What is revealed when firms disagree with short sellers?*

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Abstract

We investigate the causes and consequences of firms disagreeing with short sellers by repurchasing company stock. Though short sellers are generally adept at identifying overvalued equity and agency problems can bias managerial decisions, these repurchases are motivated by private information that dominates the information of short sellers. Information channels include future earnings, changes in risk, and acquisition activity. We observe one exception: Managers are more likely to defend overvalued stock if an activist investor previously identified the management team as inefficient. Our results suggest that short sellers and other investors can glean information from publicly available repurchase disclosures: An implementable trading strategy based on our findings yields annual abnormal returns of approximately 7%.

1 Introduction

The extant literature overwhelmingly paints short sellers as sophisticated investors. Evidence suggests they possess superior information (e.g., Christophe, Ferri, and Angel (2004); Karpoff and Lou (2010); Boehmer, Jones, and Zhang (2015); Fang, Huang, and Karpoff (2016)) and information processing skills (e.g., Engelberg, Reed, and Ringgenberg (2012)). Short sellers' trades are profitable: Negative abnormal returns trail periods associated with high short interest (e.g., Seneca (1967); Figlewski (1981); Desai, Ramesh, Thiagarajan, and Balachandran (2002); Asquith, Pathak, and Ritter (2005)) and positive abnormal returns follow low short interest (Boehmer, Huszar, and Jordan (2010)). Short selling disclosures prompt negative stock price reactions (e.g., Aitken, Frino, McCorry, and Swan (1998)), consistent with other market participants recognizing short sellers' competence.

The goal of this study is to investigate a common case in which short sellers trade against another informed party: the firm itself. Short sellers and firms actively disagree when, concurrent with an increase in short interest, firms repurchase company stock. Repurchases are executed at the discretion of managers, who are privy to inside information unavailable to short sellers. However, managers are prone to behavioral biases (as in Malmendier and Tate (2005)) and may conduct repurchases for reasons unrelated to valuation, such as compensation-related incentives (Cheng, Harford ,and Zhang (2015)). We examine instances in which short sellers and firms actively trade against each other to expose managerial motives and to determine whose information ultimately dominates.

Specifically, we investigate two primary questions. First, do managers repurchase against short selling based on private information? Second, does the combined effect of short sellers' negative information and managers' potential agency motivations for repurchases outweigh managers' positive private information, or are short sellers wrong? We address these questions by examining abnormal returns after firms repurchase against active short selling. We then investigate the channels for managerial information, why short sellers trade against the firm, and a special case when short sellers' information dominates. Finally, we examine an enhanced trading strategy for short sellers based on publicly revealed repurchases.

We define "disagreement" as cases where the firm engages in non-trivial repurchases while

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short interest increases meaningfully in the same quarter. We find that firms and short sellers disagree with one another significantly more frequently than expected based on the unconditional probabilities of repurchasing and short selling. We then calculate abnormal returns immediately following disagreement quarters. We find that next-quarter abnormal returns are positive and significant on average, consistent with the positive, private information incorporated in repurchases outweighing the combined effects of the short sellers' negative information and any agency costs associated with repurchases. In other words, on average, when short sellers and firms disagree, the information set of the firm dominates.

An alternative interpretation is that positive ex-post abnormal stock returns following disagreement are consistent with repurchases providing liquidity to the market (as in Hillert, Maug, and Obernberger (2016)) in order to artificially inflate stock prices (as in Liu and Swanson (2016)). If repurchases are simply serving as a mechanism to pump up prices, we would expect prices to mean-revert quickly. Yet, in addition to identifying positive abnormal returns over the following three-month period, we find no evidence of reversals in the abnormal return patterns over the subsequent two years.

We next examine the nature of the firm's informational advantage. We begin by considering two obvious sources: future disclosures of material, non-public information through 8-K filings and quarterly earnings announcements. Controlling for the magnitude and direction of unexpected news in regressions modeling next-quarter abnormal returns renders the coefficient associated with disagreement insignificant and curtails the difference in returns between disagreement firms and firms with high short selling but low repurchases. We also directly examine the relation between disagreement and returns around 8-K and earnings releases. Aggregate abnormal returns around 8-K announcements in the subsequent six months are 134 bps greater on average when firms disagree with short sellers than when short selling increases but firms do not repurchase and 54 bps greater when firms disagree than when both short selling and repurchasing are low. Differences in abnormal returns around the subsequent earnings announcements follow a similar pattern: Disagreement group returns around earnings announcements are 62 bps greater than returns around earning announcements for other quarters with high short selling but low repurchases and 48 bps greater than quarters with low short selling and low repurchases. These results suggest that the informational advantage of firms over short sellers relates to private information subsequently released through

8-Ks filings and earnings reports.

We also examine whether the informational advantage of the firm pertains to changes in risk or acquisition activity. The change in implied volatility around the subsequent earnings announcement and the change in beta around the quarter of interest are lower on average when firms disagree with short sellers than when they do not. Additionally, we find disagreement firms are less likely to bid for a public target, generally considered bad news to investors, in the subsequent 12 months. These results suggest firms also incorporate private information related to declines in firm risk and corporate M&A policies into their decision to disagree with short sellers.

Our results clearly point to the firm's informational advantage over short sellers. Why then do short sellers actively trade against firms? One potential explanation is that we have identified a subset of shorts that do not represent a directional bet against the firm. For example, perhaps these positions are part of a larger hedging strategy. Another explanation is that, due to lags in repurchase disclosures, short sellers are not fully aware of repurchase activity when betting against the firm.[1] Our evidence points to the short sellers being temporarily unaware of repurchase transactions. When we examine changes in short interest around repurchase disclosures, we observe short sellers incorporating repurchase activity into their trades; specifically, short sellers tend to reduce their positions after firms disclose increased repurchases.

While our primary findings suggest that the information set of the firm dominates that of short sellers, we do not claim that firms always repurchase based on an informational advantage. In fact, we do identify one subset of firms disagreeing with short sellers in which the informational advantage of the firm is attenuated: firms recently targeted by activist investors. Given that activists are generally effective at identifying poor management, we interpret these results as being consistent with managers repurchasing based on positive, private information, except in cases where the management team has been previously targeted for inefficiency.

In a final series of tests, we quantify the incremental value to short sellers of the information contained in repurchase disclosures by constructing a long-short portfolio that purchases firms that repurchased stock while short interest was increasing and sells firms that did not repurchase during short selling. Our results suggest that short sellers stand to gain an extra 7 percentage points

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[1]Information on repurchases is publicly available in the earnings announcement 30 to 45 days after quarter end. Information on short selling is publicly observable every 15 days during the quarter.

annually by reallocating their short positions away from firms that disclose significant repurchases. All information used to construct this portfolio is publicly available, rendering this trading strategy implementable.

2 Literature Review

Our study relates to three strands of literature. The first pertains to short selling, particularly the literature documenting that short sellers are well-informed investors whose trades predict future returns. The second involves share repurchases, relating to the information content of and motives for these trades. The third concerns a broader literature studying disagreement among informed parties. Below we briefly review each branch of research, then outline our contribution to the literature.

The current literature portrays short sellers as savvy investors with exceptional information processing skills. They anticipate corporate events, including negative earnings surprises, analyst downgrades, downward revisions in analyst earnings forecasts, and even fraud (Christophe, Ferri, and Angel (2004); Karpoff and Lou (2010); Boehmer, Jones, and Zhang (2015)). In addition to successfully predicting news events, short sellers are also exceptional information processors once news is released (Engelberg, Reed, and Ringgenberg (2012)).

Both their superior information and information processing skills contribute to the abnormal profit that short sellers earn on average. Numerous studies (e.g., Asquith, Pathak, and Ritter (2005); Boehmer, Jones, and Zhang (2008); and Desai, Ramesh, Thiagarajan, and Balachandran (2002)) document negative abnormal returns following periods of high short interest, with the most informed shorts emanating from institutional "nonprogram" trades (Boehmer, Jones, and Zhang (2008)).[2] Short sellers even know which stocks to avoid and when to exit: On average, firms associated with extremely *low* short interest tend to earn *positive* abnormal returns (Boehmer, Huszar, and Jordan (2010)), and short sellers incorporate private information into their decision to cover the short (Boehmer, Duong, and Huszar (2017)).

Profiting from overvaluation is not the only motive for shorting. For example, an investor may short a stock to hedge against a convertible bond purchase. Yet, evidence in support of short sellers

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[2]Program trades are defined as simultaneous trades in 15 or more stocks worth at least $1 million.

successfully exploiting overvaluation is strong. In fact, in his survey of short selling, Reed (2013) concludes that "one of the most robust findings of the literature is the fact that short sellers are generally informed traders, meaning short sales predict negative future returns."

Managers are privy to non-public information, and evidence suggests they often reveal this information through share repurchases. Repurchase announcements are associated with positive and significant returns immediately and up to four years into the future (e.g., Vermaelen (1981), Comment and Jarrell (1991), Stephens and Weisbach (1998), Jagannathan and Stephens (2003), Chan, Ikenberry, and Lee (2004), Ikenberry, Lakonishok, and Vermaelen (1995), Bargeron, Bonaime, and Thomas (2017), Manconi, Peyer, and Vermaelen (2017)). Further, repurchase announcements are associated with reductions in systematic risk and cost of capital (Grullon and Michaely (2004)), and improved operating performance for firms that actually repurchase stock (Lie (2005)). While evidence is mixed on whether managers optimally time repurchases on average (Bonaime, Hankins, and Jordan (2016)), certain firms successfully obtain their stock for below-average prices (Dittmar and Field (2015)). Managers frequently mention undervaluation in press releases announcing the initiation of repurchase programs, sometimes using language such as "good investment" or "best use of cash" to describe the repurchase program (Peyer and Vermaelen (2009); Bonaime (2012)). While it is possible that some of these managers are overconfident, believing that their stock is undervalued when in fact it is not (as in Malmendier and Tate (2005)), or dishonest, undervaluation is commonly accepted among academics as a primary driver of share repurchases (e.g., Vermaelen (1981), Grullon and Michaely (2004), Brav, Graham, Harvey, and Michaely (2005), Louis and White (2007)).

