What is revealed when firms repurchase against short selling?*

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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 contain positive, private information that dominates short sellers' information on average. Information channels include future earnings, changes in risk, and acquisition activity. Repurchases are not informative if an activist investor recently identified the management team as inefficient or if repurchases are dilution-motivated or conducted under a preset plan. 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 7.5%.

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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 high short interest periods (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. Firms execute repurchases 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 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 special cases 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 short interest increases meaningfully in the same quarter. We find that firms and short sellers

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disagree with one another significantly more frequently than expected based on the unconditional repurchasing and short selling probabilities. We then calculate abnormal returns immediately following disagreement. Next-quarter abnormal returns are positive and significant on average, consistent with the positive, private information 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 firm's information set dominates.

Our finding that the firm's information dominates is highly robust. It holds across multiple abnormal returns measures, after controlling for a host of firm characteristics related to repurchasing and short interest, in models including firm and time fixed effects, and whether we define disagreement using changes or levels in short interest.

Several alternative stories may be consistent with positive abnormal returns following disagreement. One explanation is we identify a subset of shorts that do not represent a directional bet against the firm. Perhaps these short positions are instead part of a larger hedging strategy. However, when we exclude short selling likely motivated by hedging, the relation between disagreement and subsequent returns is similar in magnitude and significance. Another interpretation is that firms repurchase against short selling to provide liquidity (as in Hillert, Maug, and Obernberger (2016)) and artificially inflate stock prices (as in Liu and Swanson (2016)). If repurchases are simply 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 months, 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 by regressing abnormal returns associated with these disclosures on repurchase and short selling indicators. Aggregate abnormal returns around 8-K announcements in the subsequent six months are 166 bps greater on average when firms disagree with short sellers than when short selling increases but firms do not repurchase and

59 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. 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 next examine whether the firm's informational advantage pertains to changes in risk or acquisition activity. The change in beta around the quarter of interest is lower on average when firms disagree with short sellers than when they do not. Additionally, we find disagreement firms are less likely to bid on a public target, generally considered bad news to investors, in the subsequent 12 months. These results suggest firms also incorporate private information related to 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? Our evidence indicates short sellers are uncertain of the size and timing of repurchase transactions due to lags in repurchase disclosures.[1] 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 firm's information set dominates short sellers', we do not claim that firms *always* repurchase based on an informational advantage. In fact, we identify several disagreement cases in which the firm's informational advantage is attenuated. The first case includes 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 in which the management team has been recently targeted for inefficiency. Disagreement also does not predict positive abnormal returns within firms experiencing substantial dilution or firms that recently announced preset repurchase plans. These results are consistent with repurchases counteracting dilution or conducted under a previously established contract with an investment bank being less informative.

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

[1]Information on repurchases is not publicly available until the earnings announcement 30 to 45 days after quarter end. Prior to 2007 information on short selling is publicly observable every month; after 2007 short interest is available every 15 days.

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 7.5 percentage points 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; 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).

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

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 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 repurchase 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

[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).

overpricing. Our evidence instead suggests disagreement among firms and short sellers is due to underpricing: Firms 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 about the information content of "disagreement" repurchases, along with two mutually exclusive hypotheses that assert a dominant information set and predict the effect of these repurchases on shareholder value.

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 disagree by repurchasing.

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

Managers are privy to private, value-relevant information about the firm's prospects. Therefore, managers' information set could 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 could have access to more accurate firm-specific information, short sellers could have superior information processing skills. For example, managers have private information on firm cash flows, but short sellers could 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 could 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* compare abnormal returns following disagreement to zero to ascertain whose information set prevails.

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. Our sample begins in 2004, when the SEC begins requiring firms to disclose the number of shares repurchased and average repurchase price per share in all quarterly (10-Q) and annual (10-K) filings. We multiply shares repurchased by average repurchase price to calculate total repurchase dollar value, which we scale by beginning-of-quarter market capitalization. Beginning in 2007 firms report short interest on the 15th business day and the last business day of each month, but prior to 2007 firms only report short interest on the 15th business day. For consistency across our sample period, we measure quarterly short interest on the 15th business day of the last month in the quarter. We then scale short interest by the number of shares outstanding on the same day. Because short sellers are unlikely to 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. After excluding financials and utilities (SIC codes 4800–4829, 4910–4949, and 6000–6999), we identify 150,123 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.[5] Of interest is the high repurchase/high short selling group, which we term the "disagreement" group because firms are actively buying stock while short sellers are actively selling it.

In our sample 26.2% 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 (15.5% versus 12.5%). This 3.0 percentage point (or 24%) difference in repurchase frequency is significant at the 1% level. The

[4] Our results are robust to including financial and utilities. See Appendix B.

[5] Our results are not sensitive to the choice of cutoff. Appendix B presents results with three alternative choices of high/low cutoffs: 0.25% and 0.75% of shares outstanding, as well as a cutoff based on annual repurchase and short selling percentiles.

disagreement group comprises 4.1% of all firm-quarters. Chi-square tests strongly reject the null hypothesis of independence of repurchases and changes in short interest, with the disagreement group contributing heavily to the Chi-squared statistic.

5 Do Firms Repurchase Based on Information?

We now examine whether managers repurchase based on information when faced with pressure from short sellers. 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 univariate results

We utilize four abnormal returns measures. Our first three measures are 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 3-month abnormal returns following high short selling (Panel A) and repurchases (Panel B). Panel A confirms that short sellers, on average, have accurate predictions about firm value: When short sellers increase their positions, firms significantly underperform during the next quarter. On average, high short selling firm-quarters underperform Fama-French size and book-to-market (size and momentum) matched portfolios by 29 bps (32 bps) and DGTW matched portfolios by 41 bps over the next quarter. Further, 4-factor calendar time portfolio estimates suggest monthly underperformance of over 30 bps, or 91 bps quarterly.

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 high short selling stocks are negative and statistically significant, with estimates ranging from -50 bps to -65 bps using the buy-and-hold approach and -124 bps (-41.4 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 71 bps and 103 bps for buy-and-hold abnormal returns and up to 113 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 130 and 238 bps greater following periods of high short selling if the firm simultaneously repurchases. Greater returns after disagreement among firms and short sellers is consistent with managers engaging short sellers based on positive, private information. Further, the positive abnormal returns following disagreement suggest that managerial information dominates short sellers' information on average. The evidence supports the *Informed Manager Hypothesis* and the *Dominant Manager Hypothesis*.

