Short Interest vs. Short Selling

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Abstract:

We examine the relation between the monthly reported short interest (the number of shares that are in outstanding short positions) and short selling. We aggregate transaction level short selling into monthly short turnover (a measure of the shorting flow) and find that short turnover and short interest have a correlation of slightly over 45%, which is much lower than our expectations. We also examine whether short interest and/or short selling are informative of future returns. We find that short selling (the shorting flow) shows evidence of predicting returns, while short interest does not. We also examine short selling around the announcement of monthly short interest. We find that short selling increases prior to the announcement of monthly short interest.

Short Interest vs. Short Selling

I. Introduction

The purpose of this study is to examine the relation between reported monthly short interest and short selling transaction information. Short interest is the reported number of shares that are in outstanding short positions at the settlement date, while aggregated short selling data gives the level of shorting flow.

Researchers find that the level of short activity using short sale transaction data is higher than suggested by short interest data. For instance, Diether, Lee and Werner (2009) find that short sale transactions account for 23.9% of NYSE and 31.3% of NASDAQ share volume in their 2005 sample, while the average monthly short interest is only 5.4 and 4.4 days to cover for NYSE and NASDAQ respectively.[1] Similarly, Boehmer, Jones, and Zhang (2008) find that from 2000 through 2004 short selling is 12.9% of NYSE volume, but monthly short interest is only 2% in 2004. Further, Boehmer et al. use a double sorting technique to conclude that changes in short interest is not a predictor of future cross section of returns when controlling for short sale transactions.

We aggregate transaction level short selling into monthly short turnover, a measure of shorting flow. As short interest is the sum of short sales minus covering transactions, we expect that short interest and shorting flow metrics will be highly correlated. Since short sellers are considered to be informed and short interest announcements are treated as news in the financial literature, we expect that shorting flow metrics will reflect the information contained in the short

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[1] In a separate study, Diether et al. (2009) find that short selling represents around 25% of volume for a sample of NYSE (and control) stocks, and 36% for a sample of NASDAQ (and control) stocks using a sample time period of February 1, 2005 through July 31, 2005.

interest announcement. That is, we expect to see greater shorting flow activity around *bad news* short interest announcements than around *good news* announcements. Boehmer, Jones, and Zhang (2008) find that shorting flow dominates short interest in predicting returns. We expect to find similar results in our sample. We extend this line of thought and propose that shorting flow metrics return predictability is enhanced around *bad news* short interest announcements.

We find that short turnover and short interest have a correlation of only slightly more than 45%. We find that shorting flow shows evidence of predicting returns, while short interest does not. It appears that short interest announcements are confirmations rather than new news. We examine shorting flow around the announcement of monthly short interest and find that short selling increases prior to the announcement of monthly short interest, with the increase in short turnover being greater in stocks with the highest increase in relative short interest. We also find that, in general, the return predictability of short sellers prior to short-interest announcements is no better than normal, but is enhanced for short sellers of stocks with the largest increase in relative short interest.

II. Data Description

The data used in the analysis come from several sources. We obtain daily prices, volume, shares outstanding, and returns from the Center of Research on Security Prices (CRSP). We gather monthly short-interest data for the stocks in our sample from Compustat. In response to Regulation SHO, short-sale transactions data were made available from January 2005 through December 2006. The short sale transaction data does not contain information on the covering of short sales, so we only know the number of new short sale transactions. We aggregate these short-sale transactions data to the daily and the monthly level. We obtain short-sale transactions data for the NASDAQ stocks from proprietary sources, for the period from January 2007 to the end of September 2009.[2] This proprietary shorting data allows us to extend the time period when comparing short interest data to the shorting flow data.

After merging the data from the different sources, we restrict our sample to ordinary common stocks (CRSP Sharecode 10 or 11), stocks that trade everyday of the sample time period (January 1, 2005 to September 30, 2009), and stocks that have prices greater than $2. The total number of stocks included in our sample is 861 NASDAQ-listed stocks. We have 1,028,895 stock-day observations and 49,077 stock-month observations.

Table 1 reports statistics that describe our sample. Panel A reports the figures for the entire sample time period. The average stock in our sample has a price (*Price*) of $25.91 and a market capitalization (*Size*) of $28,194,594. Further, the average price volatility (*Pvolt*), which is the difference between the daily high price and the daily low price scaled by the daily high price, is 3.95 percent. The average share turnover (*Turn*), which is the daily CRSP volume as a percent of shares outstanding, is 1.1661, indicating that nearly 1.2 percent of shares outstanding are traded each day.

