequency across both firms and time. The authors group firms every year into infrequent, moderate, and frequent repurchasers according to whether firms buy back in no more than four months, between five and eight months, and at least nine months respectively. In their sample, half of repurchasing firms repurchase four times or less in a year and only roughly 20% of firms repurchase nine times or more in a year. We obtain similar numbers for our data set. In the light of these results, this section is dedicated to discuss the validity of both instrumented *Repurchase Intensity* and lagged *Repurchase Intensity* as proxies for exogenous *Repurchase Intensity*. Furthermore, we utilize the heterogeneity in repurchasing frequency among firms to refine our identification strategy.

If firms repurchase infrequently and spread their repurchases randomly, lagged *Repurchase Intensity* might not be a good estimator of exogenous *Repurchase Intensity*. To evaluate this concern, we take a look at the probability of a repurchase taking place conditional on a repurchase having taken place in the previous month. For our data set, we find that 71% of months following a repurchase month have repurchase activity. Restricting this analysis to infrequently repurchasing firms, we obtain a conditional probability of 51%. Thus, although repurchase frequency is different among firms, even for infrequently repurchasing firms there is a high probability that a repurchase month is followed by another repurchase month because repurchases cluster.

Repurchase frequency is also a major concern for the conceptual validity of our instruments. If infrequently repurchasing firms distort price efficiency, the very noisy estimates of *Repurchase Intensity* for infrequently repurchasing firms might not be able to pick up on these effects. Here, it is important to note that share repurchases are predicted within active programs. Considering active programs instead of calendar years, changes the repurchase frequency statistics substantially. Now, only 39% of firms repurchase infrequently and 32% repurchase frequently. Thus, the majority of firms repurchases at least five times a year in the 12 months after the start of the program. Furthermore, infrequently repurchasing firms only represent 8,737 repurchase months of the total of 38,177 repurchase months.

The differences in repurchasing frequency also allow for a refinement of our identification strategy. In Table 10, we follow Dittmar and Field (2015) and group repurchasing firms every year into three categories according to their repurchase frequency (infrequent, moderate, frequent). Each of the three categories is identified by a dummy variable. Thus, we use firm-years without repurchase activity as our baseline category. We would expect that the efficiency gain is strongest for high frequency firms and lowest for low frequency firms. Our results corroborate our expectations. In column (1) and column (2), we observe that price delay is lower in repurchasing years irrespective of repurchase frequency. Furthermore, price delay is lower, the more frequent repurchases take place. In column (3) and column (4), we observe the same pattern for measures of idiosyncratic risk and synchronicity. Note, however, that idiosyncratic risk is not significantly lower when firms repurchase infrequently.

4.7.2 Alternative measures of price efficiency

In this section, we discuss alternative measures of price efficiency. To the extent that these measures are feasible within the context of our analysis, we use them to check the robustness of our results.

Variance ratios have a long history as measures of price efficiency dating back to at least Lo and MacKinlay (1988). The authors argue that if prices would follow a random walk, the ratio of short-run variance to long-run variance should be equal to the number of short-run windows fitting in one long-run window. Variance ratios are often estimated for annual or even longer periods and compare, for example, the variance of weekly returns to the variance of monthly returns (Cf., e.g., Saffi and Sigurdsson, 2011, Griffin, Kelly, and Nardari, 2010). Since the analyses in this paper compile daily observations into monthly efficiency measures, a sensible variance ratio would have to relate daily return variances to weekly return variances. For estimating weekly variance ratios, we face the problem that we would have to rely on only four observations since a month has only four weeks. Thus, we are not able to obtain meaningful variance ratios.

Idiosyncratic volatility would be a natural measure of idiosyncratic risk and is therefore a sensible alternative for measuring idiosyncratic information. However, compared to *R-squared* and *Market Correlation,* idiosyncratic volatility has been used rarely in the literature (we are only aware of its application in Ferreira and Laux, 2007). We define idiosyncratic volatility as the variance of the residual of a simple market model regression and find results which are consistent with our earlier findings: When repurchases are high, idiosyncratic volatility is low (see Table A9 of the Internet Appendix). Results on total volatility are reported in Table 7.

Phillips (2011) proposes an adjusted version of *Delay* where lagged market returns are substituted by market adjusted stock returns. He argues that this measure captures the speed with which idiosyncratic information is incorporated in the stock price. We find that this measure and *Delay* are highly correlated (correlation coefficient: 0.88*)* and using idiosyncratic price delay instead of *Delay* yields similar results (See Table A10 of the Internet Appendix).

There is also a variety of price efficiency measures that are computed for each trading day using intraday data (cf., e.g., Boehmer and Wu, 2013). To integrate these measures into our analyses, we have to average these daily measures over all trading days in a month. Therefore, intraday data does not necessarily allow for a more precise measurement of the effect of share repurchases on price efficiency. A very well established approach to examine price efficiency using intraday data is to look at the autocorrelation of changes in stock prices.[16] In Table A11 of the Internet Appendix, we provide the results using this measure as our dependent variable. All of our major results are robust to this measure.

4.7.3 Share repurchases and the post earnings announcement drift

Our earlier analyses do not support the notion that firms increase the speed with which positive, public information is incorporated into the stock price. However, price delay, which we use in these earlier analyses, solely captures the speed with which systematic information is incorporated into the stock price. Although Hou and Moskowitz (2005) demonstrate that price delay also captures the speed with which public, idiosyncratic information is incorporated into the stock price,[17] we have not yet directly examined this link. The post earnings

[16] We obtain data on the autocorrelation of absolute changes in stock prices from the Market Mircostructure Database of the Financial Markets Research Center at Vanderbilt University.

[17] Hou and Moskowitz (2005) show that their measure, which relates systematic public information to stock returns, is highly correlated with the size of the earnings announcement drift. The authors find that there is a monotonic relation between price delay and the drift in stock returns after earnings announcements which is to say that less delayed stocks incorporate the information from earnings announcements (i.e. earnings surprises) faster into stock prices. Thereby, the authors establish that their measure captures the speed with

announcement drift (PEAD) allows to assess this question directly. The PEAD drift refers to the empirical observation first made by Ball and Brown (1968) that returns tend to be positive (negative) after positive (negative) earnings surprises. Bernard and Thomas (1989, 1990) suggest that this drift is the result of an underreaction of investors who fail to immediately incorporate the information conveyed by the earnings surprise. Thus, if firms increase the speed at which idiosyncratic information is incorporated into the stock price, the drift after positive earnings surprises should be smaller when firms buy back shares.

Note that this analysis cannot provide further evidence for firms providing price support at fundamental values because the underlying argument builds on overreaction whereas PEAD builds on underreaction. Therefore, we cannot generate any predictions on the impact of share repurchases on the post earnings announcement drift after negative earnings surprises and solely focus on positive earnings surprises.

We measure earnings surprises as the difference between actual earnings and the average of the most recent consensus forecasts, scaled by the stock price two days before the announcement date.[18] We measure the drift as the cumulative difference between a stock's daily returns and the daily value-weighted market returns. Table 2 reports descriptive statistics on *Earnings Surprise* and the PEAD. Our sample covers 37,001 earnings announcement events of firms with repurchase programs.

Our research design is inspired by Boehmer and Wu (2013) who use the earnings announcement drift to examine the informational content of short selling. In Table 11, we regress the absolute cumulated market adjusted returns from t+2 to t+6 on variables indicating positive and negative earnings surprises,[19] one of our repurchase variables, and the interaction between the positive surprise indicator variable and the repurchase variable. We include *Relative Spread* as an additional control to rule out that any improvements in the drift are caused by liquidity provision via repurchases.[20] We start the analysis by pooling all

which both systematic and idiosyncratic information are incorporated into the stock price.

[18]All of the additional data needed for the analysis of this section is obtained from I/B/E/S.

[19]We define an earnings announcement to be a positive surprise if it is above the 75th percentile of *Earnings Surprise* and to be negative if it is below the 25th percentile of *Earnings Surprise*.

[20]Sadka (2006) and Chordia, Goyal, Sadka, Sadka, and Shivakumar (2009) document that the earnings

quarter observations and subsequently add firm fixed effects and month fixed effects.

The interactions between positive earnings surprises and repurchases are our variables of interest. If firms actively incorporate positive information by buying back stocks, the coefficient on the interaction should be negative. However, the coefficients are not statistically different from zero in all specifications. Hence, in line with earlier analyses, our results provide no evidence for the notion that firms actively incorporate information.

Most of the other coefficients come in with the expected signs. The absolute drift is larger for both positive and negative earnings surprises. For negative earnings surprises the coefficient is generally larger than for positive surprises suggesting a stronger drift after negative news. The positive coefficients for *Relative Spread* are in line with our expectations suggesting a more pronounced drift for illiquid stocks.

For our repurchase measures we obtain mixed results. While the coefficient for *Repurchase Intensity* is statistically insignificant, the coefficient for *Remaining Volume* is positive, but no longer statistically significant once we include time-fixed effects.

4.7.4 Price support and the financial market crisis.

In order to ensure that our main results of Table 6 are not driven by the financial market crisis, we exclude all observations after August 2008 and re-do the analysis of Section 4.4. Our results are also robust to restricting the data set in this way (see Table A12 of the Internet Appendix).

5 Conclusion

In this paper, we examine the impact of share repurchases on price efficiency and the information content of stock prices. The evidence is neither consistent with the notion that share repurchases incorporate private information into the stock price nor with the notion that share repurchases increase the noise in stock returns. We find that share repurchases

announcement drift is more pronounced for illiquid stocks.

increase the accuracy with which negative information is incorporated into the stock price. We conclude that share repurchases increase the price efficiency of stock prices by providing price support at fundamental values.

References

Babenko, I., 2009, "Share Repurchases and Pay-Performance Sensitivity of Employee Compensation Contracts," *Journal of Finance*, 64(1), 117–150.

Bagwell, L. S., 1991, "Share repurchase and takeover deterrence," *The RAND Journal of Economics*, 22(1), 72–88.

Ball, R., and P. Brown, 1968, "An empirical evaluation of accounting income numbers," *Journal of Accounting Research*, 6(2), 159–178.

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

Ben-Rephael, A., J. Oded, and A. Wohl, 2013, "Do Firms Buy Their Stock at Bargain Prices? Evidence from Actual Stock Repurchase Disclosures," *Review of Finance*, pp. 1–42.

Bernard, V. L., and J. K. Thomas, 1989, "Post-earnings-announcement drift: Delayed price response or risk premium," *Journal of Accounting Research*, 27(3), 1–36.

———, 1990, "Evidence that stock prices do not fully reflect the implications of current earnings for future earnings," *Journal of Accounting and Economics*, 13(4), 305–340.

Bessembinder, H., 2003, "Issues in assessing trade execution costs," *Journal of Financial Markets*, 6(3), 233–257.

Boehmer, E., and E. K. Kelley, 2009, "Institutional Investors and the Informational Efficiency of Prices," *Review of Financial Studies*, 22(9), 3563–3594.

Boehmer, E., and J. J. Wu, 2013, "Short Selling and the Price Discovery Process," *Review of Financial Studies*, 26(2), 287–322.

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

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

Brav, A., J. R. Graham, C. R. Harvey, and R. Michaely, 2005, "Payout policy in the 21st century," *Journal of Financial Economics*, 77(3), 483–527.

Bris, A., W. N. Goetzmann, and N. Zhu, 2007, "Efficiency and the Bear: Short Sales and Markets Around the World," *Journal of Finance*, 62(3), 1029–1079.

Chordia, T., A. Goyal, G. Sadka, R. Sadka, and L. Shivakumar, 2009, "Liquidity and the Post-Earnings-Announcement Drift," *Financial Analysts Journal*, 65(4), 18–32.

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

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

Dittmar, A. K., 2000, "Why Do Firms Repurchase Stock?," *Journal of Business*, 73(3), 331–355.

Edmans, A., L. Goncalves-Pinto, Y. Wang, and M. Xu, 2014, "Strategic News Releases in Equity Vesting Months.," Unpublished working paper. European Corporate Governance Institute.

Fenn, G. W., and N. Liang, 2001, "Corporate payout policy and managerial stock incentives," *Journal of Financial Economics*, 60(1), 45–72.