Yet, undervaluation is not the only motive for repurchasing stock. Other motives include reducing agency costs (Jensen (1986)), fending off takeovers (Billett and Xue (2007)), altering capital structure (Dittmar (2000); Bonaime, Oztekin, and Warr (2014)), and cancelling out the dilutive effect of stock option exercise (Kahle (2002)). A recent literature suggests a more nefarious motive for stock repurchases: to meet earnings per share thresholds (e.g., Hribar, Jenkins, and Johnson (2006); Almeida, Fos, and Kronlund (2016)), particularly if executive bonuses are tied to these thresholds (Cheng, Harford ,and Zhang (2015)) and the firm is not financially constrained (Farrell, Unlu and Yu (2014)). In addition, more and more repurchase programs are being outsourced to investment banks through ASRs (Bargeron, Kulchania, and Thomas (2011)) and other preset re-

purchase plans (Bonaime, Harford, and Moore (2017)). While these types of repurchases signal a commitment to follow through on the repurchase plan, they reduce the firm's ability to time trades in such a way as to exploit underpricing.

Other research examines disagreement among informed parties and its relation to future stock returns. For example, Carlin, Longstaff, and Matoba (2014) document that disagreement among investors (Wall Street mortgage dealers) is associated with higher expected returns, as well as increased volatility and trading volume. On the flip side, when analysts disagree about earnings forecasts, future returns are abnormally low (Diether, Malloy, and Scherbina (2002)), especially for illiquid stocks (Sadka and Scherbina (2007)).

Other studies examine disagreement between short sellers and hedge funds, another group of investors considered to be sophisticated and well-informed. Jiao, Massa, and Zhang (2016) note that hedge funds establish simultaneous long and short positions for hedging purposes, not necessarily as a directional bet, and that studying the intersection of short selling (changes in short interest) and hedge fund trading (changes in holdings) may help to disentangle "informed short demand" from hedging. Consistent with hedge fund positions contributing to the information content of short positions, highly shorted stocks also associated with high hedge fund ownership indeed fail to underperform (Nezafat, Shen, Wang, and Wu (2016)).

Our study differs from the aforementioned research by focusing on repurchase transactions in which the firm itself is the informed trader. Several prior studies have examined the interaction between repurchases and trades by corporate insiders. The general consensus is that announced and actual repurchases correlate positively with insider purchases *and sales*, but repurchases concurrent with insider purchases are more likely to be based on information. Accordingly, the direction of insider trading portends post-repurchase stock returns (Babenko, Tserlukevich, and Vedrashko (2012); Bonaime and Ryngaert (2013)) and operating performance (Louis, Sun, and White (2010)).

In this paper we examine cases in which firms disagree with short sellers by repurchasing considerable amounts of stock while short sellers increase their bets against the firm. In the past few decades, both repurchasing and short-selling activity have increased sharply. In 2012 almost half of all U.S. public firms conducted share repurchases, worth over $364 billion in the aggregate (Farre-Mensa, Michaely, and Schmalz (2014)). Further, short sales accounted for 20% of trading volume on the NYSE between 2004 and 2007 (Boehmer and Wu (2013)), up from 13% from 2000 to

2004 (Boehmer, Jones, and Zhang (2008)). Given the frequency of repurchasing and short selling, firms and short sellers will naturally trade against one another on occasion. However, consistent with the causal relation between short selling and repurchasing established by Campello and Saffi (2015), we find that firms and short sellers actually trade against one another significantly more frequently than expected based on the unconditional probabilities of repurchasing and short selling. We use this relatively common intersection of share repurchase and short selling activity as a new laboratory in which to reexamine disagreement among informed traders.

Examining the intersection of share repurchase and short selling allows us to contribute to each of the three prior strands of literature. First, the extant short selling literature presents overwhelming evidence in support of short sellers being informed. We add to this line of research by identifying a special—though not uncommon—case in which short sellers are revealed to be incorrect. Second, the repurchase literature is rich in theories and evidence explaining managerial motives behind these transactions. While repurchases have long been viewed as a tool for managers to communicate good news about the firm, recently academic research and the popular press have placed stock repurchases under increased scrutiny, suggesting that managers repurchase to boost compensation (Cheng, Harford ,and Zhang (2015)) and that these repurchases are associated with real economic consequence (Almeida, Fos, and Kronlund (2016)).[3] In expectation, firms with increasing short interest are more likely to be overvalued, putting downward pressure on share prices and magnifying managers' incentives to defend stock prices. Yet, our evidence points to positive, private information, not managerial self-interest, as the primary driver behind repurchases concurrent with short selling pressure. Finally, we contribute to the literature on disagreement among informed investors and its relation to future stock prices. Lamont (2012) also examines interactions between firms and short sellers, with a focus on firms' anti-shorting actions. He notes that firms go to great lengths, including criminal accusations, legal threats and deliberate technical disturbances, to deter short sellers from betting against their stock. Further, he documents that firms engaging in these types of behaviors succeed at creating short sale constraints, which contribute to overpricing. Our evidence instead suggests disagreement among firms and short sellers is due to underpricing: Firms

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[3]E.g., "As Companies Step Up Buybacks, Executives Benefit Too" (*The Wall Street Journal*, May 5, 2013), "The Repurchase Revolution" (*The Economist*, September 13, 2014), "Buybacks Can Juice Per-Share Profit, Pad Executive Pay" (*The Wall Street Journal*, October 28, 2014), "Beware the Stock-Buyback Craze" (*The Wall Street Journal*, June 19, 2015), "Stock Buybacks Enrich the Bosses Even when Business Sags" (*Reuters*, December 10, 2015), and "Quick and Dirty: Are Companies too Short-Termism?" (*The Economist*, October 8–14, 2016).

repurchase based on positive, private information that is revealed in the near future. Disagreement, on average, is followed by positive abnormal returns.

3   Hypothesis Development

Prior studies characterize short sellers as sophisticated investors, adept at identifying overvalued stocks. Why, then, do managers repurchase stock as short sellers increase their positions? If managers' private information motivates repurchases, whose information dominates? In this section we introduce our primary hypothesis, along with two conditional hypotheses, pertaining to managerial motives and information content behind disagreement with short sellers.

Managers acquire private information about the firm's performance, prospects, and risks by nature of their position within the firm. The first hypothesis posits that managers choose to repurchase against short selling when they have positive information that is not currently reflected in the stock price.

Informed Manager Hypothesis*: Managers repurchase against short selling based on positive, private information.*

The above hypothesis predicts that abnormal returns following periods of disagreement are greater than abnormal returns following the counterfactual, periods of short selling in which the firm does not repurchase.

The alternative hypothesis is that managers do not base their decision to repurchase against short sellers on positive, private information. Rather, repurchases could be motivated by a desire to return cash to shareholders or to avoid dilution. More nefariously, due to overconfidence or misaligned incentives, managers may repurchase overpriced stock, thereby destroying shareholder value. The alternative hypothesis suggests abnormal returns following periods of disagreement are no greater than following periods in which short sellers increase their positions, but firms do not repurchase.

If managers repurchase stock in the face of short selling based on private information as predicted by the *Informed Manager Hypothesis*, then a natural question is: Do the negative effects of short

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sellers' information and managers' potential agency motivations outweigh the managers' positive private information? This question motivates the two following hypotheses.

Managers are privy to private, value-relevant information about the firm's prospects and short positions are sometimes established as hedges, not directional bets against the firm. Therefore, managers' information set may dominate that of short sellers. Stated formally:

Dominant Manager Hypothesis*: Managers' positive information on firm value outweighs short sellers' negative information and any negative value implications of agency-motivated repurchases.*

This hypothesis predicts that abnormal returns following periods of disagreement will be positive.

On the other hand, while managers may have access to more accurate firm-specific information, short sellers may be superior information processors. For example, managers have private information on firm cash flows, but short sellers may better estimate the correlation of firm cash flows with other firms in the industry or with the market as a whole. Additionally, managers evaluating their own company may be prone to behavioral biases or have competing personal incentives to support stock prices or reduce the number of shares outstanding through a stock repurchase. The above cases could lead to the trades of shorts sellers containing more information than the firm's repurchases. Stated formally:

Dominant Short Seller Hypothesis*: Short sellers' negative information and any negative value implications of agency-motivated repurchases outweigh managers' positive information on firm value.*

This hypothesis predicts that abnormal returns following periods of disagreement are negative.

To summarize, empirical tests of the *Informed Manager Hypothesis*, which predicts that managers repurchase against short selling based on information, compare abnormal returns following disagreement to abnormal returns following increases in short interest unaccompanied by repurchases. Tests of the *Dominant Manager* and *Dominant Short Seller Hypotheses* relate abnormal returns following disagreement to zero to ascertain whose information set prevails.