Panel B examines abnormal returns the quarter after high repurchases. Substantial repurchases are associated with positive and significant next-quarter abnormal returns ranging from 98 bps for size and book-to-market adjusted returns to 155 bps (51.5 bps/month x 3) using calendar time portfolios. Bifurcating high repurchase firm-quarters on short selling activity reveals that returns following high repurchase/high short selling "disagreement" quarters do not meaningfully differ from returns following other high repurchase periods. While the magnitude of returns following high repurchase/low short selling quarters is consistently greater than disagreement quarters, the difference is not statistically significant. In sum, when firms disagree with short sellers, ex post

returns more closely resemble returns generally associated with repurchases than short selling.

5.2 Abnormal returns regressions

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 regression setting, which allows us to explicitly control for observable time-varying firm characteristics and unobservable time-invariant firm characteristics with fixed effects. Our regression setting limits our analyses to the three buy-and-hold abnormal returns metrics. As shown in Table 2 the buy-and-hold returns measures represent more conservative estimates than calendar time portfolio returns, thereby reducing the likelihood of identifying abnormal performance or significant differences across groups of firms.

5.2.1 Baseline regressions. In Table 3 we regress next-quarter abnormal returns on indicator variables for repurchase/short selling classifications, with the low repurchase/low short selling group 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 industry, liquidity, market returns, return volatility, institutional ownership, and short interest level. These variables are further motivated and described in detail in Appendix A. 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. We also include firm and quarter fixed effects. 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 next-quarter Fama-French size and book-to-market adjusted returns, Fama-French size and momentum adjusted returns, and DGTW size, book-to-market and momentum adjusted returns.

Of interest is the high short selling/high repurchase "disagreement" coefficient as well as the difference in this coefficient and the high short selling/low repurchase coefficient. Focusing on

the first model, we see that the disagreement group earns quarterly abnormal returns 78 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 approximately two percentage points greater than if the firm chooses not to repurchase. 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 107 bps (83 bps) and the low repurchase/high short selling group by 226 bps (174 bps) over the next quarter when we adjust returns by size and momentum (DGTW portfolio returns). These results suggest that managers trade on positive information revealed (or at least partially revealed) over the next three months. The low short selling/high repurchase group also outperforms; its coefficients are not statistically different from disagreement coefficients. Overall, these results suggest that when both repurchases and short selling are elevated, abnormal returns more closely resemble the positive returns generally following other repurchases as opposed to the negative returns generally following short selling.[6]

We include control variables in all models but omit them for the sake of brevity. In untabulated results we observe that abnormal returns are positively related to operating income volatility, market returns, and firm return volatility, but negatively related to firm size and short interest level.

5.2.2 Robustness to short interest subsets and level. In this section we address two potential concerns. The first is that an increase in short interest of 0.5% (our cutoff) represents a smaller relative change for firms with high short interest levels. Hence, we verify that our results hold within the subsample of firms with high beginning short interest. Second, we confirm that our inferences are unchanged if we base our high/low short interest cutoffs on *levels* instead of *changes*.

Panel A of Table 4 shows next-quarter abnormal returns regressions for the subset of firms with beginning short interest greater than 5%. As before, repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are "low." Disagreement

[6]The results presented in Table 3 are robust to using alternative high/low cutoffs for repurchasing and short selling (0.25%, 0.75%, or a cutoff based on annual percentiles), to including financials and utilities, and to conditioning on firms with authorized share repurchase programs. See Appendix B.

coefficients imply a premium relative to the low short selling/low repurchase group ranging from 150 bps to 177 bps, depending on the abnormal returns measure. F-statistics also suggest a meaningful difference in abnormal returns after disagreement versus high short selling/low repurchases across all three returns measures. These results confirm our Table 3 results hold within firms already experiencing high short interest levels, for which a 0.5% increase in short interest represents a relatively smaller change. In fact, the coefficients associated with disagreement and the returns differential across the disagreement and high short selling/low repurchase groups are slightly greater within high short interest firms.

Our subsample analyses reveal another interesting finding: Low short selling/high repurchase coefficients increase in magnitude when we impose a cutoff for short interest levels. These results are 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.

Panel B of Table 4 uses the full sample but bases the high/low short selling classification on levels rather than changes; specifically, our high short interest cutoff is 5%. Using short interest levels in lieu of changes results in increases in disagreement coefficients and in the difference between the disagreement and high short selling/low repurchase coefficients. These results reinforce our finding that managers act on positive, private information when repurchasing during periods of heightened short selling. One difference worth noting is that, relative to our baseline regressions in Table 3, high short selling/low repurchases coefficients are lower and no longer significant. These results are consistent with short interest changes containing more information about subsequent returns than short interest levels, providing further justification for using changes throughout the rest of our study.

5.2.3 Robustness to excluding hedging-motivated short selling. Our results point to firms disagreeing with short sellers by repurchasing based on positive, private information, which dominants the information set of short sellers. But what if these short positions in fact hedge related long positions? If so, firms are not necessarily "disagreeing" with short sellers but rather trading on information while short sellers are not. To address this concern, we exclude two common cases in which short selling may represent a hedge rather than a directional bet against the firm.

First, because short equity positions hedge long convertible debt positions, we exclude firm-quarters with positive convertible debt. Second, during merger negotiations investors may engage in merger arbitrage, establishing a short position in the bidder and a long position in the target. We thus exclude firm-quarters in which SDC reports the firm being a bidder in a merger negotiation.

Table 5 reports next-quarter abnormal returns regressions, excluding hedging-motivated short selling. Excluding hedging-motivated short selling implies that the remaining short selling cases are likely information-based and thus associated with lower expected ex-post abnormal returns. Yet, when we exclude firms-quarters associated with convertible debt and mergers, returns after short selling are similar, even slightly higher, than those in baseline Table 3 models. Disagreement coefficients range from 89 bps to 126 bps, and the difference between returns following disagreement and high short selling but low repurchases hovers around two percentage points per quarter. These results suggest that the positive returns following disagreement are not driven by cases in which short sellers are hedging as opposed to betting against the firm.