Ferreira, M. A., and P. A. Laux, 2007, "Corporate Governance, Idiosyncratic Risk, and Information Flow," *The Journal of Finance*, 62(2), 951–989.

Fishman, M. J., and K. M. Hagerty, 1992, "Insider Trading and the Efficiency of Stock Prices," *RAND Journal of Economics*, 23(1), 106–122.

Fu, F., and S. Huang, 2015, "The Persistence of Long-Run Abnormal Returns Following Stock Repurchases and Offerings," *Management Science*, forthcoming.

Gompers, P., J. Ishii, and A. Metrick, 2003, "Corporate Governance and Equity Prices," *The Quarterly Journal of Economics*, 118(1), 107–156.

Griffin, J. M., P. J. Kelly, and F. Nardari, 2010, "Do Market Efficiency Measures Yield Correct Inferences? A Comparison of Developed and Emerging Markets," *Review of Financial Studies*, 23(8), 3225–3277.

Grossman, S. J., and M. H. Miller, 1988, "Liquidity and market structure," *The Journal of Finance*, 43(3), 617–633.

Grullon, G., and R. Michaely, 2004, "The information content of share repurchase programs," *Journal of Finance*, 59(2), 651–680.

Henker, T., and J.-X. Wang, 2006, "On the importance of timing specifications in market microstructure research," *Journal of Financial Markets*, 9(2), 162–179.

Hillert, A., E. G. Maug, and S. Obernberger, 2015, "Stock Repurchases and Liquidity," *Journal of Financial Economics*, forthcoming.

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

Hou, K., and T. J. Moskowitz, 2005, "Market Frictions, Price Delay, and the Cross-Section of Expected Returns," *Review of Financial Studies*, 18(3), 981–1020.

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

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

——— , 2000, "Stock repurchases in Canada: Performance and strategic trading," *Journal of Finance*, 55(5), 2373–2397.

Jensen, M. C., 1986, "Agency Costs of Free Cash Flow, Corporate Finance, and Takeovers," *American Economic Review*, 76(2), 323–329.

Kleibergen, F., and R. Paap, 2006, "Generalized reduced rank tests using the singular- value decomposition," *Journal of Econometrics*, 127, 97–126.

Lee, C. M. C., and M. J. Ready, 1991, "Inferring Trade Direction from Intraday Data," *Journal of Finance*, 46(2), 733–746.

Lo, A., and A. MacKinlay, 1988, "Stock market prices do not follow random walks: evidence from a simple specification test," *Review of Financial Studies*, 1(1), 41–66.

Lou, D., 2014, "Attracting Investor Attention through Advertising," *Review of Financial Studies*, forthcoming.

Morck, R., B. Yeung, and W. Yu, 2000, "The information content of stock markets: Why do emerging markets have synchronous stock price movements?," *Journal of Financial Economics*, 58(1), 215–260.

Peyer, U., and T. Vermaelen, 2009, "The nature and persistence of buyback anomalies," *Review of Financial Studies*, 22(4), 1693–1745.

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

Piotroski, J. D., and B. T. Roulstone, 2004, "The Influence of Analysts, Institutional Investors, and Insiders on the Incorporation of Market, Industry, and Firm-Specific Information into Stock Prices," *Accounting Review*, 79(4), 1119–1151.

Roll, R., 1988, "R2," *Journal of Finance*, 43(3), 541–566.

Sadka, R., 2006, "Momentum and post-earnings-announcement drift anomalies: The role of liquidity risk," *Journal of Financial Economics*, 80(2), 309–349.

Saffi, P. A. C., and K. Sigurdsson, 2011, "Price Efficiency and Short Selling," *Review of Financial Studies*, 24(3), 821–852.

Sias, R. W., and L. T. Starks, 1997, "Return autocorrelation and institutional investors," *Journal of Financial Economics*, 46(1), 103 – 131.

Skinner, D. J., 2008, "The evolving relation between earnings, dividends, and stock repurchases," *Journal of Financial Economics*, 87(3), 582–609.

Stephens, C. P., and M. S. Weisbach, 1998, "Actual Share Reacquisitions in Open-Market Repurchase Programs," *Journal of Finance*, 53(1), 313–333.

Stock, J. H., and M. Yogo, 2005, *Testing for weak instruments in linear IV regression. Identification and inference for econometric models*in: Donald W.K. Andrews and James H. Stock, eds: Essays in Honor of Thomas Rothenberg, Cambridge University Press, Cambridge.

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

Tables

Table 1: Description of Variables. The table describes all control variables and some repurchase variables. For each variable the table reports the definition, the data source, and the unit of measurement. Variables denoted with (ln) are expressed as natural logarithms.

Name	Definition	Source	Unit
Accelerated Share Repurchase	Repurchase via accelerated share repurchase	SEC	binary
Acquiror	1 if firm is currently (time between announcement and end of the offer) bidding for another company	SDC	binary
Amihud	Monthly average of daily Amihud illiquidity ratio	CRSP	ratio
Analysts	Number of analysts (ln)	IBES	Unit
Book to Market	Book value equity / market cap, winsorized at 1%	Comp.	ratio
Book Value Equity	Common equity (Compustat item: ceqq)	Comp.	million
Cash	Cash and Short-Term Investments (Compustat item: cheq)	Comp.	million
Convertible Issue	1 if convertible issue takes place in respective month	SDC	binary
Delay	Price efficiency measure constructed as the ratio of the R^2 estimates of the extended market model and the base model	CRSP	ratio
Coefficient-based Delay	Price efficiency measure constructed as the ratio of the lag-weighted sum of the coefficients of the lagged market returns relative to the sum of all coefficients	CRSP	ratio
Deviation from $30	Absolute difference between *Price* and $30 (ln)	CRSP	unit
Dividends	Total Dividends (Compustat item: dvt)	Comp.	million
Earnings Surprise	Difference between actual earnings and the consensus forecast scaled by price	IBES	ratio
EBITDA	Operating income before depreciation (Compustat item: oibdpq)	Comp.	million
Governance	Governance Index of Gompers, Ishii, and Metrick (2003)	ISS	unit
Insider Ownership	Shares held by insiders scaled by shares outstanding	Exec.	ratio
Leverage	(Total asset - book value equity) / (total asset - book value equity + market cap)	Comp. /CRSP	ratio
Market Cap	Monthly average of daily market capitalization (ln)	CRSP	million
Market Correlation	Correlation between daily stock return and contemporaneous market return	CRSP	unit
Net Insider Trading	Insider buying minus insider selling scaled by *Market Cap*	TR Insider Data	ratio
Options Exercised	Number of shares obtained by option exercises of coporate insiders in the respective month divided by shares outstanding	TR Insider Data	ratio
Options outstanding	Outstanding options scaled by shares outstanding	Comp.	ratio

Table 1: Description of Variables. (continued)

Name	Definition	Source	Unit
Order Imbalance	Monthly average of absolute difference between buy and sell orders scaled by total number of orders (ln)	TAQ	ratio
Price Impact	Monthly average of intraday price impact, transaction based (ln)	TAQ	ratio
Private Repurchase	Repurchase via private transaction	SEC	binary
Program Month	Difference between current month and month before start of the repurchase program plus 1 (ln)	SEC	unit
Program Size (scaled)	Size of the repurchase program scaled by shares oustanding as of the beginning of the program	SEC	ratio
Relative Spread	Monthly average of intraday relative spread, time-weighted (ln)	TAQ	ratio
Remaining Volume	Remaining Volume at the beginning of the months that can be repurchased under the program scaled by shares outstanding	SEC	ratio
Repurchase Volume	Dollar Volume of shares repurchased during the month	SEC	million
Repurchase Dummy	1 if repurchase transaction takes place	SEC	binary
Repurchase Intensity	Number of shares repurchased during the month divided by the number of shares outstanding at the last trading day of the previous month	SEC /CRSP	ratio
Repurchase Intensity (TV)	Number of shares repurchased during the month divided by the number of shares traded over the current month	SEC /CRSP	ratio
Return	Monthly stock return	CRSP	unit
Return > 0	Monthly stock return if positive, else zero	CRSP	unit
Return < 0	Monthly stock return if negative, else zero	CRSP	unit
R-squared	R-squared estimate of the market model	CRSP	ratio
S&P 500	1 if firm is in the S&P 500	CRSP	binary
SEO	1 if SEO takes place in respective month	SDC	binary
Shares Outstanding	Number of shares outstanding at last trading day of month	CRSP	million
Target	1 if firm is currently (time between announcement and end of the offer) a target of another company	SDC	binary
Tender Offer	Repurchase via tender offer or Dutch auction	SEC	binary
Total Assets	Total assets (Compustat item: atq) (ln)	Comp.	million
Trading Volume	Monthly total dollar trading volume (ln)	CRSP	million
Turnover	Trading volume scaled by market cap	CRSP	ratio
Volatility	Standard deviation of daily returns over one month (ln)	CRSP	unit

Table 2: Descriptive Statistics. This table provides descriptive statistics for the repurchase variables used, for the dependent variables, and for the control variables for firms which had an open repurchase programs at some point between 2004 and 2010. Additionally, the table provides information on the repurchase variables in repurchase months, on the repurchase programs, and earnings announcements. The repurchase variables and the control variables are defined in Table 1. We report the arithmetic mean, the median, the standard deviation (S.D.), the within-firm standard deviation (S.D. within), the 1st percentile, and the 99th percentile of the distribution for each variable. None of the variables is expressed in natural logarithms. Within-firm variation is calculated from a regression of the respective variable on firm fixed effects.

	Mean	Median	S.D.	S.D. (within)	1^{st} Perc.	99^{th} Perc.	N
Dependent Variables							
Delay	0.504	0.465	0.306	0.253	0.032	1.000	158,471
Coefficient-based Delay	1.973	1.940	0.630	0.566	0.705	3.482	158,471
R-squared	26.84%	22.17%	22.62%	18.53%	0.01%	81.21%	158,471
|Market Correlation|	0.456	0.471	0.246	0.197	0.010	0.901	158,471
Repurchase measures							
Repurchase Volume (mill.)	12.8	0.0	97.9	82.6	0.0	286.4	158,471
Repurchase Intensity	0.16%	0.00%	0.55%	0.53%	0.00%	2.58%	158,471
Repurchase Intensity (TV)	1.64%	0.00%	5.71%	5.25%	0.00%	29.22%	158,471
Remaining Volume	4.54%	2.05%	6.77%	3.77%	0.00%	33.46%	158,471
Repurchase measures in repurchase months							
Repurchase Volume (mill.)	49.3	5.1	167.3	121.9	0.0	740.7	38,155
Repurchase Intensity	0.68%	0.38%	0.96%	0.81%	0.00%	4.56%	38,155
Repurchase Intensity (TV)	6.81%	3.33%	10.01%	7.47%	0.00%	53.07%	38,155
Remaining Volume	6.90%	4.84%	7.22%	3.85%	0.00%	36.62%	38,155
Program Descriptives							
Program Month	16	12	14.02	9.37	1	67	6,537
Program Size (scaled)	6.59%	5.27%	4.86%	3.66%	0.47%	25.11%	6,537
Control variables							
Acquisition Dummy	0.096	0	0.295	0.268	0	1	158,471
Analysts	7.001	5	6.839	2.266	0	28	158,471
Book to Market	0.655	0.527	0.580	0.393	-0.172	3.385	158,471
Cash to Assets	16.9%	8.5%	19.1%	7.1%	0.1%	78.3%	158,471
Deviation from $30	18.4	15.9	39.2	15.2	0.3	70.9	158,471
Dividends to Assets	0.92%	0.00%	2.03%	1.14%	0.00%	13.54%	158,471
Exogenous Delay	0.661	0.684	0.118	0.115	0.304	0.842	158,471
EBITDA to Assets	0.027	0.026	0.035	0.021	-0.078	0.124	158,471
Governance (ln)	2.183	2.197	0.303	0.045	1.386	2.708	68,014
Insider Ownerhsip	5.24%	2.59%	7.89%	3.73%	0.15%	45.14%	86,746
Leverage	0.435	0.376	0.290	0.092	0.022	0.974	158,471
Market Cap (mill.)	4796.7	629.0	17456.4	4284.0	11.6	84770.3	158,471
Net Insider Trading	-0.07%	0.00%	0.87%	0.86%	-1.33%	0.37%	154,753
Options Exercised	0.08%	0.00%	0.26%	0.25%	0.00%	1.59%	158,471
Options outstanding	8.77%	7.07%	13.13%	7.36%	0.00%	32.50%	151,863

Table 2: Descriptive Statistics (continued).

