

Why do short interest levels predict stock returns?

Ferhat Akbas*, Ekkehart Boehmer*, Bilal Erturk[◇], and Sorin Sorescu*

January 31, 2008

Abstract

High levels of short interest predict negative abnormal returns, but the reasons for this predictability are not well understood. Two popular explanations suggest very different interpretations. According to Miller (1977), stocks are overvalued in the presence of short-sale constraints, and the subsequent negative abnormal returns represent a correction of this overvaluation. Based on recent evidence in the accounting and microstructure literature, an alternative explanation is that short sellers are highly informed traders and short interest, therefore, predicts future returns due to its information content. We discriminate between the *overvaluation* and the *information* hypotheses and find support for the latter. Therefore, our evidence suggests that short sellers act as specialized monitors who generate value-relevant information in the stock market.

Keywords: Short selling, short interest, overvaluation, stock returns

JEL Classification: G12, G14

* Mays Business School, Department of Finance, Texas A&M University, College Station, TX 77843-4218. [◇] Spears School of Business, Department of Finance, Oklahoma State University, Stillwater, OK 74078-4011. We are indebted to Bart Danielsen for providing short interest data and to Wesley Chan for providing data on public news. We thank Kerry Back, Dave Blackwell, Mike Gallmeyer, Shane Johnson, Dmitry Livdan, and Jay Ritter for useful comments.

Why do short interest levels predict stock returns?

Abstract

High levels of short interest predict negative abnormal returns, but the reasons for this predictability are not well understood. Two popular explanations suggest very different interpretations. According to Miller (1977), stocks are overvalued in the presence of short-sale constraints, and the subsequent negative abnormal returns represent a correction of this overvaluation. Based on recent evidence in the accounting and microstructure literature, an alternative explanation is that short sellers are highly informed traders and short interest, therefore, predicts future returns due to its information content. We discriminate between the *overvaluation* and the *information* hypotheses and find support for the latter. Therefore, our evidence suggests that short sellers act as specialized monitors who generate value-relevant information in the stock market.

A puzzling empirical finding is that stocks with high levels of short interest are followed by negative abnormal returns (Asquith and Meulbroek 1996, Desai et al. 2002). This finding appears inconsistent with the Efficient Markets Hypothesis because it implies that current public information can predict future stock returns. The literature offers two popular explanations for this predictability that we label the *overvaluation hypothesis* and the *information hypothesis*. They differ substantially in their implications, and our objective is to design tests that empirically discriminate between the two.

The overvaluation hypothesis is an implication of Miller's (1977) model. It holds that stocks with high levels of short interest are overvalued because pessimistic investors are unable to establish short positions, leaving only the optimists to participate in the pricing process. In this model, market forces are unable to prevent overpricing in the amount of shorting costs when these costs are high. The greater the shorting costs, the greater the possible overpricing; and therefore, the lower the subsequent stock returns.

The information hypothesis builds on a broadening base of empirical research demonstrating that short sellers are well informed traders. Short-sale practitioners tend to be investors with superior analytical skills (Gutfleish and Atzil, 2004) and typically initiate short positions when they can infer low fundamental valuation from public sources. For example, short sellers may engage in forensic accounting, looking for high levels of accrual as evidence of hidden bad news (Sloan, 1996). Or they may examine divergence between earnings and cash flows, or abnormally elevated price-earning ratios. As a result, they earn substantial abnormal returns on their trading (Boehmer, Jones, and Zhang, 2007). But the adjustment to short sellers' information is not instantaneous; in fact, Boehmer et al. show

that abnormal returns on shorting strategies persist for up to 60 days. Therefore, short interest—the level of outstanding shorts—could have predictive power for future returns.

Differentiating between the overvaluation hypothesis and the information hypothesis is important, because their theoretical implications are strikingly different. In Miller's model, uninformed but irrationally optimistic investors take long positions while the irrationally pessimistic investors (equally uninformed) take short positions. When short positions are more difficult to establish than long positions, stocks will be overvalued as a result of the optimists' long trades. The overvaluation eventually dissipates when the fundamental value is revealed. Thus, under the overvaluation hypothesis, short interest has no information content and short sellers themselves play no role in correcting this overvaluation.

Under the information hypothesis, short sellers are regarded as informed traders whose absence from the market makes prices noisier. They play an active role in making prices more efficient by trading on negative information. Because this process is not instantaneous, their positions (which are publicly observable at a monthly frequency) provide investors with a signal that the stock is overvalued. In contrast to the overvaluation hypothesis, this implies that the level of short interest is related to fundamental information about the stock and gives short sellers a role in making prices more efficient.

While the extant empirical evidence is consistent with elements from both the overvaluation and information hypotheses, it is insufficient to discriminate between the two explanations. Negative returns following periods with high short interest, a prominent empirical result, are consistent with both hypotheses. Stocks can be overpriced in the presence of binding short sale constraints and dispersion of investor opinion, and we would

observe underperformance when prices subsequently revert to equilibrium. Under the information hypothesis, short interest would also be associated with subsequent negative returns, but in this case it is the negative information short sellers have that drives prices down.

In this paper, we design empirical tests to differentiate between the overvaluation and information hypotheses and find that the information effect is dominant. Our results are consistent with the view that short sellers are informed traders who can identify value-relevant information about publicly traded firms. We show that their holdings, as reflected in monthly short interest reports, predict public news announcements, earning surprises, and returns. In this capacity, short-sellers join the ranks of stock analysts, institutional investors, underwriters, auditors, and bank lenders, who have been shown to provide similar information-acquiring functions.¹

Our information hypothesis is similar to the theoretical argument in Diamond and Verrechia (1987), but with one important difference. Their model assumes a pure rational expectations economy where the level of short interest is publicly observable and its informational content incorporated into stock prices immediately. Therefore, short interest in their model can predict changes in firm fundamentals but not returns. However, price adjustment to short sellers' information is far from instantaneous (see Boehmer, Jones, and Zhang, 2007). This suggests a limits-to-arbitrage setting, where stock prices do not

¹ For example, underwriter quality has been shown to influence the extent of IPO underpricing (Beatty and Ritter, 1986; Carter and Manaster, 1990), as has the identity of an IPO firm's auditors (Beatty, 1989). A long literature documents the positive effect of bank loan announcements on a firm's stock price (e.g., Mikkelsen and Partch, 1986; James, 1987; Lummer and McConnell, 1989), including the finding that announced loans from higher-quality lenders are associated with more positive borrower abnormal returns (Billett, Flannery, and Garfinkel, 1995). Also, Brennan and Subramanyam (1995) report that the equity of firms which are followed by a larger number of investment analysts trade with smaller bid-ask spreads, reflecting lower informational asymmetries across traders in the market. Finally, Boehmer and Kelley (2007) report that institutional investors improve the efficiency of security prices.

incorporate information immediately and deterministically. We believe that this is a sensible approach, because trading strategies based on short interest tend to be risky. For example, a trading strategy that consistently shorts stocks in the highest short interest decile and goes long on stocks in the lowest short interest decile will earn an average return of 1.51% per month. But this return varies over time. The strategy has a beta of 0.69 and a standard deviation of 5.1%. Consequently, risk-averse arbitrageurs may not be able to exploit overvaluation immediately. Moreover, shorting strategies are subject to additional risks that confound this effect. For example, a short squeeze could force short sellers to liquidate early, before the stock moves in the expected direction (De Long et al., 1990). Finally, the risk associated with these strategies may limit short sellers' ability to raise capital from third parties (Shleifer and Vishny, 1997). For these reasons, we believe that the information hypothesis is best represented in combination with a limits-to-arbitrage argument, and our analysis builds on this insight.