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4 The Joint Frequency of Short Selling and Repurchases

We source our share repurchase and short interest data from the Compustat Fundamentals Quarterly and Supplement Short Interest files, respectively. Beginning in 2004 the SEC requires firms to disclose the number of shares repurchased and average repurchase price per share in all quarterly (10-Q) and annual (10-K) filings. Thus, we begin our sample in 2004 and calculate the total dollar value of repurchases as the number shares purchased times the average price per share, which we scale by beginning-of-quarter market capitalization. Beginning in 2007 short sales are reported twice per month (on the 15th business day and the last business day of each month), but prior to 2007 short sales are only reported on the 15th business day of each month. For consistency across our sample period, we measure quarterly short interest as the number of shares shorted on the 15th business day of the last month in the quarter, scaled by the number of shares outstanding on the same day. Because short sellers would not incur the costs and risks associated with a net increase in short interest unless they believe the stock is currently overvalued, we use quarterly changes in short interest to gauge short sellers' sentiment. We identify 198,503 firm-quarters that appear in both databases between 2004 and 2014.[4]

We begin by examining the joint frequency of share repurchase and short selling activity in Table 1. We characterize firms as having "high" repurchases if repurchases are greater than or equal to 0.5% of market capitalization. Firms are dubbed "high" short selling firms if their quarter-to-quarter change in short interest exceeds 0.5%. Otherwise, we consider firms to have "low" repurchases or short selling. Of interest is the high repurchase/high short selling group, which we term the "disagreement" group due to the fact that firms are actively buying stock while short sellers are actively selling it.

In our sample 25.2% of firm-quarters are associated with high short selling and 13.3% with high repurchases. Interestingly, we observe high repurchase levels more frequently within high short selling firm-quarters than low short selling firm-quarters (15.6% versus 12.6%). This 3.0 percentage point (or 23.8%) difference in repurchase frequency is significant at the 1% level. The disagreement group comprises 3.9% of all firm-quarters. Chi-square tests strongly reject the null hypothesis of independence of repurchase and changes in short interest, with the disagreement

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[4]The results throughout the paper are stronger if we exclude financial firms and utilities from our analysis.

group contributing heavily to the Chi-squared statistic.

5 Do Firms Repurchase Based on Information?

We now turn to the question of whether managers repurchase based on information, particularly in the face of pressure from short sellers, by examining the subset of firms in the high short selling group. Our empirical strategy is to examine abnormal stock returns the quarter following the quarter in which we classify firms as high/low repurchase firms and high/low short selling firms.

5.1 Methodology and baseline results

We utilize four measures of abnormal returns. Our first three measures are based on buy-and-hold cumulative abnormal quarterly returns, calculated as follows:

$$AbRet_{i,t} = \prod_{t=1}^{3}(1 + r_{i,t}) - \prod_{t=1}^{3}(1 + r_{p,t}) \tag{1}$$

where $r_{i,t}$ refers to the return on stock i in month t, and $r_{p,t}$ refers to the return at month t on one of three matched portfolios: (i) the Fama-French 25 size and book-to-market portfolio, (ii) the Fama-French 25 size and momentum portfolio, or (iii) the Daniel, Grinblatt, Titman, and Wermers (1997) (henceforth "DGTW") 125 size, book-to-market and momentum portfolios.

For our final measure, we calculate calendar time portfolios using a Fama-French 4-factor model:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_1(R_{mkt,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \epsilon_t \tag{2}$$

where $R_{p,t}$ is the return at month t on an equally weighted portfolio of stocks in the same repurchasing/short selling bucket, $R_{f,t}$ and $R_{mkt,t}$ are the risk-free rate and the return on the market at month t, and SMB_t, HML_t, and MOM_t are the monthly returns on the Fama-French size, book-to-market, and momentum factors in month t. We report the intercept term (α) of the regression, which represents the average monthly excess return. Note that, although the time periods are identical, the first three measures are quarterly while the third measure represents a monthly average over the quarter.

In Table 2 we present our baseline abnormal returns results during the quarter following the

short selling/repurchase classification quarter. We confirm that short sellers, on average, have accurate predictions about firm value: When short sellers increase their positions, firms significantly underperform during the next quarter, according to all returns measures. On average, firm-quarters associated with high short selling underperform Fama-French size and book-to-market (size and momentum) matched portfolios by 27 bps (30 bps) and DGTW matched portfolios by 39 bps over the next quarter. Further, 4-factor calendar time portfolio estimates suggest monthly underperformance of over 27 bps, or 81 bps quarterly.

However, when we segment our sample on concurrent repurchase activity, we discover that returns to short selling vary substantially depending upon whether or not the firm repurchases. In the absence of repurchasing, next-quarter returns to firms in which short sellers actively increase their positions are negative and statistically significant, with estimates ranging from -43 bps to -57 bps using the buy-and-hold approach and -110 bps (-36.6 bps/month x 3) using the calendar time approach. Yet, if the firm disagrees with short sellers by simultaneously repurchasing, abnormal returns are positive and significant over the next quarter, with estimates between 46 bps and 78 bps for buy-and-hold abnormal returns and up to 90 bps for calendar time portfolio abnormal returns. This difference in returns following high short selling quarters across firms with and without repurchases is highly significant. Our estimates imply that abnormal returns are between 99 and 199 bps greater following periods of high short selling if the firm simultaneously repurchases. The greater returns after firms disagree with short sellers suggest managers engage short sellers based on positive, private information. The positive abnormal returns following disagreement suggest that managerial information dominates short sellers' information on average.

5.2 Controlling for firm characteristics

There is much debate on how to properly estimate abnormal returns. For our purposes, if abnormal returns measures are systematically biased in a way related to repurchasing and short selling activity, then our inferences may be flawed. For example, if firms that repurchase tend to be larger and abnormal returns estimates for larger firms tend to be biased downward, then we may falsely infer managers of repurchasing firms trade out of self-interest. In this section, we examine abnormal returns in a multivariate setting, which allows us to explicitly control for observable time-varying firm characteristics and unobservable time-invariant firm characteristics through the use of firm

fixed effects.

5.2.1 Abnormal returns regressions. In an effort to more precisely estimate the information imbedded in repurchases concurrent with short selling, in Table 3 we model abnormal returns in a regression setting in which we include indicator variables for each repurchase/short selling group, with the low repurchase/low short selling group serving as our base. We control for a host of additional variables, which include: firm size, cash, operating income, non-operating income, book-to-market, leverage, CAPEX, operating income volatility, repurchase announcements in the same, liquidity, market returns, return volatility, institutional ownership, and the level of short interest. These variables are further motivated and described in detail in Appendix A. We also include firm and quarter fixed effects. Adding controls known to be related to short selling or repurchases helps to alleviate concerns that potential biases in our abnormal returns measures are correlated with firms characteristics also related to repurchase or short selling activity. Firm fixed effects capture firm-specific, time-invariant traits, and quarter fixed effects capture time-varying biases in our abnormal returns measures. The dependent variables are quarterly Fama-French size and book-to-market adjusted returns in Models (1)–(3), Fama-French size and momentum adjusted returns in Models (4)–(6), and DGTW size, book-to-market and momentum adjusted returns in Models (7)–(9). Returns are measured over the quarter following the repurchase/short selling classification quarter.

Of interest are coefficients on the high short selling/high repurchase "disagreement" group indicator variable as well as the difference in this coefficient and that of the high short selling/low repurchase group. Focusing on the first model, we see that the disagreement group earns quarterly abnormal returns 57 bps above the low repurchase/low short selling base category. Further, F-tests associated with the differences in the disagreement and high short selling/low repurchase groups suggest that, when a firm actively disagrees with short sellers by repurchasing as short sellers increase their positions, next-quarter returns are 149 bps greater than if the firm chooses not to repurchase. These results suggest that managers trade on positive information revealed (or at least partially revealed) over the next three months. Control variables are included in all models but omitted for the sake of brevity. In untabulated results we observe that abnormal returns are positively related to operating income volatility, the percentage of firms in the same industry

announcing share repurchases, market returns, and firm return volatility, but negatively related to firm size, short interest level and lagged returns.

Next, we begin to examine the nature of the information that managers who disagree with short sellers possess. We begin with two obvious information releases: 8-K filings and earnings reports. Firms are required to file form 8-K with the Securities and Exchange Commission to announce material, corporate events on a more timely basis, as opposed to waiting to release this information in quarterly filings. Our variable *8-K sum* captures the direction and magnitude of the information in these corporate filings by summing the 3-day CARs around these information releases over the quarter matching our abnormal returns measurement quarter. Next, we augment our model with *earnings surprise*, the 3-day CARs around the earnings announcement that occurs during the quarter in which we measure our dependent variable.

If returns in disagreement firms are driven by corporate releases, then we expect to observe a decline in the disagreement coefficient when we include controls for the direction and magnitude of private information subsequently released. In Models (2) and (3), we see that the coefficients on *8-K sum* and *earnings surprise* are positive and significant but, more importantly, that the disagreement coefficient drops from 57 bps to 24 bps with the inclusion of *8-K sum* in Model (2) and down to an insignificant 4 bps with the addition of *earnings surprise* in Model (3). While coefficients on the high short/low repurchase and low short/high repurchase also move towards zero, it is interesting to note that the inclusion of returns around subsequent information releases affects the disagreement group the most. The continued significance in the F-test of the difference between the disagreement and high short selling/low repurchase groups in Model (3) suggests that positive managerial information other than earnings and 8-K announcements is revealed during the quarter after disagreement.

We confirm that our results follow similar patterns using alternative returns measures. The disagreement group outperforms the low repurchase/low short selling base group by 96 bps (51 bps) and the low repurchase/high short selling group by 178 bps (139 bps) over the next quarter when we adjust returns by size and momentum (DGTW portfolio returns) in Model (4) (Model (7)). These results are consistent with information motivating repurchases in the presence of short selling. Further, we document that augmenting the model with returns around information releases (8-K filings and earnings announcements) attenuates the relationship between disagreement and

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returns, which suggests that the nature of the information on which managers are making repurchase decisions is related to material, non-public information in 8-K filings as well as earnings.