We also report summary statistics for several short-selling variables. *Sh_vol* is the daily short volume while *Sh_int* is the monthly short interest obtained from Compustat.[3] To standardize different short-selling measures, we scale both the daily short volume and the monthly short interest by shares outstanding. Short turnover (*sh_turn*) is therefore, the percentage of shares outstanding that are shorted on a particular day. Several studies use this measure of

[2] The proprietary data is only available for short sales that execute on NASDAQ and does not include short sales on alternative venues. While the publicly available Reg SHO data has information about off exchange short-sales, we do not include off exchange shorts to be consistent with the proprietary data we have from 2007 to 2009. For robustness, we perform the analysis for shorting on and off the NASDAQ exchange during 2005 through 2006, when the Reg SHO data is available, and we find that the results are qualitatively similar to those we report in this paper.

[3] Monthly short interest is the number of shares that are currently in short positions as of the monthly settlement date.

short selling (Christophe, Ferri, and Hsieh, 2010, and Asquith, Pathak, and Ritter, 2005). Relative short interest (*RSI*) is the number of shares in uncovered short positions as a percentage of shares outstanding. Studies using relative short interest include Figlewski and Webb (1993), Senchack and Starks (1993), Danielsen and Sorescu (2001), Boehmer, Huszar, and Jordan (2010), among others. Panel A reports that the average stock has a daily short volume of 220,975, a monthly short interest of 4,397,273, a daily short turnover of 0.18 percent, and a relative short interest of 7.09 percent.

Panel B reports changes in *RSI* and short turnover on short-interest announcement days. Short interest is announced eight business days after the settlement day, which is the 15th of each month. If the 15th is not a trading day, then the closest day prior to the 15th is used as the settlement day. The average change in *RSI*, reported at the short interest announcement, is nearly 0.025. Announcement day short turnover is 0.1756 for announcements in the lowest quartile based on the size of the change in *RSI*. Interestingly, the announcement-day short turnover is 0.2098 for announcements in the highest quartile based on the size of the change in *RSI*. The difference is 0.0342 (p-value = 0.000) suggesting that short sellers respond to the announcement of changes in *RSI*.

III. Empirical Results

Our first set of tests compares both the levels of short turnover, relative short interest and the information contained in both short turnover and relative short interest. Our second set of tests examine daily short turnover around short-interest announcements.

II.A. Shorting Flow versus Short Interest

We begin by examining the correlation between short interest and short turnover. We aggregate daily short turnover to the monthly level in order to provide a better comparison to short interest, which is reported at the monthly level. Table 2 reports the correlation matrix with the different shorting measures and other factors used in the analysis. In column [2], we find that the correlation between monthly short turnover, which is a measure of the shorting flow, and short interest is 0.4578 (p-value = 0.000). While the positive correlation is expected, the magnitude of the correlation is rather low. The low correlation is possibly explained by inferences made in Diether and Werner (2009) that show that the median contract length of a short position in NASDAQ stocks is 8 days. The major difference between short interest and short turnover is that short interest reports the number of shares that are in outstanding short positions while short turnover reports the flow of short sales than are eventually covered. Finding an unexpectedly low correlation indicates that the much of the shorting flow is covered in the short term.

Table 2 also reports the correlation with several other stock characteristics. We show that both short turnover and short interest relate directly with prices, price volatility, and share turnover. However, we find that short turnover relates directly with market cap while short interest relates inversely with market cap. This difference may be explained by the propensity of market capitalization to inversely proxy short-sale constraints (D'Avolio, 2002; Arnold et al., 2005; and Xu, 2007). Prior work argues that institutions are generally the lenders of shares to short sellers and therefore, larger-cap stocks, which are generally held by institutions, face less binding short-sale constraints. Investors holding short positions over longer periods of time likely face lower equity borrowing costs. Therefore, observing an inverse relation between short interest (longer-term short positions) and size is somewhat expected.