Perhaps closest to our analysis is the work by Asquith, Pathak, and Ritter (2005). They find that stocks with high levels of short interest and low institutional ownership subsequently earn abnormally low returns. To the extent that high short interest and low institutional holdings identify binding constraints on shorting, this result is consistent with the overvaluation hypothesis. But alternative interpretations are also possible. In particular, the higher shorting costs associated with lower institutional ownership are more likely to discourage uninformed, rather than informed traders from shorting. As a consequence, higher short selling in stocks with low institutional ownership could indicate that the marginal short seller is better informed. If true, the subsequent lower returns reflect the adjustment to new information as in the information hypothesis (with limits to arbitrage),

rather than the correction of mispricing as in the overvaluation hypothesis. Consistent with this interpretation, Asquith, Pathak and Ritter document that among short-sale constrained firms, “valuation” shorts have more predictive power than “arbitrage” shorts. Arbitrage shorts are less likely to reveal information about the stock, because they typically exploit the mispricing in related securities, such as convertible bonds issued by the same firm. This finding, while not fully exploited in Asquith et al.’s paper, suggests the information of short sellers could affect the relation between short interest and subsequent returns, and our analysis is intended to differentiate it from the overvaluation story.

Prior evidence lends support to both the overvaluation and the information hypotheses. Boehme, Danielsen, and Sorescu (2006) provide direct evidence in support of the former. Using proxies for short sale constraints and dispersion of investors’ beliefs, they show that overvaluation is confined to those stocks that have both high short-sale constraints and high dispersion of beliefs. Diether, Malloy, and Scherbina (2002) find that dispersion of investors’ beliefs, as proxied by dispersion in analysts’ forecast, predicts lower subsequent returns. In the presence of short sale constraints, this predictability is consistent with the overvaluation hypothesis.

Several recent studies provide evidence that is consistent with informed short sellers, but they do not contrast the different predictions of the overvaluation and information hypotheses. Boehmer, Jones, and Zhang (2007) examine daily shorting flows and show that short sellers can systematically identify relatively overvalued stocks. Highly shorted stocks earn significantly lower risk-adjusted return over the next 60 days when compared to lightly shorted stocks. Wu (2007) and Boehmer and Kelley (2007) construct several measures of informational efficiency and find that daily shorting flows are

positively related to these measures. These results, all derived from daily flows of short selling, suggest that short sellers are highly informed traders and that their information moves prices for several weeks. Consistent with the delayed adjustment to shorters' information, Desai et al. (2002) show that the higher the short interest the greater its informativeness. Cohen, Diether and Malloy (2007) contend that shorting demand signals informed trading. By differentiating between supply and demand shifts in the shorting market, Cohen, Diether, and Malloy show that stock returns are predicted only by changes in shorting demand, not shorting supply. Moreover, this predictability is stronger for stocks with lower levels of analyst coverage.

Finally, there is also some evidence that short sellers possess information about fundamentals. For example, Christophe, Ferri, and Angel (2004) find that negative earnings surprises are preceded by abnormal short selling. Francis, Venkatachalam, and Zhang (2006) show that short sellers are able to predict downward analyst forecast revisions, while Desai, Krishnamurthy, and Venkataraman (2006) find that short sellers are able to anticipate earnings restatements.

Overall, the evidence suggests that short sellers are informed traders whose activity ultimately helps prices incorporate more information, and our study helps to understand why the level of their holdings has predictive power about returns and fundamentals. Our results suggest that the return predictability of short interest cannot be fully explained with a Miller-type (1977) argument. Rather, the results are consistent with informed short sellers and the idea that the level of their holdings, short interest, is informative. Short sellers provide value-relevant information about future fundamental value, especially for stocks with low institutional ownership. These results corroborate recent evidence that short

sellers contribute in important ways to price discovery in financial markets and imply that restrictions on short selling could impose significant indirect costs on other market participants. Moreover, our findings add to a long debate about the source of the negative relationship between short interest and future returns. Specifically, our evidence suggests that this relationship arises because high short interest implies that the marginal short seller contributes more to price discovery, and not because of the inherent inefficiency associated with pessimists being driven out of the market.

The rest of the paper is organized as follows. In Section 1, we discuss the design of our empirical strategy. In Section 2, we describe the data sources and methodology. We present empirical results in Section 3 and conclude in Section 4.

I. Test design and interpretation

We propose two novel approaches to discriminate between the overvaluation hypothesis and the information hypothesis. Miller (1977) argues that as short sale constraints become more binding, fewer pessimists enter the market, resulting in higher market prices. This implies a positive relation between changes in shorting constraints and contemporaneous overpricing. Following Asquith, Pathak, and Ritter, we consider high levels of short interest (which indicates high shorting demand) and low levels of institutional ownership (which indicates a low supply of lendable shares) as proxies for shorting constraints. Thus, under the overvaluation hypothesis, we expect abnormal returns to be positively correlated with contemporaneous changes in short interest and negatively correlated with contemporaneous changes in institutional holdings.

The information hypothesis also predicts a positive relation between returns and contemporaneous changes in short interest, but for a different reason. Here, the positive

relation arises because smart short sellers become more active when prices are rising (see Brent et al. 1990, Dechow et al. 2001, Diether, Lee, and Werner 2007). But in contrast to Miller, the information hypothesis predicts that changes in institutional holdings are also positively related to contemporaneous abnormal returns. Holding the level of short interest constant, a decline in institutional holdings implies that short positions are now more likely to contain negative information about fundamentals. This is because lower institutional holdings increase the cost of shorting, so the marginal short seller is more informed (Diamond and Verrecchia, 1987). Rational investors who observe a decline in institutional ownership without a corresponding decline in short interest can then infer the negative information and cause a decline in market stock prices. These theoretical predictions are summarized in Table 1.

For our second approach, we exploit the relation between short interest and subsequent unexpected news. Miller's prediction arises from disagreement among investors; short sellers are more pessimistic than other traders, but have no private information about fundamentals. In contrast, the information hypothesis implies that short sellers are informed and have information about fundamentals that other traders do not have. Thus, higher levels of short interest should be followed by predominantly unfavorable public news. Moreover, the information advantage of short sellers should be greater in stocks with lower levels of institutional holdings, because the higher shorting costs for these stocks imply that short transactions are more likely to be initiated by informed traders (Diamond and Verrecchia, 1987). Table 2 summarizes the theoretical predictions related to this second testing approach. We use two different measures of unexpected public information: a count of public news items and earnings surprises.

All tests favor the information hypothesis over the overvaluation hypothesis. First, we find that the relation between stock returns and contemporaneous changes in institutional holdings is indeed positive. This is consistent with the information hypothesis but not with Miller's overvaluation hypothesis. Second, we show that the level of short interest predicts unexpected public information – higher short interest is associated with more negative news items and more negative earnings surprises in the future. In general, the predictive power of short interest decreases with the level of institutional ownership. To the extent that institutional ownership proxies for the supply of lendable shares (Asquith, Pathak, and Ritter), this finding is consistent with Diamond and Verrecchia's (1987) argument that the level of short interest is most informative in stocks with higher shorting restrictions. Again, this supports the information hypothesis.

II. Data and methodology

Data on stock returns are from the Center for Research on Security Prices at University of Chicago (CRSP) for all common stocks listed on NYSE, Amex, and NASDAQ (share code 10 or 11), between January 1988 and December 2005. Monthly short interest, *Short*, is based on outstanding shorts reported by the exchanges, standardized by the number of shares outstanding. Data on institutional ownership are obtained from 13-F filings, available from Thomson Financial. We define institutional holdings, *IO*, as the sum of the holdings of all institutions for each stock in each quarter, divided by the number of shares outstanding obtained from CRSP. Stocks that have available return data but no reported institutional holdings are assumed to have zero institutional ownership.

Size is the market value of equity calculated as the number of shares outstanding times the month-end share price. *B/M* is the ratio of book to market value of equity. Book

value is computed as in Fama and French (2002) and measured at the most recent fiscal year-end that precedes the calculation date of market value by at least three months.² We exclude firms with negative book values. The stock's momentum (*MOM*) is computed as its raw return over the previous 12 months.