5.2.4 Do managers temporarily fool the market by propping up stock prices in the short-run?. Firms actively disagreeing with short sellers by repurchasing experience positive and significant next-quarter returns that are greater than returns to other firms with increases in short interest. It is possible that 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 returns holds over time would give futher credence to an information story.

Table 6 presents fixed effects regressions analogous to those in Table 3; we simply modify the dependent variable to span a longer time window of 24 months. If managers are only temporarily propping up stock prices out of self-interest, we expect 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 170 and 272 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 with time to between 651 to 929 bps over 24 months. In summary, the results are consistent with disagreement firms trading on information, not temporarily misleading investors.

6 What Do Managers Know?

In the prior section we established that, on average, managers have positive information when they trade against short sellers by repurchasing company stock. In this section we examine the nature of this information. We begin with the relation between ex-post abnormal returns and future information releases in 8-K disclosures and earnings reports. We then more directly examine how the firm's decision to trade against short sellers relates to the direction and magnitude of future information released by the company, as well as the firm's risk profile and acquisition activity.

In Table 7 we augment our next-quarter abnormal returns regressions from Table 3 with information release proxies to determine the nature of the information that managers disagreeing 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. *8-K sum* captures the direction and magnitude of information in 8-K filings by summing the 3-day CARs around these information releases over the quarter matching our abnormal returns measurement quarter. We also add to our model *earnings surprise*, the 3-day CARs around the earnings announcement related to the classification quarter that occurs during the quarter in which we measure our dependent variable.

As expected *8-K sum* and *earnings surprise* coefficients are positive and significant. Moreover, if these corporate releases drive returns after disagreement, then we expect a decline in the disagreement coefficient when we include controls for the direction and magnitude of their information content. Indeed, the disagreement coefficient drops with the inclusion of *8-K sum* alone and falls even further and loses significance with the addition of *earnings surprise*. While coefficients on the high short/low repurchase and low short/high repurchase also move towards zero, including returns around subsequent information releases affects the disagreement group the most. However, the continued significance in the difference between disagreement and high short selling/low repurchase groups suggests that positive managerial information other than earnings and 8-K announcements is also revealed during the quarter after disagreement.

In Table 8 we more directly examine how the firm's decision to trade against short sellers relates to future information released by the company, as well as the firm's risk profile and acquisition

activity. We regress proxies for the direction and magnitude of information, changes in firm risk, and acquisition activity on high/low repurchase and short selling indicator variables. Again, 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 Table 3.

The first model of Table 8 examines the sum of 3-day cumulative abnormal returns around all 8-K reports filed within six months of our classification quarter. When firms disagree with short sellers by repurchasing, they release more positive information in the near future: The sum of CARs around 8-Ks over the next six months is greater by 59 bps. In contrast, when short interest increases but firms do not trade against short sellers, total CARs surrounding 8-Ks over the next six months is 107 bps lower. This economically meaningful 166 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 also 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.

Next, we model *earnings surprise*, 3-day earnings announcement CARs 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 earnings announcement CARs around 54 bps greater than firms with low short selling and low repurchases. Further, when firms disagree with short sellers, earnings surprises are 73 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, -107 bps for *8-K sum* versus -19 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.

Grullon and Michaely (2004) find that repurchasing firms experience reductions in risk relative to non-repurchasing firms. We examine changes in systematic risk or β. We estimate βs using a Fama-French 4-factor model of daily returns over the year prior to our classification quarter and the year after our classification quarter. We require at least 100 days of returns for each β calculation. The change in β is the difference in market βs between the pre and post periods. 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 and high short selling/low repurchase coefficient are statistically significant at the 1% level.

Finally, we examine acquisition announcement likelihood over the next year. We are specifically interested in the likelihood of acquiring 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 Schlingemann, 2014). Short selling firms are significantly more likely to announce acquisitions of public firms 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. But these effects are negated if the firm simultaneously repurchases. 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 while they are increasing their bets against the firms.

Table 9 examines short interest changes after quarterly repurchase disclosures. Firms first reveal repurchases in earnings announcements released after the quarter end. We regress next-month short interest changes (in percentage terms) on disclosed repurchase changes during the quarter. If short sellers are aware of repurchase activity before the announcement, then we would expect the

repurchase change coefficient 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. The first model in Table 9 presents our base model. The second model 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 10% level. These results are consistent with short sellers responding to a change in repurchases once it is revealed.

Next, we examine if increases versus decreases in repurchases primarily drive the negative relation between disclosed repurchase changes and short selling. Specifically, we augment our models with an indicator variable equal to one if repurchases decrease or remain constant and an interaction term between this indicator and repurchase change. The repurchase change coefficient, now representing the effect of repurchase increases, remains negative and significant and is greater in magnitude than before. 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.

In short, the evidence suggests that short sellers learn about repurchases in earnings announcements and adjust their trading based on publicly revealed repurchase changes. Specifically, when short sellers learn firms increased repurchases, they tend to reduce their positions. The short sellers' incomplete information about repurchases 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 Less Informative Repurchases

We have established that, on average, managers who decide to repurchase as short selling increases possess positive information about the firm revealed to the market in the near future. In this section, we recognize that the information content of repurchases likely varies. Here we reexamine quarterly buy-and-hold abnormal returns following the short selling/repurchase classification

quarter, using interactions between the classification and proxies for the information content of repurchases: activist investor presence, dilution, and preset repurchase plans.

First, we consider 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; Klein and Zur, 2009). Further, an activist may target firms with excess cash and pressure them to distribute cash to shareholders through a repurchase. We hypothesize that firms targeted by activists may be more prone to agency problems (either inefficient management, excess cash holdings, or both) and that their repurchases are less likely to be based on information.

Table 10 models abnormal returns as a function of short selling and repurchase activity, interacted with activist investor presence. The negative and significant sum of the activist and activist/disagreement interaction coefficients ((-2.833) + (-0.185) = -3.018) in the first model suggests that, if an activist targeted the firm over the prior six months, which we identify using 13-D filings, repurchases 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 next-quarter abnormal returns for disagreement firms are *negative* (-200 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 = -44 bps; p-value = 0.76). Results are similar using alternative abnormal returns measures. 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 negative returns in this subset of disagreement firms as being consistent with some managers—those previously identified by activists as being inefficient—repurchasing against short selling out of self-interest or at least not repurchasing based on private, positive information.