	Mean	Median	S.D.	S.D. (within)	1^{st} Perc.	99^{th} Perc.	N
Relative Spread	0.77%	0.17%	1.75%	1.05%	0.02%	9.17%	158,471
Return	0.008	0.004	0.144	0.144	-0.354	0.420	158,471
Target Dummy	0.004	0.000	0.064	0.064	0.000	0.000	158,471
Total Assets	10582.6	904.4	83539.8	23738.2	17.8	139280.4	158,471
Volatility	0.028	0.022	0.022	0.020	0.006	0.111	158,471
Earnings announcements							
Earnings surprise	-0.002	0.000	0.022	0.021	-0.144	0.032	37,001
CAR(+2,+6)	0.000	-0.001	0.056	0.056	-0.145	0.154	37,001

Table 3: Analysis of Repurchase Activity. The table presents OLS regressions of *Repurchase Intensity* and *Remaining Volume* on *Returns*, instruments and control variables. All variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Dependent Variable:	Repurchase Intensity	Repurchase Intensity	Remaining Volume
	(1)	(2)	(3)
Method:	OLS	OLS	OLS
Repurchase Intensity$_{t-1}$		0.2001***	
		(16.45)	
Program Month$_t$ (ln)	–0.0006***	–0.0005***	–0.0070***
	(–12.47)	(–12.08)	(–13.51)
Program Size$_t$	0.0316***	0.0260***	0.8628***
	(16.16)	(15.37)	(39.13)
Options Exercised$_t$	0.0159**	0.0214***	0.0002
	(2.03)	(2.76)	(0.01)
Net Insider Tading$_t$ (scaled)	–0.0110***	–0.0103***	0.0093
	(–2.96)	(–2.99)	(1.22)
Options Outstanding$_t$	0.0005*	0.0004*	–0.0020
	(1.94)	(1.87)	(–0.95)
Return$_{t-1} > 0$	0.0001	0.0001	–0.0008
	(0.60)	(0.58)	(–0.88)
Return$_{t-1} < 0$	–0.0034***	–0.0034***	0.0015
	(–10.32)	(–10.41)	(0.98)
Book to Market$_{t-3}$	0.0002***	0.0002***	–0.0001
	(3.34)	(3.03)	(–0.06)
Total Assets$_{t-3}$ (ln)	0.0009***	0.0009***	0.0008
	(8.72)	(9.62)	(0.58)
Cash to Assets$_{t-3}$	0.0015***	0.0014***	0.0127***
	(4.14)	(4.62)	(2.80)
EBITDA to Assets$_{t-3}$	0.0009	0.0006	–0.0123
	(1.03)	(0.74)	(–1.30)
Dividends to Assets$_{t-3}$	–0.0008	–0.0009	0.0473*
	(–0.41)	(–0.56)	(1.93)
Leverage$_{t-3}$	–0.0048***	–0.0041***	0.0024
	(–13.03)	(–13.65)	(0.53)
Acquiror Dummy$_t$	–0.0004***	–0.0003***	0.0005
	(–5.39)	(–4.86)	(1.13)
Target Dummy$_t$	–0.0004	–0.0003	0.0005
	(–1.61)	(–1.10)	(0.35)
Relative Spread$_{t-1}$ (ln)	–0.0000	0.0001*	0.0004
	(–0.13)	(1.83)	(0.62)
Constant	–0.0042***	–0.0034***	0.0071
	(–6.43)	(–6.30)	(0.88)
R^2 (within firm)	0.061	0.102	0.563
Observations	134,081	133,869	134,428
Firm FE and Month FE	Y	Y	Y

Table 4: The Influence of Repurchases on Delay. The table presents OLS and GMM-regressions of *Delay* and *Coefficient-based Delay* on either *Repurchase Intensity* or *Remaining Volume* and control variables. The dependent variable is *Delay* in specification (1)-(3) and *Coefficient-based Delay* in specification (4)-(6). In specifications (1) and (4) the repurchase variables are instrumented using *Program Size* and *Program Month* as instruments. Instrumented variables are in italics and marked with a circumflex. In specifications (2) and (5) the repurchase variables are included as predetermined values. The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for both tests. The t-tests for the instruments are from the first-stage regressions. The test suggested by Stock and Yogo (2005) rejects the hypothesis that the bias exceeds the OLS bias by more than 5% in all cases.

Dependent Variable:	Delay			Coefficient-based Delay		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
$\widehat{Repurchase\ Intensity}_t$	–2.8020***			–4.5158**		
	(–2.91)			(–2.31)		
Repurchase Intensity$_{t-1}$		–0.6429***			–1.2656***	
		(–5.49)			(–4.72)	
Remaining Volume$_t$			–0.0612***			–0.1240***
			(–2.66)			(–2.63)
Delay$_{t-1}$	0.0875***	0.0868***	0.0867***			
	(26.68)	(26.64)	(26.63)			
Coefficient-based Delay$_{t-1}$				0.0298***	0.0296***	0.0295***
				(10.57)	(10.57)	(10.56)
Return$_{t-1} > 0$	–0.0160**	–0.0119*	–0.0118*	–0.0223	–0.0170	–0.0168
	(–2.28)	(–1.70)	(–1.68)	(–1.38)	(–1.06)	(–1.04)
Return$_{t-1} < 0$	–0.0893***	–0.0812***	–0.0806***	–0.1671***	–0.1524***	–0.1511***
	(–8.64)	(–8.16)	(–8.10)	(–7.28)	(–6.80)	(–6.74)
Program Initiation$_t$	0.0352***	0.0277***	0.0256***	0.0651***	0.0509***	0.0468***
	(7.44)	(8.16)	(7.49)	(6.42)	(6.75)	(6.15)
Market Cap$_{t-1}$ (ln)	–0.0320***	–0.0334***	–0.0336***	–0.0573***	–0.0594***	–0.0597***
	(–10.16)	(–10.66)	(–10.72)	(–9.05)	(–9.44)	(–9.51)
Book to Market$_{t-3}$	0.0183***	0.0174***	0.0172***	0.0319***	0.0305***	0.0302***
	(6.37)	(6.09)	(6.03)	(5.31)	(5.09)	(5.03)
Volatility$_{t-1}$ (ln)	–0.0437***	–0.0442***	–0.0442***	–0.0783***	–0.0787***	–0.0788***
	(–21.36)	(–21.53)	(–21.57)	(–17.67)	(–17.73)	(–17.79)
Analysts$_{t-1}$ (ln)	–0.0087***	–0.0094***	–0.0096***	–0.0183***	–0.0196***	–0.0199***
	(–3.03)	(–3.24)	(–3.31)	(–3.05)	(–3.23)	(–3.29)

Table 4: The Influence of Repurchases on Delay (continued).

Dependent Variable:	Delay			Coefficient-based Delay		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Relative Spread$_{t-1}$ (ln)	0.0392***	0.0392***	0.0396***	0.0674***	0.0676***	0.0683***
	(18.64)	(18.65)	(18.85)	(14.38)	(14.40)	(14.57)
Deviation from \$30$_{t-1}$	0.0029***	0.0029***	0.0029***	0.0056***	0.0057***	0.0057***
	(2.83)	(2.84)	(2.85)	(2.59)	(2.63)	(2.65)
Trading Volume$_{t-1}$ (scaled)	0.0119***	0.0125***	0.0126***	0.0132**	0.0144**	0.0147**
	(4.41)	(4.63)	(4.70)	(2.12)	(2.36)	(2.42)
Change in Short Interest$_{t-1}$	–0.0224	–0.0321	–0.0447	–0.0657	–0.0528	–0.0776
	(–0.41)	(–0.61)	(–0.84)	(–0.57)	(–0.46)	(–0.67)
Institutional Ownership$_{t-3}$	–0.0815***	–0.0853***	–0.0846***	–0.0846***	–0.0898***	–0.0883***
	(–7.20)	(–7.50)	(–7.43)	(–3.78)	(–4.00)	(–3.94)
Constant		0.7138***	0.7176***		2.2576***	2.2652***
		(32.70)	(32.86)		(51.04)	(51.17)
R^2 (within firm)	0.131	0.149	0.149	0.094	0.112	0.112
Observations	155,573	156,718	156,718	155,556	156,700	156,700
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Hansen's J (test)	1.15			0.98		
Hansen's J (p-value)	28.43%			32.22%		
Kleibergen-Paap (test)	319.8			319.2		
Kleibergen-Paap (p-value)	0.00%			0.00%		

Table 5: The Influence of Repurchases on R-squared and Absolute Market Correlation. The table presents OLS and GMM-regressions of *R-squared* and *Market Correlation* on either *Repurchase Intensity*, or *Remaining Volume* and control variables. The dependent variable is *R-squared* in specification (1)-(3) and *Market Correlation* in specification (4)-(6). In specifications (1) and (4) the repurchase variables instrumented using *Program Size* and *Program Month* as instruments. Instrumented variables are in italics and marked with a circumflex. In specifications (2) and (5) the repurchase variables are included as predetermined values. The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for both tests. The t-tests for the instruments are from the first-stage regressions. The test suggested by Stock and Yogo (2005) rejects the hypothesis that the bias exceeds the OLS bias by more than 5% in all cases.

Dependent Variable:		R-squared			|Market Correlation|	
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
$\widehat{Repurchase\ Intensity}_t$	1.7350**			2.0315***		
	(2.41)			(2.65)		
Repurchase Intensity_{t-1}		0.4569***			0.5377***	
		(5.46)			(6.19)	
Remaining Volume_t			0.0407**			0.0481***
			(2.33)			(2.59)
R-squared_{t-1}	0.1423***	0.1418***	0.1417***			
	(37.32)	(37.38)	(37.36)			
$\|\text{Market Correlation}\|_{t-1}$				0.1220***	0.1216***	0.1215***
				(34.23)	(34.39)	(34.37)
Program Initiation_t	–0.0309***	–0.0255***	–0.0240***	–0.0319***	–0.0262***	–0.0245***
	(–8.89)	(–10.81)	(–10.09)	(–8.56)	(–10.12)	(–9.37)
Market Cap_{t-1} (ln)	0.0221***	0.0227***	0.0228***	0.0242***	0.0249***	0.0250***
	(9.83)	(10.10)	(10.14)	(9.74)	(10.05)	(10.09)
Book to Market_{t-3}	–0.0128***	–0.0127***	–0.0126***	–0.0126***	–0.0123***	–0.0122***
	(–6.47)	(–6.43)	(–6.38)	(–5.64)	(–5.51)	(–5.46)
Analysts_{t-1} (ln)	0.0032	0.0038*	0.0040*	0.0060***	0.0068***	0.0070***
	(1.56)	(1.83)	(1.90)	(2.63)	(2.96)	(3.03)
Relative Spread_{t-1} (ln)	–0.0273***	–0.0271***	–0.0274***	–0.0278***	–0.0276***	–0.0279***
	(–17.75)	(–17.67)	(–17.88)	(–16.73)	(–16.57)	(–16.79)
Deviation from $\$30_{t-1}$	–0.0030***	–0.0031***	–0.0031***	–0.0030***	–0.0030***	–0.0030***
	(–3.90)	(–3.90)	(–3.91)	(–3.66)	(–3.66)	(–3.67)
Trading Volume_{t-1} (scaled)	0.0068	0.0066	0.0065	0.0044	0.0041	0.0040
	(1.63)	(1.59)	(1.57)	(1.06)	(1.01)	(0.98)

Table 5: The Influence of Repurchases on R-squared and Absolute Market Correlation (continued).