We measure *unexpected public information* in two ways. First, we use the (signed) count of public news items from Chan (2003).³ His data covers a random sample of approximately one-quarter of CRSP stocks during the period from 1980 to 2000. News items come from the Dow Jones Interactive Publications Library, which incorporates all newspapers with over 500,000 subscribers. For each stock covered, Chan collects the dates at which the stock was mentioned in the headline or lead paragraph of an article of one of the publications covered. About half the stocks have at least one news item each month, and less than 5% of stocks have public news during more than five days per month.⁴ Tests involving Chan's data are conducted on this more restrictive sample.

One limitation of the news count data is the absence of specific information about the content of the news items. We use a method similar to Chan's to overcome this limitation. To infer the news content, we compute the cumulative abnormal return (CAR) as the average daily market-adjusted return around the news date (Brown and Warner 1985):

² Book value is defined as total assets (data 6) minus total liabilities (data 181) plus balance sheet deferred taxes and investment tax credit (data 35) minus the book value of preferred stock. Depending on data availability, the book value of preferred stock is based on liquidating value (data 10), redemption value (data 56), or carrying value (data 130), in order of preferences.

³ The signed count is obtained by assigning a value of +1 to all news items with favorable content, and a value of -1 to news items with unfavorable content.

⁴ We thank Wesley Chan for sharing his database. See Chan (2003) for a detailed data description.

$$CAR_i = \frac{1}{4} \sum_{j=-2}^{j=1} (r_{ij} - r_{mj}) \quad (1)$$

where r_{ij} is the stock i 's return on day j and r_{mj} is the return on the equally-weighted CRSP market index on day j . Day $j=0$ is the news date.⁵

To filter out noise associated with daily price movements, we classify small CARs as neutral. We use two different filters: *NEWS1* classifies $|CAR| \leq 0.5\%$ as neutral, while *NEWS2* classifies items with $|CAR| \leq 1\%$ as neutral.⁶ Then we assign numerical values of +1 to all positive news items, zero to all neutral items, and -1 to all negative news items and compute a monthly aggregate news measure by averaging the (signed) values of all news items that month. Months with no news items are assigned an aggregate news measure equal to zero.

Our second measure of unexpected news is based on earning surprises. To obtain earning surprises we begin with quarterly earnings and announcement dates from COMPUSTAT. We then construct two measures of earnings surprises: standardized unexpected earnings (*SUE*) and cumulative abnormal returns around the earnings announcement (*CAR*).

Following Foster, Olsen, and Shevlin (1984), we define *SUE* in month t as

$$SUE_t = \frac{EPS_q - E[EPS_q]}{\sigma_t} \quad (2)$$

where q is the quarter, EPS_q are the most recent quarterly earnings per share, $E[EPS_q]$ are expected earnings per share, and σ_t is the standard deviation of unexpected earnings (EPS_q)

⁵ In case of adjacent news events with overlapping $[-2, 1]$ event windows, the second news event is deleted.

⁶ For robustness, we experiment with a $\pm 1.5\%$ filtering band, and also further consider the case where no filtering band is used. In this latter case, a content is classified as positive for $CAR > 0\%$ and negative for $CAR < 0\%$. In all cases, the results remain qualitatively similar.

– $E[EPS_q]$) over the preceding eight quarters. To estimate expected earnings we use a seasonal random walk model as in Chan, Jegadeesh, and Lakonishok (1996):⁷

$$E[EPS_q] = \alpha + EPS_{q-4} \quad (3)$$

The second measure of earnings surprises is the average daily market-adjusted return around the earnings announcement date (*CAR*). Earning-surprise *CARs* are computed in the same manner as the *CARs* used infer the content of news items.

We begin with a standard portfolio-sorting approach to test the ability of short interest to predict future returns, unexpected news, and earnings surprises. Each month, we rank stocks on the basis of short interest, changes in short interest, institutional ownership, or changes in institutional ownership, and assign them to decile portfolios. For each portfolio we compute either contemporaneous returns (measured over the calendar month of portfolio formation) or subsequent returns (measured over the calendar month following portfolio formation). We use both equally-weighted raw returns and abnormal returns based on a four-factor model.⁸ The latter are computed as the intercept from the following regression:

$$r_{pt} - r_{ft} = \alpha + \beta_1(r_{mt} - r_{ft}) + \beta_2SMB_t + \beta_3HML_t + \beta_4MOM_t + \varepsilon_{pt} \quad (4)$$

where $r_{pt} - r_{ft}$ is the portfolio return minus the return on one-month T-bill, $r_{mt} - r_{ft}$ is the market excess return, *SMB* is the size factor return, *HML* is the book-to-market factor

⁷ For robustness we also estimate expected earnings using a seasonal AR(1) model:

$E[EPS_t] = EPS_{t-4} + \alpha + \beta(EPS_{t-1} - EPS_{t-5})$. The results (untabulated) are very similar to those obtained with the seasonal random walk model.

⁸ For robustness, we also examine stock returns based on value-weighted and log-value-weighted portfolios. The value-weighted returns are consistent with the equally weighted returns, except that significance levels are generally lower, perhaps due to lower statistical power. Nonetheless, the returns of the hedge portfolios remain statistically significant at the one percent level. The log-value-weighted results are almost identical to the main equally-weighted results presented in the tables.

return, and MOM is the momentum factor return. Factor returns are obtained from Kenneth French's web site at Dartmouth College. Aside from the sorts, we also use a multivariate predictive regression to verify the robustness of our results.

III. Results

We begin by replicating Asquith, Pathak, and Ritter's (2005) findings and report the results in Table 3. Panel A of Table 3 shows that heavily shorted stocks underperform lightly shorted stocks by 1.51% per month on an absolute basis, and by 1.72% on a risk-adjusted basis. For the most heavily shorted stocks (decile 10), the average short interest is 8.8% and the average monthly risk adjusted return is 0.52% ($t = -3.03$). The results presented in Panel A are quite similar to those obtained by Asquith Pathak and Ritter and are consistent with both the overvaluation and information hypotheses.

Panel B examines the role of institutional ownership (IO) for the most heavily shorted decile. Asquith, Pathak, and Ritter (2005) find that low IO predicts negative returns for these stocks. Columns (1) and (2) in Panel B present the average level of IO and short interest for three portfolios sorted on IO.

Columns (3) and (4) replicate the findings of Asquith, Pathak and Ritter: both the absolute (Ret) and abnormal (α) returns are lowest for the lowest IO group (IO1). The difference in raw returns between the lowest and highest IO groups (IO3-IO1) is significant at the 1% level, and the difference in α is significant at the 10% level.

While Asquith, Pathak and Ritter interpret this evidence as consistent with Miller's (1977) theory, our new evidence in columns (5) through (8) illustrates the relevance of the information hypothesis. We report, for each IO group, the average public news count during the month that follows the portfolio formation period. Column (5) and (6) show the

results corresponding to the *NEWS1* measure ($|CAR| \geq 0.5\%$) and the *NEWS2* measure ($|CAR| \geq 1.0\%$), respectively. We also report the average earnings surprise (SUE and CAR) corresponding to the next earnings announcement following the portfolio formation period (columns (7) and (8)).

Panel B shows that low IO forecasts not only negative future returns, but also negative future public news and earning surprises. If shorting is more difficult for low IO stocks, this suggests that shorts in the IO1 portfolio are particularly informed about deteriorating fundamentals, a result consistent with the information hypothesis.

We now turn to more formal tests designed to discriminate between the overvaluation and information hypotheses.

A. Changes in shorting constraints and contemporaneous returns

Our first set of tests builds on Miller's prediction that stocks with binding short sale constraints (high short interest and low institutional ownership) are overpriced. Since the extent of overpricing is proportional to the level of short sale constraints, it follows that overpricing should exacerbate as short sale constraints become more binding. Therefore, we should observe a positive relation between changes in short sale constraints and contemporaneous stock returns.

Asquith, Pathak, and Ritter (2005), propose that stocks are short-sale constrained when they have low levels of institutional ownership (low supply) and high level of short interest (high demand). Thus, a decrease in institutional ownership or an increase in short interest (or both) would imply greater constraints on shorting. We examine each of these two dimensions separately.