Finally, we examine two subsets of repurchase transactions unlikely based on private information: dilution-motivated repurchases and repurchases conducted under preset plans. Firms often conduct repurchases to offset dilution related to stock option exercise (Kahle, 2002). Because these

repurchases align with stock option exercises, they are less likely driven by a firm's private information regarding stock price and firm fundamentals. We identify firms with significant dilution by comparing the change in shares outstanding net of repurchases to two cutoffs; we categorize a firm-quarter as being associated with dilution if the quarterly percentage change in shares outstanding minus the percentage of shares repurchased is greater than 0.25% or 0.50%.

Panel A of Table 11 shows next-quarter abnormal returns regressions on dilution indicators interacted with short selling/repurchase groups. Coefficients on dilution interactions with both repurchasing groups (disagreement or low short selling/high repurchase) are negative and significant, consistent with dilution-motivated repurchases containing less information than other repurchases. The net effect of dilution-motivated repurchase on returns is close to zero; F-tests reveal that returns to dilution-motivated repurchases coupled with short selling are consistently negative but only marginally significant and dilution-motivated repurchases without short selling do not significantly differ from zero. Yet, among firms that experience dilution and increasing short interest, those that repurchase fair between 91 and 181 bps better in terms of next-quarter abnormal returns.

Next, we examine preset repurchases, which include accelerated repurchase plans (ASRs) and Rule 10b5-1 plans. Preset repurchase plans are contracts between the firm and an investment bank that allows the bank to buy back stock on the firm's behalf. While ASRs and Rule 10b5-1 plans differ in terms of speed, commitment level, and safe harbor and affirmative defense status, both have gained popularity in the recent past and both represent repurchase transactions established prior to the time of the actual repurchase (Bargeron, Kulchania, and Thomas, 2011; Bonaime, Harford, and Moore, 2017). Repurchases under preset plans are less likely to convey information because these plans are established in advance and represent a stronger commitment to repurchase announced amounts. In other words, these repurchases are likely to occur whether or not short interest changes. Thus, we hypothesize that repurchases under preset plans are less informative.

Panel B of Table 11 shows next-quarter abnormal returns regressions with short selling and repurchase indicators as well as interactions with a preset repurchase indicator. The preset repurchase indicator equals one if the firm announced an ASR or Rule 10b5-1 repurchase plan within the past 6 months.[7] Because firms with preset repurchase plans are almost fully contained within our "high" repurchase group, we only interact the preset repurchase indicator with the disagreement

[7]These data are available from Bonaime, Harford, and Moore (2017), who describe the hand-collection process.

indicator and the low short/high repurchase indicator. Abnormal returns following disagreement continue to be positive and significant if repurchases are not under preset plans; however, post-disagreement abnormal returns equal -29 bps (p-value = 0.827) if the repurchases are conducted under a preset plan. Further, returns following preset repurchases around short selling are not significantly different from returns following high short selling but low repurchases. These results are consistent with repurchases concurrent with short selling containing little information if they fall under a preset repurchase plan.

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 repurchase information once it becomes public. Specifically, we examine abnormal returns to an implementable trading strategy, which uses a long-short calendar time portfolio approach.

Table 12 presents daily abnormal returns on a portfolio that purchases stocks associated with disagreement and sells stocks with high short selling but low repurchases. 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 high short selling but low repurchase firms in the prior quarter. $R_{f,t}$ and $R_{mkt,t}$ are the risk-free rate and the market return 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 the first model 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 3.1 bps per day in excess return, or 7.8 percent annually. Results are similar in the second model, where stocks enter the portfolio two days after the repurchase disclosure 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 2.2 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) or one year (252 trading days), we obtain comparable results: Investors can earn 3.0 bps per day or 7.5 percent annually by adopting either of 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 disclosures. Short sellers can add value to their trading strategy by unraveling their bet against the firm when repurchases are disclosed. As Table 9 suggests, some short sellers already heed this advice. Further, other investors can learn from both parties and generate abnormal returns of approximately 7.5 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 possess positive, private information when the firm repurchases as short interest increases. When firms repurchase against short selling, next-quarter abnormal returns are between 130 bps and 238 bps higher than returns following other short selling. In fact, abnormal returns following disagreement are positive and significant on average. Further, we pinpoint the nature of the managers' information. 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 future acquisitions of public companies.

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 variation in abnormal returns to the disagreement group by segmenting on perceived managerial efficiency and repurchase information content. 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. Further, disagreement returns are approximately zero if repurchases are used to counter dilution or conducted under a preset plan with an investment bank. Our results are consistent with managers incorporating less private, positive information into repurchase decisions in these instances.

We conclude by quantifying the incremental value of repurchase disclosures to short sellers. We construct a long-short portfolio that purchases firms that disagree with short sellers by repurchasing stock and sells firms that did not repurchase during short selling. This portfolio earns positive and significant abnormal returns of 7.5 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 do not predict negative 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. 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	96,868	13,890	110,758
	% Total	64.5%	9.3%	73.8%
	% Row	87.5%	12.5%	100.0%
	χ^2 contribution	7.6	49.5	57.1
High	Frequency	33,270	6,095	39,365
	% Total	22.2%	4.1%	26.2%
	% Row	84.5%	15.5%	100.0%
	χ^2 contribution	21.40	139.40	160.80
All	Frequency	130,138	19,985	150,123
	% Total	86.7%	13.3%	100.0%
	χ^2 contribution	29	188.9	217.9
χ^2 p-value = 0.000				

This table presents joint frequencies of share repurchases and changes in short interest for our full sample of 150,123 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

Panel A: Abnormal Returns Following Short Selling

	All high short selling	Low repurchases	High repurchases	High - Low
Quarterly size and B/M adjusted	-0.285**	-0.495***	0.807***	1.302***
	(-2.29)	(-3.48)	(3.71)	(5.01)
Quarterly size and momentum adjusted	-0.316**	-0.576***	1.032***	1.609***
	(-2.57)	(-4.09)	(4.78)	(6.24)
Quarterly DGTW returns	-0.407***	-0.649***	0.707**	1.356***
	(-3.13)	(-4.29)	(3.20)	(5.06)
Monthly Fama-French 4-factor α	-0.303***	-0.414***	0.378***	0.793***
	(-2.706)	(-3.148)	(3.485)	(4.638)