Dependent Variable:	R-squared			|Market Correlation|		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Change in Short Interest$_{t-1}$	–0.0137	–0.0105	–0.0018	0.0444	0.0478	0.0582
	(–0.36)	(–0.28)	(–0.05)	(1.09)	(1.18)	(1.44)
Institutional Ownership$_{t-3}$	0.0285***	0.0314***	0.0309***	0.0581***	0.0612***	0.0607***
	(3.61)	(3.97)	(3.91)	(6.67)	(7.01)	(6.94)
Constant		–0.0500***	–0.0526***		0.0877***	0.0847***
		(–3.39)	(–3.55)		(5.34)	(5.15)
R^2 (within firm)	0.231	0.246	0.246	0.185	0.201	0.201
Observations	155,569	156,715	156,715	155,574	156,720	156,720
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Hansen's J (test)	0.89			0.91		
Hansen's J (p-value)	34.47%			34.06%		
Kleibergen-Paap (test)	316.8			316.5		
Kleibergen-Paap (p-value)	0.00%			0.00%		

Table 6: Panel A. The Influence of Repurchases on Delay in Up and Down Markets. The table presents OLS and GMM-regressions of *Delay and Coefficient-based Delay* (Panel A), and *R-squared* and *Absolute Market Correlation* (Panel B) on *Repurchase Intensity* or *Remaining Volume,* interaction terms of dummy variables identifying up and down markets and the repurchase variables, and control variables (untabulated). The controls are the same as in Table 4, respectively Table 5. In the GMM-specifications, the repurchase variables are instrumented using *Program Size* and *Program Month.* The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for both tests. The t-tests for the instruments are from the first-stage regressions. The test suggested by Stock and Yogo (2005) rejects the hypothesis that the bias exceeds the OLS bias by more than 5% in all cases.

Dependent Variable:		Delay			Coefficient-based Delay	
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Rep. $\widehat{Intensity}_t$ x Up Market$_t$	–1.4623			–2.1348		
	(–1.28)			(–0.91)		
Rep. $\widehat{Intensity}_t$ x Down Market$_t$	–4.5103***			–7.1483***		
	(–4.42)			(–3.24)		
Rep. Intensity$_{t-1}$ x Up Market$_t$		–0.3315**			–0.5418	
		(–2.22)			(–1.61)	
Rep. Intensity$_{t-1}$ x Down Market$_t$		–1.0563***			–2.2267***	
		(–6.19)			(–5.90)	
Rem. Volume$_t$ x Up Market$_t$			–0.0415*			–0.0929*
			(–1.69)			(–1.86)
Rem. Volume$_t$ x Down Market$_t$			–0.0884***			–0.1671***
			(–3.55)			(–3.11)
R^2 (within firm)	0.130	0.149	0.149	0.094	0.112	0.112
Observations	156,713	156,718	156,718	156,695	156,700	156,700
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y
Hansen's J (test)	2.33			3.11		
Hansen's J (p-value)	31.11%			21.08%		
Kleibergen-Paap (test)	318.0			316.9		
Kleibergen-Paap (p-value))	0.00%			0.00%		

Table 6: Panel B. The Influence of Repurchases on R-squared and Absolute Market Correlation in Up and Down Markets.

Dependent Variable:		R-squared			|Market Correlation|	
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Rep. $\widehat{Intensity}_t$ x Up Market$_t$	0.4383			1.2604		
	(0.54)			(1.41)		
Rep. $\widehat{Intensity}_t$ x Down Market$_t$	4.1306***			4.1448***		
	(5.09)			(5.09)		
Rep. Intensity$_{t-1}$ x Up Market$_t$		0.0872			0.2421**	
		(0.85)			(2.21)	
Rep. Intensity$_{t-1}$ x Down Market$_t$		1.0307***			1.0198***	
		(7.81)			(7.88)	
Rem. Volume$_t$ x Up Market$_t$			0.0272			0.0418**
			(1.49)			(2.12)
Rem. Volume$_t$ x Down Market$_t$			0.0793***			0.0788***
			(4.04)			(3.94)
R^2 (within firm)	0.232	0.251	0.251	0.186	0.207	0.207
Observations	156,707	156,712	156,712	156,712	156,717	156,717
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y
Hansen's J (test)	4.79			2.28		
Hansen's J (p-value)	9.11%			32.04%		
Kleibergen-Paap (test)	318.8			318.5		
Kleibergen-Paap (p-value)	0.00%			0.00%		

Table 7: The Influence of Repurchases on Volatility and Kurtosis. The table presents OLS and GMM-regressions of *Volatility*, and *Kurtosis* on either *Repurchase Intensity* or *Remaining Volume* and control variables. The dependent variable is *Volatility* in specification (1)-(3) and *Kurtosis* in specification (4)-(6). In specifications (1) and (4) the repurchase variables are instrumented using *Program Size* and *Program Month* as instruments. Instrumented variables are in italics and marked with a circumflex. In specifications (2) and (5) the repurchase variables are included as predetermined values. The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for both tests. The t-tests for the instruments are from the first-stage regressions. The test suggested by Stock and Yogo (2005) rejects the hypothesis that the bias exceeds the OLS bias by more than 5% in all cases.

Dependent Variable:	Volatility (ln)			Kurtosis (ln)		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
$\widehat{Repurchase\ Intensity}_t$	–14.4293***			–2.0354*		
	(–7.93)			(–1.85)		
Repurchase Intensity_{t-1}		–1.4424***			–0.6724***	
		(–7.99)			(–3.73)	
Remaining Volume_t			–0.3187***			–0.0541*
			(–7.40)			(–1.96)
Volatility_{t-1} (ln)	0.3087***	0.3097***	0.3091***			
	(53.93)	(52.41)	(52.53)			
Kurtosis_{t-1} (ln)				–0.0288***	–0.0302***	–0.0302***
				(–10.01)	(–10.61)	(–10.62)
$\text{Return}_{t-1} > 0$	–0.0480***	–0.0660***	–0.0658***	–0.0215**	–0.0196*	–0.0194*
	(–3.39)	(–4.51)	(–4.51)	(–1.98)	(–1.80)	(–1.79)
$\text{Return}_{t-1} < 0$	–0.6106***	–0.5726***	–0.5694***	–0.0682***	–0.0634***	–0.0628***
	(–33.99)	(–32.72)	(–32.58)	(–4.86)	(–4.58)	(–4.54)
Program Initiation_t	0.1116***	0.0618***	0.0533***	0.0687***	0.0612***	0.0593***
	(13.79)	(11.84)	(9.94)	(10.73)	(11.55)	(11.10)
Market Cap_{t-1} (ln)	–0.0958***	–0.1012***	–0.1024***	–0.0252***	–0.0264***	–0.0266***
	(–14.75)	(–15.15)	(–15.31)	(–7.39)	(–7.71)	(–7.75)
Book to Market_{t-3}	0.0447***	0.0415***	0.0406***	0.0133***	0.0123***	0.0121***
	(6.85)	(6.22)	(6.14)	(3.86)	(3.55)	(3.50)
Analysts_{t-1} (ln)	0.0152***	0.0154***	0.0151***	0.0045	0.0043	0.0041
	(2.69)	(2.68)	(2.63)	(1.39)	(1.31)	(1.25)

Table 7: The Influence of Repurchases on Volatility and Kurtosis (continued).

Dependent Variable:	Volatility (ln)			Kurtosis (ln)		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Relative Spread$_{t-1}$ (ln)	0.0771***	0.0843***	0.0849***	–0.0021	–0.0017	–0.0013
	(15.97)	(17.14)	(17.27)	(–0.78)	(–0.64)	(–0.50)
Deviation from \$30$_{t-1}$	0.0020	0.0013	0.0014	–0.0008	–0.0007	–0.0007
	(1.07)	(0.68)	(0.75)	(–0.61)	(–0.59)	(–0.59)
Trading Volume$_{t-1}$ (scaled)	0.0278***	0.0238***	0.0242***	–0.0076	–0.0076	–0.0074
	(3.48)	(3.03)	(3.07)	(–1.57)	(–1.55)	(–1.53)
Change in Short Interest$_{t-1}$	0.9591***	0.9603***	0.9270***	–0.0095	–0.0084	–0.0213
	(10.63)	(10.86)	(10.59)	(–0.13)	(–0.11)	(–0.28)
Institutional Ownership$_{t-3}$	0.0391*	0.0398*	0.0433**	–0.0124	–0.0136	–0.0130
	(1.88)	(1.88)	(2.05)	(–1.01)	(–1.11)	(–1.06)
Constant		–1.6007***	–1.5876***		1.6635***	1.6672***
		(–34.77)	(–34.54)		(69.43)	(69.59)
R^2 (within firm)	0.523	0.541	0.541	0.006	0.024	0.024
Observations	155,571	156717	156,717	155,566	156,712	156,712
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Hansen's J (test)	0.03			0.88		
Hansen's J (p-value)	86.11%			34.92%		
Kleibergen-Paap (test)	318.9			318.9		
Kleibergen-Paap (p-value)	0.00%			0.00%		

Table 8: The Influence of Contemporaneous Repurchases. The table presents OLS regressions of *Delay*, *Coefficient-based Delay*, *R-squared*, and *Absolute Market Correlation* on contemporaneous repurchase variables and control variables. The dependent variable is *Delay* in specification (1), *Coefficient-based Delay* in (2), *R-squared* in (3), and *Absolute Market Correlation* in (4). In Panel A *Repurchase Intensity* is included as repurchase variables. Panel B includes *Repurchase Dummy* and Panel C includes *Repurchase Dummy* interacted with dummy variables identifying up and down markets. The controls are the same as in Table 4, respectively Table 5. Repurchase variables and controls are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Panel A: Contemporaneous Repurchase Intensity

Dependent Variable:	Delay	Coeff.-based Delay	R-squared	|Market Correlation|
	(1)	(2)	(3)	(4)
Repurchase Intensity$_t$	0.0606	–0.0635	–0.0347	–0.0082
	(0.52)	(–0.25)	(–0.41)	(–0.09)
R^2 (within firm)	0.150	0.112	0.246	0.202
Observations	155,987	155,970	155,983	155,988
Firm FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y

Panel B: Contemporaneous Repurchase Dummy

Dependent Variable:	Delay	Coeff.-based Delay	R-squared	|Market Correlation|
	(1)	(2)	(3)	(4)
Repurchase Dummy$_t$	–0.0067***	–0.0124***	0.0032**	0.0040***
	(–3.51)	(–2.99)	(2.30)	(2.66)
R^2 (within firm)	0.150	0.112	0.246	0.202
Observations	155,987	155,970	155,983	155,988
Firm FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y

Panel C: Contemporaneous Repurchase Dummy in Up and Down Markets

Dependent Variable:	Delay	Coeff.-based Delay	R-squared	|Market Correlation|
Rep. Dummy$_t$ x Up Market$_t$	–0.0033	–0.0048	–0.0017	0.0004
	(–1.39)	(–0.95)	(–1.00)	(0.23)
Rep. Dummy$_t$ x Down Market$_t$	–0.0121***	–0.0233***	0.0105***	0.0095***
	(–4.98)	(–4.22)	(5.70)	(5.05)
R^2 (within firm)	0.149	0.112	0.246	0.201
Observations	156,718	156,700	156,715	156,720
Firm FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y

Table 9: Panel A. Harmful Repurchases - Influence on Delay. The table presents OLS regressions of *Delay* and *R-squared* on dummy variables, interaction terms of contemporaneous *Repurchase Intensity* with the dummy variables, and control variables (untabulated). The controls are the same as in Table 4 and Table 5 respectively. The repurchase variables and the control variables are defined in Table 1. The dependent variable is *Delay* in Panel A and *R-squared* in Panel B. *Net Insider Selling* is a dummy variable indicating net insider selling in the respective month. *High Insider Ownership*, *High Options Outstanding*, *High Cash*, and *High Governance* are dummy variables equal to 1 if the respective firm characteristic at the beginning of the program is above the median of all programs. *High Insider Options Excercised* is a dummy variable equal to 1 if the aggregated sum of insider options exercised over the whole program duration is above the median of all programs. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Dependent Variable:	Delay					
	(1)	(2)	(3)	(4)	(5)	(6)
Interaction variable:	Net Insider Selling	High Insider Ownership	High Options Outstanding	High Insider Options Exercised	High Cash	High Governance
Interaction variable$_t$	0.0066***	–0.0151***	0.0090***	–0.0134***	0.0121***	–0.0183***
	(3.31)	(–4.09)	(2.98)	(–5.03)	(4.20)	(–4.19)
Rep. Intensity$_t$ * Interaction variable$_t$	–0.0525	0.2496	–0.0925	0.2367	0.0947	0.2050
	(–0.25)	(1.20)	(–0.50)	(1.41)	(0.55)	(0.68)
Rep. Intensity$_t$ * (1 - Interaction variable$_t$)	0.1582	–0.0262	0.0989	0.0644	–0.1381	–0.0508
	(1.06)	(–0.13)	(0.61)	(0.38)	(–0.79)	(–0.25)
High – Low	–0.2106	0.2758	–0.1914	0.1724	0.2328	0.2558
	(–0.84)	(0.94)	(–0.78)	(0.74)	(0.96)	(0.70)
R^2	0.355	0.218	0.355	0.355	0.355	0.214
Observations	152,210	84,487	155,987	155,987	155,987	67,606
Firm FE	N	N	N	N	N	N
Month FE	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y

Table 9: Panel B. Harmful Repurchases - Influence on R-Squared.