We also examine the relation between current month shorting activity and next-month future returns. Several studies show that short sellers can predict negative returns (Senchack and Starks, 1993; Figleski and Webb, 1993; Aitken et al., 1998; Dechow et al., 2001; Desai et al., 2002; Boehmer, Jones, and Zhang, 2008; and Diether, Lee, and Werner, 2009). In columns [7] through [9], we report the next month's raw CRSP return, next month's three-factor risk-adjusted return, and next month's four-factor risk-adjusted return. In the first row, we find that monthly short turnover relates negatively with all three measures of next-month returns. In the second row however, we find that monthly short interest relates inversely with next month's raw return but short interest is unrelated to next month's returns when controlling for other risk factors (columns [8] and [9]). This result indicates that more information about future negative returns is contained in shorting flow than in the level of open short positions. This finding may help reconcile a division in the literature. Some studies question whether short sellers are informed when examining monthly short interest (Brent, Morse, and Stice, 1990; Figlewski, 1981; Vu and Caster, 1987; Bhattacharya and Gallinger, 1991; Senchack and Starks, 1993; Choie and Hwang, 1994; Woolridge and Dickinson, 1994; and Boehmer, Huszar, and Jordan, 2010), while other studies, examining higher frequency shorting data, show that short sellers reliably predict negative returns (Aitken et al., 1998; Christophe, Ferri, and Angel, 2004; Boehmer, Jones, and Zhang, 2008; Diether, Lee, and Werner, 2009; and Engelberg, Reed, and Ringgenberg, 2010). Our findings support Boehmer, Jones, and Zhang who find that five-day shorting flow data dominates changes in short interest in predicting 20-day returns.

We recognize that other factors affect the predictability of shorting activity. Therefore, Table 3 reports the results from estimating the following equation using pooled monthly data.

$$ret_{i,m+1} = \beta_0 + \beta_1\, size_{i,m} + \beta_2\, pvolt_{i,m} + \beta_3\, turn_{i,m} + \beta_4 sh\_turn_{i,m} + \beta_5 RSI_{i,m} + \varepsilon_{i,m+1} \qquad (1)$$

The dependent variables include the CRSP raw return during month $m+1$ (columns [1] through [3]), the three-factor risk-adjusted return during month $m+1$ (columns [4] through [6]), and the four-factor risk-adjusted return during month $m+1$ (columns [7] through [9]). The independent variables are the monthly market capitalization ($Size_{i,m}$), the monthly price volatility ($Pvolt_{i,m}$), the monthly turnover ($Turn_{i,m}$), the monthly short turnover ($Sh\_turn_{i,m}$), and the monthly relative short interest ($RSI_{i,m}$). Each of the independent variables is measured in month m. We compare the return predictability of short turnover to the return predictability of relative short interest using a standard F-test. The F-test tests for equality between the two estimates ($Sh\_turn_{i,m}$ and $RSI_{i,m}$). In response to a Hausman test, we estimate the equation above using two-way fixed effects. Qualitatively similar results are obtained when using pooled OLS while controlling for conditional heteroskedasticity and clustering in the error terms.

In column [1], we find that monthly short turnover relates inversely with next-month raw returns (estimate = -0.1973, p-value = 0.000) after controlling for other independent factors. Similarly, we find that monthly short interest produces a negative estimate (estimate = -0.0007, p-value = 0.000). When including both monthly short turnover and short interest, we find that an F-test rejects equality (F-statistic = 54.11, p-value = 0.000) indicating that the estimate for short turnover is more negative than the estimate for short interest. This result again supports the conclusions we draw from Table 2 and suggests that shorting flow contains more information than short interest. Columns [5] through [9] produce qualitatively similar results to those in columns [1] through [3]. We find in columns [5] and [8] that the relation between monthly short interest and future (three-factor and four-factor risk-adjusted) returns is significant. However, that significance goes away in columns [6] and [9] when controlling for monthly short turnover.

Combined, our findings from this first set of tests indicate that there is evidence of substantial information contained in shorting flows and, to a lesser extent, in monthly short interest.

II.B. Shorting around Short Interest Announcements

Senchack and Starks (1993) find negative abnormal returns around short-interest announcements indicating that short-interest announcements contain information about future stock performance. In a different framework, Boehmer, Huszar, and Jordan (2010) find that stocks with low short interest outperform stocks with high short interest, thus indicating that the level of short interest is an important signal for market participants. In this subsection, we explore the trading activity of short sellers around short-interest announcements. These tests are warranted because any information contained in short-interest announcements is likely to be known by short sellers. Prior studies argue that short sellers are more reactive then proactive when trading around firm-specific announcements (Daske, Richardson, and Tuna, 2005; and Engelberg, Reed, and Ringgenberg, 2010) indicating that short sellers are not likely to trade prior to firm-specific events.[4] However, short-interest announcements are likely to be endogenously known by short sellers and, therefore, short sellers may proactively trade prior to the dissemination of the announcement.