Panel B: Abnormal Returns Following Repurchases

	All high repurchases	Low short selling	High short selling	High - Low
Quarterly size and B/M adjusted	0.984***	1.067***	0.807***	-0.254
	(7.68)	(6.75)	(3.71)	(-0.94)
Quarterly size and momentum adjusted	1.218***	1.299***	1.032***	-0.266
	(9.58)	(8.31)	(4.78)	(-1.00)
Quarterly DGTW returns	1.008***	1.140***	0.707**	-0.433
	(7.39)	(6.68)	(3.20)	(1.55)
Monthly Fama-French 4-factor α	0.515***	0.572***	0.378***	-0.194
	(6.041)	(6.115)	(3.485)	(-1.355)

This table presents abnormal returns during Quarter +1 for firms classified as having "high" changes in short interest (Panel A) or "high" repurchases (Panel B) 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

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	0.783**	1.071***	0.829***
	(2.196)	(3.330)	(2.779)
High short selling & Low repurchase	-1.212***	-1.193***	-0.911***
	(-3.535)	(-4.017)	(-3.149)
Low short selling & High repurchase	0.893***	0.967***	1.111***
	(3.266)	(3.823)	(3.703)
F-tests with p-values:			
Disagreement -	1.995***	2.264***	1.74***
High short selling & Low repurchase	[0.000]	[0.000]	[0.000]
Disagreement -	-0.11	0.104	-0.282
Low short selling & High repurchase	[0.771]	[0.775]	[0.413]
Controls	Firm size, Cash, Operating Income, Non-operating income, Book-to-market, Leverage, Lagged returns, CAPEX, Operating income volatility, Industry announcements, Illiquidity, Market return, Return volatility, Institutional ownership, Short interest level		
Observations	100,755	98,974	89,367
Adjusted R^2	0.0538	0.0486	0.0390

This table presents regressions of next-quarter buy-and-hold abnormal returns on repurchase/short selling classification indicators and control variables, listed above and 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, Fama-French 25 portfolios matched on size and momentum, or DGTW portfolios matched on size, book-to-market and momentum, as noted. Control variables and firm and quarter fixed effects are included in all regressions. Standard errors are double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 4. Short Interest Subsamples and Level

Panel A: High Short Interest Subset

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	1.504**	1.771***	1.597***
	(2.670)	(3.309)	(2.946)
High short selling & Low repurchase	-0.945**	-0.822*	-1.193**
	(-2.059)	(-1.978)	(-2.182)
Low short selling & High repurchase	1.732***	1.764***	2.215***
	(2.973)	(3.253)	(3.432)
F-tests with p-values:			
Disagreement -	2.449***	2.593***	2.79***
High short selling & Low repurchase	[0.000]	[0.000]	[0.000]
Disagreement -	-0.228	0.007	-0.618
Low short selling & High repurchase	[0.728]	[0.991]	[0.389]
Observations	32,554	31,848	28,617
Control variables	Yes	Yes	Yes
Adjusted R^2	0.0508	0.0454	0.0384

Panel B: Short Interest Level Classification

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	1.287***	1.634***	1.518***
	(3.424)	(4.016)	(3.864)
High short interest & Low repurchase	-0.650	-0.494	-0.371
	(-1.625)	(-1.395)	(-1.107)
Low short interest & High repurchase	0.781***	0.886***	0.966***
	(3.477)	(3.849)	(3.783)
F-tests with p-values:			
Disagreement -	1.937***	2.128***	1.889***
High short interest & Low repurchase	[0.000]	[0.000]	[0.000]
Disagreement -	0.506	0.748	0.552
Low short interest & High repurchase	[0.213]	[0.107]	[0.189]
Observations	100,755	98,974	86,003
Control variables	Yes	Yes	Yes
Adjusted R^2	0.0536	0.0483	0.0302

This table presents regressions of next-quarter abnormal returns on repurchase/short selling classification indicators and control variables. Panel A shows next-quarter buy-and-hold abnormal returns regressions for the subset of firms with short interest greater than 5%. 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%. 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 double clustered by firm and 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. Excluding Hedging-Motivated Short Selling

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	0.887**	1.255***	0.901***
	(2.433)	(2.893)	(2.859)
High short selling & Low repurchase	-1.171***	-1.121***	-0.906**
	(-3.617)	(-3.548)	(-2.620)
Low short selling & High repurchase	0.976***	1.053***	1.152***
	(3.645)	(3.898)	(3.431)
F-tests with p-values:			
Disagreement -	2.058***	2.376***	1.807***
High short selling & Low repurchase	[0.000]	[0.000]	[0.000]
Disagreement -	-0.089	0.202	-0.251
Low short selling & High repurchase	[0.827]	[0.676]	[0.508]
Observations	85,497	84,184	75,479
Control variables	Yes	Yes	Yes
Adjusted R^2	0.0543	0.0487	0.0351

This table presents regressions of next-quarter abnormal returns on repurchase/short selling classification indicators and control variables, excluding short selling cases likely motivated by hedging rather than information. Specifically, we exclude firm-quarters in which the firm is a bidder in a merger or acquisition or has convertible debt. 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. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 6. Do Managers Temporarily Prop Up Stock Prices?

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	2.516**	2.717**	1.696
	(2.178)	(2.223)	(1.239)
High short selling & Low repurchase	-6.667***	-6.572***	-4.815***
	(-5.156)	(-6.291)	(-4.078)
Low short selling & High repurchase	3.086**	2.486*	1.754
	(2.466)	(2.007)	(1.355)
F-tests with p-values:			
Disagreement -	9.183***	9.289***	6.511***
High short selling & Low repurchase	[0.000]	[0.000]	[0.000]
Disagreement -	-0.570	0.231	-0.058
Low short selling & High repurchase	[0.532]	[0.815]	[0.945]
Observations	100,774	98,998	89,383
Controls	Yes	Yes	Yes
Adjusted R^2	0.280	0.279	0.253

This table presents regressions of 24-month long-run abnormal returns on repurchase/short selling classification 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. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 7. Information Releases and Next-quarter Abnormal Returns