Each quarter q , we sort stocks into quintile portfolios based on the level of short interest at the end of that quarter, and further sort each portfolio into quintiles based on changes in institutional ownership between the end of quarters q and $q+1$. We compute contemporaneous raw and abnormal portfolio returns from the end of quarter q to the end of quarter $q+1$. Under Asquith, Pathak and Ritter's interpretation, an increase in institutional ownership would imply an increase in the supply of lendable stocks, which in turn would relax short sale constraints. The overvaluation hypothesis predicts that relaxing short sale constraints should allow prices to come down to their fundamental value. Thus, if the overvaluation hypothesis holds, we expect a negative relation between stock returns and contemporaneous changes in institutional ownership.

The results are presented in Table 4. Panel A of Table 4 shows results obtained using raw returns. Contrary to Miller's overvaluation predictions, stocks with increasing levels of institutional ownership are associated with higher contemporaneous returns.⁹ To test the statistical significance of this relation, we construct hedge (long-short) portfolios that take long positions in stocks with the largest increases in institutional ownership ($\Delta IO5$) and short positions in stocks with smallest increases in institutional ownership ($\Delta IO1$).

Across all short interest quintiles, large increases in institutional ownership ($\Delta IO5$) are always associated with higher returns when compared to small increases ($\Delta IO1$). The returns of the hedge portfolios are always positive and statistically significant at better than the 1% level. This is particularly true for the most heavily shorted stocks ($Short5$), where

⁹ The relation between changes in institutional ownership and contemporaneous stock returns is also explored by Griffin et al. (2003), Nofsinger and Sias (1999), and Wermers (1999). However, none of these studies condition on the level of short interest or examine the informational content of short selling.

short sale constraints are presumably most binding: the return of the hedge portfolio is 7.71% per month during the quarter for which the change in institutional ownership is calculated ($t=15.23$). The overvaluation hypothesis would predict negative returns here. Not only is the hedge return positive, but its magnitude is highest among all hedge returns obtained with various portfolios sorted on short interest. In fact, hedge returns are monotonically increasing with the level of short interest. Miller's overvaluation hypothesis would predict a monotonically decreasing relation.

Panel B of Table 4 repeats the analysis of Panel A with abnormal returns computed as the intercept from the four-factor Fama-French-Carhart model. The results are similar to those reported in Panel A, suggesting that the relation between contemporaneous returns and changes in institutional ownership is not driven by the common four factors. Overall, the results presented in Table 4 do not support the joint hypothesis that (1) Miller's model is correct and (2) institutional ownership proxies for the supply of lendable shares.¹⁰

B. The information content of short interest

In our second set of tests to discriminate between the overvaluation and information hypotheses, we ask if short interest can predict future deterioration in firm fundamentals. We use subsequent public news and earnings announcements to infer changes in fundamentals. Under the information hypothesis, if higher levels of short interest are associated with higher shorting costs (D'Avolio, 2002; Boehme, Danielsen, and Sorescu,

¹⁰ For completeness, we also examine the relation between contemporaneous returns and changes in the level of short interest. As previously discussed (cf. Table 1), this test cannot differentiate between the Miller and information hypotheses because a positive relation is expected in both cases. We rank stocks into quintiles based on institutional ownership and then rank each portfolio into additional quintiles based on changes in short interest. The results (not tabulated) show that changes in short interest are positively related to contemporaneous return, as expected.

2006), the predictive power of short interest should be increasing in the level of short interest. In addition, if institutional ownership proxies for supply of shortable stock (Asquith, Pathak, and Ritter, 2005), predictability should be inversely related to the level of institutional ownership (Diamond and Verrechia, 1987). In contrast, the overvaluation hypothesis implies no relation between short interest, institutional ownership and subsequent earning surprises.

The results, presented in Tables 5 through 8, provide strong support for the information hypothesis. All tables address the ability of short interest to predict deteriorating fundamentals, but they differ in terms of dependent variables and econometric methods. We use public news counts as dependent variables in Tables 5 and 7 and earning surprises in Tables 6 and 8. Portfolio sorts are used in Tables 5 and 6 and Fama-Macbeth regressions are used in Tables 7 and 8.

B.1. Portfolio sorts

We first examine the relation between short interest and future news content. The information hypothesis predicts that heavy shorting is followed by unfavorable public news. The results in Table 5 confirm this hypothesis. Panel A of Table 5 shows the univariate relation between current short interest and future news content. As conjectured, for both *NEWS* measures, stocks with the highest short interest levels are followed by negative public news. Moreover, the relation between short interest and news content is negative and nearly-monotonic. To assess the statistical significance of this relation we compute the difference in news content between stocks belonging to the top and bottom short interest decile. This difference, shown at the bottom of the panel, is always significant at the 1% level.

In Panel B of Table 5 we explore the incremental role of institutional ownership. The top section of the panel shows results corresponding to the first measure of public news (*NEWS1*), which uses a $\pm 0.5\%$ filtering bound. The bottom section uses *NEWS2*, which is based on a $\pm 1.0\%$ bound. Under the information hypothesis, if institutional ownership is correlated with the supply of lendable shares (Asquith, Pathak, and Ritter), we would expect the relation between short interest and future news content to be stronger for lower levels of institutional ownership, since shorts are more likely to be informed in this case (Diamond and Verrecchia). Miller's overvaluation hypothesis makes no such prediction. We sort stocks into quarterly quintiles based on the level of institutional ownership (IO). We also sort stocks (independently) into quintiles based on the monthly level of short interest. This results in 25 monthly portfolios obtained from independent sorts on IO and short interest. We then compute next month's average news content (signed) for each of the 25 portfolios and average these across calendar months.

We expect a negative relation between the predictive ability of short interest (measured as the difference in news count between the top and bottom *SHORT* quintiles), and institutional ownership. The last two lines in each section of Panel B provide support for this conjecture. Although the relation between *SHORT*'s predictive ability is not monotonically declining with IO, the corresponding rank correlations are in fact negative as predicted ($\rho = -0.61$ for *NEWS1*, and $\rho = -0.56$ for *NEWS2*).¹¹

Having shown that short interest predicts public news content in general, we now turn to a more commonly used type of public news, earning surprises, which are available

¹¹ Although high in magnitude, the rank correlations do not attain statistical significance ($p=0.28$ and $p=0.32$, respectively). This could be due to the low power of the statistical test, which is based on only five observations.

for the entire sample of stocks. Panel A of Table 6 reports descriptive statistics about earnings surprises during our sample period. We sort stocks into quintiles based on standardized unexpected earnings (SUE). For each group, we report the average value of SUE, as well as the average cumulative abnormal returns (CARs) surrounding earning announcements. As expected, the two measures are highly correlated. Stocks with the most positive earnings surprises earn a CAR of 0.53% per day during the four-day announcement window. At the other extreme, CARs are -0.43% per day for stocks with the most negative earning surprises.

In Panel B we sort stocks into quarterly short interest quintiles and compute the next quarter's earning surprises (SUE and CARs) for each quintile. These are then averaged across quarters. We find that short interest can indeed predict future earning surprises. In the case of SUE, stocks with the highest short interest predict lower future values of SUE than stocks with lower short interest, and the difference is significant at the 10% level. The predictability is even more striking when CARs are used as a measure of earning surprises: a hedge portfolio that is long in lightly shorted stocks and short in heavily shorted stocks earns 0.31% per day during the four days surrounding earning announcements, and this return is statistically significant at better than the 1% level. These results provide *prima facie* evidence that short interest is quite informative about changes in fundamentals that are yet to be incorporated into stock prices.

We explore the incremental role of institutional investors in Panels C and D. As we did in Panel B of Table 5, we sort stocks (independently) into quarterly quintiles based on the level of institutional ownership (IO), and also into quintiles based on short interest levels. We compute next quarter's earning surprises for each of the 25 portfolios, and

average these across quarters. Panel C reports the results obtained with the SUE measure of earning surprises. Results based on CAR are reported in Panel D. Consistent with the information hypothesis, the predictive power of short interest decreases with institutional ownership. For example, in Panel D, among stocks with low institutional ownership (IO1), a hedge portfolio that takes long positions in heavily shorted stocks and short positions in lightly shorted stocks earns an abnormal return of 0.70% per day ($t=7.13$) around earning announcements. This value declines monotonically to 0.04% ($t=0.35$) for stocks with high levels of institutional ownership (IO5), and hedge portfolio returns are significant at the 5% level for four of the IO quintiles. The results obtained with SUE in Panel C are similar.