5.3 Do managers temporarily fool the market by propping up stock prices in the short-run?

Thus far we have established that firms that actively disagree with short sellers by repurchasing while short sellers increase their positions experience next-quarter returns that are significantly greater than returns to other firms with increases in short interest. In fact, returns to disagreement firms are positive and significant and related to subsequent releases of private information. These results are consistent with managers acting on positive, private information, on average, when deciding to disagree with short sellers.

But what if managers are able to temporarily fool investors, either by provisionally propping up stock prices through repurchases, by manipulating earnings or by releasing misleading information? Three months already represents a substantial amount of time to mislead investors, but insuring that the relationship between the interaction of repurchases and short selling and returns holds over time will bolster the private information story. Results in Panel A of Table 4 are analogous to the fixed effects regressions in Table 3; we simply modify the dependent variable to span a longer time window. We show results for 3 months (as in Table 3) and 24 months. All firm controls are included but not shown for brevity.

If managers are only temporarily propping up stock prices out of self-interest, we expect to observe mean reversion in the long-term. However, we observe no reversion to the mean. The coefficient on disagreement consistently remains above zero, growing to between 64 and 177 bps over 24 months according to our estimates. Importantly, F-tests comparing the coefficients on the disagreement group and the high short selling/low repurchase group reveal that the returns differential widens over time, from a range of 139 to 178 bps at three months to 659 to 795 bps after 24 months.

In Panel B of Table 4 we present monthly α's calculated using a calendar time portfolio approach based on the Fama-French 4-factor model, as described in Section 5.1. These results are robust. The coefficient associated with 24 months implies a 6.38% (0.266 x 24) abnormal return over two years. Again, abnormal returns to the disagreement group dominate returns to the high short selling/low

repurchase group, which are consistently negative and significant. Returns differentials decline with time, but remain positive, significant and economically meaningful, at 43 bps per month. in summary, the results in Table 4 are consistent with disagreement firms trading on information, not temporarily misleading investors.

5.4   Robustness to short interest subsets and level

In this section we address two potential concerns. First, we verify that our results hold across various subsamples of firms created based on beginning level of short interest. Second, we confirm that our inferences are unchanged if we substitute short interest *levels* instead of *changes* in our categorization of high/low short selling firms. Table 5 presents these robustness tests.

Panel A of Table 5 shows regressions of next-quarter buy-and-hold abnormal returns for subsets of firms with beginning levels of short interest greater than 2.5% or 5%, as indicated. (As before, repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are "low.") The coefficient associated with the disagreement group in Model (1), whose independent variable is Fama-French size and book-to-market adjusted abnormal returns, implies a premium relative to the low short selling/low repurchase group of 59 bps, not economically different from the 57 bps premium from Table 2. However, when we increase the cutoff to 5% in Model (2) the disagreement coefficient increases to imply a 116 bps premium. Similar patterns hold when we adjust returns using Fama-French size and momentum portfolios in Models (3) and (4) or DGTW portfolios in Models (5) and (6). Further, F-statistics confirm the statistical difference in the disagreement and high short selling/low repurchases coefficients, across both subsamples and all three returns measures. These results suggest that the information content of repurchases against short selling is greater when the prior level of short interest is higher. Our subsample analyses reveal another interesting finding: Coefficients associated with the low short selling/high repurchasing group increase in magnitude as we impose cutoffs for short interest levels. These results are also consistent with repurchases in the face of short selling pressure being associated with positive information, whether the short selling pressure begins high and increases further (as our disagreement coefficient indicates) or simply begins high.

In Panel B of Table 5 we use our full sample of firms but alter the definition of "high" and "low" short selling firms to be based on levels rather than changes; specifically, our cutoff for high short

selling level is 5%. Using short interest levels in lieu of changes results in increases in the magnitude of the disagreement coefficients and of the difference in the disagreement and high short selling/low repurchase coefficients, reinforcing our finding that managers act on positive, private information when repurchasing during period of heightened short selling. One difference worth noting is that the magnitude of the coefficient associated with high short selling/low repurchases is lower and now insignificant. These results are consistent with short interest changes containing more information about subsequent returns than short interest levels, providing further justification for the use of changes throughout our study.

6   What Do Managers Know?

We have established that, on average, managers possess positive information about the firm when they trade against short sellers by repurchasing company stock. In Table 6 we examine the nature of this information. Namely, we are interested in how the firm's decision to trade against short sellers is related to the direction and magnitude of future information released by the company, as well as the firm's risk profile and acquisition activity. We regress proxies for the nature of information, changes in firm risk and acquisition activity on indicator variables denoting whether short selling increases substantially or not and whether repurchases are high or low. Our base group is firms with low changes in short interest and low repurchases. We include firm and quarter fixed effects as well as all control variables from Model (1) in Table 3, not shown for the sake of brevity.

Model (1) of Table 6 examines the sum of 3-day cumulative abnormal returns around 8-K reports filed during the 6-month period following our classification quarter. When firms disagree with short sellers by repurchasing, more positive information is released in the future: The sum of CARs around 8-Ks over the next 6 months is greater by 54 bps. In contrast, when short interest increases, but firms do not trade against short sellers, the sum CARs surrounding 8-Ks over the next 6 months is 80 bps lower. This economically meaningful 134 bps difference is statistically significant at the 1% level. These results are consistent with short sellers correctly identifying firms that will release bad news in the near future, unless the firm simultaneously repurchases. It is worth noting that repurchases during periods of increasing short interest are associated with subsequent 8-K CARs that are greater than, though not statistically different from, 8-K CARs in the low short

selling/high repurchase group.

Column (2) presents a model of *earnings surprise*, the 3-day CAR around the earnings announcement after the short selling/repurchase classification quarter. The disagreement coefficient, significant at the 1% level, implies that firms that repurchase while short interest is increasing experience abnormal returns around earnings announcements 48 bps greater than firms with low changes in short interest and low repurchases. Further, when firms disagree with short sellers, earnings surprises are 62 bps greater than when short sellers increase their positions but firms do not trade against them. The coefficients associated with the high short selling/low repurchase groups differ substantially across the two types of information releases, -80 bps for *8-K sum* versus -15 bps for *earnings surprise*. This suggests that, while short sellers accurately predict lower earnings on average, the majority of information on which they trade is unrelated to earnings.

In Columns (3) and (4) we examine changes in firm risk. Grullon and Michaely (2004) find that repurchasing firms experience reductions in risk relative to non-repurchasing firms. Model (3) examines changes in implied volatility around earnings announcements, defined as the change in the implied volatility of the 365-day at-the-money straddle in the 5-day window around the earnings announcement date divided by the implied volatility of the straddle at the beginning of the 5-day window.[5] Model (4) examines changes in systematic risk or β. We estimate β's using a Fama-French 4-factor model of daily returns over the year prior to the beginning of our classification quarter and the year after the end of our classification quarter. We require at least 100 days of returns for each beta calculation. The change in β is the difference in market β's between the pre and post periods. Using either implied volatility or β to proxy for risk, we see that firms that experience increases in short selling are associated with significant increases in risk, unless the firm simultaneously repurchases. F-tests reveal that the difference in the disagreement coefficients and the high short selling/low repurchase coefficients are statistically significant at the 1% level.

Finally, we examine the likelihood of announcing an acquisition of another firm over the next year. We specifically care about the likelihood of announcing an acquisition of a *public* target, as these announcements are associated with negative abnormal returns and are thus considered bad news for the acquirer (Moeller, Schlingemann, and Stulz (2004); Bargeron, Lehn, Moeller, and

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[5]We use Optionmetrics data to calculate the implied volatility. Specifically, we use the interpolated volatility surface for the constant maturity 365-day options and take the average of the implied volatilities of the at-the-money call and the at-the-money put as the volatility of the straddle.

Schlingemann (2014)). We see that short selling firms are significantly more likely to announce an acquisition of a public firm in the near future while all repurchasing firms (firms in the disagreement group and in the low short selling/high repurchase groups) are less likely to announce an acquisition of a public target. The coefficients on the disagreement group and the other high short selling group are significantly different at the 1% level.

Overall, regressions modeling future information and changes in risk show that repurchasing firms—even those repurchasing while short selling increases—possess positive, private information that is revealed in the near future. After short interest increases, firms on average disclose more negative information, have more negative earnings surprises, experience increases in risk and are more likely to acquire a public target. These effects are negated if the firm simultaneously repurchases while short interest increases. In this case, in fact, firms subsequently reveal positive information, on average, and are significantly less likely to acquire a public target.

7   Why Do Short Sellers Trade Agaisnt Firms?

We have established that abnormal returns following disagreement are significantly positive, and that firms, at least on average, repurchase based on information. Why, then, do sophisticated short sellers bet against repurchasing firms? We present evidence in this section suggesting that short sellers reduce their positions when firms disclose increases in repurchases, consistent with short sellers being uncertain of repurchase activity at the time they are increasing their bets against the firms.

In Table 7 we examine changes in short interest after firms disclose quarterly repurchases. Firms first reveal repurchases in earnings announcements released after the quarter end. Hence, we regress the change in short interest during the month following the repurchase disclosure on the change in repurchases over the disclosed quarter.[6] If short sellers are already aware of a firm's repurchase activity before the announcement, then we would expect the coefficient on the change in repurchases to be insignificant or, given the observed positive correlation between short selling and repurchasing, positive. A negative coefficient would instead be consistent with short sellers being uncertain of the firm's repurchase activity until the disclosure is released. Model (1) of Table 7

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[6]The dependent variable in Table 7 regressions, change in short interest, is in percentage terms.

presents our base model. Model (2) adds the 3-day CAR during the earnings announcement window to control for the effects of other information released during the earnings announcement period. In both models, the coefficient associated with changes in repurchases is negative and significant at the 0.01 level. These results are consistent with short sellers responding to a change in repurchases once it is revealed.

