JOURNAL OF FINANCIAL AND QUANTITATIVE ANALYSIS Vol. 55, No. 8, Dec. 2020, pp. 2431–2465

doi:10.1017/S0022109019000851

Why Do Firms Disagree with Short Sellers? Managerial Myopia versus Private Information

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Abstract

Though short sellers on average succeed at identifying overvalued equity, firms often signal disagreement with short sellers by repurchasing stock when short interest increases. We investigate whether this disagreement reflects a myopic defense of inflated prices, or positive private information. These repurchases appear motivated by managers' private information, not agency issues, even when managerial benefits to short-termism are enhanced or monitoring is weaker. Managers' informational advantage relates to subsequent news, earnings, and risk, but is attenuated if activists target management or insiders sell. A trading strategy based on our findings earns 7.5% annually.

I. Introduction

Do managers sacrifice long-term shareholder value to support stock prices in the short-term? Theory predicts stock-based incentives can induce managerial myopia (Stein (1988), (1989)), and surveyed managers admit to myopic behavior such as forfeiting positive net present value projects to avoid delivering disappointing earnings or cutting dividends (Graham, Harvey, and Rajgopal (2005), Brav, Graham, Harvey, and Michaely (2005)). Recent empirical studies corroborate these theoretical predictions and survey responses by showing firms reduce investments and strategically release good news when stock-based compensation incentives heighten managerial interest in stock price (Edmans, Fang, and Lewellen (2017), Edmans, Goncalves-Pinto, Groen-Xu, and Wang (2018)).

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Share repurchases represent a potential mechanism to temporarily support stock prices at shareholders' expense. Consistent with managers using repurchases to prop up prices for personal gain, Edmans, Fang, and Huang (2018) and Moore (2018) show repurchases increase around chief executive officer (CEO) equity vesting dates. Another growing literature suggests managers use repurchases to meet earnings per share (EPS) thresholds linked to CEO bonuses and analysts' estimates and these types of repurchases are associated with declines in employment and investment (Cheng, Harford, and Zhang (2015), Almeida, Fos, and Kronlund (2016)). Numerous press articles and political statements also highlight the dangers of managerial short-termism in repurchase transactions.[1]

This paper directly tests for managerial short-termism in repurchases by investigating a subset of firms in which the incentives for myopic behavior are magnified: firms actively under attack from short sellers. The extant literature overwhelmingly paints short sellers as informed, sophisticated investors.[2] Firms go to great lengths, including criminal accusations, legal threats, and deliberate technical disturbances, to deter short sellers from betting against their stock and can successfully create short sale constraints, which contribute to overpricing (Lamont (2012)). Hence, in expectation, firms with increasing short interest are more likely to be overvalued. The overvaluation signal and the price pressure from short selling place downward pressure on share price. The prevalence of repurchases makes them a convenient, surreptitious tool for managers to defend overvalued stock.

Alternatively, inside information may motivate repurchasing against short sellers. Managers possess private, value-relevant information by nature of their positions within the firm and may act in long-term shareholders' interest by repurchasing undervalued stock. When confronted with increasing pressure from short sellers, do managers tend to behave myopically, or in the interest of shareholders? The answer to this question has implications for executive compensation, financial market regulation, and investment strategies.

We investigate two alternative hypotheses explaining why firms trade against short sellers. The *Managerial Short-Termism Hypothesis* posits myopic managers repurchase overvalued stock against short-selling pressure. By repurchasing overvalued stock, managers temporarily defend an inflated stock price and mechanically increase EPS. Cross-sectionally, this myopic behavior may intensify when it allows management to achieve higher bonuses, realize greater returns from stock sales and option exercises, or when governance is poor. The price pressure from significant short selling exacerbates these career and compensation concerns.

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

[2]For example, Diamond and Verrechia (1987), Senchack and Starks (1993), Asquith and Meulbroek (1995), Dechow, Hutton, Meulbroek, and Sloan (2001), Desai, Ramesh, Thiagarajan, and Balachandran (2002), Boehmer, Huszar, and Jordan (2010), Drake, Rees, and Swanson (2011), and Ben-David, Drake, and Roulstone (2015).

On the other hand, the *Private Information Hypothesis* posits managers repurchase against short selling because they possess positive private information. In a semi-strong efficient market, managers are privy to information not yet impounded in stock prices. Suppose this information is good news of which short sellers are unaware. If short sellers increase their positions, they place downward pressure on price, which in turn increases the probability of undervaluation based on the managers' information set. If managers respond to undervaluation by repurchasing stock, short-selling pressure can increase the likelihood of information-based repurchases.

To disentangle these hypotheses, we focus on the subset of stocks short sellers have identified as overvalued. We define "disagreement" as cases in which the firm engages in nontrivial repurchases while short interest increases meaningfully. We find that firms and short sellers disagree with one another significantly more frequently than expected based on unconditional repurchasing and short-selling probabilities. In fact, after controlling for observable firm characteristics related to repurchasing and short selling as well as unobservables through firm and time fixed effects, we find that, when short interest increases, repurchase likelihood increases by 2 percentage points. This is an economically meaningful increase given the 13.3% unconditional mean likelihood.

We identify the implied motive for disagreement by computing ex post abnormal stock returns. Our approach assumes that abnormal returns reflect the private information of short sellers and managers when it is subsequently revealed. Abnormal returns following disagreement are positive and significant on average, consistent with the positive private information in repurchases outweighing short sellers' negative information and any agency costs associated with repurchases. In fact, disagreement generally carries significantly more positive information than repurchasing and short selling independently. This positive interactive effect is inconsistent with managers using repurchases to artificially inflate stock prices. Instead, it suggests managers possess *particularly good* information about future firm performance when they repurchase against short selling. These findings are highly robust. They hold across multiple abnormal return measures, after controlling for a host of firm characteristics related to repurchasing and short selling, in models including firm and time fixed effects, and whether we define disagreement using short interest changes or levels.

Several alternative stories may be consistent with positive abnormal returns following disagreement. For example, not all short positions represent a directional bet against the firm. Some are instead part of a larger hedging strategy. However, when we exclude short selling likely motivated by hedging, post-disagreement abnormal returns are similar in magnitude and significance. Another possibility is that firms repurchase against short selling to provide liquidity (as in Hillert, Maug, and Obernberger (2016)) and support 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, we find no evidence of reversals in abnormal returns over the next 2 years.

We next investigate managerial information channels. We begin by considering future material information releases through 8-K corporate disclosures and earnings reports. Abnormal returns around information releases following

short-selling quarters are significantly higher when firms disagree. We then examine whether the firm's informational advantage pertains to changes in risk and find that market βs increase on average after short selling, unless the firm repurchases. These results suggest the informational advantage of firms over short sellers relates to private information subsequently released through 8-K filings and earnings reports and to imminent changes in risk.

While we primarily focus on informed trading by short sellers and firms, other informed traders also compete in the market. To understand the extent to which the firm's information dominates that of other informed traders, we incorporate 3 additional prominent informed traders into our analyses: insiders, analysts, and activist investors. Disagreement continues to be associated with positive abnormal returns after analyst downgrades but does not consistently predict positive returns when top insiders sell abnormal amounts of stock. We also show that the firm's informational advantage is attenuated if activists recently targeted the firm. These results are consistent with the firm's information set dominating unless insiders' trades contradict the firm's positive repurchase signal or activists attack management.

We next isolate scenarios in which managerial short-termism is especially likely to drive repurchases against short selling. We focus on repurchases that could be used to manipulate CEO compensation or meet quarterly earnings forecasts, and on firms with poor corporate governance. If short-termism drives disagreement, we expect lower ex post abnormal returns. Yet, abnormal returns are not significantly lower in these cases. These findings provide additional support for private information, not managerial short-termism, motivating repurchases around short selling.

To quantify the incremental value of the information in repurchase disclosures not immediately impounded in stock price, we construct an implementable long–short portfolio. The portfolio purchases firms that repurchased stock while short interest was increasing and sells firms that did not repurchase during short selling. We find short sellers stand to gain an extra 7.5 percentage points annually by reallocating their short positions away from firms that disclose significant repurchases.

Our results overall point to the firm's informational advantage over short sellers. Why then do short sellers actively trade against firms if they lose on average? Our evidence indicates short sellers are uncertain of the size and timing of repurchase transactions due to lags in repurchase disclosures. Firms disclose repurchases in quarterly filings released up to 30 or 45 days after quarter end. When firms disclose increased repurchases, short sellers tend to reduce their positions. This finding suggests the observed positive relation between short selling and repurchases does not result from repurchases causing increases in short selling. Instead, repurchases result in *decreases*. We also investigate if repurchases are related to short-selling disclosures, which occur on a monthly (2004–2007) or bi-weekly (2007–2014) basis, generally with a 10-trading-day lag. We show they are, but in the opposite direction: Short interest increases generally predict repurchase increases.