Overall, the results in Tables 5 and 6 provide strong evidence in favor of the information hypothesis. We show that short interest predicts negative future public news and negative future earning surprises, and this prediction is stronger for firms with low levels of institutional ownership (cf. Table 2). Under Miller's overvaluation hypothesis, earning surprises should be unrelated to current levels of short interest and institutional ownership.

B.2. Fama-Macbeth regressions

The portfolio sorting method allows for non-monotonic relationships between the dependent and independent variables, but a possible shortcoming is that correlations with excluded variables could result in spurious relations. To address this concern, we estimate Fama-Macbeth regressions in which the dependent variable is, alternatively, the signed news count (Table 7) and the earnings surprise (Table 8). The independent variables of interest are the level of short interest and institutional ownership. Since the predictive power of short interest is expected to be stronger for lower levels of institutional

ownership, we add an interactive term which is the product of these two variables. In addition, we control for size, book-to-market, and momentum returns. The information hypothesis predicts a negative sign on the short interest variable and a positive sign on the interaction term of short interest and institutional ownership (cf. Table 2). By contrast, the overvaluation hypothesis predicts no relation between short interest, institutional ownership, and future earning surprises.

Panel A of Table 7 presents results using the actual values of the independent variables. In Panel B, we transform all independent variables into decile ranks and then standardize these ranks to take values between zero and one. This transformation makes the coefficient interpretation more intuitive and comparable across variables and minimizes the effect of outliers. In each panel, we run monthly cross-sectional regressions and compute time-series averages of the coefficient estimates, as in Nagel (2005). Columns (1) and (2) use *NEWS1*, and columns (3) and (4) use *NEWS2* as dependent variables.

Similar to the results of Table 5, we find that short interest predicts subsequent public news content. The coefficient of *short* is significant and negative in both panels of Table 7, for all four specifications. We find weaker support for the secondary hypothesis that *short*'s predictability is stronger for low levels of institutional ownership (*IO*). The coefficient of the interactive *short*IO* term is positive throughout the table, but is significant only for the *NEWS2* regression in Panel A.

Table 8 follows the same structure as Table 7 but explains earning surprises instead of news counts. Also, due to the nature of the earnings data, regressions are estimated each quarter as opposed to monthly. As before, we use SUE (columns 1 and 2) and CARs (columns 3 and 4) to measure earning surprises. As in Table 6, we find that short interest

predicts subsequent earnings surprises, and this predictability decreases with the level of institutional ownership. The coefficient of *short* is negative in both panels and always significant at better than the 1% level. In addition, the coefficient of the interactive *short*IO* term is always positive and strongly significant, as expected.

The standardized approach in Panel B makes it easier to interpret these results. For example, in column (3) the coefficient of short interest is -0.659% (t-value -10.61). This corresponds to *short*'s predictive ability for the lowest *IO* decile. Using the interaction term *short*IO*, we can infer that *short*'s predictive ability for the highest *IO* decile is close to zero and positive ($-0.659\% + 0.886\% = 0.227\%$). A similar result is obtained when SUE is used instead of CAR as dependent variable (column 1).

Overall, the Fama-McBeth regressions confirm inferences from the portfolio sorts: short interest predicts deteriorating earnings, and the predictive ability is stronger for lower levels of institutional ownership when shorts are more likely to be informed. These findings support for the information hypothesis.

IV. Conclusion

Asquith et al. (2005) suggest that stocks with high short interest and low institutional ownership are short-sale constrained. They argue that the return predictability associated with short interest is caused by high shorting costs, which prevent negative opinions to be impounded into stock prices as predicted by Miller (1977). We expand their analysis by considering Diamond and Verrechia's (1987) information hypothesis, modified to account for price-adjustment delays associated with limits to arbitrage. Our results suggest that it is the information reflected in short interest, rather than a Miller-type

correction of mispricing, that explains the return predictability associated with short interest.

References

- Arnold, Tom, Alexander W. Butler, Timothy F. Crack, and Yan Zang, 2005, The information content of short interest: A natural experiment, *Journal of Business*, 78, 1307-1335.
- Asquith, Paul and Lisa Meulbroek, 1996, An empirical investigation of short interest, working paper, Harvard University.
- Asquith, Paul, Parag A. Pathak, and Jay R. Ritter, 2005, Short interest, institutional ownership, and stock returns, *Journal of Financial Economics*, 78, 243-276.
- Beatty, Randolph P., 1989, Auditor reputation and the pricing of initial public offerings, *The Accounting Review*, 64(4), 693-709.
- Beatty, Randolph P., and Jay R. Ritter, 1986, Investment banking, reputation, and the underpricing of initial public offerings, *Journal of Financial Economics* 15, 213-232.
- Billett, Matthew T., Mark J. Flannery and Jon A. Garfinkel, 1995, The effect of lender identity on a borrowing firm's equity return, *Journal of Finance*, 50(2), 699-718.
- Boehme, R., Danielsen, and Sorin Sorescu, 2006, Short sale constraints, differences of opinion, and overvaluation, *Journal of Financial and Quantitative Analysis*, 41(1), 455-487.
- Boehmer, Ekkehart, Charles M. Jones, and Xiaoyan Zhang, 2007, Which shorts are informed? *Journal of Finance*, forthcoming.
- Boehmer, Ekkehart, and Eric Kelley, 2007, Institutional investors and the informational efficiency of prices, Working Paper, Texas A&M University.
- Brennan, Michael J. and Avanidhar Subramanyam, 1995, Investment analysis and price formation in securities markets, *Journal of Financial Economics*, 38(3), 361-381.

- Brent, Averil, Dale Morse, and E. Kay Stice, 1990, Short interest: explanations and tests, *Journal of Financial and Quantitative Analysis*, 25, 273-289.
- Brown, Stephen J., and Jerold B. Warner, 1985, Using daily stock returns: the case of event studies, *Journal of Financial Economics*, 14, 3-31.
- Carter, Richard and Steven Manaster, 1990, Initial public offerings and underwriter reputation, *Journal of Finance*, 1990, 45(4), 1045-1067.
- Chan, Louis, Narasimhan Jegadeesh, and Josef Lakonishok, 1996, Momentum strategies, *Journal of Finance*, 51, 1681-1713.
- Chan, Wesley S, 2003, Stock price reaction to news and no-news: drift and reversal after headlines, *Journal of Financial Economics*, 70, 223–260.
- Christophe, Stephen E., Michael G. Ferri, and James J. Angel, 2004, Short-selling prior to earnings announcements, *Journal of Finance*, 59, 1845-1875.
- Cohen, Lauren, Karl B. Diether, and Christopher J. Malloy, 2007, Supply and demand shifts in the shorting market, *Journal of Finance*, forthcoming.
- D’Avolio, Gene, 2002, The market for borrowing stock, *Journal of Financial Economics*, 66, 271-306.
- De Long, J. Bradford, Andrei Shleifer, Lawrence H. Summers, and Robert J. Waldman, 1990, Noise trader risk in financial markets, *Journal of Political Economy*, 98, 703-738.
- Dechow, Patricia M., Amy P. Hutton, Lisa Meulbroek, and Richard Sloan, 2001, Short-sellers, fundamental analysis, and stock returns, *Journal of Financial Economics*, 61, 77-106.