Next, we distinguish if the negative relation between changes in repurchases and short selling after the disclosure of repurchases is driven primarily by increases in repurchases. Specifically, in Models (3) and (4) we augment Models (1) and (2), respectively, by adding an indicator variable equal to one if repurchases decreased or remained constant and an interaction term between this indicator and change in repurchases. The coefficient on repurchase change, now representing the coefficient for increases in repurchases, remains negative and significant and is greater in magnitude than before (-1.834 versus -1.058). The interaction term is insignificant but positive, and F-tests show that the sum of the coefficients on repurchase change and the interaction term is insignificant. These results suggest that the negative relation between short selling and revealed repurchases is driven by increases, not decreases, in repurchases.

Finally, Models (5) and (6) replace the continuous measure of change in repurchases with dummy variables indicating the firm moved from the non-repurchase group to the repurchase group or vice versa. Consistent with the earlier models, the results indicate that short interest decreases after firms disclose they started repurchasing and does not change significantly when firms disclose they stopped repurchasing. The small but statistically significant decrease suggests that a small set of short sellers substantially unwind their short positions in response to unexpected increases in repurchases or a large group of short sellers respond only mildly. (e.g. Model (6) indicates short interest in the month following the disclosure of repurchasing decreases by 0.03% of shares outstanding, on average, if the firm moved from a non-repurchasing quarter to a repurchasing quarter.)

In short, the evidence suggests that short sellers learn about firm repurchases when the repurchases are revealed in earnings announcements and adjust their trading accordingly. Specifically, when short sellers learn firms increased repurchases, they tend to reduce their positions. The short sellers incomplete information about firm repurchasing helps explain why short sellers incur the cost of short selling when firms repurchase, even though subsequent returns are positive, on average,

after disagreement quarters.

8 Cross-sectional Heterogeneity in the Information Content of Disagreement Repurchases

We have established that, on average, managers who decide to repurchase as short selling increases possess positive information about the firm that is revealed to the market in the near future. In this section, we recognize that the information content of repurchases likely varies in the cross-section. Here we reexamine buy-and-hold abnormal returns during the quarter following the classification quarter within our short selling/repurchase groups, based on whether or not an activist investor has recently targeted the firm. Activist investors represent a third informed party; they are considered sophisticated investors who are generally successful at identifying poor management (e.g., Brav, Jiang, Partnoy, and Thomas (2008), Clifford (2008), and Klein and Zur (2009)). We hypothesize that firms targeted by activists are run by less efficient managers, who may be more prone to agency problems.

Table 8 shows regressions of buy-and-hold abnormal returns as a function of short selling and repurchase activity, interacted with the presence of an activist investor. The negative and significant sum of the coefficient on activist and the coefficient on activist interacted with disagreement (-239 bps) suggests that, if an activist invested in the firm over the prior six months, which we identify using 13-D filings, repurchases by the firm when short interest increases are less informative than in the absence of activists. These results suggest that the information content of repurchases against short selling is lower for managers targeted by activists.

We also find that subsequent quarter abnormal returns for disagreement firms are *negative* (-163 bps) if an activist investor is present. Further, the informational advantage of the firm relative to short sellers is nil if an activist has targeted the firm. Abnormal returns to disagreement firms targeted by activists are not statistically different from abnormal returns to high short selling/low repurchase firms targeted by activist (difference = -29 bps; *p*-value = 0.79). Results are similar using Fama-French size and momentum adjusted returns in Model (2) and DGTW returns in Model (3). These results are consistent with information-based repurchasing when firms trade against short sellers, unless an activist is involved. Given that activists generally get involved to

shake up a team of underperforming managers, we interpret these results as being consistent with some managers—those previously identified by activists as being inefficient—repurchasing out of self-interest or at least not repurchasing based on private, positive information.

9   Trading Strategy

Our evidence thus far suggests that, when firms and short sellers disagree, the information of the firm dominates that of short sellers on average. In this section we quantify the incremental value of the information associated with repurchases that remains after the disclosure of the repurchases. Specifically, we examine abnormal returns to an implementable trading strategy, which uses a long-short calendar time portfolio approach.

Table 9 presents daily abnormal returns on a portfolio that purchases stocks associated with disagreement and sells stocks with only high short selling. Abnormal returns are daily Fama-French 4-factor α's, calculated as follows:

$$R_{Disagreement,t} - R_{HighShort,t} = \alpha_p + \beta_1(R_{mkt,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \epsilon_t$$

where $R_{Disagreement,t}$ is the return at day t on an equally weighted portfolio of disagreement stocks, and $R_{Highshort,t}$ is the return at day t on an equally weighted portfolio of firms in the high short selling group, but not the high repurchase group, the prior quarter. $R_{f,t}$ and $R_{mkt,t}$ are the risk-free rate and the return on the market at day t, and SMB_t, HML_t, and MOM_t are the daily returns on the Fama-French size, book-to-market, and momentum factors in month t.

In Model (1) stocks enter the portfolio one day after repurchases are disclosed and remain in the portfolio until one day prior to the next disclosure. This long-short portfolio earns 2.9 bps per day in excess return, or 7.3 percent annually. Results are similar in Model (2), where stocks enter the portfolio two days after repurchases are disclosed and remain in the portfolio until two days prior to the next disclosure: Investors who buy a portfolio of stocks associated with disagreement and short a portfolio of stocks for which short sellers increased their positions but the firm did not repurchase earn 2.1 bps in daily abnormal returns. When we instead allow stocks to enter the portfolios the day after repurchases are disclosed and remain for one quarter (63 trading days) in Model (3) or one year (252 trading days) in Model (4), we obtain comparable results: Investors can earn 2.6–2.8 bps per day or 6.6–7.1 percent annually by adopting these strategies.

Overall, these results suggest that, on average, managers repurchase based on positive information that dominates the perceived negative information of short sellers, but that this information is not fully impounded into stock prices at the time of repurchase disclosure. Short sellers can add value to their trading strategy by unraveling their bet against the firm when repurchases are disclosed. As Table 7 suggests, many short sellers already heed this advice. Further, other investors can learn from both parties and generate abnormal returns of approximately 7 percent annually by buying a portfolio of disagreement stocks while shorting a portfolio of stocks in which short sellers have been increasing their positions but firms have not engaged in share repurchases.

10   Concluding Remarks

Short sellers are sophisticated investors generally proficient at uncovering overvalued stocks. Why, then, are repurchases, which should be motivated by undervaluation, more likely as short interest increases? We postulate that managers possess positive, non-public information about the firm, which they incorporate into repurchase decisions. Our main empirical strategy involves identifying cases where the firm actively "disagrees" with short sellers by repurchasing non-trivial amounts of stock while short interest increases meaningfully, then estimating ex-post abnormal returns. If managers base repurchase decisions on positive, private information, then we expect ex-post returns to be greater when firms repurchase against short selling than when they do not. Alternatively, if managers are simply propping up stock prices or manipulating earnings, then we expect ex-post abnormal returns to be no better or even worse when firms repurchase against short selling.

Our results strongly support the idea that managers are in possession of positive, private information when they decide to repurchase as short interest increases. When firms repurchase against short selling, next-quarter abnormal returns are between 139 bps and 178 bps higher than returns following other cases of short selling. In fact, abnormal returns following disagreement are positive and significant on average. Further, we pinpoint the nature of the information that managers possess. Firms that disagree with short sellers release significantly better news through subsequent 8-K filings, report unexpectedly good earnings, experiences declines in risk, and are less likely to engage in acquisitions of public companies in the future.

We next examine why short sellers actively bet against repurchasing firms when our evidence

suggests that this behavior is suboptimal. The answer is simple: Lags in repurchase disclosures prevent short sellers from being fully aware of repurchase activity at the time of their trades. After firms disclose repurchases, more precisely increases in repurchases, short sellers react by decreasing their positions.

While our primary empirical analysis focuses on the average firm, we do examine the cross-sectional variation in abnormal returns to the disagreement group by segmenting on perceived managerial skill. If the current management team has been previously identified as inefficient (using the presence of an activist investor as a proxy), ex-post abnormal returns for the disagreement group become statistically indistinguishable from the returns for the short selling only group. These results are inconsistent with managers acting upon private, positive information in this subset of firms.

We conclude by quantifying the incremental value to short sellers of the information contained in repurchase disclosures. We construct a long-short portfolio that purchases firms that disagree with short sellers by repurchased stock and sells firms that did not repurchase during short selling. This portfolio earns positive and significant abnormal returns of 7 percent on an annual basis. Further, because all information used to construct this portfolio is publicly available at the time of investment, this trading strategy is fully implementable.

Our results have several practical implications. First, we uncover a case in which short sellers are at an informational disadvantage and their trades are not associated with negative ex post abnormal returns. Our results imply that short sellers should take heed when trading against the firm and that other investors mimicking short sellers can increase profits by factoring in simultaneous trades by the firm. Second, our results do not support the increasingly common view, expressed often in the popular press, that managers repurchase purely out of self-interest. Though we do identify a subset of repurchases potentially motivated by self-interest in firms targeted by activist investors, overall our results imply that these types of repurchases are not the norm.