	Size & B/M adjusted returns		Size & momentum adjusted returns		DGTW returns	
Disagreement	0.448	0.197	0.708**	0.462	0.369	0.198
	(1.475)	(0.626)	(2.544)	(1.644)	(1.383)	(0.743)
High short selling & Low repurchase	-0.950***	-0.901***	-0.902***	-0.866***	-0.540**	-0.517*
	(-2.994)	(-2.764)	(-3.375)	(-3.311)	(-2.053)	(-1.903)
Low short selling & High repurchase	0.665**	0.451	0.712***	0.500**	0.842***	0.682**
	(2.564)	(1.665)	(2.934)	(2.045)	(2.894)	(2.326)
8-K CARs	0.708***	0.488***	0.696***	0.475***	0.767***	0.560***
	(16.917)	(10.492)	(17.338)	(10.628)	(11.538)	(6.814)
Earnings surprise		0.638***		0.638***		0.560***
		(18.519)		(17.065)		(9.318)
F-tests with p-values:						
Disagreement -	1.398***	1.098***	1.61***	1.328***	0.909**	0.715*
High short selling & Low repurchase	[0.004]	[0.020]	[0.000]	[0.001]	[0.030]	[0.082]
Disagreement -	-0.217	-0.254	-0.004	-0.038	-0.473	-0.484
Low short selling & High repurchase	[0.498]	[0.436]	[0.992]	[0.905]	[0.114]	[0.105]
Observations	88,798	88,681	88,626	88,507	79,450	79,353
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.196	0.237	0.189	0.231	0.151	0.172

This table presents regressions of next-quarter abnormal returns on repurchase/short selling classification indicators and control variables, with additional independent variables capturing returns around future information releases. *8-K CAR* is the sum of 3-day cumulative abnormal returns, calculated using a market model, around all 8-K filings over the next quarter. 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. 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. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 8. What Do Managers Know?

	8-K CARs	Earnings Surprise	$\Delta\ \beta$	Acquisition of Public Target
Disagreement	0.589*	0.543***	-0.002	-0.005***
	(1.955)	(4.006)	(-0.181)	(-2.981)
High short selling & Low repurchase	-1.074***	-0.190*	0.022***	0.005***
	(-4.398)	(-1.757)	(2.727)	(5.828)
Low short selling & High repurchase	0.393	0.505***	0.003	-0.003**
	(1.541)	(4.851)	(0.483)	(-2.330)
F-tests with p-values:				
Disagreement -	1.663***	0.733***	-0.024***	-0.01***
High short selling & Low repurchase	[0.000]	[0.000]	[0.031]	[0.000]
Disagreement -	0.196	0.038	-0.005	-0.002
Low short selling & High repurchase	[0.456]	[0.751]	[0.433]	[0.575]
Observations	88,974	100,600	100,964	100,964
Control variables	Yes	Yes	Yes	Yes
Adjusted R^2	0.102	0.0279	0.131	0.0277

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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 9. Do Short Sellers Respond to Repurchase Disclosures?

	Δ Short Interest			
Δ Repurchase	-0.927*	-0.893*	-1.747**	-1.709**
	(-1.958)	(-1.881)	(-2.335)	(-2.288)
Earnings surprise		-0.002***		-0.002***
		(-2.900)		(-2.906)
Δ Repurchase * Repurchase decrease			1.173	1.140
			(0.929)	(0.904)
Repurchase decrease			-0.010	-0.011
			(-0.871)	(-0.921)
Observations	101,434	101,380	101,434	101,380
Control variables	Yes	Yes	Yes	Yes
Adjusted R^2	0.0369	0.0373	0.0369	0.0373
F-tests with p-values:				
Δ Repurchase + Interaction			-0.574	-0.569
			[0.564]	[0.568]

This table presents regressions of changes in short interest as a function of changes in repurchases. Δ *Repurchase* is quarterly change in repurchase, revealed at the earnings announcement. Δ *Short Interest* is the change in short interest 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. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 10. Disagreement and Managerial Inefficiency

	Size & B/M adjusted returns	Size & Momentum adjusted returns	DGTW returns
(1) Disagreement	1.019***	1.056***	1.296***
	(3.126)	(3.756)	(4.255)
(2) Activist & Disagreement	-2.833**	-3.278**	-2.702**
	(-2.185)	(-2.291)	(-2.051)
(3) High short selling & Low repurchase	-1.194***	-1.115***	-1.130***
	(-3.758)	(-3.576)	(-3.989)
(4) Activist & High short selling & Low repurchase	-0.176	-0.416	-0.611
	(-0.205)	(-0.480)	(-0.710)
(5) Low short selling & High repurchase	0.923***	1.043***	0.986***
	(3.277)	(3.412)	(3.556)
(6) Activist & Low short selling & High repurchase	-0.258	0.330	-0.137
	(-0.271)	(0.213)	(-0.143)
(7) Activist	-0.185	0.031	-0.157
	(-0.409)	(0.065)	(-0.316)
F-tests with p-values:			
(2) + (7)	-3.018***	-3.247***	-2.859***
	[0.006]	[0.008]	[0.013]
(1) + (2) +(7)	-1.999*	-2.191*	-1.563
	[0.087]	[0.074]	[0.188]
((1) + (2)) - ((3) + (4))	-0.444	-0.691	0.335
	[0.756]	[0.613]	[0.812]
Observations	100,755	86,003	98,974
Control variables	Yes	Yes	Yes
Adjusted R^2	0.0538	0.0304	0.0486

This table presents regressions 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. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 11. Disagreement and Repurchase Information Content