- Desai, Hemang, K. Ramesh, S. Ramu Thiagarajan, and Bala V. Balacahandran, 2002, An investigation of the informational role of short interest in the Nasdaq market, *Journal of Finance*, 57, 2263-2287.
- Desai, H., S. Krishnamurthy, and K. Venkataraman, 2006, Do short sellers target firms with poor earnings quality?: Evidence from earnings restatements, *Review of Accounting Studies*, 11, 71-90.
- Diamond, Douglas W., and Robert E. Verrecchia, 1987, Constraints on short selling and asset price adjustment to private information, *Journal of Financial Economics*, 18, 277-311.
- Diether, Karl B., Christopher J. Malloy, and Anna Scherbina, 2002, Differences of opinion and cross section of stock returns, *Journal of Finance*, 57, 2113-2141.
- Diether, Karl B., Kuan-Hui Lee, and Ingrid M. Werner, 2007, Short-Sale strategies and return predictability, *Review of Financial Studies*, forthcoming.
- Duffie, Darrell, Nicolae Garleanu, and Lasse H. Pedersen, 2002, Securities lending, shorting, and pricing, *Journal of Financial Economics*, 66, 307-339.
- Fama, Eugene, and Kenneth French, 2002, Testing trade-off and pecking order predictions about dividends and debt, *Review of Financial Studies*, 15, 1-33.
- Foster, George, Chris Olsen, and Terry Shevlin, 1984, Earnings releases, anomalies, and the behavior of security returns, *The Accounting Review*, 59, 574-603.
- Francis, Jennifer, Mohan Venkatachalam, and Yun Zhang, 2006, Do short sellers convey information about changes in fundamentals or risk? Working Paper, Duke University.

- Griffin, John, M., Jeffrey Harris, and Selim Topaloglu, 2003, The dynamics of institutional and individual trading, *Journal of Finance*, 58, 2285-2320.
- Gutfleish, Ron and Lee Atzil, "Spotting Clues in Qs," in "Short Selling: Strategies, Risks and Rewards," Frank J. Fabozzi, editor, Wiley Finance, 2004
- Hirshleifer, David, Siew Hong Teoh, and Jeff Jiewei Yu, 2007, Do short sellers arbitrage accrual based return anomalies?, Working paper, Ohio State University.
- James, Christopher, 1987, Some evidence on the uniqueness of bank loans, *Journal of Financial Economics*, 19(2), 217-236.
- Jones, Charles M., and Owen A. Lamont, 2002, Short-sale constraints and stock returns, *Journal of Financial Economics*, 66, 207-239.
- Lummer, Scott L. and John J. McConnell, 1989, Further evidence on the bank lending process and the capital-market response to bank loan agreements, *Journal of Financial Economics*, 25(1), 99-122.
- Mikkelson, Wayne H. and M. Megan Partch, 1986, Valuation effects of security offerings and the issuance process, *Journal of Financial Economics*, 15(1/2), 31-60.
- Miller, Edward M., 1977, Risk, uncertainty, and divergence of opinion, *Journal of Finance* 32, 1151-1168.
- Nagel, Stefan, 2005, Short sales, institutional investors and the cross-section of stock returns, *Journal of Financial Economics*, 78, 277-309.
- Nofsinger, John, R., Richard Sias, 1999, Herding and feedback trading by institutional and individual investors, *Journal of Finance*, 54, 2263-2295.
- Shleifer, Andrei and Robert W. Vishny, 1990, Equilibrium short horizons of investors and firms, *American Economic Review*, 80, 148-153.

Shleifer, Andrei and Robert W. Vishny, 1997, The limits of arbitrage, *Journal of Finance*, 52, 35-55.

Sloan, Richard G, 1996, Do stock prices reflect information in accruals and cash flows about future earnings? *The Accounting Review*, 71, 289-315.

Wermers, Russ, 1999, Mutual fund herding and the impact on stock prices, *Journal of Finance*, 54, 581-622.

Wu, Julie, 2007, Short selling and the informational efficiency of prices, Working paper, Texas A&M University.

Table 1
Discriminating between the overvaluation and information hypotheses using contemporaneous stock returns

Hypothesis	Sign of the correlation between contemporaneous stock returns and	
	Changes in <i>Short Interest</i>	Changes in <i>Institutional Ownership</i>
Overvaluation	Positive	Negative
Information	Positive	Positive

Table 2
Discriminating between the overvaluation and information hypotheses using predictability of unexpected public information

Hypothesis	Sign of the correlation between unexpected public information and	
	Current levels of short interest	Interactive effect of Institutional Ownership
Overvaluation	Null	Null
Information	Negative	Positive

Table 3
Short interest, institutional ownership, and future returns

The sample contains common stocks listed on the NYSE, Amex, and Nasdaq during the period from January 1988 to December 2005. Each month, we sort stocks into short interest deciles based on *Short*, the ratio of short interest to shares outstanding. Panel A shows the time-series means of firm characteristics, holding-period raw returns (*Ret*), and abnormal monthly returns (α) computed as the intercept from a four-factor model including *mktf*, *smb*, *hml*, and *umd*. All returns are measured over a one month horizon, during the month following portfolio formation. *IO* is the percentage of shares owned by institutions as reported in 13F filings. *Size* is the market value of equity and defined as share price times the number of shares outstanding. *BM* is the book value of equity divided by the market value of equity calculated at least three months before the short interest data. In Panel B, stocks in the highest short interest decile are further sorted into three groups based on the level of institutional ownership. For each group, we show raw returns, abnormal returns, institutional ownership, level of short interest, a count of future news items (*NEWS*), as well as two measures of earning surprises: *SUE* and *CAR*. *NEWS* is the sum of positive-content news items minus the sum of negative-content news items during the month following portfolio formation. We infer news content from the sign of the cumulative abnormal return (*CAR*) measured around the news date [-2, +1]. To filter out noise associated with daily price movements, we classify small *CAR*s as neutral. We use two different filters: *NEWS1* classifies $|CAR| \leq 0.5\%$ as neutral, while *NEWS2* classifies items with $|CAR| \leq 1\%$ as neutral. Then we assign numerical values of +1 to all positive news items, zero to all neutral items, and -1 to all negative news items and compute a monthly aggregate news measure by averaging the (signed) values of all news items that month. Months with no news items are assigned an aggregate news measure equal to zero. *SUE* is the change in earnings per share from quarter $q-4$ to quarter q divided by the standard deviation of unexpected earnings over the last eight quarters. *CAR* is the average market adjusted abnormal return (in percent) during the [-2, +1] window around the earnings announcement date. T-statistics are shown in italics and are based on robust standard errors. *, **, and *** denote significance level at the 10%, 5%, and 1% level, respectively.

Panel A: Sorts on short interest

	Short	IO	Size	BM	Ret	α
P1 (low)	0.004	12.79	66.63	1.09	1.99***	1.20***
	0.025	16.62	122.93	0.96	1.77***	0.97***
	0.090	20.78	730.98	0.91	1.76***	0.85***
	0.214	26.18	1,313.95	0.85	1.71***	0.77***
	0.402	31.85	2,102.61	0.78	1.46***	0.52***
	0.665	37.52	3,189.79	0.70	1.38***	0.39**
	1.052	42.40	3,065.11	0.67	1.14***	0.10
	1.685	45.91	2,465.56	0.65	1.09***	0.03
	2.968	46.82	1,792.51	0.69	0.77*	-0.23
P10 (high)	8.823	49.03	1,025.90	0.79	0.48	-0.52***
P1 – P10					1.51***	1.72***
<i>t-value</i>					4.36	8.14

Table 3 (continued)*Panel B: Sorts on institutional ownership for the most shorted decile*

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	IO	Short	Ret	α	NEWS1	NEWS2	SUE	CAR
IO1 (low)	19.09	8.62	-0.28	-1.00**	-0.072***	-0.043**	-0.185***	-0.091***
	49.53	8.48	0.67	-0.31**	-0.041**	-0.012	-0.039	-0.044
IO3 (high)	78.39	9.36	1.04**	-0.24	-0.006	0.021	0.263***	0.108***
3 – 1	59.30	0.74	1.32***	0.76*	0.066**	0.065**	0.448***	0.199***
<i>t-value</i>			2.71	1.84	2.13	2.13	9.21	5.30

Table 4
Changes in institutional ownership and contemporaneous returns

The sample contains common stocks listed on the NYSE, Amex, and Nasdaq during the period from January 1988 to December 2005. We first sort stocks into quintile portfolios based on short interest (*Short*) in quarter q . Then we sort each quintile into quintile portfolios based on ΔIO , the change in institutional ownership from quarter q to $q+1$. For each portfolio, we report absolute (raw) returns in Panel A, and abnormal returns in Panel B. Abnormal returns are computed as the intercept from a four-factor model that includes the three Fama-French factors (*mktrf*, *smb*, and *hml*) augmented with the momentum factor (*umd*). T-statistics are shown in italics and are based on robust standard errors. *, **, and *** denote significance level at the 10%, 5%, and 1% level, respectively.