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Table 1. The Joint Frequency of Short Selling and Share Repurchases

Δ Short interest		Share repurchases		
		Low	High	All
Low	Frequency	129,787	18,661	148,448
	% Total	65.4%	9.4%	74.8%
	% Row	87.4%	12.6%	100.0%
	χ^2 contribution	9.9	64.6	74.5
High	Frequency	42,251	7,804	50,055
	% Total	21.3%	3.9%	25.2%
	% Row	84.4%	15.6%	100.0%
	χ^2 contribution	29.5	191.5	221.0
All	Frequency	172,038	26,465	198,503
	% Total	86.7%	13.3%	100.0%
	χ^2 contribution	39.4	256.1	295.5
	χ^2 p-value = 0.000			

This tables presents joint frequencies of share repurchases and changes in short interest for our full sample of 198,503 firm-quarters between 2004 and 2014. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low."

Table 2. Next-quarter Abnormal Returns Following Increases in Short Selling

	All high Δ short selling	Low repurchases	High repurchases	High - Low
Quarterly size and B/M adjusted	-0.271**	-0.432***	0.562***	0.994***
	(-2.55)	(-3.56)	(2.94)	(3.44)
Quarterly size and momentum adjusted	-0.296***	-0.504***	0.776***	1.280***
	(-2.82)	(-4.19)	(4.11)	(5.72)
Quarterly DGTW returns	-0.388***	-0.569***	0.456**	1.025***
	(-3.48)	(-4.41)	(2.37)	(4.42)
Monthly Fama-French 4-factor α	-0.274***	-0.366***	0.299***	0.664***
	(-2.99)	(-3.365)	(2.904)	(4.438)

This table presents abnormal returns during Quarter +1 for firms classified as having "high" changes in short interest during Quarter 0. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Quarterly abnormal returns are cumulative buy-and-hold abnormal returns during Quarter +1, calculated as follows:

$$AbRet_{i,t} = \prod_{t=1}^{3}(1 + r_{i,t}) - \prod_{t=1}^{3}(1 + r_{p,t})$$

where $r_{i,t}$ refers to the return on stock i in month t, and $r_{p,t}$ refers to the return on the matched Fama-French 25 size and book-to-market portfolio, Fama-French 25 size and momentum portfolio, or DGTW size, book-to-market and momentum portfolio at month t. Monthly Fama-French 4-factor α's are monthly abnormal returns calculated over Quarter +1 using a calendar time portfolio approach:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_1(R_{mkt,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \epsilon_t$$

where $R_{p,t}$ is the return at month t on an equally weighted portfolio of stocks in the same repurchasing/short selling bucket, $R_{f,t}$ and $R_{mkt,t}$ are the risk-free rate and the return on the market at month t, and SMB_t, HML_t, and MOM_t are the monthly returns on the Fama-French size, book-to-market, and momentum factors in month t. We report the intercept term (α) of the regression, which represents the average monthly excess return. t-statistics are presented in parentheses, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 3. Controlling for Firm Characteristics and Information Releases

	Size & B/M adjusted returns			Size & momentum adjusted returns			DGTW returns		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Disagreement	0.570**	0.239	0.040	0.958***	0.573**	0.380*	0.507*	0.033	-0.121
	(2.262)	(1.038)	(0.178)	(3.874)	(2.561)	(1.729)	(1.896)	(0.135)	(-0.508)
High short * Low repurchase	-0.923***	-0.711***	-0.675***	-0.826***	-0.591***	-0.561***	-0.880***	-0.707***	-0.659***
	(-4.806)	(-3.820)	(-3.715)	(-4.344)	(-3.236)	(-3.164)	(-4.282)	(-3.436)	(-3.290)
Low short * High repurchase	0.872***	0.656***	0.495**	0.965***	0.727***	0.571***	0.956***	0.721***	0.579***
	(4.068)	(3.254)	(2.574)	(4.551)	(3.692)	(3.037)	(3.940)	(3.171)	(2.659)
Lagged returns	-0.025***	-0.011**	-0.012**						
	(-5.855)	(-2.174)	(-2.519)						
Lagged returns (momentum)				-0.014***	-0.001	-0.002			
				(-2.987)	(-0.152)	(-0.351)			
Lagged returns (DGTW)							-0.028***	-0.019***	-0.020***
							(-4.946)	(-2.592)	(-2.913)
8-K CARs		0.689***	0.471***		0.677***	0.457***		0.737***	0.517***
		(22.271)	(14.036)		(22.175)	(13.748)		(12.154)	(6.793)
Earnings surprise			0.645***			0.645***			0.607***
			(22.034)			(22.804)			(11.276)
F-tests with p-values:									
Disagreement - High short * Low repurchase	1.493***	0.950***	0.715***	1.784***	1.164***	0.941***	1.387***	0.740***	0.538**
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.006]	[0.041]
Controls included:	Firm size, Cash, Operating Income, Non-operating income, Book-to-market, Leverage, CAPEX, Operating income volatility, Industry announcements, Illiquidity, Market return, Return volatility, Institutional ownership, Short interest level								
Observations	129,314	114,211	114,077	127,174	114,111	113,980	110,680	98,492	98,387
Number of firms	6,327	5,392	5,385	6,201	5,371	5,366	5,378	4,709	4,706
Adjusted R^2	0.044	0.182	0.223	0.041	0.176	0.219	0.0307	0.138	0.163

This table presents regressions of next-quarter buy-and-hold abnormal returns on repurchase/short selling classification indicators and control variables, defined in Table A1. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. The dependent variables are buy-and-hold abnormal returns adjusted using Fama–French 25 portfolios matched on size and book-to-market in Models (1)–(3), using Fama-French 25 portfolios matched on size and momentum in Models (4)–(6), and using DGTW portfolios matched on size, book-to-market and momentum in Models (7)–(9). Control variables, defined in Table A1, and firm and quarter fixed effects are included in all regressions. Standard errors are clustered at the firm level. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 4. Do Managers Fool Investors in the Short Run by Temporarily Propping Up Stock Prices?

Panel A: Buy-and-hold Abnormal Returns

	Size & B/M adjusted returns		Size & momentum adjusted returns		DGTW returns	
	3 months (1)	24 months (2)	3 months (3)	24 months (4)	3 months (5)	24 months (6)
Disagreement	0.570**	1.460	0.958***	1.769*	0.507*	0.636
	(2.262)	(1.502)	(3.874)	(1.762)	(1.896)	(0.538)
High short * Low repurchase	-0.923***	-6.488***	-0.826***	-6.311***	-0.880***	-5.952***
	(-4.806)	(-10.168)	(-4.344)	(-9.782)	(-4.282)	(-7.165)
Low short * High repurchase	0.872***	2.731***	0.965***	2.471***	0.956***	1.504
	(4.068)	(3.352)	(4.551)	(2.972)	(3.940)	(1.515)
F-tests with p-values:						
Disagreement - High short * Low repurchase	1.493***	7.948***	1.784***	8.080***	1.387***	6.588***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	129,314	129,333	127,174	127,208	110,680	110,710
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	6,327	6,327	6,201	6,202	5,378	5,379
Adjusted R^2	0.0435	0.144	0.041	0.140	0.0307	0.0993

Panel B: Calendar Time Portfolio Approach: Monthly Fama-French 4-factor α

	3 months (1)	24 months (2)
Disagreement	0.299***	0.266***
	(2.904)	(3.498)
High short, Low repurchase	-0.366***	-0.162*
	(-3.365)	(-1.690)
Low short, High repurchase	0.444***	0.334***
	(5.552)	(6.477)
Low short, Low repurchase	0.186	0.207
	(1.305)	(1.472)
Disagreement - High short, Low repurchase	0.664***	0.427***
	(4.438)	(3.491)

This table presents 3-month and 24-month long-run abnormal returns following repurchase/short selling classification quarters. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. Panel A shows regressions of long-run buy-and-hold abnormal returns on repurchase/short selling classification indicators and control variables, defined in Table A1. The dependent variables are buy-and-hold abnormal returns adjusted using Fama-French 25 portfolios matched on size and book-to-market, Fama-French 25 portfolios matched on size and momentum, or DGTW portfolios matched on size, book-to-market and momentum, as noted. All control variables from Table 3 are included, but omitted for brevity. Firm and quarter fixed effects are included in all regressions, and errors are clustered at the firm level. Panel B presents monthly Fama-French 4-factor α's, calculated using a calendar time portfolio approach, over varying time periods following the repurchase/short interest classification quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 5. Robustness to Short Interest Subsets and Levels

Panel A: Short Interest Subsets

	Size & B/M adjusted returns		Size & momentum adjusted returns		DGTW returns	
	Short interest > 2.5%	Short interest > 5%	Short interest > 2.5%	Short interest > 5%	Short interest > 2.5%	Short interest > 5%
	(1)	(2)	(3)	(4)	(5)	(6)
Disagreement	0.590*	1.163***	0.857***	1.507***	0.680**	1.288***
	(1.921)	(2.588)	(2.853)	(3.425)	(2.101)	(2.698)
High short * Low repurchase	-0.584**	-0.760**	-0.452**	-0.575*	-0.582**	-0.944**
	(-2.514)	(-2.369)	(-1.968)	(-1.795)	(-2.354)	(-2.511)
Low short * High repurchase	1.286***	1.604***	1.307***	1.623***	1.598***	2.030***
	(4.289)	(3.667)	(4.480)	(3.794)	(4.583)	(3.684)
F-tests with p-values:						
Disagreement - High short * Low repurchase	1.174***	1.923***	1.309***	2.082***	1.262***	2.232***
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	65,445	38,359	64,405	37,623	57,398	33,693
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	4,419	3,410	4,343	3,345	3,811	2,946
Adjusted R^2	0.0458	0.0490	0.0396	0.0424	0.0416	0.0458