Panel A: Dilution-motivated repurchases

	Size & B/M adjusted returns		Size & Momentum adjusted returns		DGTW returns	
Dilution cutoff:	0.25%	0.50%	0.25%	0.50%	0.25%	0.50%
(1) Disagreement	1.446**	1.416***	1.882***	1.704***	1.571**	1.460***
	(2.156)	(3.032)	(3.094)	(3.931)	(2.575)	(3.377)
(2) Dilution & Disagreement	-1.215	-1.555**	-1.522**	-1.537**	-1.484*	-1.773***
	(-1.586)	(-2.397)	(-2.150)	(-2.395)	(-1.958)	(-2.850)
(3) High short selling & Low repurchase	-1.042**	-1.009**	-0.880**	-0.930***	-1.109***	-1.106***
	(-2.333)	(-2.384)	(-2.485)	(-2.883)	(-2.806)	(-2.970)
(4) Dilution & High short selling	-0.297	-0.536	-0.574	-0.698	-0.066	-0.118
& Low repurchase	(-0.630)	(-0.931)	(-1.376)	(-1.407)	(-0.154)	(-0.208)
(5) Low short selling & High repurchase	1.026***	1.127***	1.264***	1.252***	1.246***	1.343***
	(2.928)	(3.643)	(3.746)	(4.378)	(3.212)	(4.258)
(6) Dilution & Low short selling	-0.142	-0.370	-0.417	-0.428	-0.266	-0.568
& High repurchase	(-0.357)	(-0.874)	(-1.017)	(-1.087)	(-0.570)	(-1.170)
(7) Dilution	-0.803**	-0.847**	-1.031***	-1.159***	-0.589	-0.601
	(-2.456)	(-2.515)	(-3.272)	(-3.744)	(-1.507)	(-1.418)
F-tests with p-values:						
(1) + (2) +(7)	-0.572	-0.986*	-0.671*	-0.992*	-0.502	-0.914*
	[0.149]	[0.051]	[0.010]	[0.053]	[0.219]	[0.074]
(5) + (6) + (7)	0.081	-0.090	-0.184	-0.335	0.391	0.174
	[0.825]	[0.832]	[0.571]	[0.358]	[0.324]	[0.685]
((1) + (2)) - ((3) + (4))	1.57***	1.406**	1.814***	1.795**	1.262***	0.911
	[0.003]	[0.041]	[0.001]	[0.011]	[0.007]	[0.137]
Observations	100,581	100,581	98,802	98,802	85,959	85,959
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.0541	0.0542	0.0490	0.0491	0.0305	0.0305

Panel B: Preset repurchases

	Size & B/M adjusted returns	Size & Momentum adjusted returns	DGTW returns
(1) Disagreement	0.809**	1.109***	0.814**
	(2.145)	(3.318)	(2.478)
(2) Preset repurchase & Disagreement	-1.103	-1.602	-1.099
	(-0.719)	(-1.183)	(-0.776)
(3) Low short selling & High repurchase	0.896***	0.975***	1.079***
	(3.216)	(3.798)	(3.590)
(4) Preset repurchase & Low short selling & High repurchase	-0.224	-0.608	-0.835
	(-0.165)	(-0.497)	(-0.635)
(5) High short selling & Low repurchase	-1.211***	-1.192***	-1.155***
	(-3.535)	(-4.016)	(-3.666)
F-tests with p-values:			
(1) + (2)	-0.294	-0.493	-0.285
	[0.827]	[0.693]	[0.823]
((1) + (2)) - (5)	0.917	0.699	0.870
	[0.496]	[0.573]	[0.489]
(3) + (4)	0.672	0.367	0.244
	[0.609]	[0.759]	[0.853]
Observations	100,755	98,974	86,003
Control variables	Yes	Yes	Yes
Adjusted R^2	0.0538	0.0485	0.0304

This table presents regressions of next-quarter buy-and-hold abnormal returns on repurchase/short selling indicators, interacted with repurchase information content indicators, and control variables. *Dilution* is an indicator variable equal to one if the change in shares outstanding without a repurchase would have exceeded 0.25% or 0.50%, as noted. *Preset repurchase* is an indicator variable equal to one if the firm announced an accelerated share repurchase plan or Rule 10b5-1 share repurchase plan within the past 6 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. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table 12. Trading Strategy

Time relative to repurchase disclosures:	+1 to -1	+2 to -2	+1 to 63	+1 to 252
Daily α	0.031***	0.022***	0.030***	0.030***
	(4.251)	(3.119)	(4.209)	(4.379)
Observations	2,610	2,608	2,609	2,609
Adjusted R^2	0.260	0.266	0.273	0.260

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. Stocks enter the portfolio one or two days after the repurchase disclosure and remain in the portfolio until one or two days prior to the next disclosure, for one quarter (63 trading days), or for one year (252 trading days), as noted. t-statistics are presented in parentheses, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Appendix A: 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 1st and 99th 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 10th percentile to 8.9 at the 90th percentile. Larger, more mature firms are more likely to distribute cash to shareholders through a repurchase (Dittmar, 2000). Further, larger firms could be easier to short due to higher institutional ownership, though short sellers could 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 10th percentile to 55.5% at the 90th 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 10th percentile but 6.1% (0.6%) at the 90th 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, could 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, could affect the decision to repurchase as firms could use a repurchase to alter capital structure. Firms at the 10^{th} percentile have no debt in their capital structure while firms at the 90^{th} 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 10^{th} percentile to approximately 23% at the 90^{th} percentile for both measures. Repurchases positively affect liquidity (Hillert, Maug, and Obernberger, 2016), and the liquidity of a stock could 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 could 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 could 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 10^{th} percentile mirrors the 90^{th} 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 10^{th} percentile to 8.9% at the 90^{th} 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 10^{th} percentile operate in industries with no repurchase announcements during the quarter while firms at the 90^{th} 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 10^{th} percentile to 95.4% at the 90^{th} percentile.

Table A1. Summary Statistics

Variable	N	Mean	P10	P50	P90
Firm size	148,244	6.148	3.557	6.098	8.886
Cash	149,915	0.228	0.013	0.135	0.611
Operating income	141,313	0.011	-0.050	0.026	0.063
Non-operating income	149,444	0.002	-0.002	0.001	0.007
Operating income volatility	144,500	0.035	0.004	0.014	0.059
Book-to-market	147,974	0.567	0.120	0.451	1.146
CAPEX	143,813	0.013	0.001	0.007	0.032
Leverage	144,889	0.197	0.000	0.142	0.477
Lagged returns	138,672	0.550	-25.851	-1.635	25.744
Lagged returns (momentum)	136,171	0.616	-25.255	-1.391	25.478
Lagged returns (DGTW)	126,291	0.514	-24.908	-1.359	24.746
Illiquidity (*1,000)	147,413	0.000	0.000	0.000	0.000
Return volatility	147,613	0.032	0.014	0.027	0.056
Market return	147,794	0.025	-0.098	0.028	0.118
8-K sum	109,474	0.227	-20.368	0.000	20.002
Earnings surprise	146,784	-0.094	-10.310	-0.231	9.905
Industry announcements	141,667	0.019	0.000	0.015	0.042
Institutional ownership	128,445	0.582	0.103	0.636	0.963

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.