Table 4 reports the results of an event study that examines daily short turnover around monthly short-interest announcements. To determine statistical significance, we calculate two different measures of short turnover. The abnormal short turnover is the daily short turnover on a particular day during the event window less a benchmark, which we define as the average daily

[4] Christophe, Ferri, and Hsieh (2010) find abnormal shorting activity prior to analyst downgrades and argue that information about recommendation changes is leaked to short sellers. However, Blau and Wade (2010) find that shorting activity is abnormally high prior to both downgrades and upgrades, suggesting that short sellers do not appear to be informed when front-running analyst recommendation changes.

short turnover from day *t-20* to *t-11*. We recognize the possibility that event windows – including the use of the benchmark – may overlap. Therefore, we also include a standardized measure of short turnover, which is calculated following Lakonishok and Vermaelen (1986) and Koski and Scruggs (1998). We take the difference between short turnover on a particular day less the mean short turnover during the entire sample time period. The difference is then divided by the standard deviation of daily short turnover during the entire sample time period. The standardization procedure allows the standardized short measure for each stock to be similarly distributed with a zero mean and a unit variance.

To ascertain the information contained in short-interest announcements, we sort announcements into quartiles based on the change in relative short interest and create two types of announcements. '*Bad news*' announcements are announcements in the highest *RSI* change quartiles while '*good news*' announcements are those in the lowest *RSI* change quartile. If short-interest announcements are indeed a signal to be bearish and bullish investors, then *bad news* announcements reflect stocks with the largest increase in *RSI*, which is a bearish signal. Similarly, *good news* announcements consist of stocks with the largest decrease in *RSI*, which is a bullish signal. If short sellers attempt to trade on the information contained in short-interest announcements, then we expect abnormal short turnover prior to announcement days, particularly for *bad news* announcements.

We examine all announcements and report the outcomes in Table 4 columns [1] through [3]. Interestingly, we find that short turnover spikes the day before short-interest announcements. The statistical significance of this result is robust to both the abnormal and standardized short measures. Columns [4] through [6] report the results for announcements in the lowest quartile based on the change in *RSI*. Similar to the results in the first three columns, we find abnormal short turnover on the day before *good news* short-interest announcements. Columns [7] through [9] show the results for announcements in the highest quartile based on the change in *RSI*. As expected, we observe a much larger increase in the short turnover the day before these announcements. In particular, we find that short turnover increases to 0.286 percent on day *t-1*. This represents a 36.3 percent increase in short turnover relative to day *t-2*. The observed spike in short turnover the day before the announcement day is statistically significant according to both the abnormal and standardized measures. Further, this finding is consistent with the idea that short sellers front run short-interest announcements, particularly those announcements that contain the most bearish signal.

We recognize the need to control for other factors that affect shorting activity. We therefore estimate the following equation using pooled data.

$$Sh\_turn_{i,t-3,t-1} = \beta_0 + \beta_1 pvolt_{i,t-3,t-1} + \beta_2 turn_{i,t-3,t-1} + \beta_3 ret_{i,t-3,t-1} + \beta_4 pvolt_{i,t-8,t-4} + \beta_5 turn_{i,t-8,t-4} + \beta_6 ret_{i,t-8,t-4} + \beta_7 ANN_{i,t} + \varepsilon_{i,t-3,t-1} \qquad (2)$$

The dependent variable is the average daily short turnover from day *t-3* to *t-1*, where day *t* is the current trading day. We include contemporaneous price volatility ($Pvolt_{t-3,t-1}$), turnover ($Turn_{t-3,t-1}$), and return ($Ret_{t-3,t-1}$) as well as lagged price volatility ($Pvolt_{t-8,t-4}$), turnover ($Turn_{t-8,t-4}$), and return ($Ret_{t-8,t-4}$). These independent variables are similar to those used in Diether, Lee, and Werner (2009) and others. The variable of interest is the dummy variable *ANN*, which is equal to one if day *t* is the short-interest announcement day; zero otherwise. As before, we partition the announcements into *good news* (announcements in lowest quartile based on *RSI* change) and *bad news* (announcements in highest quartile based on *RSI* change) announcements depending on the change in relative short interest from the previous month. A Hausman test again rejects the presence of Random Effects while an *F*-test supports the use of fixed effects. However, when controlling for the dummy variable *ANN*, including day fixed effects violates the full rank assumption required for consistent estimates. Therefore, we only control for stock fixed effects. Results obtained from using pooled OLS while controlling for conditional heteroskedasticity and clustering in the error terms produce qualitatively similar results.