Dependent Variable:	R-squared					
	(1)	(2)	(3)	(4)	(5)	(6)
Interaction variable:	Net Insider Selling	High Insider Ownership	High Options Outstanding	High Insider Options Exercised	High Cash	High Governance
Interaction variable$_t$	–0.0057***	0.0100***	–0.0094***	0.0083***	–0.0108***	0.0160***
	(–3.95)	(3.30)	(–4.28)	(4.28)	(–5.11)	(4.26)
Rep. Intensity$_t$ * Interaction variable$_t$	0.1181	–0.1408	0.0894	–0.1113	–0.0309	–0.0879
	(0.79)	(–0.88)	(0.66)	(–0.88)	(–0.25)	(–0.36)
Rep. Intensity$_t$ * (1 - Interaction variable$_t$)	–0.1869*	0.0299	–0.0971	–0.1568	0.0403	0.0045
	(–1.71)	(0.18)	(–0.80)	(–1.31)	(0.32)	(0.03)
High – Low	0.3051*	–0.1707	0.1865	0.0454	–0.0712	–0.0924
	(1.72)	(–0.75)	(1.04)	(0.27)	(–0.41)	(–0.32)
R^2	0.429	0.328	0.429	0.429	0.429	0.325
Observations	152,206	84,486	155,983	155,983	155,983	67,603
Firm FE	N	N	N	N	N	N
Month FE	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y

Table 10: Repurchase Frequency. The table presents OLS regressions of *Delay, Coefficient-based Delay, R-squared* and *Absolute Market Correlation* on dummy variables for different repurchase frequency categories. The dummy variables are defined as in Dittmar and Field (2015). *Infrequent* is one if a firm conducts repurchases in four or fewer months in a calendar year and zero otherwise. *Moderate* is one if a firm conducts repurchases in five to eight months in a calendar year and zero otherwise. *Frequent* is one if a firm conducts repurchases in nine or more months in a calendar year and zero otherwise. The controls are the same as in Table 4, respectively Table 5. All variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Dependent Variable:	Delay	Coeff.-based Delay	R-squared	|Market Correlation|
	(1)	(2)	(3)	(4)
Method:	OLS	OLS	OLS	OLS
Infrequent_t	–0.0059***	–0.0082*	0.0006	0.0025
	(–2.70)	(–1.77)	(0.37)	(1.46)
Moderate_t	–0.0126***	–0.0211***	0.0046**	0.0074***
	(–4.53)	(–3.48)	(2.25)	(3.35)
Frequent_t	–0.0172***	–0.0211***	0.0066**	0.0102***
	(–4.52)	(–2.60)	(2.19)	(3.28)
R^2 (within firm)	0.149	0.112	0.246	0.201
Observations	156,718	156,700	156,715	156,720
Firm FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Controls	Y	Y	Y	Y

Table 11: The Influence of Repurchases on Post Earnings Announcement Drift. The table presents OLS regressions of absolute *CAR(+2,+6)* on either *Repurchase Intensity*, or *Remaining Volume,* dummy variables identifying positive and negative earnings surprises, and interaction terms. *CAR(+2,+6)* is the sum of market adjusted returns over a 5-day period starting on the second day after the earnings announcement. Earnings surprises are measured as the difference between actual earnings and the most recent consensus forecasts, scaled by the stock price two days before the announcement date. The dummy variables identify the bottom and top-quartiles of earning surprises. Repurchase variables and controls are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Dependent Variable:	|CAR(+2,+6)|					
	(1)	(2)	(3)	(4)	(5)	(6)
Positive Earnings Surprise	0.0089***	0.0064***	0.0008	0.0088***	0.0062***	0.0012*
	(15.37)	(9.60)	(1.26)	(14.21)	(8.31)	(1.66)
Negative Earnings Surprise	0.0127***	0.0113***	0.0047***	0.0126***	0.0109***	0.0046***
	(19.74)	(14.96)	(7.26)	(19.68)	(14.77)	(7.28)
Repurchase Intensity	0.0366	0.0583	0.0292			
	(0.70)	(1.01)	(0.54)			
Rep. Intensity x Pos. Surprise	0.0078	0.0914	0.1626			
	(0.07)	(0.75)	(1.35)			
Remaining Volume				0.0170***	0.0378***	−0.0063
				(4.16)	(5.89)	(−1.18)
Rem. Volume x Pos. Surprise				−0.0005	−0.0019	−0.0035
				(−0.06)	(−0.21)	(−0.46)
Relative Spread (ln)	0.0116***	0.0162***	0.0157***	0.0118***	0.0165***	0.0157***
	(29.71)	(14.16)	(11.70)	(29.55)	(14.48)	(11.82)
Constant	0.1131***	0.1456***	0.1383***	0.1135***	0.1465***	0.1383***
	(39.85)	(18.37)	(15.70)	(39.75)	(18.68)	(15.85)
R^2	0.076	0.038	0.122	0.077	0.040	0.123
Observations	36,397	36,397	36,397	36,581	36,581	36,581
Firm FE	N	Y	Y	N	Y	Y
Month FE	N	N	Y	N	N	Y

Internet Appendix for "Actual Share Repurchases, Price Efficiency, and the Information Content of Stock Prices"

October 23, 2015

This Internet Appendix provides additional analyses and results that were omitted from our paper "Actual Share Repurchases, Price Efficiency, and the Information Content of Stock Prices". The discussion can be found in the main text of the paper and the tables in the Internet Appendix are referred to as A-#, where # is the table number in the appendix.

Table 1: Description of Variables. The table describes all additional variables in this appendix. For each variable the table reports the definition, the data source, and the unit of measurement. We obtain the *Auto-correlation of Price Changes* from the Market Microstructure Database of the Financial Markets Research Center (FMRC) at Vanderbilt University. Variables denoted with (ln) are expressed as natural logarithms.

Name	Definition	Source	Unit
|Auto-correlation of Price Changes|	Absolute Auto-correlation of high-frequency price changes. Price changes are measured in absolute terms.	FMRC	unit
Idiosyncratic Delay	Price efficiency measure constructed as the ratio of the R^2 estimates of an extended model that addtionally includes 5 lags of market-adjusted stock returns and the base model	CRSP	ratio
Coefficient-based Idiosyncratic Delay	Price efficiency measure constructed as the ratio of the lag-weighted sum of the coefficients of the lagged market-adjusted stock returns relative to the sum of all coefficients	CRSP	ratio
Delay Based on Industry Returns	Price efficiency measure constructed as the ratio of the R^2 estimates of an extended model that includes the contemporaneous and 5 lags of the value-weighted SIC2-Industry returns and a base model with the contemporaneous Industry return	CRSP	ratio
Coefficient-based Delay Based on Industry Returns	Price efficiency measure constructed as the ratio of the lag-weighted sum of the coefficients of the lagged value-weighted SIC2-Industry returns relative to the sum of all coefficients	CRSP	ratio
Idiosyncratic Volatility	Volatility of the residual from a simple market model regression estimated each month using daily returns	CRSP	unit

Table 2: Descriptive Statistics. The table provides descriptive statistics for all additional variables in this appendix. We report the arithmetic mean, the median, the standard deviation (S.D.), the within-firm standard deviation (S.D. within), the 1st percentile, and the 99th percentile of the distribution for each variable. Within-firm variation is calculated from a regression of the respective variable on firm fixed effects.

	Mean	Median	S.D.	S.D. (within)	1^{st} Perc.	99^{th} Perc.	N
Dependent Variables							
Idiosyncratic Delay	0.489	0.437	0.311	0.251	0.029	1.000	158,471
Coefficient-based Idiosyncratic Delay	1.895	1.863	0.603	0.547	0.684	3.377	158,471
Delay Based on Industry Returns	0.478	0.425	0.318	0.242	0.017	1.000	158,471
Coefficient-based Delay Based on Industry Returns	1.914	1.882	0.663	0.556	0.578	3.469	158,347
IdiosyncraticVolatility (ln)	-7.958	-8.018	1.257	1.011	-10.602	-4.683	158,471
|Auto-correlation of Price Changes|	0.237	0.234	0.064	0.045	0.093	0.385	147,986

Table 3: Tobit Analysis of Repurchase Activity. The table presents Tobit regressions of *Repurchase Intensity* and *Remaining Volume* on *Returns*, instruments and control variables for months with an open repurchase program. The estimated model is specified as right-censored at 0 and left-censored at 1. All variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Dependent Variable:	Repurchase Intensity	Repurchase Intensity	Remaining Volume
	(1)	(2)	(3)
Method:	Tobit	Tobit	Tobit
Repurchase Intensity$_{t-1}$		0.3088***	
		(20.80)	
Program Month$_t$ (ln)	–0.0041***	–0.0036***	–0.0167***
	(–25.80)	(–24.77)	(–23.28)
Program Size$_t$	0.0238***	0.0188***	0.7761***
	(6.44)	(5.93)	(20.11)
Options Exercised$_t$	0.0572**	0.0804***	–0.0194
	(2.00)	(2.80)	(–0.35)
Net Insider Tading$_t$ (scaled)	–0.0315**	–0.0352**	0.0316
	(–2.16)	(–2.42)	(1.46)
Options Outstanding$_t$	0.0033	0.0016	–0.0116
	(0.64)	(0.34)	(–0.91)
Return$_{t-1} > 0$	–0.0060***	–0.0059***	–0.0017
	(–4.97)	(–5.19)	(–1.07)
Return$_{t-1} < 0$	–0.0107***	–0.0107***	–0.0007
	(–8.72)	(–8.77)	(–0.31)
Book to Market$_{t-3}$	0.0003	0.0000	0.0016
	(0.48)	(0.01)	(1.06)
Total Assets$_{t-3}$ (ln)	0.0035***	0.0034***	–0.0026
	(5.24)	(5.60)	(–0.80)
Cash to Assets$_{t-3}$	0.0050***	0.0049***	0.0214**
	(2.95)	(3.17)	(2.35)
EBITDA to Assets$_{t-3}$	0.0071	0.0058	–0.0477***
	(1.41)	(1.26)	(–2.78)
Dividends to Assets$_{t-3}$	0.0118	0.0106	0.0668
	(1.60)	(1.61)	(1.62)
Leverage$_{t-3}$	–0.0258***	–0.0237***	0.0223**
	(–11.42)	(–11.45)	(2.58)
Acquiror Dummy$_t$	–0.0011***	–0.0010***	0.0009
	(–4.77)	(–4.57)	(1.38)

Table 3: Tobit Analysis of Repurchase Activity (continued).