Panel A: Contemporaneous raw returns and changes in institutional ownership

	Short interest quintiles				
	Short 1 (low)				Short 5 (high)
$\Delta IO1$ (low)	1.29***	0.56	-0.59	-1.33**	-3.04***
	1.08***	0.70**	0.39	-0.09	-0.69
	1.67***	0.78**	0.81**	0.67*	0.24
	2.13***	2.02***	2.07***	1.93***	1.90***
$\Delta IO5$ (high)	3.49***	4.09***	3.98***	4.10***	4.67***
5-1	2.20***	3.53***	4.57***	5.43***	7.71***
t-stat	8.82	9.52	11.48	10.63	15.23
All Stocks (Ret)	1.94	1.63	1.33	1.06	0.62
All Stocks (IO)	14.34	23.60	34.82	44.40	48.12

Panel B: Contemporaneous abnormal returns and changes in institutional ownership

	Short interest quintiles				
	Short 1 (low)				Short 5 (high)
$\Delta IO1$ (low)	0.41**	-0.37*	-1.57***	-2.30***	-3.14***
	0.29	-0.18	-0.49***	-1.01***	-1.69***
	0.94***	-0.03	-0.04	-0.19	-0.77***
	1.34***	1.20***	1.22***	1.07***	0.96***
$\Delta IO5$ (high)	2.64***	3.19***	3.04***	3.22***	3.75***
5-1	2.23	3.56	4.61	5.52	6.89
t-stat	8.05	8.36	10.97	9.94	12.84
All Stocks (Ret)	1.12	0.76	0.43	0.16	-0.39
All Stocks (IO)	14.34	23.60	34.82	44.40	48.12

Table 5
Short interest as predictor of public news: a portfolio approach

The sample contains common stocks listed on the NYSE, Amex, and Nasdaq during the period from January 1988 to December 2000. We also require that each stock be included in Chan's (2003) news database. Each month, we sort stocks into short interest deciles based on *Short* (Panel A). We also sort stocks, independently, into *Short* and *IO* (Panel B). *Short* is the ratio of short interest to shares outstanding. *IO* is the percentage of shares owned by institutions as reported in 13F filings. The table shows the average signed count of public news items (*NEWS*) collected during the month following the measurement of *Short* and *IO*. We infer news content from the sign of the cumulative abnormal return (CAR) measured around the news date [-2, +1]. To filter out noise associated with daily price movements, we classify small CARs as neutral. We use two different filters: *NEWS1* classifies $|CAR| \leq 0.5\%$ as neutral, while *NEWS2* classifies items with $|CAR| \leq 1\%$ as neutral. Then we assign numerical values of +1 to all positive news items, zero to all neutral items, and -1 to all negative news items and compute a monthly aggregate news measure by averaging the (signed) values of all news items that month. Months with no news items are assigned an aggregate news measure equal to zero. Panel A also shows the average level of short interest for each *Short* decile. T-statistics are shown in italics and are based on robust standard errors. *, **, and *** denote significance level at the 10%, 5%, and 1% level, respectively.

Panel A: Future news count as a function of current short interest

	<i>Short</i>	<i>NEWS1</i>	<i>NEWS2</i>
P1(low)	0.002	0.037***	0.043***
	0.017	0.046***	0.042***
	0.051	0.037***	0.045***
	0.116	0.032***	0.043***
	0.231	-0.001	0.024***
	0.409	-0.008	0.016
	0.685	-0.020	0.019
	1.152	-0.012	0.014
	2.182	-0.041***	0.001
P10(high)	7.462	-0.040***	-0.012
P10-P1	7.460	-0.077***	-0.054***
t-value		-4.33	-3.69

Table 5 (continued)*Panel B: Future news count as a function of short interest and institutional ownership*

<i>News</i> Definition	IO1 (low)			IO5 (high)			1-5	t-value
<i>NEWS1</i>	Short 1	0.045***	0.031***	0.056***	0.021	0.037	0.008	0.34
		0.055***	0.028***	0.032**	0.013	0.024	0.031	1.50
		0.056***	0.024	-0.004	-0.016	-0.053**	0.108	3.47
	Short 5	-0.025	-0.002	0.019	-0.015	-0.037	0.011	0.36
		-0.055*	-0.061***	-0.072***	-0.024	-0.023	-0.031	-0.83
		1-5	0.100	0.092	0.128	0.045	0.060	
t-value	3.30	3.70	6.80	2.06	2.02			
<i>NEWS2</i>	Short 1	0.042***	0.036***	0.056***	0.020	0.063***	-0.021	-0.96
		0.059***	0.029***	0.041***	0.041***	0.040***	0.019	1.02
		0.051***	0.044***	0.019*	0.010	-0.006	0.057	2.16
	Short 5	-0.022	0.028**	0.036***	0.026*	0.008	-0.030	-1.15
		-0.031	-0.027	-0.036***	0.009	0.018	-0.050	-1.45
		1-5	0.073	0.063	0.092	0.011	0.044	
t-value	2.45	2.94	5.75	0.65	1.6			

Table 6**Short interest as predictor of earnings surprises: a portfolio approach**

The sample contains common stocks listed on the NYSE, Amex, and Nasdaq during the period from January 1988 to December 2005. In Panel A, we sort stocks into quintiles based on standardized unexpected earnings, (*SUE*), defined as the change in earnings per share from quarter *q*-4 to quarter *q* divided by the standard deviation of unexpected earnings over the last eight quarters. We report time-series means of *SUE* and announcement abnormal returns, CARs, defined as the daily average of the market-adjusted abnormal return (in percent), computed during the [-2, +1] window around the earnings announcement date. In Panel B, we sort on quarter *q* short interest (*Short*) and report the time-series average of *SUE* and CAR. *Short* is the ratio of short interest to shares outstanding. In Panels C and D we conduct an independent double sort, first on quarter *q* institutional ownership (*IO*) and then on quarter *q* short interest (*Short*). *IO* is the percentage of shares owned by institutions as reported in 13F filings. Panel C reports the average *SUE* for the next-quarter earnings announcement, and Panel D reports the corresponding CAR. T-statistics are shown in italics and are based on robust standard errors. *, **, and *** denote significance level at the 10%, 5%, and 1% level, respectively.

Panel A: Descriptive statistics on earning surprises

	SUE 1 (low)				SUE 5 (high)
SUE	-2.00	-0.22	0.14	0.60	2.19
CAR	-0.43	-0.19	0.22	0.42	0.53

Panel B: Future earnings surprises as a function of current short interest

	Short1 (low)	Short2	Short3	Short4	Short5 (high)	1 – 5	t-value
SUE	0.14***	0.14***	0.21***	0.19***	0.05	0.09	1.94
CAR	0.29***	0.16***	0.07**	0.03**	-0.02	0.31	4.79

Panel C: Future SUE as a function of current short interest and institutional ownership

	IO1 (low)				IO5 (high)	1 – 5	t-value
Short 1	0.14***	0.11***	0.08***	0.15***	0.24**	-0.07	-0.69
	0.12***	0.09***	0.07*	0.18***	0.32***	-0.20	-3.34
	0.09***	0.08**	0.12***	0.23***	0.32***	-0.23	-4.10
	0.11**	0.02	0.08*	0.18***	0.34***	-0.23	-3.85
Short 5	-0.10**	-0.11**	-0.16***	-0.01	0.25***	-0.35	-4.71
1 – 5	0.24	0.22	0.24	0.16	-0.01		
t-value	4.59	4.84	3.89	2.36	-0.53		