Table 5 reports the results from estimating equation (2). Columns [1] and [2] report the results when *ANN* is equal to one for all announcements. Columns [3] and [4] ([5] and [6]) show the results when *ANN* is equal to one for *good* (*bad*) *news* announcements. We find in columns [1] and [2] that the dummy variable *ANN* produces reliably positive estimates indicating that short turnover during the three days prior to short-interest announcements is abnormally high. This result is consistent with the conclusions that we draw from our univariate tests in Table 4.

In columns [3] and [4], we find that, when *ANN* captures only *good news* announcements – or announcements in the lowest quartile based on the *RSI* change – the dummy variable produces estimates statistically close to zero. This result is robust to the inclusion of different control variables. Interestingly, columns [5] and [6] show that, after controlling for other independent factors that affect short turnover, the dummy variable *ANN*, which captures announcements in the highest quartile based on the *RSI* change, produces reliably positive estimates. This result indicates that the observed abnormal shorting activity prior to all announcements (columns [1] and [2]) is driven by announcements containing the most negative information. We compare the dummy variable estimates in columns [5] and [6] to the estimates in columns [3] and [4] using a standard *F*-test. We find that the *F*-statistic comparing the estimates for *ANN* in columns [3] and [5] is 15.01 (p-value = 0.000) thus rejected the null that the two estimates are equal and indicating that the short turnover prior to *bad news* announcements is markedly higher than the short turnover prior to *good news* announcements. Similar results are found when comparing the estimates for *ANN* in columns [4] and [6].[5] Combined with the univariate results in the previous table, our findings in Table 5 suggests that short sellers front-run short-interest announcements, which are likely endogenously known by short sellers. This type of front-running is driven by short-interest announcements with the largest increase in *RSI* from the previous month.

II.C. Return Predictability of Shorting around Short Interest Announcements

Thus far, we have documented that shorting flow contains information about the future underperformance of stocks as monthly short turnover relates inversely with future returns. To a lesser extent, we find that short interest also contains some return predictability. In previous tests, we have also shown that short sellers tend to front-run short-interest announcements particularly for announcements with the largest increase in relative short interest. In this subsection, we combine tests of return predictability and pre-announcement shorting activity to determine whether front-running short-interest announcements improves the return predictability of short sellers in general.

To conduct these tests, we follow the general methods of Diether, Lee, and Werner (2009), Christophe, Ferri, and Hsieh (2010), and Engelberg, Reed, and Ringgenberg (2010) by estimating the following equation using pooled data.

$$Sh\_turn_{i,t\text{-}3,t\text{-}1} = \beta_0 + \beta_1 pvolt_{i,t\text{-}3,t\text{-}1} + \beta_2 turn_{i,t\text{-}3,t\text{-}1} + \beta_3 ret_{i,t\text{-}3,t\text{-}1} + \beta_4 pvolt_{i,t\text{-}8,t\text{-}4} + \beta_5 turn_{i,t\text{-}8,t\text{-}4} + \beta_6 ret_{i,t\text{-}8,t\text{-}4} + \beta_7 ret_{i,t.t+1} + \beta_8 ANN_{i,t} + \beta_9 ANN_{i,t} \times ret_{i,t.t+1} + \varepsilon_{i,t\text{-}3,t\text{-}1} \quad (3)$$

[5] The F-statistic comparing these estimates is 15.65 (*p*-value = 0.000), again rejecting equality between the estimates for *ANN*.