Appendix B: Robustness

Appendix B verifies the robustness of our Table 3 abnormal returns regressions.

- Our original high/low cutoff for repurchasing and short selling groups is 0.5% of shares outstanding. Table B1 shows results using cutoffs of 0.25% in Panel A and 0.75% in Panel B. Panel C uses cutoffs based on annual percentiles, which line up approximately to the observed statistics in Table 1. Specifically, "high" repurchases correspond to firm-quarters in the top decile of repurchases that year, and "high" short selling implies increases in short interest in the top quintile.
- Following much of the prior literature, we exclude financial firms and utilities because these industries are highly regulated. In Table B2 we leave these companies in the sample.
- Some companies experiencing increases in short interest may not repurchase because they do not have an authorized repurchase plan. In Table B3 we limit our sample to firms with at least one repurchase authorization reported in the Securities Data Corporation database within the past four years.

Our results are robust to using alternative cutoffs, including financials and utilities, and conditioning on firms with authorized repurchase programs.

Table B1. Alternative Cutoffs

Panel A: 0.25% Cutoff

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	0.589**	0.813***	0.776***
	(2.109)	(3.209)	(3.620)
High short * Low repurchase	-1.186***	-1.171***	-0.774**
	(-3.565)	(-4.080)	(-2.674)
Low short * High repurchase	0.902***	0.890***	1.035***
	(2.935)	(3.062)	(3.083)
F-tests with p-values:			
Disagreement -	1.775***	1.984***	1.55***
High short * Low repurchase	[0.000]	[0.000]	[0.000]
Disagreement -	-0.313	-0.077	-0.259
Low short * High repurchase	[0.34]	[0.814]	[0.443]
Observations	100,755	98,974	89,367
Controls	Yes	Yes	Yes
Adjusted R^2	0.0539	0.0486	0.0390

Panel B: 0.75% Cutoff

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	0.741*	0.975**	0.603
	(1.720)	(2.374)	(1.607)
High short * Low repurchase	-1.341***	-1.302***	-1.210***
	(-3.894)	(-4.327)	(-4.112)
Low short * High repurchase	0.900***	0.964***	1.117***
	(3.212)	(4.113)	(3.822)
F-tests with p-values:			
Disagreement -	2.082***	2.277***	1.813***
High short * Low repurchase	[0.001]	[0.000]	[0.002]
Disagreement -	-0.159	0.011	-0.514
Low short * High repurchase	[0.717]	[0.979]	[0.225]
Observations	100,755	98,974	89,367
Controls	Yes	Yes	Yes
Adjusted R^2	0.0538	0.0485	0.0391

Panel C: Annual Percentile Cutoffs

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	0.783*	1.179***	0.712*
	(1.859)	(2.910)	(1.835)
High short * Low repurchase	-1.429***	-1.395***	-1.232***
	(-4.105)	(-4.693)	(-4.073)
Low short * High repurchase	0.682**	0.859***	0.846**
	(2.344)	(3.428)	(2.690)
F-tests with p-values:			
Disagreement -	2.212***	2.574***	1.944***
High short * Low repurchase	[0.001]	[0.000]	[0.002]
Disagreement -	0.101	0.32	-0.134
Low short * High repurchase	[0.828]	[0.498]	[0.788]
Observations	100,755	98,974	89,367
Controls	Yes	Yes	Yes
Adjusted R^2	0.0538	0.0486	0.0391

This table presents regressions of next-quarter abnormal returns on repurchase/short selling classification indicators and control variables, using alternative cutoffs for "high" and "low" repurchase and short selling classifications. In Panel A (Panel B) repurchases and changes in short interest are labeled "high" if they exceed 0.25% (0.75%) of shares outstanding; otherwise, they are considered "low." In Panel C "high" repurchases denotes repurchase levels in the top annual decile; "high" short selling indicates changes in short interest in the top annual quintile. Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table B2. Including Financials and Utilities

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	0.570*	0.958***	0.507*
	(2.006)	(3.719)	(1.997)
High short * Low repurchase	-0.923***	-0.826**	-0.880***
	(-2.711)	(-2.671)	(-2.883)
Low short * High repurchase	0.872***	0.965***	0.956***
	(3.617)	(3.993)	(3.423)
F-tests with p-values:			
Disagreement -	1.493***	1.784***	1.387***
High short * Low repurchase	[0.000]	[0.000]	[0.000]
Disagreement -	-0.302	-0.007	-0.449
Low short * High repurchase	[0.321]	[0.98]	[0.127]
Observations	129,025	126,851	110,510
Controls	Yes	Yes	Yes
Adjusted R2	0.0502	0.0454	0.0280

This table presents regressions of next-quarter abnormal returns on repurchase/short selling classification indicators and control variables, including financials and utilities (SIC codes 4800–4829, 4910–4949, and 6000–6999). 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. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.

Table B3. Open Market Repurchase Announcers

	Size & B/M adjusted returns	Size & momentum adjusted returns	DGTW returns
Disagreement	1.211***	1.587***	1.076**
	(2.780)	(3.869)	(2.455)
High short * Low repurchase	-1.606***	-1.456***	-1.543***
	(-3.881)	(-3.884)	(-3.370)
Low short * High repurchase	0.845***	1.027***	1.044***
	(2.964)	(3.867)	(2.982)
F-tests with p-values:			
Disagreement -	2.817***	3.043***	2.619***
High short * Low repurchase	[0.000]	[0.000]	[0.000]
Disagreement -	0.366	0.56	0.032
Low short * High repurchase	[0.355]	[0.137]	[0.941]
Observations	33,603	33,003	31,755
Controls	Yes	Yes	Yes
Adjusted R^2	0.0587	0.0483	0.0625

This table presents regressions of next-quarter abnormal returns on repurchase/short selling classification indicators and control variables, for the subset of firms with at least one open market repurchase announcement reported in SDC during the prior four years. 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. 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 double clustered by firm and quarter. t-statistics are presented in parentheses, p-values in brackets, and *, **, and *** denote significance at the 10%, 5% and 1% levels, respectively.