Although testing causality is beyond the scope of this paper, taken together, our results are consistent with the observed positive relation between short selling

and repurchases resulting from short selling causing repurchases as in Campello, Matta, and Saffi (2018), and not vice versa. While managers can observe and respond relatively quickly to short selling, short sellers cannot react to repurchases in a timely fashion due to reporting lags. Moreover, when firms disclose increases in repurchases, short sellers react *negatively*. Finally, short sellers have no motive to deliberately disagree with firms because abnormal returns following disagreement are positive on average.[3]

This paper makes several contributions. We contribute to the managerial myopia and repurchase literatures by finding that private information, not managerial short-termism, drives repurchases, even when managerial incentives are heightened by short-selling pressure and exacerbated by managerial incentives, a desire to meet earnings forecasts, or weak corporate governance. We also identify the channels through which managers incorporate private information into their repurchase decisions. We contribute to the short-selling literature by identifying a case in which short sellers' information is dominated by that of another informed party: the firm itself. Our findings are surprising in that short sellers being informed investors whose trades predict negative future returns is "one of the most robust findings of the literature" (Reed (2013)). Finally, we introduce firms themselves into the literature on disagreement among informed investors and show the firm's information generally dominates. We frame these contributions within the context of the existing literature in Section II.

II. Literature Review

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. Both repurchasing and short-selling activity have increased sharply in the past few decades (Boehmer, Jones, and Zhang (2008), Boehmer and Wu (2013), and Farre-Mensa, Michaely, and Schmalz (2014)). Given the frequency of repurchasing and short selling, firms and short sellers will naturally trade against one another on occasion. However, firm/short seller disagreement occurs more than unconditional probabilities predict. We use this relatively common intersection of repurchases and short selling as a new laboratory in which to untangle whether managerial myopia or positive private information drive repurchases. Examining this intersection contributes to the literatures on share repurchases, managerial myopia, short selling, and disagreement among informed parties. Below we briefly review each branch of research, then outline our contribution.

A. Share Repurchase Literature

Managers are privy to nonpublic information, which they often reveal through share repurchases. Repurchase *announcements* are associated with positive and significant returns immediately and up to 4 years into the future.[4]

[3]We also implement tests using Regulation SHO, which relaxed short-selling constraints for a random sample of Russell 3000 firms. As we describe in more detail in Section X.C, in our first stage model, the change in the magnitude of short selling and frequency of high short-selling quarters for the treated sample is not significantly different than for the control sample.

[4]For example, Vermaelen (1981), Comment and Jarrell (1991), Chan, Ikenberry, and Lee (2004), Ikenberry, Lakonishok, and Vermaelen (1995), Bargeron, Bonaime, and Thomas (2017), and Manconi, Peyer, and Vermaelen (2019).

Managers frequently mention undervaluation when initiating a repurchase program, sometimes describing it as a "good investment" or the "best use of cash" (Peyer and Vermaelen (2009), Bonaime (2012)). In sum, academics commonly accept undervaluation as a share repurchase motive.

A recent literature suggests a more nefarious motive for some stock repurchases: to meet earnings per share thresholds (Hribar, Jenkins, and Johnson (2006)) and boost compensation (Cheng et al. (2015), Farrell, Unlu, and Yu (2014)). Almeida et al. (2016) show repurchases motivated by earnings manipulation are associated with declines in employment and investment. The popular press has placed stock repurchases under increased scrutiny as well.

We contribute to the repurchase literature by focusing on the subsample of firms with increasing short interest. An increase in short interest amplifies managers' incentives to defend stock prices because it places downward pressure on prices. Yet, despite focusing on this subsample, our evidence points to positive private information, not managerial short-termism, as the primary driver behind actual repurchases. Managers use repurchases as a means to safely trade on positive private information and to signal impending good news to other market participants.[5]

B. Managerial Myopia Literature

Theory shows how managerial myopia may lead to information manipulation and inefficient investment (e.g., Stein (1989)). Empirical works finds some support for managerial myopia. Survey evidence reveals that 78% of executives would sacrifice long-term value to meet earnings targets (Graham et al. (2005)). A recent line of research uses CEO equity vesting schedules to instrument for enhanced managerial incentives to manipulate stock price and finds managers reduce investment growth (Edmans et al. (2017)), strategically release news (Edmans et al. (2018)), and increase M&A and repurchase activity (Edmans et al. (2018), Moore (2018)) around equity vesting. We contribute to this literature by presenting a case in which managers have an incentive to prop up stock prices using firm resources and, perhaps surprisingly, find the average managerial team does not behave myopically.

C. Short-Selling Literature

The literature portrays short sellers as savvy investors with exceptional information processing skills (e.g., Christophe, Ferri, and Angel (2004), Christophe, Ferri, and Hsieh (2010), Karpoff and Lou (2010), and Boehmer, Jones, and Zhang (2015)). Both their information and processing skills contribute to the abnormal profits short sellers earn on average. Numerous studies (e.g., Asquith, Pathak, and Ritter (2005), Boehmer et al. (2008), and Desai et al. (2002)) document negative abnormal returns following periods of high short interest. 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

[5] Managers can trade on positive, price-relevant information either personally or on behalf of shareholders through a stock repurchase. Rule 10b-18's safe harbor provisions combined with the scarcity of legal challenges to repurchases suggest that benefiting from private information through repurchasing stock is the safer option.

short sales predict negative future returns." We add to this line of research by identifying a special, though not uncommon, case in which short sellers are revealed to be incorrect on average.

D. Disagreement Literature

Other research examines disagreement among informed parties and its relation to future stock returns. Jiao, Massa, and Zhang (2016) study the intersection of short selling and hedge fund trading to disentangle "informed short demand" from hedging. Highly shorted stocks also associated with high hedge fund ownership fail to underperform (Nezafat, Shen, Wang, and Wu (2019)). Massa, Qian, Xu, and Zhang (2015) use manager-short seller agreement, not *dis*agreement, to examine competition in trading on negative private information. Instead of racing with short sellers to profit from *negative* information, in our setting managers disagree with short sellers and repurchase based on *positive* information.

Our paper focuses on repurchase transactions in which the firm itself is the informed trader. Several prior studies examine the interaction between repurchases and trades by corporate insiders. The general consensus is that repurchases correlate positively with insider purchases *and sales* (e.g., Ben-Rephael, Oded, and Wohl (2014), Bonaime and Ryngaert (2013)), but 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)).

We contribute to this 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 documents that firms succeed at creating short sale constraints, which contribute to overpricing. Our evidence instead suggests disagreement among firms and short sellers is generally due to private information indicating *under*pricing: Firms repurchase based on positive private information revealed in the near future.

III. Hypothesis Development

As discussed above, a rich theoretical literature investigates myopic managers deploying firm resources to manipulate investors' perception of firm value for personal gain. To sharpen our tests of repurchase motivations, we focus on the sample of firm-quarters with heightened short-termism concerns: firm-quarters with increases in short interest. Our hypotheses distinguish between managerial short-termism and private information as motives for repurchases within these firm-quarters.

The *Managerial Short-Termism Hypothesis* posits misaligned incentives exacerbated by short-selling pressure motivate short-term focused managers to defend the stock price by repurchasing overvalued stock, thereby destroying shareholder value. The pressure on the stock price resulting from short selling increases managers' urgency to defend the price, thus increasing repurchases. This 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.

Because managerial short-termism may not manifest on average but only in certain cases in which the benefits of disagreement are magnified or the costs are reduced, we also examine two sub-hypotheses. The *Magnified Benefits Sub-Hypothesis* posits disagreement is motivated by enhanced benefits of repurchasing such as increased compensation or meeting earnings forecasts. The *Diminished Monitoring Sub-Hypothesis* posits disagreement is motivated by weak corporate governance. The *Magnified Benefits* (*Diminished Monitoring*) *Sub-Hypothesis* predicts that post-disagreement abnormal returns are no greater than returns following other high short-selling periods specifically in subsamples in which the benefits to repurchasing are greater (when monitoring is lower).

Alternatively, the *Private Information Hypothesis* posits that, even during disagreement when short sellers are betting on overvaluation, positive private information motivates repurchases. Managers acquire private information about the firm's performance, prospects, and risks by the nature of their position within the firm and repurchase if their perceived undervaluation exceeds their reservation level. The *Private Information Hypothesis* predicts returns after disagreement quarters will be higher than the counterfactual of returns after short-selling quarters in which the firm does not disagree by repurchasing: Managers' positive private information will subsequently be revealed and reflected in the stock price, resulting in higher ex post returns, on average.

The ex post abnormal returns resulting from the *Private Information Hypothesis* fall into one of two regions that distinguish whose information dominates. If the managers' positive private information incorporated into repurchases outweighs short sellers' negative information and any value destruction from agency-motivated repurchases, then abnormal returns following periods of disagreement will be positive. On the other hand, while managers could access more accurate firm-specific information, short sellers could have private information on the broader market or superior information processing skills. For example, managers could have private information on firm cash flows, but short sellers could better estimate the correlation of firm cash flows with the entire market. In these cases, if short sellers' negative information dominates the positive information managers incorporate into repurchases, the subsequent returns will be less than zero but greater than the returns to short-selling quarters in which they do not repurchase.

IV. The Joint Frequency of Short Selling and Repurchases

We source our share repurchase and short interest data from the Compustat Fundamentals Quarterly and Supplemental Short Interest files, respectively. Our sample begins in 2004, when the Securities and Exchange Commission 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 calendar day and the last business day of each month, but prior to 2007 firms only report short interest on the 15th calendar day. For consistency across our sample period, we measure quarterly short interest on the 15th calendar day of the last month in the quarter.

We then scale short interest by the number of shares outstanding on the same day and calculate quarterly changes.[6] 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.[7]

A. Univariate Summary Statistics

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 quarterly repurchases are at least 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.[8,9] Of interest is the high repurchase/high short-selling group, which we term the "disagreement" group because firms actively buy stock while short sellers actively sell 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% vs. 12.5%). This 3.0 percentage point (or 24%) difference in repurchase frequency is significant at the 1% level. The 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.