The dependent variable and the independent variables are defined the same as those in Table 5. We include two new variables. The first is the four-factor risk-adjusted return from day t to $t+1$.[6] If short sellers can predict negative returns at the daily level – as documented in Boehmer, Jones, and Zhang (2008), Diether, Lee, and Werner (2009), and Engelberg, Reed, and Ringgenberg (2010), then the estimate for $ret_{i,t,t+1}$ is expected to be negative. We also include an interaction variable $ANN \times Ret_{t,t+1}$. The purpose for doing so is to determine whether the common negative relation between shorting activity and subsequent returns is stronger or weaker when conditioning on the short-interest announcement. If pre-announcement short selling improves the return predictability of short sellers then the interaction estimate is expected to be negative. As before, we partition the announcements into *good news* and *bad news* announcements depending on the change in relative short interest from the previous month. A Hausman test and F-tests again supports the use of fixed effects. However, when controlling for the dummy variable *ANN*, including day fixed effects violates the full rank assumption required for consistent estimates. Therefore, we only control for stock fixed effects as before.[7]

Table 6 reports the results from estimating equation (3). Similar to the format of previous tables, columns [1] and [2] report the results when *ANN* captures all monthly short interest announcements while columns [3] and [4] ([5] and [6]) present the estimates when *ANN* captures *good* (*bad*) *news* announcements. In column [1], we find that the estimate for $ret_{i,t,t+1}$ is negative (estimate = -0.0641, p-value= 0.000) indicating that short selling from day $t-3$ to $t-1$ relates inversely with returns from day t to $t+1$. This result is consistent with the idea that short sellers predict negative returns at the daily level (Boehmer, Jones, and Zhang, 2008; and Diether, Lee,

[6] Similar results are obtained when using CRSP raw returns and three-factor risk-adjusted returns as an independent variable.
[7] Qualitatively similar results are obtained when using pooled OLS while controlling for conditional heteroskedasticity and clustering in the error terms.

and Werner, 2009). Similar to the methods used in Engelberg, Reed, and Riggenberg (2010), we condition the return predictability of short sellers by interacting the announcement day dummy with $ret_{i,t.t+1}$. In column [2], we find that the interaction estimate is statistically close to zero (estimate = 0.0032, *p*-value = 0.916) indicating that the return predictability contained in short selling is no better than normal prior to short-interest announcements.

Columns [3] and [4] show the results when conditioning on announcements with the greatest decrease in *RSI* from the previous month (*good news* announcements). Interestingly, the interaction estimate in column [4] is positive (estimate = 0.0944, *p*-value = 0.039) indicating that the return predictability in shorting activity is reduced prior to *good news* announcements.

Columns [5] and [6] report the estimates when *ANN* captures announcements of the greatest increase in *RSI* from the previous month (*bad news* announcements). As before we find that the estimate for $ret_{i,t.t+1}$ is negative (estimate = -0.1241, *p*-value = 0.000) suggesting that short sellers can predict negative returns. Further, we find that the interaction estimate is -0.1255 (*p*-value = 0.059) indicating that the short selling prior to *bad news* announcements increases the return predictability of short sellers. This intriguing result indicates that the observed increase in short turnover prior to short-interest announcements driven by *bad news*, improves short sellers' ability to predict negative returns at the daily level. Stated differently, front-running short-interest announcements with the largest increase in relative short interest from the previous announcement increases the profitability of short sellers.

IV. Conclusion

In this paper we examine monthly short interest and short selling. Short interest is reported monthly and represents the number of shares that are in outstanding short positions, while short selling information is available at the transaction level and measures shorting flow. We expect a high level of correlation between the reported monthly short interest and short activity in a stock, but find that the correlation is only about 45%.

Previous studies using short interest find conflicting evidence as to whether or not short interest is predictive of future returns, while studies using short sale transaction data find evidence that daily short selling is predictive of future returns. We examine both monthly short interest and short sale flow, and find that short sale flow is more predictive of future returns than monthly short interest.

We also examine short selling activity around monthly short interest announcements. We find that short selling increases prior to monthly short interest announcements. We also find that short selling increases more prior to announcements when monthly short interest increases.

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Table 1
Summary Statistics

The table reports statistics that describe the sample. In Panel A, we report summary statistics for several stock characteristics. *Price* is the CRSP ending price. *Size* is the market capitalization in $ billions. *Pvolt* is the price volatility, which is the difference between the daily high price and the daily low price scaled by the daily high price. *Turn* is the daily CRSP trading volume as a percent of shares outstanding. *Sh_vol* is the daily short-sale volume from the Regulation SHO data. *Sh_Int* is the short interest obtained from Compustat. *Sh_turn* is the daily short volume as a percent of shares outstanding while *RSI* is the relative short interest – or the Compustat short interest scaled by shares outstanding. In Panel B report some of the shorting activity variables on short interest announcement days. *ΔRSI* is the change in relative short interest that occurs at the short interest announcement. Columns [2] and [3] report the daily short turnover on announcement days when *ΔRSI* is in the lowest quartile and *ΔRSI* is in the highest quartile, respectively.