Dependent Variable:	Repurchase Intensity	Repurchase Intensity	Remaining Volume
	(1)	(2)	(3)
Method:	Tobit	Tobit	Tobit
Target Dummy$_t$	–0.0026**	–0.0024**	0.0023
	(–2.25)	(–2.14)	(1.54)
Relative Spread$_{t-1}$ (ln)	–0.0010***	–0.0006***	0.0010
	(–4.09)	(–2.70)	(1.03)
Constant	–0.0179***	–0.0154***	0.0326*
	(–4.65)	(–4.41)	(1.91)
sigma	0.0110***	0.0108***	0.0280***
	(45.29)	(44.29)	(27.93)
Pseudo-R^2	–0.227	–0.244	–0.825
Observations	82,831	82,659	83,106
Firm FE	Y	Y	Y
Month FE	Y	Y	Y

Table 4: Panel A. The Influence of Change in Short Interest on Delay. The table presents OLS -regressions of *Delay* and *R-squared* on *Change in Short Interest*, predetermined *Repurchase Intensity*, and control variables. The dependent variable is *Delay* in Panel A and *R-squared* in Panel B. The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Dependent Variable:	Delay			
	(1)	(2)	(3)	(4)
Method:	OLS	OLS	OLS	OLS
Change in Short Interest$_{t-1}$	–0.2278***	–0.1279**	–0.1182**	–0.0367
	(–3.98)	(–2.38)	(–2.17)	(–0.69)
Delay$_{t-1}$		0.2690***	0.2285***	0.0865***
		(58.91)	(49.95)	(26.44)
Repurchase Intensity$_{t-1}$		–0.7744***	–0.4180***	–0.6437***
		(–5.87)	(–3.31)	(–5.51)
Return$_{t-1} > 0$		–0.1058***	–0.0089	–0.0116*
		(–11.66)	(–1.19)	(–1.66)
Return$_{t-1} < 0$		0.0627***	–0.0746***	–0.0825***
		(5.49)	(–7.26)	(–8.28)
Program Initiation$_t$		0.0281***	0.0284***	0.0273***
		(7.92)	(7.83)	(8.01)
Market Cap$_{t-1}$ (ln)		–0.0505***	–0.0198***	–0.0338***
		(–42.86)	(–11.90)	(–10.75)
Book to Market$_{t-3}$		0.0077***	–0.0040*	0.0174***
		(3.12)	(–1.76)	(6.05)
Volatility$_{t-1}$ (ln)			–0.0520***	–0.0442***
			(–22.29)	(–21.42)
Analysts$_{t-1}$			0.0143***	–0.0092***
			(5.41)	(–3.15)
Relative Spread$_{t-1}$ (ln)			0.0621***	0.0388***
			(28.20)	(18.33)
Deviation from \$30$_{t-1}$			0.0136***	0.0030***
			(10.54)	(2.95)
Trading Volume$_{t-1}$ (scaled)			0.0291***	0.0125***
			(6.12)	(4.64)
Institutional Ownership$_{t-3}$			–0.0445***	–0.0837***
			(–5.62)	(–7.23)
Constant	0.6796***	0.8617***	0.5758***	0.7114***
	(93.63)	(74.35)	(39.10)	(32.47)
R^2 (within firm)	0.084	0.330	0.354	0.149
Observations	158,709	158,706	155,864	155,864
Firm FE	N	N	N	Y
Month FE	Y	Y	Y	Y

Table 4: Panel B. The Influence of Change in Short Interest on R-squared.

Dependent Variable:	R-squared			
	(1)	(2)	(3)	(4)
Method:	OLS	OLS	OLS	OLS
Change in Short Interest$_{t-1}$	0.1175***	0.0365	0.0041	–0.0078
	(2.91)	(0.95)	(0.11)	(–0.21)
R-squared$_{t-1}$			0.1448***	0.1412***
			(37.66)	(37.10)
Repurchase Intensity$_{t-1}$			0.5412***	0.4612***
			(6.47)	(5.51)
Program Initiation$_t$			–0.0244***	–0.0253***
			(–10.73)	(–10.70)
Market Cap$_{t-1}$ (ln)			0.0439***	0.0230***
			(21.24)	(10.17)
Book to Market$_{t-3}$			–0.0148***	–0.0127***
			(–7.18)	(–6.38)
Analysts$_{t-1}$				0.0037*
				(1.77)
Relative Spread$_{t-1}$ (ln)				–0.0269***
				(–17.36)
Deviation from \$30$_{t-1}$				–0.0031***
				(–3.99)
Trading Volume$_{t-1}$ (scaled)				0.0065
				(1.57)
Institutional Ownership$_{t-3}$				0.0301***
				(3.74)
Constant	0.2118***	0.2103***	–0.0834***	–0.0484***
	(42.45)	(44.76)	(–5.79)	(–3.26)
R^2 (within firm)	0.144	0.209	0.244	0.245
Observations	158,703	158,703	158,703	155,860
Firm FE	N	Y	Y	Y
Month FE	Y	Y	Y	Y

Table 5: Panel A. The Influence of Trading Volume on Delay. The table presents OLS -regressions of *Delay* and *R-squared* on *Trading Volume*, predetermined *Repurchase Intensity*, and control variables. The dependent variable is *Delay* in Panel A and *R-squared* in Panel B. The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Dependent Variable:	Delay			
	(1)	(2)	(3)	(4)
Method:	OLS	OLS	OLS	OLS
Trading Volume$_{t-1}$ (scaled)	–0.1065***	–0.0254***	0.0291***	0.0124***
	(–3.78)	(–2.74)	(6.12)	(4.63)
Delay$_{t-1}$		0.2689***	0.2286***	0.0864***
		(59.04)	(49.93)	(26.41)
Repurchase Intensity$_{t-1}$		–0.7729***	–0.4187***	–0.6437***
		(–5.86)	(–3.32)	(–5.51)
Return$_{t-1} > 0$		–0.0853***	–0.0091	–0.0117*
		(–8.18)	(–1.21)	(–1.68)
Return$_{t-1} < 0$		0.0390***	–0.0744***	–0.0823***
		(3.03)	(–7.23)	(–8.27)
Program Initiation$_t$		0.0276***	0.0283***	0.0272***
		(7.75)	(7.82)	(8.00)
Market Cap$_{t-1}$ (ln)		–0.0496***	–0.0198***	–0.0339***
		(–40.89)	(–11.90)	(–10.78)
Book to Market$_{t-3}$		0.0072***	–0.0040*	0.0174***
		(2.91)	(–1.75)	(6.06)
Volatility$_{t-1}$ (ln)			–0.0521***	–0.0442***
			(–22.27)	(–21.41)
Analysts$_{t-1}$			0.0143***	–0.0091***
			(5.41)	(–3.13)
Relative Spread$_{t-1}$ (ln)			0.0620***	0.0387***
			(28.17)	(18.28)
Deviation from \$30$_{t-1}$			0.0136***	0.0030***
			(10.55)	(2.96)
Change in Short Interest$_{t-1}$			–0.1151**	–0.0328
			(–2.11)	(–0.61)
Institutional Ownership$_{t-3}$			–0.0445***	–0.0837***
			(–5.62)	(–7.22)
Constant	0.6982***	0.8592***	0.5752***	0.7111***
	(81.69)	(74.35)	(39.02)	(32.43)
R^2 (within firm)	0.096	0.331	0.354	0.149
Observations	158,709	158,706	155,806	155,806
Firm FE	N	N	N	Y
Month FE	Y	Y	Y	Y

Table 5: Panel B. The Influence of Trading Volume on R-squared.

Dependent Variable:	R-squared			
	(1)	(2)	(3)	(4)
Method:	OLS	OLS	OLS	OLS
Trading Volume$_{t-1}$	0.0737***	0.0208***	0.0125**	0.0065
	(3.81)	(3.39)	(2.31)	(1.57)
R-squared$_{t-1}$		0.3383***	0.1460***	0.1412***
		(63.98)	(37.90)	(37.10)
Repurchase Intensity$_{t-1}$		0.5183***	0.5443***	0.4613***
		(5.61)	(6.51)	(5.51)
Program Initiation$_t$		–0.0253***	–0.0243***	–0.0252***
		(–10.37)	(–10.66)	(–10.66)
Market Cap$_{t-1}$ (ln)		0.0333***	0.0435***	0.0230***
		(39.83)	(20.92)	(10.19)
Book to Market$_{t-3}$		–0.0041**	–0.0149***	–0.0127***
		(–2.55)	(–7.21)	(–6.37)
Analysts$_{t-1}$				0.0037*
				(1.76)
Relative Spread$_{t-1}$ (ln)				–0.0269***
				(–17.35)
Deviation from \$30$_{t-1}$				–0.0031***
				(–4.00)
Change in Short Interest$_{t-1}$				–0.0095
				(–0.25)
Institutional Ownership$_{t-3}$				0.0301***
				(3.74)
Constant	0.1969***	–0.0490***	–0.0838***	–0.0486***
	(32.67)	(–7.71)	(–5.78)	(–3.27)
R^2 (within firm)	0.154	0.416	0.244	0.246
Observations	158,703	158,703	158,703	155,802
Firm FE	N	N	Y	Y
Month FE	Y	Y	Y	Y

Table 6: Panel A. The Influence of Repurchases on Delay Based on Industry Returns. The table presents OLS and GMM-regressions of *Delay based on Industry returns* and *Coefficient-based Delay based on Industry returns* on either *Repurchase Intensity* or *Remaining Volume* and control variables in Panel A. Panel B presents OLS and GMM-regressions of *Delay based on Industry returns* and *Coefficient-based Delay based on Industry returns* on *Repurchase Intensity* or *Remaining Volume,* interaction terms of dummy variables identifying positive and negative value-weighted SIC2-industry returns, a dummy variable identifying positive industry returns, the repurchase variables, and control variables (untabulated). For the estimataion of the delay measures based on industry returns the base model regresses the firm's stock returns on value-weighted SIC2-industry returns. The extended model additionally includes 5 lags of industry returns. The dependent variable is *Delay based on Industry returns* in specification (1)-(3) and *Coefficient-based Delay based on Industry returns* in specification (4)-(6). In specifications (1) and (4) the repurchase variables are instrumented using *Program Size* and *Program Month* as instruments. Instrumented variables are in italics and marked with a circumflex. In specifications (2) and (5) the repurchase variables are included as predetermined values. The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for both tests. The t-tests for the instruments are from the first-stage regressions. The test suggested by Stock and Yogo (2005) rejects the hypothesis that the bias exceeds the OLS bias by more than 5% in all cases.

Dependent Variable:		Delay based on Industry returns			Coeff.-based Delay based on Industry returns	
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
$\widehat{\mathit{Repurchase\ Intensity}}_t$	–2.0092**			–2.8212		
	(–2.06)			(–1.37)		
Repurchase Intensity$_{t-1}$		–0.6348***			–1.3023***	
		(–5.29)			(–4.94)	
Remaining Volume$_t$			–0.0258			–0.0223
			(–1.18)			(–0.47)
Delay$_{t-1}$ (Industry returns)	0.0847***	0.0849***	0.0850***			
	(23.80)	(23.90)	(23.92)			
Coeff.-based Delay$_{t-1}$ (Ind. ret.)				0.0386***	0.0385***	0.0385***
				(12.46)	(12.53)	(12.54)
Return$_{t-1} > 0$	–0.0170**	–0.0138**	–0.0137**	–0.0275*	–0.0237	–0.0235
	(–2.47)	(–2.01)	(–1.99)	(–1.65)	(–1.42)	(–1.41)
Return$_{t-1} < 0$	–0.0594***	–0.0533***	–0.0529***	–0.1024***	–0.0953***	–0.0949***
	(–5.88)	(–5.49)	(–5.45)	(–4.37)	(–4.16)	(–4.14)
Program Initiation$_t$	0.0295***	0.0235***	0.0222***	0.0535***	0.0449***	0.0429***
	(6.39)	(7.30)	(6.80)	(5.26)	(6.07)	(5.71)
Market Cap$_{t-1}$ (ln)	–0.0435***	–0.0443***	–0.0443***	–0.0845***	–0.0852***	–0.0851***
	(–13.25)	(–13.58)	(–13.58)	(–11.74)	(–11.91)	(–11.89)

Table 6: Panel A. The Influence of Repurchases on Delay Based on Industry Returns (continued).