TABLE 1
The Joint Frequency of Short Selling and Share Repurchases

Table 1 reports 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."

		Share Repurchases		
ΔShort Interest		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	21.4	139.4	160.8
All	Frequency	130,138	19,985	150,123
	% Total	86.7	13.3	100.0
	χ^2 contribution	29.0	188.9	217.9
	χ^2 p-value = 0.000			

[6]For example, if we measure repurchases during the first calendar quarter of the year, then the corresponding change in short interest is measured from Dec. 15th of the prior year to Mar. 15th of the current year. Our results are robust to using short interest levels rather than changes.

[7]Our results are robust to including financials and utilities. See the Supplementary Material.

[8]Our results are not sensitive to high/low cutoff choice. The Supplementary Material presents results with alternative cutoffs: 0.25% and 0.75% of shares outstanding, as well as a cutoff based on repurchase and short-selling percentiles.

[9]The time horizon of short sellers varies, but Diether (2008) finds the mean loan contract lasts 38 trading days. By focusing on quarterly changes in aggregate short interest, our analysis emphasizes long-horizon short interest trends and mitigates the noise from short-horizon trading. Consistent with quarterly changes in short interest being based on information, we observe negative abnormal returns after short selling on average.

B. Regression Analysis

Although univariate summary statistics reject the independence of short selling and repurchasing, underlying firm characteristics could drive this relation. Hence, we next regress a high repurchase indicator variable on a high short-selling indicator and firm-level controls for size, cash, operating and nonoperating income, book-to-market ratio, leverage, capital expenditures, operating income volatility, industry repurchase announcement frequency, illiquidity, lagged returns, market returns, return volatility, and institutional ownership. Appendix A further motivates and describes these variables. We also include firm fixed effects to capture time-invariant unobservables and quarter fixed effects to capture macro trends. Standard errors are double clustered by firm and quarter.

Table 2 shows that the likelihood of high repurchases is greater in quarters with high short selling. After controlling for firm characteristics and firm and

TABLE 2

Share Repurchases and Short Selling

Table 2 reports ordinary least squares (OLS) regressions of an indicator variable for high repurchases on high short-selling indicators and control variables, defined in Table A1. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding. 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, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Variable	1	2	3	4
HIGH_SHORT_SELLING	0.020***	0.017***	0.017***	0.017***
	(7.297)	(5.836)	(6.651)	(6.812)
FIRM_SIZE	0.027***	0.027***	0.025***	0.023***
	(6.573)	(6.698)	(8.706)	(7.834)
CASH	0.084***	0.084***	0.091***	0.091***
	(4.554)	(4.586)	(6.081)	(6.139)
OPERATING_INCOME	0.057*	0.055*	0.006	0.017
	(1.975)	(1.964)	(0.259)	(0.714)
NON_OPERATING_INCOME	−0.042	−0.034	−0.010	−0.004
	(−0.380)	(−0.310)	(−0.119)	(−0.044)
BOOK_TO_MARKET	0.003	0.003	0.005*	0.006*
	(0.685)	(0.783)	(1.802)	(1.879)
LEVERAGE	−0.106***	−0.095***	−0.081***	−0.081***
	(−7.201)	(−6.512)	(−7.584)	(−7.584)
CAPEX	−0.311***	−0.309***	−0.290***	−0.296***
	(−4.498)	(−4.468)	(−5.659)	(−5.709)
OPERATING_INCOME_VOLATILITY	−0.028	−0.031**	−0.023**	−0.022**
	(−1.665)	(−2.093)	(−2.216)	(−2.048)
INDUSTRY_ANNOUNCEMENTS	1.274***	1.267***	1.017***	1.015***
	(9.861)	(9.792)	(10.750)	(10.707)
ILLIQUIDITY	0.003**	0.003**	0.002**	0.002**
	(2.199)	(2.066)	(2.399)	(2.409)
LAGGED_RETURNS	−0.000***	−0.000***	−0.000***	−0.000***
	(−5.286)	(−5.636)	(−5.466)	(−5.518)
MARKET_RETURNS	−0.079***	−0.078***	−0.013	−0.011
	(−3.066)	(−2.968)	(−0.507)	(−0.430)
RETURN_VOLATILITY	−0.752***	−0.672***	−0.449***	−0.455***
	(−5.313)	(−4.929)	(−4.291)	(−4.260)
INSTITUTIONAL_OWNERSHIP	−0.030	0.010	0.013	0.012
	(−1.651)	(0.500)	(0.846)	(0.815)
SHORT_INTEREST_LEVEL		−0.335***	−0.283***	−0.288***
		(−5.569)	(−6.822)	(−6.980)
LAG_HIGH_SHORT_SELLING			−0.001	−0.001
			(−0.478)	(−0.463)
LAG_HIGH_REPURCHASE			0.323***	0.323***
			(36.221)	(36.205)
CONCURRENT_RETURNS				−0.000***
				(−3.565)
No. of obs.	129,270	129,270	126,418	126,409
Adj. R^2	0.314	0.315	0.388	0.388

quarter fixed effects, firm-quarters associated with high short selling are 2 percentage points more likely to be classified as high repurchase, an economically meaningful increase given that the unconditional likelihood of observing high repurchases is 13.3%. This result continues to hold when we augment the model with the short interest level in model 2, lagged short-selling and repurchase indicators in model 3, and concurrent returns in model 4. Control variables generally take on expected signs. High repurchases are more likely among firms with larger market capitalizations, more cash, less debt, less capital expenditures, lower operating income volatility, more repurchase announcements in the industry, more illiquid stocks, lower lagged and concurrent returns, less stock return volatility, and low levels of short interest. Lagged short interest does not significantly impact the likelihood of high repurchases, but lagged repurchases do, consistent with some persistence in repurchase behavior.

V. 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 after we classify firms as high/low repurchase firms and high/low short-selling firms.

A. Methodology and Univariate Results

We use 4 abnormal returns measures. Our first 3 measures are buy-and-hold cumulative abnormal quarterly returns, calculated as follows:

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

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 1 of 3 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) (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:

$$\begin{aligned} &R_{p,t} - R_{f,t} \\ &= \alpha_p + \beta_1(R_{\text{mkt},t} - R_{f,t}) + \beta_2\text{SMB}_t + \beta_3\text{HML}_t + \beta_4\text{MOM}_t + \epsilon_t, \end{aligned} \tag{2}$$

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 $R_{\text{mkt},t}$ are the risk-free rate and the market return 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), which represents the average monthly excess return. Note that, although the time periods are identical, the first 3 measures are quarterly while the 4th measure represents a *monthly* average over the quarter.

Table 3 reports 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

TABLE 3
Next-Quarter Abnormal Returns

Table 3 reports 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:

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

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 αs are monthly abnormal returns calculated over Quarter +1 using a calendar time portfolio approach:

$$R_{p,t} - R_{f,t} = \alpha_p + \beta_1(R_{\text{mkt},t} - R_{f,t}) + \beta_2\text{SMB}_t + \beta_3\text{HML}_t + \beta_4\text{MOM}_t + \epsilon_t,$$

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 *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	All High Short Selling	Low Repurchases	High Repurchases	High - Low
Panel A. Abnormal Returns Following Short Selling				
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***
	(−2.71)	(−3.15)	(3.49)	(4.64)
Panel B. Abnormal Returns Following Repurchases				
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
	(6.04)	(6.12)	(3.49)	(−1.36)

positions, firms significantly underperform in 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 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 equal to −124 bps (−41.4 bps/month × 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. Our estimates imply abnormal returns are between 130 and 238 bps greater following periods of high short selling if the firm

simultaneously repurchases. This difference is highly significant. Greater returns after disagreement among firms and short sellers are consistent with managers engaging short sellers based on positive private information. Further, the positive abnormal returns following disagreement suggest managerial information dominates short sellers' information on average. The evidence supports the *Private Information Hypothesis* as opposed to the *Managerial Short-Termism Hypothesis*.

Panel B examines abnormal returns after high repurchases. 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 × 3) using calendar time portfolios. Bifurcating on short-selling activity reveals that, despite greater agency concerns, "disagreement" repurchases continue to predict positive and significant next-quarter abnormal returns.

B. Abnormal Returns Regressions

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. Because the calendar time portfolio approach to estimating abnormal returns does not produce a firm-level measure, our regression setting limits our analyses to the 3 buy-and-hold abnormal returns metrics.[10] As reported in Table 3 the buy-and-hold returns measures represent more conservative estimates than calendar time portfolio returns.

Baseline Regressions

In Table 4 we regress next-quarter abnormal returns on indicators for repurchase/short-selling classifications, with the low repurchase/low short-selling group as our base. We employ firm and quarter fixed effects as well as controls from Table 2 (omitted for brevity). 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 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 2 percentage points greater than if the firm chooses not to repurchase. Our results follow similar patterns when we use alternative return 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

[10]The calendar time portfolio approach creates one-time series of returns for each group of firms based on their short-selling and repurchasing behavior by averaging monthly returns of all firms in a portfolio each month.