Panel B: Short Interest Level

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
	(1)	(2)	(3)
Disagreement	1.110***	1.518***	1.193***
	(3.419)	(4.785)	(3.152)
High short * Low repurchase	-0.413	-0.269	-0.266
	(-1.505)	(-1.003)	(-0.910)
Low short * High repurchase	0.787***	0.890***	0.854***
	(3.640)	(4.151)	(3.667)
F-tests with p-values:			
Disagreement - High short * Low repurchase	1.523***	1.778***	1.453***
	[0.000]	[0.002]	[0.000]
Observations	129,314	127,174	110,680
Control variables	Yes	Yes	Yes
Number of firms	6,327	6,201	5,378
Adjusted R^2	0.0433	0.0404	0.0306

This table presents next-quarter abnormal returns following repurchase/short selling classification quarters. Panel A shows regressions of next-quarter buy-and-hold abnormal returns for subsets of firms with high *levels* of short interest (>2.5% and >5%, as indicated). As before, repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. In Panel B we alter the definition of "high" and "low" short selling firms to be based on level rather than changes; specifically, our cutoff is 5%. The dependent variables are buy-and-hold abnormal returns adjusted using Fama-French 25 portfolios matched on size and book-to-market, Fama-French 25 portfolios matched on size and momentum, or DGTW portfolios matched on size, book-to-market and momentum, as noted. All control variables from Table 3 are included, but omitted for brevity. Firm and quarter fixed effects are included in all regressions, and errors are clustered at the firm level. *t*-statistics are presented in parentheses, *p*-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 6. What Do Managers Know?

	8-K CARs (1)	Earnings Surprise (2)	Δ Implied Volatility (3)	Δ β (4)	Acquisition of Public Target (5)
Disagreement	0.543**	0.477***	-0.001	-0.001	-0.004**
	(2.144)	(3.969)	(-0.983)	(-0.174)	(-2.501)
High short * Low repurchase	-0.796***	-0.145*	0.002**	0.018***	0.005***
	(-4.389)	(-1.938)	(2.077)	(4.787)	(6.550)
Low short * High repurchase	0.414**	0.400***	-0.001	0.001	-0.004***
	(2.201)	(4.746)	(-1.384)	(0.154)	(-3.167)
F-tests with p-values:					
Disagreement -	1.339***	0.622***	-0.003**	-0.019***	-0.009***
High short * Low repurchase	[0.000]	[0.000]	[0.031]	[0.004]	[0.000]
Observations	114,416	129,134	65,229	129,560	129,560
Control variables	Yes	Yes	Yes	Yes	Yes
Number of firms	5,401	6,318	3,528	6,341	6,341
Adjusted R^2	0.0410	0.0144	0.0520	0.0331	0.00154

This table presents regressions of proxies for information, risk and acquisition activity on repurchase/short selling indicators and control variables. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. All control variables from Table 3 are included, but omitted for brevity. Firm and quarter fixed effects are included in all regressions, and errors are clustered at the firm level. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 7. Do Short Sellers Respond to Repurchase Disclosures?

	(1)	(2)	(3)	(4)	(5)	(6)
Δ Repurchase	-1.058***	-1.034***	-1.834**	-1.804**		
	(-2.765)	(-2.700)	(-2.565)	(-2.523)		
Earnings surprise		-0.002***		-0.002***		-0.002***
		(-4.439)		(-4.439)		(-4.442)
Δ Repurchase * Repurchase decrease			1.330	1.304		
			(1.340)	(1.314)		
Repurchase decrease			-0.005	-0.005		
			(-0.541)	(-0.574)		
Begin repurchase					-0.027**	-0.026**
					(-2.454)	(-2.353)
End repurchase					0.003	0.003
					(0.290)	(0.275)
Observations	130,379	130,324	130,379	130,324	130,379	130,324
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Number of firms	6,411	6,409	6,411	6,409	6,411	6,409
Adjusted R2	0.0384	0.0387	0.0384	0.0387	0.0384	0.0387
F-tests with p-values:						
Δ Repurchase + Interaction			-0.504	-0.500		
			[0.423]	[0.427]		

This table presents regressions of changes in short interest as a function of changes in repurchases. In Models (1)–(4), changes in repurchase are calculated as the quarterly change in repurchase, revealed at the earnings announcement. Changes in short interest are measured the month after the repurchase disclosure. *Earnings surprise* is the 3-day cumulative abnormal return around the earnings announcement when repurchases were disclosed, calculated using a market model. *Repurchase decrease* is an indicator variable equal to one if the change in repurchase is non-positive. In Models (5) and (6), changes in repurchase are captured by whether the firm began repurchasing, i.e., moved from the low to high repurchase group, or stopped repurchasing, i.e., moved from the high to low repurchase group, over the prior quarter. All control variables from Table 3 are included, but omitted for brevity. Firm and quarter fixed effects are included in all regressions, and errors are clustered at the firm level. *t*-statistics are presented in parentheses, *p*-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 8. Cross-sectional Heterogeneity in Managerial Self-Interest

	Size & B/M Adjusted Returns (1)	Size & Momentum Adjusted Returns (2)	DGTW Returns (3)
(1) Disagreement	0.756***	1.141***	0.739***
	(2.895)	(4.432)	(2.673)
(2) Activist * Disagreement	-2.331**	-2.295**	-2.951***
	(-2.298)	(-2.365)	(-2.664)
(3) High short * Low repurchase	-0.885***	-0.747***	-0.813***
	(-4.526)	(-3.864)	(-3.897)
(4) Activist * High short * Low repurchase	-0.403	-0.838	-0.723
	(-0.559)	(-1.168)	(-0.881)
(5) Low short * High repurchase	0.888***	0.984***	0.934***
	(4.003)	(4.489)	(3.914)
(6) Activist * Low short * High repurchase	-0.140	-0.159	0.320
	(-0.172)	(-0.197)	(0.259)
(7) Activist	-0.058	-0.056	0.175
	(-0.136)	(-0.132)	(0.375)
F-tests with p-values:			
(2) + (7)	-2.389**	-2.351***	-2.776***
	[0.013]	[0.010]	[0.006]
(1) + (2) +(7)	-1.633*	-1.210	-2.037**
	[0.080]	[0.169]	[0.037]
((1) + (2)) - ((3) + (4))	-0.287	0.431	-0.676
	[0.790]	[0.679]	[0.550]
Observations	129,314	127,174	110,680
Control variables	Yes	Yes	Yes
Number of firms	6,327	6,201	5,378
Adjusted R^2	0.0435	0.0405	0.0307

This table presents regression of next-quarter buy-and-hold abnormal returns on repurchase/short selling indicators, interacted with whether or not the firm has recently been targeted by an activist investor, and control variables. *Activist* is an indicator variable equal to one if the firm has been targeted by an activist investor (identified through 13-D filings) over the prior six months. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. The dependent variable in Model (1) (Models (2)) is buy-and-hold abnormal returns adjusted using Fama-French 25 portfolios matched on size and book-to-market (momentum). The dependent variable in Model (3) is buy-and-hold abnormal returns adjusted using DGTW portfolios matched on size, book-to-market, and momentum. All control variables from Table 3 are included, but omitted for brevity. Firm and quarter fixed effects are included in all regressions, and errors are clustered at the firm level. *t*-statistics are presented in parentheses, *p*-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 9. Trading Strategy

Days relative to repurchase disclosures:	+1 to -1 (1)	+2 to -2 (2)	+1 to 63 (3)	+1 to 252 (4)
Daily α	0.029***	0.021***	0.028***	0.026***
	(4.072)	(3.033)	(4.011)	(3.937)
Observations	2,610	2,608	2,609	2,609
Adjusted R^2	0.198	0.204	0.219	0.189

This table presents daily Fama-French 4-factor α's associated with an implementable trading strategy, which uses a long-short calendar time portfolio approach. Specifically, the portfolio is long stocks associated with disagreement between firms and short sellers, and short stocks with high short selling activity only. Fama-French 4-factor α's are daily abnormal returns calculated as follows:

$$R_{Disagreement,t} - R_{Highshort,t} = \alpha_p + \beta_1 (R_{mkt,t} - R_{f,t}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \epsilon_t$$

where $R_{Disagreement,t}$ is the return at day t on an equally weighted portfolio of disagreement stocks, and $R_{Highshort,t}$ is the return at day t on an equally weighted portfolio of firms in the high short selling group the prior quarter. $R_{f,t}$ and $R_{mkt,t}$ are the risk-free rate and the return on the market at day t, and SMB_t, HML_t, and MOM_t are the daily returns on the Fama-French size, book-to-market, and momentum factors in month t. We report the intercept term (α) of the regression, which represents the average daily excess return. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. In Models (1), (3), and (4) stocks enter the portfolio one day after the repurchase disclosure while in Model (2) stocks enter two days after the disclosure. In Model (1) (Model (2)) stocks remain in the portfolio until one day (two days) prior to the next disclosure. In Model (3) stocks remain in the portfolio for one quarter (63 trading days), and in Model (4) stocks remain for one year (252 trading days). t-statistics are presented in parentheses, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Appendix: Variable Definitions

In Table A1 we present summary statistics on our control variables. Apart from our measures of abnormal returns, we winsorize all variables at the 1$^{\text{st}}$ and 99$^{\text{th}}$ percentiles to mitigate the effect of outliers. All variables are measured at the end of the quarter prior to the repurchase/short selling classification quarter.