Panel D: Future earning-event CARs a function of current short interest and institutional ownership

	IO1 (low)				IO5 (high)	1 – 5	t-value
Short 1	0.47***	0.31***	0.21***	0.15***	0.12	0.35	3.21
	0.33***	0.18***	0.13***	0.14***	0.06*	0.27	5.55
	0.27***	0.13***	0.05**	0.06***	0.07**	0.20	2.77
	0.02	0.05	0.01	0.02	0.07**	-0.05	-0.56
Short 5	-0.23**	-0.18***	-0.09**	-0.01	0.08**	-0.31	-3.62
1 - 5	0.70	0.49	0.29	0.16	0.04		
t-value	7.13	5.21	3.57	2.17	0.35		

Table 7
Short interest as predictor of public news: a regression approach

The sample contains common stocks listed on the NYSE, Amex, and Nasdaq during the period from January 1988 to December 2000. We also require that each stock be included in Chan's (2003) news database. The table shows monthly Fama-Macbeth regressions where the dependent variable is a signed count of lagged monthly news items (*NEWS*). We infer news content from the sign of the cumulative abnormal return (CAR) measured around the news date [-2, +1]. To filter out noise associated with daily price movements, we classify small CARs as neutral. We use two different filters: *NEWS1* classifies $|CAR| \leq 0.5\%$ as neutral, while *NEWS2* classifies items with $|CAR| \leq 1\%$ as neutral. Then we assign numerical values of +1 to all positive news items, zero to all neutral items, and -1 to all negative news items and compute a monthly aggregate news measure by averaging the (signed) values of all news items that month. Months with no news items are assigned an aggregate news measure equal to zero. The independent variables are *Short* (the ratio of short interest to shares outstanding), *IO* (the percentage of shares owned by institutions as reported in 13F filings), *Size* (the natural logarithm of the market value of equity), *BM* (the natural logarithm of the ratio between book value of equity and the market value of equity calculated at least three months before the short interest data) and *MOM* (the mean stock return performance over the previous 12 months). Panel A shows results using the actual values of independent variables. In Panel B we transform all independent variables into decile ranks and standardize them to take values between zero and one. In both panels, the table reports time-series averages of the coefficient estimates. T-statistics are shown in italics and are based on robust standard errors. *, **, and *** denote significance level at the 10%, 5%, and 1% level, respectively.

Panel A: Regressions based on actual values of the independent variables

	(1)	(2)	(3)	(4)
	<i>NEWS1</i>	<i>NEWS1</i>	<i>NEWS2</i>	<i>NEWS2</i>
Intercept	0.4527 <i>3.88</i>	0.3931 <i>3.73</i>	0.2668 <i>3.27</i>	0.2236 <i>2.98</i>
SIZE	-0.0254 <i>-3.65</i>	-0.0213 <i>-3.46</i>	-0.0137 <i>-2.88</i>	-0.0108 <i>-2.50</i>
BM	-0.0167 <i>-2.35</i>	-0.0133 <i>-1.90</i>	-0.0082 <i>-1.36</i>	-0.0061 <i>-1.01</i>
MOM	0.4016 <i>4.18</i>	0.4200 <i>4.22</i>	0.3180 <i>3.87</i>	0.3335 <i>3.94</i>
Short	-0.8665 <i>-2.37</i>	-0.4156 <i>-2.24</i>	-0.9428 <i>-3.45</i>	-0.4124 <i>-2.46</i>
IO	0.0465 <i>2.25</i>		0.0302 <i>2.27</i>	
Short * IO	0.8588 <i>1.11</i>		1.229 <i>2.15</i>	
R ²	2.46%	1.99%	1.94%	1.52%

Table 7 (continued)*Panel B: Regressions based on standardized values of the independent variables*

	(1)	(2)	(3)	(4)
	<i>NEWS1</i>	<i>NEWS1</i>	<i>NEWS2</i>	<i>NEWS2</i>
Intercept	0.0865 4.30	0.0795 3.87	0.0649 3.88	0.0577 3.31
SIZE	-0.1656 -3.59	-0.1203 -2.89	-0.083 -2.53	-0.0542 -1.77
BM	-0.0588 -2.77	-0.0452 -2.19	-0.0283 -1.59	-0.0212 -1.20
MOM	0.0631 4.37	0.0648 4.40	0.0472 4.15	0.0479 4.13
Short	-0.0713 -2.86	-0.0531 -3.63	-0.0622 -2.66	-0.0408 -3.26
IO	0.0464 2.57		0.0201 1.29	
Short * IO	0.0293 0.83		0.0407 1.22	
R^2	2.15%	1.76%	1.65%	1.32%

Table 8
Short interest as predictor of earnings surprises: a regression approach

The sample contains common stocks listed on the NYSE, Amex, and Nasdaq during the period from January 1988 to December 2005. We estimate quarterly Fama-Macbeth regressions using earnings surprises as the dependent variable. Earnings surprises are measured using either SUE or CAR. *SUE* is the change in quarterly earnings per share from quarter $q-4$ to quarter q , divided by the standard deviation of unexpected earnings over the last eight quarters. *CAR* is the average market-adjusted abnormal return during a $[-2, +1]$ window around the earnings announcement date. The independent variables are *Short* (the ratio of short interest to shares outstanding), *IO* (the percentage of shares owned by institutions as reported in 13F filings), *Size* (the natural logarithm of the market value of equity), *BM* (the natural logarithm of the ratio between book value of equity and the market value of equity calculated at least three months before the short interest data) and *MOM* (the mean stock return performance over the previous 12 months). Panel A shows results using the actual values of independent variables. In Panel B we transform all independent variables into decile ranks and standardize them to take values between zero and one. In both panels, the table reports time-series averages of the coefficient estimates. T-statistics are shown in italics and are based on robust standard errors. *, **, and *** denote significance level at the 10%, 5%, and 1% level, respectively.

Panel A: Regressions based on actual values of the independent variables

	(1)	(2)	(3)	(4)
	<i>SUE</i>	<i>SUE</i>	<i>CAR</i>	<i>CAR</i>
Intercept	-0.296 <i>-3.04</i>	-0.333 <i>-2.77</i>	0.946 <i>11.31</i>	0.855 <i>9.99</i>
Size	0.028 <i>3.08</i>	0.031 <i>2.74</i>	-0.067 <i>-9.49</i>	-0.057 <i>-7.98</i>
BM	-0.207 <i>-10.17</i>	-0.201 <i>-10.12</i>	0.044 <i>2.97</i>	0.052 <i>3.54</i>
MOM	6.467 <i>21.23</i>	6.616 <i>21.14</i>	0.728 <i>2.64</i>	0.855 <i>3.05</i>
Short	-0.056 <i>-9.49</i>	-0.025 <i>-7.55</i>	-0.043 <i>-10.62</i>	-0.014 <i>-4.95</i>
IO	-0.005 <i>-0.09</i>		0.065 <i>1.59</i>	
Short*IO	0.064 <i>5.91</i>		0.054 <i>8.47</i>	
R^2	6.82%	6.52%	0.93%	0.82%

Table 8 (continued)*Panel B: Regressions based on standardized values of the independent variables*

	(1)	(2)	(3)	(4)
	<i>SUE</i>	<i>SUE</i>	<i>CAR</i>	<i>CAR</i>
Intercept	0.113 4.83	-0.046 -1.64	0.455 9.17	0.253 5.15
Size	0.157 1.82	0.230 2.42	-0.402 -6.31	-0.329 -5.05
BM	-0.695 -11.73	-0.678 -12.20	0.110 2.55	0.131 3.05
MOM	0.992 17.50	0.993 17.72	0.111 3.48	0.121 3.74
Short	-0.547 -8.75	-0.372 -7.69	-0.659 -10.61	-0.163 -4.63
IO	-0.062 -1.02		-0.337 -5.79	
Short*IO	0.314 5.28		0.886 11.09	
R^2	8.13%	7.91%	1.05%	0.81%