TABLE 4
Controlling for Firm Characteristics

Table 4 reports 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 square brackets, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Size & B/M Adjusted Returns	Size & Momentum Adjusted Returns	DGTW Returns
	1	2	3
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 - high short selling & low repurchase	1.995***	2.264***	1.740***
	[0.000]	[0.000]	[0.000]
Disagreement - low short selling & high repurchase	−0.110	0.104	−0.282
	[0.771]	[0.775]	[0.413]
Disagreement - [high short selling & low repurchase + low short selling & high repurchase]	1.102*	1.297**	0.629
	[0.061]	[0.014]	[0.203]
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		
No. of obs.	100,755	98,974	89,367
Adj. R^2	0.054	0.049	0.039

we adjust returns by size and momentum (DGTW portfolio returns). The results from the *F*-tests support the *Private Information Hypothesis*, suggesting managers trade on positive information revealed (or at least partially revealed) over the next 3 months. The positive coefficient on disagreement suggests returns after disagreement are positive, consistent with the firm's information outweighing short sellers' information and inconsistent with managers myopically repurchasing overvalued stock. 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, managers' information dominates short sellers' information.[11]

We also test whether returns following disagreement differ from the sum of high short-selling/low repurchase returns and low short-selling/high repurchase returns. This difference measures whether short selling and repurchasing carry significantly more information together than separately and can be interpreted as an interactive effect. It is consistently positive and economically meaningful (ranging from 63 bps to 130 bps) and achieves statistical significance for two of

[11] The results presented in Table 4 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 the Supplementary Material.

our three returns measures. This result is the opposite of what we would expect under the *Managerial Short-Termism Hypothesis*. Instead of repurchases against short selling providing less information, we find they are *more* informative than other repurchases.

C. Robustness

Table 5 reports fixed effects regressions analogous to those in Table 4; we simply modify the sample or dependent variable to address several potential concerns. For brevity, we only tabulate returns adjusted for Fama–French 25 size and book-to-market portfolios, which tend to be our most conservative estimates. The first concern is that an increase in short interest of 0.5% (our cutoff) represents a smaller relative change for firms with a high level of short interest at the beginning of the quarter. To verify that our results hold within the subsample of firms with high beginning short interest, model 1 uses the subset of firms with beginning short interest greater than 5%. As before, repurchases and changes in short

TABLE 5
Robustness

Table 5 verifies the robustness of regressions of abnormal returns on repurchase/short-selling classification indicators and control variables. Model 1 shows next-quarter buy-and-hold abnormal returns regressions for the subset of firms with short interest greater than 5%. Model 2 alters the definition of "high" and "low" short-selling firms to be based on *level* rather than changes; specifically, our cutoff is 5%. Model 3 excludes short-selling cases likely motivated by hedging rather than information, specifically, firm-quarters in which the firm is a bidder in a merger or acquisition or has convertible debt. Model 4 examines 24-month long-run abnormal returns. Dependent variables are buy-and-hold abnormal returns adjusted using Fama–French 25 portfolios matched on size and book-to-market calculated next quarter in models 1–3 and over the next 24 months in model 4. Repurchases and short interest changes or levels 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 4 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 square brackets, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Abnormal Returns Measurement Period			
	3-Month	3-Month	3-Month	24-Month
	Short Selling/Interest Classification			
	Short Selling	Short Interest Level	Short Selling	Short Selling
	Sample			
	High Short Interest	Full	No Hedging	Full
	1	2	3	4
Disagreement	1.504**	1.287***	0.878**	2.516**
	(2.670)	(3.424)	(2.413)	(2.178)
High short selling & low repurchase	−0.945**	−0.650	−1.189***	−6.667***
	(−2.059)	(−1.625)	(−3.700)	(−5.156)
Low short selling & high repurchase	1.732***	0.781***	0.969***	3.086**
	(2.973)	(3.477)	(3.653)	(2.466)
F-tests with p-values:				
Disagreement - high short selling & low repurchase	2.449***	1.937***	2.067***	9.183***
	[0.000]	[0.000]	[0.000]	[0.000]
Disagreement - low short selling & high repurchase	−0.228	0.506	−0.091	−0.570
	[0.728]	[0.213]	[0.824]	[0.532]
Disagreement - [high short selling & low repurchase + low short selling & high repurchase]	0.717	1.156**	1.098*	6.097***
	[0.403]	[0.032]	[0.053]	[0.001]
No. of obs.	32,554	100,755	87,353	100,774
Control variables	Yes	Yes	Yes	Yes
Adj. R^2	0.051	0.054	0.056	0.280

interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are "low." We confirm our Table 4 results hold within firms already experiencing high short interest levels. In fact, the disagreement coefficient and the returns differential across the disagreement and high short-selling/low repurchase groups are slightly greater within high short interest firms. Our subsample analysis reveals another interesting finding: The low short-selling/high repurchase coefficient increases in magnitude when we impose a cutoff for short interest levels. These results are consistent with repurchases in a high short interest environment being associated with positive information, whether the short interest begins high and increases further (as our disagreement coefficient indicates) or simply begins high.

Second, we confirm our inferences are unchanged if we base our high/low short interest cutoffs on *levels* instead of *changes*. Model 2 of Table 5 uses the full sample, but our high short interest cutoff is now 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 from Table 4. These results reinforce our finding that managers act on positive private information when repurchasing during periods of heightened short selling. One difference is that the high short-selling/low repurchase coefficient is less negative, relative to our baseline regressions, and no longer significant. These results are consistent with short interest *changes* containing more information about subsequent returns than short interest *levels*, providing further motivation for using changes throughout our paper. F-tests confirm post-disagreement returns are significantly greater than returns following high short interest without repurchases and repurchases against high short interest are more informative than repurchasing and high short interest independently.

A third concern is that short positions in conjunction with repurchases may in fact represent hedges related to 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. Model 3 of Table 5 excludes firm-quarters with positive convertible debt (because short equity positions hedge long convertible debt positions) and firm-quarters in which the Securities Data Company (SDC) reports the firm being a bidder in a merger negotiation (because during merger negotiations investors may engage in merger arbitrage). Our results are similar when we exclude firm-quarters associated with convertible debt and mergers, suggesting that the positive returns following disagreement are not driven by cases in which short sellers are hedging as opposed to betting against the firm.

Finally, if managers are able to temporarily fool investors, either by provisionally propping up stock prices through repurchases, by manipulating earnings, or by releasing misleading information, then we expect mean reversion in the long-term. Three months already represents a substantial amount of time to mislead investors, but insuring returns hold over time would give further credence to an information story. The dependent variable in model 4 thus spans a longer time window of 24 months. We observe no reversion to the mean. The disagreement coefficient grows to 252 bps over 24 months. 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 918 bps over 24 months. Consistent with repurchases against short selling being more informative than other repurchases, the interactive effect of disagreement grows as well: Disagreement is associated with 24-month returns 610 bps greater than the sum of returns following high short selling and low repurchases, and low short selling and high repurchases. In summary, the results are consistent with disagreement firms trading on information, not temporarily misleading investors.[12]

VI. What Do Managers Know?

Section V establishes that, on average, managers act on positive information when they repurchase company stock against short selling. This section studies the nature of this information. Specifically, we examine how the firm's decision to trade against short sellers relates to future information releases by modeling 8-K and earnings announcement returns as well as firm risk.

The first model of Table 6 examines the impact of future information releases; the sum of 3-day cumulative abnormal returns (CARs) around all 8-K reports filed within 3 months of our repurchase/short-selling classification quarter. Again, our base group is firms with low short selling and low repurchases. We include firm and quarter fixed effects as well as all control variables from Table 4. Firms disagreeing with short sellers release more positive information in the near future: The sum of CARs around 8-Ks over the next quarter is greater by 66 bps. In contrast, when short interest increases but firms do not trade against short sellers, total CARs surrounding 8-Ks over the next 3 months is 37 bps lower. This economically meaningful 103 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 repurchases. Further, 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. Finally, there is a significant interactive effect associated with disagreement: Subsequent 8-K CARs are 54 bps greater than independent high short selling and repurchasing would predict.[13]

Current report filings are not the only potential source of information or driver of returns. Earnings releases also convey information and often move stock prices. Thus, our second model examines earnings surprise, 3-day earnings announcement CARs after the short-selling/repurchase classification quarter. The disagreement coefficient, significant at the 1% level, implies firms that repurchase

[12] Additional tests in Table IA7 of the Supplementary Material examine repurchases unlikely based on private information: dilution-motivated repurchases and preset repurchase plans. Repurchases against short selling are associated with positive information even if motivated by dilution but contain little information if conducted under a preset plan.

[13] We investigate the likelihood of announcing 8-Ks by item type in Table IA5 of the Supplementary Material. Following disagreement, firms are significantly less likely to enter into or terminate material definitive agreements (such as bank loans, leases, or long-term contracts with buyers or suppliers), announce new financial obligations (long-term debt obligations and any off-balance sheet arrangements), amend articles and bylaws, conduct acquisitions and dispositions, sell unregistered equity, delist, and report nonreliance (i.e., errors in previously disclosed financial statements).

TABLE 6
What Do Managers Know?