Our first set of control variables are from Compustat Quarterly. We measure *firm size* as the natural log of market capitalization. The mean (median) *firm size* is 6.2 (6.1) and *firm size* varies substantially from 3.6 at the 10$^{\text{th}}$ percentile to 8.9 at the 90$^{\text{th}}$ percentile. Larger, more mature firms are more likely to distribute cash to shareholders through a repurchase (Dittmar (2000)). Further, larger firms may be easier to short due to higher institutional ownership, though short sellers may prefer to short smaller firms, whose information asymmetry and thus potential for mispricing are generally greater.

Next, we calculate cash holdings, cash flow (operating and non-operating), and cash flow volatility from quarterly Compustat data. We expect cash-rich firms and firms with higher, more stable income levels to be more likely to repurchase. *Cash* is cash and short-term investments scaled by total assets; *operating income* is operating income before depreciation scaled by total assets; *non-operating income* is non-operating income scaled by total assets; and *operating income volatility* is the standard deviation of operating income scaled by total assets, calculated over the prior 12 quarters, conditional on at least 5 quarters of prior data. About 20% of the average firm's assets are cash, but cash holdings vary substantially from 1.2% at the 10$^{\text{th}}$ percentile to 55.5% at the 90$^{\text{th}}$ percentile. Operating and non-operating income comprise 1.2% and 0.1% of assets, respectively, on average, and also exhibit substantial variation: Operating (non-operating) income scaled by assets is -3.1% (-0.2%) at the 10$^{\text{th}}$ percentile but 6.1% (0.6%) at the 90$^{\text{th}}$ percentile.

A firm's revenue serves as an additional proxy for size and also factors into profitability and thus financial health. *Book-to-market*, total common equity dividend by market capitalization, may be related to short selling and repurchasing as it proxies for investment opportunities and/or relative valuation. For the median firm, book value equals approximately half of market value. Firms with few investment opportunities should be more likely to repurchase; *CAPEX*, capital expenditure scaled by total assets, captures investment. Capital expenditures equal 1.1% of assets

for the average firm in our sample. Finally, *leverage*, the sum of total long-term debt and debt in current liabilities, scaled by total assets, may affect the decision to repurchase as firms may use a repurchase to alter capital structure. Firms at the 10th percentile have no debt in their capital structure while firms at the 90th percentile have outstanding debt obligations equivalent to 48.3% of the value of total assets.

We also gather control variables from CRSP. Both repurchase and short selling activity relate to the recent performance of the firm. *Lagged returns* are the quarterly size and book-to-market adjusted buy-and-hold returns over the prior quarter, and *lagged returns (momentum)* are the quarterly size and momentum adjusted buy-and-hold returns over the prior quarter. Benchmark portfolios are Fama-French 25 portfolios matched on size and book-to-market or momentum or Daniel, Grinblatt, Titman, and Wermers (1997) abnormal returns matched on size, book-to-market and momentum. Quarterly abnormal returns hover around zero, as expected; average (median) abnormal returns are between 0.35% and 0.29% (1.34% and 1.56%). Abnormal returns vary substantially within our sample from approximately -24% at the 10th percentile to approximately 23% at the 90th percentile for both measures. Repurchases positively affect liquidity (Hillert, Maug, and Obernberger (2016)), and the liquidity of a stock may affect a short seller's ability or desire to trade. *Illiquidity* is Amihud (2002) illiquidity, measured as the average daily absolute return divided by total dollar trading volume over the prior fiscal year. We condition on the availability of at least 100 trading days of data. Illiquidity is highly skewed; the mean value is 0.275 while the median is only 0.001. Return volatility may affect the likelihood of mispricing, and thus the likelihood of firms and investors exploiting mispricing through repurchases or short selling. *Return volatility* is the standard deviation of daily stock returns over the quarter (63 trading days), conditional on having at least 30 trading days of data. General economic conditions affect repurchase behavior (Dittmar and Dittmar (2008)) and may influence short selling. We capture broad market conditions through *market return*, the quarterly return on the value-weighted CRSP index, equal to 2.5%, on average.

To gauge the impact of information released by the company in the near future, we examine returns around subsequent 8-K filings, which are publicly available through the Securities and Exchange Commission website, and earnings announcements (from Compustat). We calculate cumulative abnormal announcement returns (CARs) around 8-Ks using a market model estimated

over 250 trading days, ending 50 days prior to the 8-K filing, and conditioning on a minimum of 100 days of returns data. We use a standard 3-day event window beginning day -1 relative to the 8-K filing and ending day +1. We then sum these cumulative abnormal announcement returns over either three or six months, as noted, to create the variable *8-K sum*. If the company released no 8-Ks, we set this variables equal to zero. *8-K sum* is approximately 0.11% on average over three months, 0.24% over six months. Indicative of firms releasing similar quantities of good and bad news, the 10th percentile mirrors the 90th percentile: -12.2% versus 12.1% over three months and -18.4% versus 18.1% over six months. *Earnings surprise* is the 3-day cumulative abnormal return around the earnings announcement associated with the quarter of interest. We calculate *earnings surprise* using a market model estimated over 250 trading days, ending 46 days prior to the earnings announcement, and conditioning on a minimum of 100 days of returns data. We again use a standard 3-day event window. The average earnings surprise is only -5.3 bps, and earnings surprise varies from -9.2% at the 10th percentile to 8.9% at the 90th percentile.

Finally, we gather repurchase announcements from the Securities Data Corporation (SDC) and institutional ownership from Thomson Reuters Institutional (13f). Prior literature documents a peer effect associated with repurchases, especially within concentrated industries (Massa, Rehman, and Vermaelen (2007)). We thus use SDC repurchase announcement data to calculate *industry announcements*, the percentage of firms in same 2-digit SIC code that announced a repurchase during the same calendar quarter. Firms at the 10th percentile operate in industries with no repurchase announcements during the quarter while firms at the 90th percentile operate in industries with 4.2% of firms announcing repurchases. Further, Grinstein and Michaely (2005) document that institutional investors prefer firms that repurchase regularly, and Campello and Saffi (2015) note that institutional ownership significantly affects the supply of shares available to short. We estimate *institutional holdings* as the total shares owned by institutions, as a percentage of shares outstanding. Institutional holdings vary from 9.2% of shares outstanding at the 10th percentile to 95.4% at the 90th percentile.

Table A1. Summary Statistics

Variable	N	Mean	P10	P50	P90
Firm size	196,169	6.174	3.591	6.116	8.948
Cash	198,129	0.195	0.012	0.098	0.555
Operating income	182,107	0.012	-0.031	0.021	0.061
Non-operating income	196,151	0.001	-0.002	0.000	0.006
Operating income volatility	186,311	0.030	0.002	0.011	0.052
Book-to-market	195,814	0.631	0.139	0.511	1.250
CAPEX	188,867	0.011	0.000	0.005	0.028
Leverage	185,892	0.202	0.000	0.145	0.483
Lagged returns	183,853	0.204	-24.443	-1.564	23.457
Lagged returns (momentum)	180,732	0.286	-23.724	-1.342	23.148
Lagged returns (DGTW)	154,887	0.035	-23.675	-1.494	22.261
Illiquidity (*1,000)	194,902	0.275	0.000	0.001	0.272
Return volatility	195,152	3.045	1.241	2.504	5.418
Market return	195,363	2.507	-9.782	2.777	11.823
8-K sum (3 month)	147,210	1.176	-121.884	0.000	120.707
8-K sum (6 month)	147,377	2.352	-183.804	0.000	181.447
Earnings surprise	194,320	-0.053	-9.249	-0.157	8.936
Industry announcements	190,029	0.020	0.000	0.016	0.042
Institutional ownership	169,755	0.556	0.092	0.591	0.954

This table presents summary statistics on firm-level characteristics. *Firm size* is the natural log of market capitalization. *Cash* is cash and short-term investments, scaled by total assets. *Operating income* is operating income before depreciation, scaled by total assets. *Non-operating* income is non-operating income scaled by total assets. *Operating income volatility* is the standard deviation of operating income scaled by total assets, calculated over the prior 12 quarters, conditional on at least 5 quarters of prior data. *Book-to-market* is total common equity dividend by market capitalization. *CAPEX* is capital expenditure scaled by total assets. *Leverage* is the sum of total long-term debt and debt in current liabilities, scaled by total assets. *Lagged returns* are the quarterly size and book-to-market adjusted buy-and-hold returns over the prior quarter, and *lagged returns (momentum)* are the quarterly size and momentum adjusted buy-and-hold returns over the prior quarter. Benchmark portfolios are Fama-French 25 portfolios matched on size and book-to-market or momentum, as noted. *Lagged returns (DGTW)* are the quarterly buy-and-hold returns over the prior quarter adjusted for size, book-to-market, and momentum using matched DGTW portfolios. *Illiquidity* is Amihud (2002) illiquidity, measured as the average daily absolute return divided by total dollar trading volume over the prior fiscal year. We condition on the availability of at least 100 trading days of data. *Return volatility* is the standard deviation of daily stock returns over the quarter (63 trading days), conditional on having at least 30 trading days of data. *Market return* is the quarterly return on the value-weighted CRSP index. *8-K sum* is the sum of 3-day cumulative abnormal returns (CARs) around 8-K filings over three or six months, as noted, calculated using a market model. If the company released no 8-Ks, we set this variable equal to zero. *Earnings surprise* is the 3-day cumulative abnormal return around the earnings announcement associated with the quarter of interest, calculated using a market model. *Industry announcements* equals the percentage of firms in same 2-digit SIC code that announced a repurchase during the same calendar quarter. *Institutional ownership* is total shares owned by institutions, expressed as a percentage of shares outstanding. Apart from our measures of abnormal returns, we winsorize all variables at the 1st and 99th percentile to mitigate the effect of outliers.