Dependent Variable:	Delay based on Industry returns			Coeff.-based Delay based on Industry returns		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Book to Market$_{t-3}$	0.0178***	0.0170***	0.0169***	0.0342***	0.0330***	0.0329***
	(6.01)	(5.77)	(5.74)	(5.30)	(5.11)	(5.09)
Volatility$_{t-1}$ (ln)	–0.0414***	–0.0416***	–0.0416***	–0.0841***	–0.0843***	–0.0841***
	(–20.60)	(–20.63)	(–20.60)	(–18.92)	(–18.96)	(–18.91)
Analysts$_{t-1}$	–0.0117***	–0.0123***	–0.0125***	–0.0189***	–0.0198***	–0.0202***
	(–4.18)	(–4.37)	(–4.44)	(–3.18)	(–3.29)	(–3.36)
Relative Spread$_{t-1}$ (ln)	0.0330***	0.0327***	0.0331***	0.0612***	0.0611***	0.0620***
	(16.03)	(15.83)	(16.04)	(13.08)	(13.03)	(13.22)
Deviation from \$30$_{t-1}$	0.0011	0.0012	0.0012	0.0012	0.0015	0.0015
	(1.12)	(1.25)	(1.24)	(0.56)	(0.70)	(0.68)
Trading Volume$_{t-1}$ (scaled)	0.0137***	0.0142***	0.0143***	0.0274***	0.0285***	0.0287***
	(4.82)	(4.91)	(4.95)	(5.66)	(5.69)	(5.72)
Change in Short Interest$_{t-1}$	0.0044	0.0001	–0.0113	–0.1335	–0.1123	–0.1348
	(0.08)	(0.00)	(–0.21)	(–1.15)	(–0.98)	(–1.17)
Institutional Ownership$_{t-3}$	–0.1110***	–0.1142***	–0.1138***	–0.1377***	–0.1430***	–0.1426***
	(–9.73)	(–9.98)	(–9.94)	(–5.95)	(–6.14)	(–6.12)
Constant		0.7529***	0.7556***		2.3490***	2.3539***
		(33.48)	(33.57)		(47.92)	(47.96)
R^2 (within firm)	0.128	0.144	0.144	0.090	0.105	0.105
Observations	155,571	156,717	156,717	155,426	156,570	156,570
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Hansen's J (test)	0.54			0.29		
Hansen's J (p-value)	46.34%			58.84%		
Kleibergen-Paap (test)	319.4			319.3		
Kleibergen-Paap (p-value))	0.00%			0.00%		

Table 6: Panel B. The Influence of Repurchases on Delay Based on Industry Returns Interacted with Positive and Negative Industry Returns.

Dependent Variable:	Delay based on Industry returns			Coeff.-based Delay based on Industry returns		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Rep. $\widehat{Intensity}_t$ x Pos. Industry Return$_t$	–1.5052			–0.4736		
	(–1.34)			(–0.20)		
Rep. $\widehat{Intensity}_t$ x Neg. Industry Return$_t$	–2.8832***			–6.3655***		
	(–2.74)			(–2.74)		
Rep. Intensity$_{t-1}$ x Pos. Industry Return$_t$		–0.5555***			–1.0171***	
		(–3.59)			(–3.05)	
Rep. Intensity$_{t-1}$ x Neg. Industry Return$_t$		–0.7490***			–1.7118***	
		(–4.44)			(–4.40)	
Rem. Volume$_t$ x Pos. Industry Return$_t$			–0.0239			–0.0080
			(–1.04)			(–0.16)
Rem. Volume$_t$ x Neg. Industry Return$_t$			–0.0292			–0.0459
			(–1.21)			(–0.87)
Positive Industry Return$_t$	0.0011	0.0035**	0.0036**	0.0008	0.0104***	0.0100**
	(0.49)	(2.11)	(2.04)	(0.15)	(2.66)	(2.37)
R^2 (within firm)	0.127	0.144	0.144	0.088	0.106	0.105
Observations	156,712	156,717	156,717	156,565	156,570	156,570
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y
Hansen's J (test)	0.84			0.33		
Hansen's J (p-value)	65.86%			84.86%		
Kleibergen-Paap (test)	311.8			311.4		
Kleibergen-Paap (p-value))	0.00%			0.00%		

Table 7: Repurchase Intensity instrumented by Cash to Assets. The table presents GMM-regressions of *Delay* and *R-squared* on *Repurchase Intensity* instrumented by *Cash to Assets* and control variables. The dependent variable is *Delay* in specification (1) and *R-squared* in (2). Instrumented variables are in italics and marked with a circumflex. The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for this test.

Dependent Variable:	Delay	R-squared
	(1)	(2)
Method:	GMM	GMM
$\widehat{Repurchase\ Intensity}_t$	5.2720	−1.2430
	(0.94)	(−0.31)
R^2 (within firm)	0.122	0.232
Observations	155,946	155,942
Firm FE	Y	Y
Month FE	Y	Y
Kleibergen-Paap (test)	40.74	40.70
Kleibergen-Paap (p-value)	0.00%	0.00%

Table 8: Panel A. Harmful Repurchases - Influence on Delay. The table present coefficients estimates for alternative specifications of the OLS regressions presented in Table 9 in the main paper. The dependent variable is *Delay* in Panel A and *R-squared* in Panel B. In specification (A) the dummy variable is set to 1 if the value of the respective variable exceeds the 75th percentile. Specification (B) additionally includes firm fixed effects. Specification (C) uses predetermined *Repurchase Intensity* and specification (D) uses *Repurchase Dummy.* The table only presents the coefficient estimates for the interaction term of the repurchase variable with the dummy variable, all other coefficient estimates are untabulated. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively.

Dependent Variable:	Delay					
	(1)	(2)	(3)	(4)	(5)	(6)
Interaction variable:	Net Insider Selling	High Insider Ownership	High Options Outstanding	High Insider Options Exercised	High Cash	High Governance
Coefficients from Table 9						
Rep. Intensity$_t$ * Interaction variable$_t$	–0.0525	0.2496	–0.0925	0.2367	0.0947	0.2050
	(–0.25)	(1.20)	(–0.50)	(1.41)	(0.55)	(0.68)
Alternative Specifications						
A) Cutoff at 75th percentile						
Rep. Intensity$_t$ * Interaction variable$_t$	n/a	0.2496	–0.0925	0.2367	0.0947	0.2050
		(1.20)	(–0.50)	(1.41)	(0.55)	(0.68)
B) Including Firm FE						
Rep. Intensity$_t$ * Interaction variable$_t$	–0.2443	0.1868	–0.0966	0.0442	0.2151	–0.0976
	(–1.26)	(0.91)	(–0.54)	(0.28)	(1.31)	(–0.35)
C) Lagged Repurchase Intensity						
Rep. Intensity$_{t-1}$ * Interaction variable$_t$	–0.0104	–0.8602***	–0.5310***	–0.3997**	–0.3114*	0.1248
	(–0.05)	(–4.08)	(–2.90)	(–2.42)	(–1.80)	(0.42)
D) Repurchase Dummy						
Rep. Dummy$_t$ * Interaction variable$_t$	–0.0164***	–0.0130***	–0.0027	–0.0063**	–0.0008	–0.0078
	(–4.73)	(–2.80)	(–0.77)	(–2.01)	(–0.21)	(–1.45)

Table 8: Panel B. Harmful Repurchases - Influence on R-Squared.

Dependent Variable:	R-squared					
	(1)	(2)	(3)	(4)	(5)	(6)
Interaction variable:	Net Insider Selling	High Insider Ownership	High Options Outstanding	High Insider Options Exercised	High Cash	High Governance
Coefficients from Table 9						
Rep. Intensity_t * Interaction variable_t	0.1181	–0.1408	0.0894	–0.1113	–0.0309	–0.0879
	(0.79)	(–0.88)	(0.66)	(–0.88)	(–0.25)	(–0.36)
Alternative Specifications						
A) Cutoff at 75th percentile						
Rep. Intensity_t * Interaction variable_t	n/a	–0.1408	0.0894	–0.1113	–0.0309	–0.0879
		(–0.88)	(0.66)	(–0.88)	(–0.25)	(–0.36)
B) Including Firm FE						
Rep. Intensity_t * Interaction variable_t	0.2596*	–0.0287	0.1410	0.0433	–0.0996	0.1701
	(1.88)	(–0.19)	(1.12)	(0.37)	(–0.85)	(0.79)
C) Lagged Repurchase Intensity						
Rep. Intensity_{t-1} * Interaction variable_t	–0.1079	0.4754***	0.2908**	0.1804	0.1855	–0.2172
	(–0.64)	(3.05)	(2.26)	(1.48)	(1.46)	(–0.89)
D) Repurchase Dummy						
Rep. Dummy_t * Interaction variable_t	0.0096***	0.0114***	0.0022	0.0038	0.0015	0.0045
	(3.72)	(3.05)	(0.85)	(1.63)	(0.57)	(1.02)

Table 9: The Influence of Repurchases on Idiosyncratic Volatility. The table presents OLS and GMM-regressions of *Idiosyncratic Volatility* on either *Repurchase Intensity*, or *Remaining Volume* and control variables. *Idiosyncratic Volatility* is the volatility of the residual from a simple market model regression estimated each month using daily returns. In specification (1) the repurchase variable is instrumented using *Program Size* and *Program Month* as instruments. Instrumented variables are in italics and marked with a circumflex. In specifications (2) the repurchase variable is included as predetermined value. The repurchase variables and the control variables are defined in Table 4. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for both tests.

Dependent Variable:	Idiosyncratic Volatility (ln)		
	(1)	(2)	(3)
Method:	GMM	OLS	OLS
$\widehat{Repurchase\ Intensity}_t$	–35.4454***		
	(–8.39)		
Repurchase Intensity$_{t-1}$		–3.7210***	
		(–9.37)	
Remaining Volume$_t$			–0.7756***
			(–7.98)
Idiosyncratic Volatility$_{t-1}$ (ln)	0.2523***	0.2479***	0.2472***
	(43.43)	(42.29)	(42.39)
Program Initiation$_t$	0.3025***	0.1802***	0.1591***
	(16.24)	(15.76)	(13.53)
Market Cap$_{t-1}$ (ln)	–0.2747***	–0.2862***	–0.2889***
	(–18.47)	(–18.89)	(–19.06)
Book to Market$_{t-3}$	0.0921***	0.0861***	0.0841***
	(6.47)	(5.99)	(5.91)
Analysts$_{t-1}$	0.0461***	0.0450***	0.0440***
	(3.66)	(3.55)	(3.49)
Relative Spread$_{t-1}$ (ln)	0.2166***	0.2346***	0.2360***
	(19.54)	(21.03)	(21.20)
Deviation from \$30$_{t-1}$	0.0111***	0.0096**	0.0099**
	(2.60)	(2.20)	(2.27)

Table 9: The Influence of Repurchases on Idiosyncratic Volatility. (continued)

Dependent Variable:	Idiosyncratic Volatility (ln)		
	(1)	(2)	(3)
Method:	GMM	OLS	OLS
Trading Volume$_{t-1}$ (scaled)	0.0990***	0.0916***	0.0925***
	(4.43)	(4.35)	(4.38)
Change in Short Interest$_{t-1}$	1.8487***	1.8362***	1.7527***
	(9.28)	(9.55)	(9.21)
Institutional Ownership$_{t-3}$	0.1316***	0.1268***	0.1351***
	(2.83)	(2.71)	(2.89)
Constant		–3.1676***	–3.1365***
		(–31.99)	(–31.75)
R^2 (within firm)	0.402	0.435	0.436
Observations	155,569	156,715	156,715
Firm FE	Y	Y	Y
Month FE	Y	Y	Y
Hansen's J (test)	0.30		
Hansen's J (p-value)	86.05%		
Kleibergen-Paap (test)	317.4		
Kleibergen-Paap (p-value))	0.00%		

Table 10: Panel A. The Influence of Repurchases on Idiosyncratic Delay. The table presents OLS and GMM-regressions of *Idiosyncratic Delay* and *Coefficient-based Idiosyncratic Delay* on either *Repurchase Intensity* or *Remaining Volume* and control variables. The dependent variable is *Idiosyncratic Delay* in specification (1)-(3) and *Coefficient-based Idiosyncratic Delay* in specification (4)-(6). For the estimation of the idiosyncratic *Delay* measures the lagged markets returns in the extended market model are substituded by market adjusted stock returns. In specifications (1) and (4) the repurchase variables are instrumented using *Program Size* and *Program Month* as instruments. Instrumented variables are in italics and marked with a circumflex. In specifications (2) and (5) the repurchase variables are included as predetermined values. The repurchase variables and the control variables are defined in Table 1. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for both tests.