Table 6 reports regressions of proxies for information and risk on repurchase/short-selling indicators and control variables. Dependent variables are: 8K_CARS, EARNINGS_SURPRISE, and $\Delta\beta$. 8K_CARS is the sum of 3-day cumulative abnormal returns around all 8-K reports filed within 3 months after our classification quarter on high/low repurchase and short-selling indicator variables. EARNINGS_SURPRISE is the 3-day earnings announcement CARs after the short-selling/repurchase classification quarter. $\Delta\beta$ is the change in market β from the year prior to our classification quarter to the year after our classification quarter. We estimate βs using a Fama–French 4-factor model of daily returns and require at least 100 days of returns for each β calculation. 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 4 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 square brackets, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	8K_CARS	EARNINGS_SURPRISE	$\Delta\beta$
	1	2	3
Disagreement	0.655***	0.543***	−0.002
	(3.252)	(4.006)	(−0.181)
High short selling & low repurchase	−0.374**	−0.190*	0.022***
	(−2.376)	(−1.757)	(2.727)
Low short selling & high repurchase	0.492***	0.505***	0.003
	(3.623)	(4.851)	(0.483)
F-tests with p-values:			
Disagreement - high short selling & low repurchase	1.029***	0.733***	−0.024***
	[0.000]	[0.000]	[0.031]
Disagreement - low short selling & high repurchase	0.163	0.038	−0.005
	[0.401]	[0.751]	[0.433]
Disagreement - [high short selling & low repurchase + low short selling & high repurchase]	0.537**	0.228	−0.027***
	[0.027]	[0.131]	[0.000]
No. of obs.	88,138	100,600	100,964
Control variables	Yes	Yes	Yes
Adj. R^2	0.038	0.028	0.131

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 across the two types of information releases, −37 bps for 8K_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.

We next examine changes in systematic risk from the year prior to our classification quarter to the year after. We estimate systematic risk using a Fama–French 4-factor model of daily returns, requiring at least 100 days of returns. The change in systematic risk 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 between the disagreement and high short-selling/low repurchase coefficient is −0.024, which corresponds to approximately 15% (25%) of the average (median) total reduction in risk around repurchase *announcements* presented in Grullon and Michaely (2004).

In sum, after short interest increases, firms on average disclose more negative information, have more negative earnings surprises, and experience increases in

risk. But these effects are mitigated if the firm simultaneously repurchases. In this case, firms subsequently reveal positive information on average. Overall, regressions modeling future information and changes in risk show repurchasing firms (even those repurchasing while short selling increases) possess positive private information that is revealed in the near future. In fact, F-tests of interactive effects suggest disagreement firms have especially high 8-K CARs and particularly large decreases in risk.

VII. Disagreement and Other Informed Trading

In this section, we factor in the trades of other informed parties, namely, insiders, analysts, and activist investors. Table 7 reexamines quarterly size and book-to-market adjusted buy-and-hold abnormal returns following the

TABLE 7

Disagreement and Other Informed Trading

Table 7 reports regressions of next-quarter buy-and-hold abnormal returns on repurchase/short-selling indicators, interacted with indicators for trading by other informed traders including activists, insiders, and analysts. The proxy for informed trading in model 1 is an indicator variable equal to 1 if the total dollar value of nonroutine open market sales is greater than purchases for the top five executives (CEO, CFO, COO, President, and Chairman of the Board), or 0 otherwise. We classify routine trades at the trade level using the methodology of Cohen, Malloy, and Pomorski (2012) and remove them from our measure of insider trading. Model 2 includes an indicator variable equal to 1 if at least one analyst downgrades the stock during the quarter and no analyst simultaneously upgrades the stock, or 0 otherwise. Model 3 includes an indicator variable equal to 1 if the firm has been targeted by an activist investor (identified through 13-D filings) over the prior 6 month, or 0 otherwise. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. The dependent variable is buy-and-hold abnormal returns adjusted using Fama–French 25 portfolios matched on size and book-to-market. All control variables from Table 4 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 square brackets, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Informed Traders		
	Insiders	Analysts	Activists
	1	2	3
(1) Disagreement	0.598	0.600*	1.019***
	(1.311)	(1.838)	(3.126)
(2) Informed trader & disagreement	0.615	1.066*	−2.833**
	(0.990)	(1.986)	(−2.185)
(3) High short selling & low repurchase	−1.330***	−1.359***	−1.194***
	(−3.302)	(−3.855)	(−3.758)
(4) Informed trader & high short selling & low repurchase	0.491	0.945*	−0.176
	(0.984)	(1.719)	(−0.205)
(5) Low short selling & high repurchase	0.617*	0.712**	0.923***
	(1.969)	(2.602)	(3.277)
(6) Informed trader & low short selling & high repurchase	0.990**	1.120**	−0.258
	(2.352)	(2.586)	(−0.271)
(7) Informed trader	−1.179***	−0.933***	−0.185
	(−3.632)	(−3.196)	(−0.409)
F-tests with p-values:			
(2) + (7)	−0.564	0.133	−3.018***
	[0.353]	[0.807]	[0.006]
(1) + (2) + (7)	0.034	0.733	−1.999*
	[0.937]	[0.277]	[0.087]
((1) + (2)) − ((3) + (4))	2.052***	2.080**	−0.444
	[0.002]	[0.016]	[0.756]
No. of obs.	100,754	100,754	100,755
Control variables	Yes	Yes	Yes
Adj. R^2	0.054	0.054	0.054

short-selling/repurchase classification quarter, using interactions with indicators for insider selling, analyst downgrades, and activist investor presence.

First, we examine how insider trading interacts with repurchase informativeness. Bonaime and Ryngaert (2013) show that repurchases concurrent with insider selling are less likely to be information-based. Further, when managers are selling stock, they have an additional incentive to behave myopically by temporarily inflating stock prices. We hypothesize that repurchases against short selling are less informative when insiders simultaneously sell stock, particularly if these sales are not routine. To test this hypothesis, we use insider trading data from Thomson Financial to identify nonroutine or "opportunistic" insider trading by top executives (Chief Executive Officer, Chief Financial Officer, Chief Operating Officer, President, and Chairman). Before calculating our net insider-selling measure, we remove routine trades, classified at the trade level using the methodology of Cohen et al. (2012). We then create an indicator variable equal to 1 if the total dollar value of top five nonroutine insiders' sales exceeds purchases during the short-selling/repurchase measurement quarter, and 0 otherwise.

Model 1 of Table 7 shows abnormal returns as a function of short-selling and repurchase activity, interacted with net insider selling. We observe only weak evidence that returns following disagreement are significantly lower when insiders are selling: The sum of the insider-selling/disagreement interaction coefficient and the insider-selling coefficient is negative but statistically insignificant. Yet, returns to disagreement firms with net insider selling are close to zero and are no longer significantly positive. Further, we see that, conditional on net insider selling, disagreement firms experience quarterly ex post returns around 2 percentage points greater than firms with high short selling but low repurchases. This difference is significant at the 1% level. In sum, when insiders are selling stock, repurchases against short selling contain positive information and do not appear to destroy value.

Second, we examine how the opinion of another potentially informed party (i.e., analysts) interacts with repurchase informativeness. Piotroski and Roulstone (2004) show analysts' comparative advantage relative to insiders is deciphering information at the industry and market levels. If analysts' estimates of firm value reflect industry-specific or market-wide events that insiders estimate less accurately, then returns following disagreement quarters with simultaneous analyst downgrades may be lower than returns following other disagreement quarters.

Model 2 of Table 7 reports abnormal returns as a function of short-selling and repurchase activity, interacted with our analyst downgrade indicator. Specifically, we use data from IBES to code an indicator variable equal to 1 if any analyst downgrades the stock and no analyst upgrades the stock during the short-selling/repurchase measurement quarter, and 0 otherwise. F-tests reveal that the negative impact of the analyst downgrade is neutralized during disagreement quarters. Further, ex post returns following analyst downgrades and disagreement remain positive, though statistically insignificant. In fact, within the subset of recently downgraded firms, disagreement firms continue to significantly outperform firms with high short selling but low repurchases by over 2 percentage points. These results are consistent with disagreement-motivated repurchases being based on positive information even when analysts project poor performance.

Third, 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), and Klein and Zur (2009)); further, the presence of an activist may magnify short-termism. We hypothesize that firms targeted by activists may be more prone to inefficient and myopic management and that their repurchases are less likely to be based on information.

Model 3 of Table 7 regresses abnormal returns on short-selling and repurchase activity, interacted with activist investor presence. The negative and significant sum of the activist and activist/disagreement interaction coefficients $((-2.833)+(-0.185)=-3.018)$ suggests that if an activist targeted the firm over the prior 6 months, which we identify using 13-D filings, then repurchases when short interest increases are less informative than in the absence of activists. We also find 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 activists (difference = −44 bps; p-value = 0.76). These results are consistent with information-based repurchasing when firms trade against short sellers, unless an activist is involved.

The results specifically support magnified short-termism as the motive for disagreement repurchases in firms targeted by activists. If activists identify inefficient managers and these inefficient managers make suboptimal repurchase decisions, then the returns following all repurchases associated with activist activity would suffer. However, if shareholder activism exacerbates short-termism, then the short-term motivated repurchases would be concentrated in the group with magnified motives for short-termism, the disagreement repurchases. The results indicate short-term motivated repurchases are concentrated in the disagreement group because we do not observe a significantly negative coefficient in the nondisagreement high repurchase group when activist attack.[14] Overall, our results suggest that activist presence likely magnifies short-termism. We further explore short-termism incentives in the next section.

VIII. Disagreement and Managerial Short-Termism

We argue that heightened short interest exacerbates managerial short-termism yet find that, on average, positive private information motivates firms to repurchase as short interest increases. However, there may be cases in which short-termism, not information, prevails as the motive for disagreement. In this section, we attempt to isolate these situations by studying three potential drivers of short-termism: CEO compensation incentives, a desire to meet quarterly earnings forecasts, and weak corporate governance. We generate a series of

[14] In an unreported F-test ((5) + (6) + (7)), we find nondisagreement repurchases associated with activist activity are not value destroying. The abnormal returns have a positive coefficient of 0.480, though not statistically different from 0 (p-value = 0.488).

indicator variables capturing these effects and interact these variables with our indicators for repurchasing and short-selling behavior in a regression of next-quarter buy-and-hold abnormal returns otherwise identical to our baseline results in Table 4. If short-termism drives repurchases in these cases, we expect ex post returns in the interacted disagreement group to be significantly lower than the disagreement group. We report these results in Table 8.

Certain features of CEO compensation packages may contribute to short-termism. If the CEO is compensated in stock, then the CEO may be personally motivated to prop up stock price through a share repurchase during vesting quarters. To identify these potential compensation-related incentives, we merge our

TABLE 8

Disagreement and Managerial Short-Termism

Table 8 reports regressions of next-quarter buy-and-hold abnormal returns on repurchase/short-selling indicators, interacted with indicators for managerial short-termism. The proxy for short-termism in model 1 is an indicator for whether the CEO's stock vested during the quarter. Model 2 includes an indicator variable equal to 1 if any part of the CEO's compensation is linked to EPS, or 0 otherwise. Model 3 includes an indicator equal to 1 if the firm's EPS is within 1 penny of missing the median analyst estimate or, if the firm repurchased, would have been within 1 penny without a repurchase, otherwise equal to 0. Model 4 uses an indicator for whether the firm meet or beat the median analyst EPS forecast using a repurchase but would have missed without the repurchase. Models 5 and 6 incorporate indicators for captured boards. The indicator in model 5 (model 6) equals 1 if more than 50% of the directors are appointed after the CEO took over (the firm-quarter observation falls within the highest quartile of the fraction of directors appointed after the CEO took over), or 0 otherwise. The short-termism proxy in model 7 equals 1 if the board is classified, or 0 otherwise. Repurchases and changes in short interest are labeled "high" if they exceed 0.5% of shares outstanding; otherwise, they are considered "low." Firm-quarters associated with "disagreement" have simultaneously high repurchases and increases in short interest. The dependent variable is buy-and-hold abnormal returns adjusted using Fama–French 25 portfolios matched on size and book-to-market. All control variables from Table 4 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 square brackets, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Short-Termism Interaction Term						
	CEO Vesting	EPS Performance Metric	Penny Off	Repurchase to Meet EPS	Captured Board (1)	Captured Board (2)	Classified Board
	1	2	3	4	5	6	7
(1) Disagreement	0.585	0.639	0.981**	0.835*	1.195**	1.024**	1.322***
	(0.947)	(1.260)	(2.473)	(1.868)	(2.397)	(2.309)	(2.961)
(2) Short-termism & disagreement	0.547	0.447	2.600*	1.009	−0.221	0.311	−0.452
	(0.589)	(0.823)	(1.903)	(1.576)	(−0.347)	(0.345)	(−0.897)
(3) High short selling & low repurchase	−1.429**	−1.720***	−0.958***	−0.959**	−0.178	−0.157	−1.077**
	(−2.493)	(−2.779)	(−2.708)	(−2.676)	(−0.443)	(−0.482)	(−2.495)
(4) Short-termism & high short selling & low repurchase	−0.461	1.477**	0.242		0.179	0.213	1.165**
	(−0.523)	(2.154)	(0.170)		(0.270)	(0.273)	(2.648)
(5) Low short selling & high repurchase	0.991***	1.274***	0.910***	0.956***	1.306***	1.280***	1.310***
	(2.876)	(2.886)	(3.092)	(3.083)	(3.269)	(3.544)	(3.346)
(6) Short-termism & low short selling & high repurchase	0.652	−0.095	2.386*	0.053	0.406	0.752	0.244
	(0.719)	(−0.168)	(1.770)	(0.122)	(0.842)	(1.188)	(0.625)
(7) Short-termism	−0.253	−0.714	−2.976***		0.214	−0.320	−0.256
	(−0.355)	(−1.489)	(−3.948)		(0.610)	(−0.780)	(−0.465)
F-tests with p-values:							
(2) + (7)	0.294	−0.267	−0.376	NA	−0.007	−0.009	−0.708
	[0.587]	[0.626]	[0.661]		[0.991]	[0.992]	[0.385]
(1) + (2) + (7)	0.879	0.372	0.605	1.844***	1.188**	1.015	0.614
	[0.185]	[0.600]	[0.485]	[0.010]	[0.039]	[0.214]	[0.407]
((1) + (2)) − ((3) + (4))	3.022***	1.329	4.297***	2.803***	0.973	1.279	0.782
	[0.004]	[0.115]	[0.004]	[0.000]	[0.173]	[0.191]	[0.192]
No. of obs.	24,933	28,670	75,617	75,617	33,717	33,717	39,452
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.065	0.059	0.060	0.060	0.052	0.052	0.052

data with compensation data from the ISS Incentive Lab, which covers the top 750 firms each year (backfilling to avoid survivorship bias) beginning in 2007. Further, if the CEO's compensation is linked to EPS, which can be manipulated by share repurchases, then the CEO may pursue repurchases, even if the company stock is not undervalued or the firm does not possess positive private information about future performance. Model 1 of Table 8 uses an indicator CEO_VESTING to show whether the CEO's stock vested during the quarter. Model 2 includes an indicator EPS_PERFORMANCE_METRIC equal to 1 if any part of the CEO's compensation is linked to EPS. We observe no evidence that post-disagreement returns are significantly lower when the CEO's stock is vesting or if the CEO's compensation is linked to EPS (F-test (2) + (7)). However, post-disagreement returns are no longer significantly different from zero when CEO compensation incentivizes short-termism (F-test (1) + (2) + (7)), and, in the case of EPS performance metrics, post-disagreement returns are not significantly different from returns following quarters in which short selling is high but repurchases are low (F-test ((1)+(2))−((3)+(4))).

We next include variables capturing a desire to meet analysts' forecasts, which could exacerbate short-termism. The first measure is an indicator variable capturing closeness to median analysts' EPS estimates. If the firm does not repurchase during the quarter, PENNY_OFF equals 1 if the actual EPS is within 1 penny of the median analyst EPS estimate, and 0 otherwise. If the firm repurchases, PENNY_OFF equals 1 if the firm would have missed earnings by a penny or less in the absence of the repurchase. Model 3 shows that next-quarter returns are significantly lower by almost 3% if the firm misses EPS by a penny, but this negative effect is attenuated in cases of disagreement. Interestingly, the interaction term on disagreement and missing by 1 penny is significantly positive, not negative as expected. Model 4 includes REPURCHASES_TO_MEET_EPS, which equals 1 if the firm used repurchases to meet or beat the median analyst estimate but would have missed earnings in the absence of the repurchase, and 0 otherwise. This variable conditions on a repurchase and thus can only be interacted with high repurchase groups. Disagreement potentially motivated by a desire to meet EPS estimates does not carry lower ex post returns; in fact, though insignificant the coefficient on the interaction term is positive and equal to about 1%. Further, abnormal returns for the disagreement firms that repurchase to meet EPS are significantly positive (184 bps).

We conclude by identifying companies with weak corporate governance based on their board structure. Models 5 and 6 incorporate indicators for captured boards. The indicator in model 5 (model 6) equals 1 if more than 50% of the directors are appointed after the CEO took over (the firm-quarter observation falls within the highest quartile of the fraction of directors appointed after the CEO took over), and 0 otherwise. The short-termism proxy in model 7 equals 1 if the board is classified, and 0 otherwise. We find that post-disagreement returns are not significantly different within poor-governance firms with captured or classified boards.

To summarize, abnormal returns following disagreement are not significantly lower when short-termism is especially likely to drive repurchasing behavior. In fact, coefficients on the interaction of short-termism proxies and disagreement are

positive in five of seven cases. Even when short-termism is likely, next-quarter abnormal return estimates are positive when the firm disagrees with short sellers by repurchasing, though these estimates only achieve statistical significance in two of seven models. Overall, even when we isolate disagreement cases most likely motivated by short-termism, we fail to find evidence of the negative abnormal returns necessary for value destruction.

IX. Trading Strategy

In this section we quantify the incremental value of the repurchase information once it becomes public. Specifically, we examine daily abnormal returns to a calendar time portfolio taking a long position in stocks associated with disagreement and a short position in stocks with high short selling but low repurchases. These abnormal returns thus represent savings to short sellers who unravel their positions after a company discloses repurchases, or profits to any investor who establishes the long short portfolio. A key difference between this trading strategy and our prior analyses of next-quarter abnormal returns is the timing of the returns calculations: We construct trading strategy portfolios immediately *after* repurchases are disclosed, yielding a more precise estimate of how much an investor could yield on a fully implementable trading strategy.

Table 9 reports daily Fama–French 4-factor αs, calculated as follows:

$$(3)\quad R_{\text{Disagreement},t} - R_{\text{HighShort},t} = \alpha_p + \beta_1(R_{\text{mkt},t} - R_{f,t}) + \beta_2 \text{SMB}_t + \beta_3 \text{HML}_t + \beta_4 \text{MOM}_t + \epsilon_t,$$

where $R_{\text{Disagreement},t}$ is the day t return on an equally weighted portfolio of disagreement stocks, and $R_{\text{High short},t}$ is the day t return on an equally weighted portfolio of high short-selling but low repurchase firms in the prior quarter. $R_{f,t}$ and $R_{\text{mkt},t}$ 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 on day t.