Dependent Variable:	Idiosyncratic Delay			Idiosyncratic Coefficient-based Delay		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
$\widehat{Repurchase\ Intensity}_t$	–3.1505***			–6.6710***		
	(–3.24)			(–3.38)		
Repurchase Intensity_{t-1}		–0.6232***			–0.9654***	
		(–5.47)			(–3.62)	
Remaining Volume_t			–0.0626***			–0.1271***
			(–2.69)			(–2.68)
Idiosyncratic Delay_{t-1}	0.1016***	0.1006***	0.1005***			
	(31.03)	(30.90)	(30.88)			
Idiosync. Coeff.-based Delay_{t-1}				0.0467***	0.0460***	0.0459***
				(17.09)	(16.91)	(16.88)
$\text{Return}_{t-1} > 0$	–0.0187***	–0.0146**	–0.0145**	–0.0050	0.0048	0.0050
	(–2.69)	(–2.11)	(–2.09)	(–0.31)	(0.30)	(0.31)
$\text{Return}_{t-1} < 0$	–0.0617***	–0.0534***	–0.0528***	–0.1617***	–0.1478***	–0.1465***
	(–5.99)	(–5.37)	(–5.31)	(–6.95)	(–6.53)	(–6.48)
Program Initiation_t	0.0301***	0.0217***	0.0197***	0.0581***	0.0384***	0.0345***
	(6.32)	(6.39)	(5.72)	(5.83)	(5.26)	(4.68)
Market Cap_{t-1} (ln)	–0.0311***	–0.0327***	–0.0329***	–0.0541***	–0.0572***	–0.0576***
	(–9.97)	(–10.50)	(–10.55)	(–9.01)	(–9.58)	(–9.64)
Book to Market_{t-3}	0.0181***	0.0174***	0.0172***	0.0268***	0.0249***	0.0245***
	(6.41)	(6.18)	(6.11)	(4.71)	(4.38)	(4.31)
Volatility_{t-1} (ln)	–0.0361***	–0.0365***	–0.0366***	–0.0645***	–0.0654***	–0.0656***
	(–17.72)	(–17.86)	(–17.89)	(–14.54)	(–14.59)	(–14.62)
Analysts_{t-1}	–0.0086***	–0.0096***	–0.0098***	–0.0074	–0.0096	–0.0098
	(–2.94)	(–3.26)	(–3.33)	(–1.22)	(–1.58)	(–1.62)

Table 10: Panel A. The Influence of Repurchases on Idiosyncratic Delay. (continued)

Dependent Variable:	Idiosyncratic Delay			Idiosyncratic Coefficient-based Delay		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Relative Spread$_{t-1}$ (ln)	0.0417***	0.0417***	0.0421***	0.0536***	0.0540***	0.0545***
	(19.92)	(19.90)	(20.11)	(11.68)	(11.79)	(11.89)
Deviation from \$30$_{t-1}$	0.0036***	0.0037***	0.0037***	0.0068***	0.0069***	0.0069***
	(3.54)	(3.54)	(3.56)	(3.20)	(3.23)	(3.24)
Trading Volume$_{t-1}$ (scaled)	0.0125***	0.0132***	0.0133***	0.0147**	0.0156**	0.0159**
	(4.65)	(4.82)	(4.88)	(2.07)	(2.12)	(2.15)
Change in Short Interest$_{t-1}$	–0.0840	–0.0914*	–0.1036**	–0.0497	–0.0873	–0.1071
	(–1.59)	(–1.73)	(–1.96)	(–0.43)	(–0.74)	(–0.92)
Institutional Ownership$_{t-3}$	–0.0920***	–0.0962***	–0.0954***	–0.1119***	–0.1187***	–0.1172***
	(–8.38)	(–8.75)	(–8.68)	(–5.11)	(–5.42)	(–5.35)
Constant		0.7371***	0.7409***		2.1839***	2.1906***
		(34.07)	(34.21)		(51.19)	(51.30)
R^2 (within firm)	0.133	0.152	0.152	0.073	0.093	0.093
Observations	155,574	156,720	156,720	155,556	156,700	156,700
Firm FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Hansen's J (test)	1.41			1.88		
Hansen's J (p-value)	49.49%			38.99%		
Kleibergen-Paap (test)	319.8			319.3		
Kleibergen-Paap (p-value))	0.00%			0.00%		

Table 11: Panel A. The Influence of Repurchases on Absolute Auto-correlation of High-frequency Price Changes. The table presents OLS and GMM-regressions of *Auto-correlation of Price Changes* on either *Repurchase Intensity*, or *Remaining Volume* and control variables in Panel A. Panel B presents OLS and GMM-regressions of *Auto-correlation of Price Changes* on *Repurchase Intensity* or *Remaining Volume,* interaction terms of dummy variables identifying up and down markets, the repurchase variables, and control variables (untabulated). In specification (1) the repurchase variable is instrumented using *Program Size* and *Program Month* as instruments. Instrumented variables are in italics and marked with a circumflex. In specifications (2) the repurchase variable is included as predetermined value. The repurchase variables and the control variables are defined in Table 4. We obtain the *Auto-correlation of Price Changes* from the Market Microstructure Database of the Financial Markets Research Center at Vanderbilt University. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006). The table reports the test statistics and the p-values for both tests.

Dependent Variable:	|Auto-correlation of Price Changes|		
	(1)	(2)	(3)
Method:	GMM	OLS	OLS
$\widehat{Repurchase\ Intensity}_t$	–0.4215*		
	(–1.96)		
Repurchase Intensity$_{t-1}$		–0.0986***	
		(–5.00)	
Remaining Volume$_t$			–0.0100*
			(–1.85)
|Auto-correlation of Price Changes|$_{t-1}$	0.4374***	0.4369***	0.4370***
	(38.19)	(37.94)	(37.94)
Return$_{t-1} > 0$	–0.0006	0.0004	0.0004
	(–0.31)	(0.19)	(0.21)
Return$_{t-1} < 0$	–0.0166***	–0.0150***	–0.0148***
	(–7.40)	(–7.16)	(–7.10)
Program Initiation$_t$	0.0032***	0.0020***	0.0016***
	(3.49)	(3.45)	(2.78)
Market Cap$_{t-1}$ (ln)	0.0042***	0.0040***	0.0040***
	(4.89)	(4.60)	(4.55)
Book to Market$_{t-3}$	–0.0015**	–0.0016**	–0.0017**
	(–1.96)	(–2.09)	(–2.13)
Volatility$_{t-1}$ (ln)	0.0002	–0.0000	–0.0000
	(0.30)	(–0.05)	(–0.06)
Analysts$_{t-1}$	0.0002	0.0002	0.0001
	(0.36)	(0.24)	(0.19)
Relative Spread$_{t-1}$ (ln)	0.0033***	0.0033***	0.0034***
	(6.48)	(6.37)	(6.50)
Deviation from \$30$_{t-1}$	0.0005***	0.0005**	0.0005**
	(2.58)	(2.55)	(2.55)

Table 11: Panel A. The Influence of Repurchases on Absolute Auto-correlation of High-frequency Price Changes (continued).

Dependent Variable:	|Auto-correlation of Price Changes|		
	(1)	(2)	(3)
Method:	GMM	OLS	OLS
Trading Volume$_{t-1}$ (scaled)	0.0079***	0.0080***	0.0080***
	(3.98)	(3.92)	(3.92)
Change in Short Interest$_{t-1}$	0.0553***	0.0524***	0.0504***
	(7.39)	(7.25)	(6.95)
Institutional Ownership$_{t-3}$	–0.0047*	–0.0050*	–0.0049*
	(–1.83)	(–1.91)	(–1.86)
Constant		0.1172***	0.1180***
		(18.83)	(18.94)
R^2 (within firm)	0.236	0.250	0.250
Observations	144,109	145,088	145,088
Firm FE	Y	Y	Y
Month FE	Y	Y	Y
Hansen's J (test)	2.16		
Hansen's J (p-value)	14.16%		
Kleibergen-Paap (test)	296.9		
Kleibergen-Paap (p-value))	0.00%		

Table 11: Panel B. The Influence of Repurchases on Absolute Auto-correlation of High-frequency Price Changes in Up and Down Markets.

Dependent Variable:	|Auto-correlation of Price Changes|		
	(1)	(2)	(3)
Method:	GMM	OLS	OLS
$Rep.\ \widehat{Intensity}_t$ x Up Market$_t$	–0.2603		
	(–1.10)		
$Rep.\ \widehat{Intensity}_t$ x Down Market$_t$	–0.5854***		
	(–2.68)		
Rep. Intensity$_{t-1}$ x Up Market$_t$		–0.0914***	
		(–3.95)	
Rep. Intensity$_{t-1}$ x Down Market$_t$		–0.1083***	
		(–3.57)	
Rem. Volume$_t$ x Up Market$_t$			–0.0062
			(–1.13)
Rem. Volume$_t$ x Down Market$_t$			–0.0152***
			(–2.68)
R^2 (within firm)	0.235	0.250	0.250
Observations	145,079	145,088	145,088
Firm FE	Y	Y	Y
Month FE	Y	Y	Y
Controls	Y	Y	Y
Hansen's J (test)	4.70		
Hansen's J (p-value)	9.54%		
Kleibergen-Paap (test)	295.1		
Kleibergen-Paap (p-value))	0.00%		

Table 12: The Influence of Repurchases in Up and Down Markets – Excluding the Financial Crisis. The table presents OLS and GMM-regressions of *Delay* and *R-squared* on *Repurchase Intensity* or *Remaining Volume,* interaction terms of dummy variables identifying up and down markets and the repurchase variables, and control variables(untabulated). The controls are the same as in Table 4, respectively Table 5. In the GMM-specifications, the repurchase variables are instrumented using *Program Size* and *Program Month*. The repurchase variables and the control variables are defined in Table 1. All months from September 2008 on are excluded. Standard errors are clustered at the firm level. t-statistics are provided in parentheses. *, **, *** indicate significance at the 10%, 5% and 1% level respectively. The Hansen-J statistic tests for the validity of the overidentifying restrictions. The Kleibergen-Paap test is for underidentification and tests for the full rank of the reduced-form coefficient matrix following Kleibergen and Paap (2006).

Dependent Variable:	Delay			R-squared		
	(1)	(2)	(3)	(4)	(5)	(6)
Method:	GMM	OLS	OLS	GMM	OLS	OLS
Rep. $\widehat{Intensity}_t$ x Up Market$_t$	0.2679			–0.7418		
	(0.27)			(–1.03)		
Rep. $\widehat{Intensity}_t$ x Down Market$_t$	–2.5728**			2.2698***		
	(–2.55)			(2.87)		
Rep. Intensity$_{t-1}$ x Up Market$_t$		–0.3664**			0.1959*	
		(–2.22)			(1.83)	
Rep. Intensity$_{t-1}$ x Down Market$_t$		–0.9202***			0.9141***	
		(–4.38)			(5.81)	
Rem. Volume$_t$ x Up Market$_t$			0.0151			–0.0098
			(0.50)			(–0.45)
Rem. Volume$_t$ x Down Market$_t$			–0.0412			0.0494**
			(–1.28)			(2.06)
R^2 (within firm)	0.060	0.085	0.085	0.101	0.126	0.126
Observations	105,800	105,814	105,814	105,802	105,816	105,816
Firm FE & Month FE & Controls	Y	Y	Y	Y	Y	Y
Hansen's J (test/p-value)	2.66/26.49%			2.96/22.81%		
Kleibergen-Paap (test/p-value)	239.3/0.00%			237.9/0.00%		

References

Kleibergen, F., and R. Paap, 2006, "Generalized reduced rank tests using the singular- value decomposition," *Journal of Econometrics*, 127, 97–126.

Stock, J. H., and M. Yogo, 2005, *Testing for weak instruments in linear IV regression. Identification and inference for econometric models*in: Donald W.K. Andrews and James H. Stock, eds: Essays in Honor of Thomas Rothenberg, Cambridge University Press, Cambridge.