In the first model stocks enter the portfolio 1 day after repurchase disclosures and remain until 1 day prior to the next disclosure. This long–short portfolio earns 3.1 bps per day in excess return, or 7.8% annually. This trading strategy remains profitable even after including any reasonable estimation of trading costs.[15] Results are similar in the second model, where stocks enter the portfolio 2 days after the repurchase disclosure and remain in the portfolio until 2 days prior to the next disclosure: Investors who buy a portfolio of disagreement stocks 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 repurchase disclosures and remain for 1 quarter (63 trading days) or 1 year (252 trading days), we obtain comparable results: Investors can earn 3.0 bps per day or 7.5% annually by adopting either of these strategies.

[15] Saffi and Sigurdsson (2011) report equally-weighted (value-weighted) average annual loan fees of 68 bps (10bps) in the United States, and Blocher, Reed, and Van Wesep (2013) document a 95th percentile of specialness (the federal funds rate minus the rebate rate) of only 250 bps per year.

TABLE 9
Trading Strategy

Table 9 presents daily Fama–French 4-factor αs 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 αs are daily abnormal returns calculated as follows:

$$R_{\text{Disagreement},t} - R_{\text{High short},t} = \alpha_p + \beta_1(R_{\text{mkt},t} - R_{f,t}) + \beta_2 \text{SMB}_t + \beta_3 \text{HML}_t + \beta_4 \text{MOM}_t + \epsilon_t,$$

where $R_{\text{Disagreement},t}$ is the return at day t on an equally weighted portfolio of disagreement stocks, and $R_{\text{High short},t}$ 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 $R_{\text{mkt},t}$ 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 1 or 2 days after the repurchase disclosure and remain in the portfolio until 1 or 2 days prior to the next disclosure, for 1 quarter (63 trading days), or for 1 year (252 trading days), as noted. t-statistics are presented in parentheses, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	Time Relative to Repurchase Disclosures			
	+1 to −1	+2 to −2	+1 to 63	+1 to 252
	1	2	3	4
Daily α	0.031***	0.022***	0.030***	0.030***
	(4.251)	(3.119)	(4.209)	(4.379)
No. of obs.	2,610	2,608	2,609	2,609
Adj. R^2	0.260	0.266	0.273	0.260

Overall, these results suggest that, on average, managers repurchase based on positive information, 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. Further, other investors can learn from both parties and generate abnormal returns of approximately 7.5% 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.

X. Do Short Sellers Respond to Firms or Vice Versa?

In this section we examine if short sellers respond to firms and vice versa. We conclude with a discussion of the implications of the sequencing of short selling and repurchasing for interpreting our hypotheses and for inferring causality.

A. Why Do Short Sellers Trade against Firms?

Why do sophisticated short sellers bet against a repurchasing firm if they lose on average? One plausible explanation is that short sellers are uncertain of repurchase activity while they are increasing their bets against the firms. Table 10 examines short interest changes after quarterly repurchase disclosures. Firms first reveal repurchases in earnings announcements released after quarter-end. We regress next-month short interest changes (in percentage terms) on disclosed repurchase changes during the quarter. A negative coefficient would be consistent with short sellers being uncertain of the firm's repurchase activity until the disclosure is released. The first model in Table 10 presents our base model. The second model adds the 3-day earnings announcement CARs to control for the effects of other

TABLE 10

Do Short Sellers Respond to Repurchase Disclosures?

Table 10 reports regressions of changes in short interest as a function of changes in repurchases. ΔREPURCHASE is quarterly change in repurchases, scaled by market capitalization, revealed at the earnings announcement. ΔSHORT_INTEREST is the change in short interest, as a percentage of shares outstanding, 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 1 if the change in repurchase is nonpositive, or 0 otherwise. All control variables from Table 4 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 square brackets, and *, **, and *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	1	2	3	4
ΔREPURCHASE	−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)
ΔREPURCHASE × REPURCHASE_DECREASE			1.173	1.140
			(0.929)	(0.904)
REPURCHASE_DECREASE			−0.010	−0.011
			(−0.871)	(−0.921)
No. of obs.	101,434	101,380	101,434	101,380
Control variables	Yes	Yes	Yes	Yes
Adj. R^2	0.037	0.037	0.037	0.037
F-tests with p-values:				
ΔREPURCHASE + interaction			−0.574	−0.569
			[0.564]	[0.568]

information released at the same time. In both models, the coefficient associated with changes in repurchases is negative and significant at the 10% level, but relatively small in economic magnitude. Model 1 suggests a 1-percentage-point increase in repurchases implies a 0.009-percentage-point decrease in short interest. These results are consistent with short sellers reacting to repurchase disclosures, but with the response being weak in economic terms.

Next, we examine if increases versus decreases in repurchases primarily drive the negative relation between disclosed repurchase changes and short selling: We augment our models with an indicator variable equal to 1 if repurchases decrease or remain constant and an interaction term between this indicator and repurchase change. The negative coefficient on ΔREPURCHASE, now specific to increases in repurchases, is greater in magnitude and significance than before and suggests a 1-percentage-point increase in repurchases is associated with a 0.017-percentage-point decrease in short interest. The interaction term is insignificant but positive, and F-tests show the sum of the coefficients on repurchase change and the interaction term is insignificant. These results suggest the negative relation between short selling and revealed repurchases is driven by increases, not decreases, in repurchases.

In short, short sellers learn about repurchases in earnings announcements and adjust their trading based on publicly revealed repurchase changes. Specifically, when short sellers learn firms increase repurchases, they tend to reduce their positions. The short sellers' incomplete information helps explain why they incur the cost of short selling when firms repurchase, even though subsequent returns are positive, on average, after disagreement quarters. However, the small economic magnitude of our coefficients coupled with our profitable proposed trading

strategy suggests that short sellers would benefit from reacting more strongly to announcements of repurchase increases.

B. Do Firms Respond to Short Sellers?

Now we examine if firms respond to disclosed changes in short interest. Managers can observe and respond to short selling in a timely fashion because short interest is publicly revealed throughout the quarter (once per month on the 15th calendar day until Sept. 2007, twice per month on the 15th and last business days thereafter). To more cleanly identify firms' reactions to short selling, we switch to more granular monthly repurchase and short interest data and test whether the most recently revealed changes in short interest are related to the current month's repurchases. Monthly repurchase amounts and average prices are reported in quarterly (10-Q) and annual (10-K) filings beginning in 2004. We hand-collect these data as described in Appendix B.

Table 11 presents regressions of monthly shares repurchased (as a proportion of beginning-of-month shares outstanding) on prior changes in short interest (also expressed as a proportion of shares outstanding). Because increases in short interest may have more of an impact on repurchases than decreases, we bifurcate changes in short interest based on the direction of the change. We present results by short interest disclosure reporting period, monthly from 2004 to Sept. 2007 and bi-weekly thereafter.[16] We also segment on fiscal quarter month because repurchase motives can vary depending on the time to quarter end due to earnings clarity and the effect on EPS. We include control variables from Table 4 as well as firm and month fixed effects.

TABLE 11
Do Firms Respond to Short Sellers?

Table 11 reports regressions of monthly repurchases as a function of prior changes in short interest. The dependent variable is monthly repurchases, scaled by the beginning-of-month number of shares outstanding in all regressions. Due to a change in short interest reporting frequency in 2007, ΔSHORT_INTEREST is the change in short interest the month before the repurchase for the first 3 models and the 2 weeks before the repurchase for the last 3 models. SHORT_DECREASE is an indicator variable equal to 1 if the change in short interest is nonpositive, or 0 otherwise. All control variables from Table 4 are included, but omitted for brevity. Firm and month fixed effects are included in all regressions, and errors are double clustered by firm and month. *t*-statistics are presented in parentheses, and *, **, and *** denote significance at the 10%, 5%, and 1% levels, respectively.

	Monthly Reporting Period (2004–2007)			15-Day Reporting Period (2007–2014)		
	1st Month	2nd Month	3rd Month	1st Month	2nd Month	3rd Month
	1	2	3	4	5	6
ΔSHORT_INTEREST	0.007*	0.008	0.000	0.007*	0.013*	0.016***
	(1.687)	(1.569)	(0.023)	(1.755)	(1.772)	(3.037)
ΔSHORT_INTEREST	−0.003	0.002	0.006	−0.012	−0.023*	−0.021**
× SHORT_DECREASE	(−0.469)	(0.203)	(0.807)	(−1.628)	(−1.882)	(−2.551)
No. of obs.	33,407	33,286	33,072	53,826	55,834	55,955
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Adj. R^2	0.141	0.209	0.156	0.132	0.173	0.149
F-tests with p-values:						
ΔSHORT_INTEREST	0.004	0.010	0.006	−0.005	−0.010	−0.005
+ interaction	[0.495]	[0.194]	[0.162]	[0.313]	[0.118]	[0.364]

[16] See http://www.finra.org/industry/short-interest-reporting for more details.

Repurchase amounts are positively related to changes in short interest during the first and second months of fiscal quarters from 2004 to 2007, though statistical significance is weak. Further, the effect of short selling on repurchases is concentrated in increases in short interest. The relation between short interest changes and repurchases is stronger during the latter part of the sample (2007–2014) with bi-weekly short interest disclosure. During all 3 months of the fiscal quarter, revealed increases in short interest are associated with increases in repurchases (significant at the 10% level). F-tests suggest decreases in short interest are unrelated to repurchases. During the latter part of our sample, a 1-percentage-point increase in short interest implies a 0.007–0.016-percentage-point increase in monthly repurchases, or a 10% to 23% increase relative to mean monthly repurchases. Overall, firms generally repurchase more after observing larger increases in short interest. Because revelations of repurchase increases are associated with *decreases* in short interest but revelations of short selling are generally associated with *increases* in repurchases, if the positive relation between short selling and repurchases is causal, short selling likely causes firms to repurchase and not vice versa. We further discuss timing and causality in the next subsection.

C. Timing and Causality

Disagreement occurs more frequently than unconditional probabilities would predict, but is the relation causal? The importance of the timing and causal nature of short seller and firm trades depends upon which hypothesis we are testing. The *Private Information Hypothesis* posits that positive private information motivates repurchases, even during disagreement when short sellers are actively betting against the stock. The *Private Information Hypothesis* does not depend on the timing of trading or information flow. While negative price responses to short selling could increase managers' perceived undervaluation, the only necessity for this hypothesis is differential information. On the other hand, the *Managerial Short-Termism Hypothesis* predicts that short selling occurs first. This hypothesis claims short sellers correctly identify overvalued stock then firms repurchase to defend the overvalued stock. Because our evidence strongly supports the *Private Information Hypothesis*, the timing of trading and information are ultimately not critical.

Nonetheless, we design and implement tests using the regulation SHO data as an exogenous shock to short selling. Regulation SHO relaxed short-selling restrictions for a random sample of Russell 3000 firms (Diether, Lee, and Werner (2009), Grullon, Michenaud, and Weston (2015)). Ideally, this would create an exogenous shock to short selling in the treated group of firms relative to the control firms. In our first stage models in Table IA8 in the Supplementary Material, however, neither the change in the magnitude nor the frequency of short selling is significantly different between the treated and control firms. The lack of differential short selling in the treated sample renders our regulation SHO tests uninformative in our setting. Hence, we cannot fully establish causality or rule out omitted variables increasing both the likelihood of repurchases and short selling. However, because we include firm-quarter fixed effects along with a host of firm-level controls, such an omitted variable must be a time-varying firm characteristic unaccounted for in these controls.

While testing causality between short selling and repurchases is thus beyond the scope of this paper, our evidence favors short selling causing repurchases, as in Campello et al. (2018). Dissimilar frequencies and lags in short interest and repurchase disclosures allow managers to observe and respond to short selling faster than short sellers can react to repurchases: Short interest is publicly revealed six times during a quarter, but repurchases are typically not announced until 30 to 45 days after quarter end. Further, while firms repurchase more when short selling increases, short sellers *decrease* their positions when firms disclose increases in repurchases. Finally, short sellers have no motive to knowingly disagree with firms because our consistent finding of positive returns after disagreement suggests they lose on average when disagreement occurs. Overall, the relative availability of public disclosures coupled with a lack of motive and our finding that short sellers unravel their positions when they learn of increased repurchases support short selling causing increased repurchases and not vice versa.

XI. Concluding Remarks

We conclude by outlining the practical implications of our results. 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 short sellers should take heed when trading against the firm and other investors mimicking short sellers can increase profits by factoring in simultaneous trades by the firm. Second, in a setting with enhanced incentives for managerial myopia, our results do not support the increasingly common view that managers repurchase to meet short-term goals at the expense of long-term shareholder value. Instead, our results imply that, even in this setting, repurchases are motivated by positive private information.

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 nonoperating), 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 nonoperating 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,

TABLE A1
Summary Statistics

Table A1 reports 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 nonoperating 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. 8K_SUM is the sum of 3-day cumulative abnormal returns (CARs) around 8-K filings over 3 months, calculated using a market model. If the company released no 8-Ks, we set this variable equal to 0. 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.

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	0.232	0.000	0.001	0.192
RETURN_VOLATILITY	147,613	0.032	0.014	0.027	0.056
MARKET_RETURN	147,794	0.025	−0.098	0.028	0.118
8K_SUM	116,510	0.339	−24.980	−1.601	24.366
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

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 nonoperating income comprise 1.2% and 0.1% of assets, respectively, on average, and also exhibit substantial variation: Operating (nonoperating) 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 divided 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 10th percentile have no debt in their capital structure while firms at the 90th percentile have outstanding debt obligations equivalent to 48.3% of the value of total assets.

We also gather control variables from the Center for Research in Security Prices (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 et al. (1997) abnormal returns matched on size, book-to-market and momentum. Quarterly abnormal returns hover around zero, as expected; average (median) abnormal returns are between 0.35% and 0.29% (1.34% and 1.56%). Abnormal returns vary substantially within our sample from approximately −24% at the 10th percentile to approximately 23% at the 90th percentile for both measures. Repurchases positively affect liquidity (Hillert et al. (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 (when multiplied by 1,000) is 0.232 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 3 months, to create the variable 8K_SUM. If the company released no 8-Ks, we set this variable equal to 0. 8K_SUM is approximately 0.34% on average over 3 months. Indicative of firms releasing similar quantities of good and bad news, the 10th percentile mirrors the 90th percentile: −25.0% versus 24.4%. EARNINGS_SURPRISE is the 3-day cumulative abnormal return around the earnings announcement associated with the quarter of interest. We calculate EARNINGS_SURPRISE using a market model estimated over 250 trading days, ending 46 days prior to the earnings announcement, and conditioning on a minimum of 100 days of returns data. We again use a standard 3-day event window. The average earnings surprise is only −5.3 bps, and earnings surprise varies from −9.2% at the 10th percentile to 8.9% at the 90th percentile.

Finally, we gather repurchase announcements from the Securities Data Corporation (SDC) and institutional ownership from Thomson Reuters Institutional (13f). Prior literature documents a peer effect associated with repurchases, especially within concentrated industries (Massa, Rehman, and Vermaelen (2007)). We thus use SDC repurchase announcement data to calculate INDUSTRY_ANNOUNCEMENTS, the percentage of firms in the same 2-digit SIC code that announced a repurchase during the same calendar quarter. Firms at the 10th percentile operate in industries with no repurchase announcements during the quarter while firms at the 90th percentile operate in industries with 4.2% of firms announcing repurchases. Further, Grinstein and Michaely (2005) document that institutional investors prefer firms that repurchase regularly, and Campello et al. (2018) note that

institutional ownership significantly affects the supply of shares available to short. We estimate INSTITUTIONAL_HOLDINGS as the total shares owned by institutions, as a percentage of shares outstanding. Institutional holdings vary from 9.2% of shares outstanding at the 10th percentile to 95.4% at the 90th percentile.

Appendix B. Hand-Collected Monthly Repurchase Data

Appendix B describes the monthly repurchase data and our hand-collection process.

1. Rule Change Requiring Increased Disclosure

In 2003 the SEC amended Rule 10b-18, also known as the "safe harbor provision," to enhance transparency of issuer repurchases. The SEC increased disclosure requirements: "Under the proposed amendments, issuers would be required to disclose, among other things, the total number of shares repurchased during the past quarter, the average price paid per share, the number of shares that were purchased as part of a publicly announced repurchase plan, and the maximum number (or approximate dollar value) of shares that may yet be purchased under the plans or programs." Beginning in 2004 the SEC required companies to report the above information on a monthly basis in 10-Q reports under Item 2 (Changes in Securities and Small Business Issuer Purchases of Equity Securities) and in 10-K reports under Item 5 (Market for Registrant's Common Equity, Related Stockholder Matters and Issuer Purchases of Equity Securities). [17]

2. Data Collection

To collect the data on monthly repurchases from 10-Q and 10-K filings, we begin with a sample of all Compustat firm-quarters from 2004 to 2014. Compustat aggregates reported repurchase amounts and prices on a quarterly basis; we first require a nonmissing/nonzero value for Compustat quarterly repurchases (cshopq). We further require the firm to have a nonmissing value for total assets (atq) and a share code of 10 or 11. We require CIK to match firms to Edgar filings and therefore drop all observations with missing CIKs. We match this subsample of Compustat firm-quarters to 10-Q and 10-K records from Edgar using CIK and fiscal quarter. This process yields 39,312 firm-quarters.

For each firm-quarter in our sample, we hand-collect the table located under Item 2 (Item 5) of the 10-Q (10-K). This table includes the starting and ending date of each month, the total number of shares repurchased each month, the average price per share paid each month, the total number of shares repurchased under an announced program each month, and the remaining shares of the announced program each month. We also gather table footnotes, which often contain additional details.

We use a combination of algorithms and hand-checking to clean the data. Formatting and units are not uniform across all firms. We consistently format dates and use Compustat to verify if repurchases are reported in shares or dollars and to adjust for possible scaling (in thousands, hundred thousands, or millions). Again, we check by hand and correct all observations for which scaling and units cannot be identified. We also correct for cumulative reporting of shares repurchased. We use the values for average price and shares repurchased to check if the value remaining under the repurchase program is reported in shares or dollars. Through this process we feel confident in the accuracy of our data.

The final sample of repurchases consists of 154,332 firm-months for 4,066 firms. Of that sample, 75,041 firm-months (48.6%) belonging to 3,313 firms (81.5%) have repurchases under an announced program.

[17] See https://www.sec.gov/Archives/edgar/data/750004/000144530514002037/sgms331201410q.htm for an example of the reporting of monthly repurchases in quarterly filings.

Supplementary Material

Supplementary Material for this article is available at https://doi.org/10.1017/S0022109019000851.

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