Panel A. Summary Statistics for Stock and Trading Characteristics

	Mean	*Median*	*Std. Deviation*	*Min*	*Max*
	[1]	[2]	[3]	[4]	[5]
Price	25.91	21.08	24.46	2.00	741.79
Size	28,194,594	6138,348	132,977,845	101,916	3,467,125,693
Pvolt	0.0395	0.0324	0.0276	0.0000	0.7149
Turn	1.1661	0.7212	2.2082	0.0001	68.5878
Sh_vol	220,975.37	30,656	1,321,965.01	0.00	107,654,551.00
Sh_Int	4,397,273.30	1,973,066	9,105,821.85	0.00	221,879,296.00
Sh_turn	0.1801	0.0942	0.5093	0.0000	49.9722
RSI	7.0908	5.2426	7.0027	0.0000	64.0791

Panel B. Characteristics of Short Interest Announcements

	All Announcements	*Announcements in the lowest ΔRSI quartile – Most Negative Changes*	*Announcements in the highest ΔRSI quartile – Most Positive Changes*
	ΔRSI	*Sh_turn$_t$*	
	[1]	[2]	[3]
Mean	0.0249	0.1756	0.2098
Median	0.0090	0.1170	0.1416
Std. Deviation	1.7218	0.3905	0.4209
Min	-4.8174	0.0000	0.0000
Max	5.0082	4.5877	5.5150

Table 2
Correlation Matrix – Monthly Short Turnover and RSI

The table reports a correlation matrix with corresponding *p*-values for variables that have been aggregated to the daily level. *Sh_turn* is the monthly short turnover. *RSI* is the Compustat monthly relative short interest. *Price* is the average daily price during each month. *Size* is the average monthly market capitalization. *Pvolt* is the average daily price volatility during a particular month. *Turn* is the total monthly volume as a percent of shares outstanding. We also report three future return variables. Ret_{m+1} is the monthly CRSP raw return during month *m+1*. Similarly, *3-Fact* Ret_{m+1} and *4-Fact* Ret_{m+1} are the three-factor and four-factor risk-adjusted returns during month *m+1*. P-values are reported in parentheses. *,**,*** denote statistical significance at the 0.10, 0.05, and the 0.01 levels.

	Sh_turn	*RSI*	*Price*	*Size*	*Pvolt*	*Turn*	Ret_{m+1}	*3-Fact* Ret_{m+1}	*4-Fact* Ret_{m+1}
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Sh_turn	1.0000	0.4578***	0.1375***	0.0496***	0.1588***	0.7012***	-0.0530***	-0.0145***	-0.0147***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.002)	(0.001)
RSI		1.0000	0.0653***	-0.0852***	0.1125***	0.5185***	-0.0303***	-0.0034	-0.0035
			(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.452)	(0.444)
Price			1.0000	0.2520***	-0.2594***	0.1526***	-0.0484***	-0.0349***	-0.0329***
				(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Cap				1.0000	-0.1067***	0.0669***	-0.0124***	-0.0102**	-0.0099**
					(0.000)	(0.000)	(0.006)	(0.025)	(0.029)
Pvolt					1.0000	0.1905***	0.0139***	0.0537***	0.0445***
						(0.000)	(0.002)	(0.000)	(0.000)
Turn						1.0000	-0.0179***	-0.0057	-0.0060
							(0.000)	(0.213)	(0.187)
Ret_{m+1}							1.0000	0.9041***	0.9038***
								(0.000)	(0.000)
3-Fact Ret_{m+1}								1.0000	0.9996***
									(0.000)
4-Fact Ret_{m+1}									1.0000

Table 3
Monthly Regression Results

The table reports the results from estimating the following equation using pooled monthly data.

$$ret_{i,m+1} = \beta_0 + \beta_1\, size_{i,m} + \beta_2\, pvolt_{i,m} + \beta_3\, turn_{i,m} + \beta_4 sh\_turn_{i,m} + \beta_5 RSI_{i,m} + \varepsilon_{i,m+1}$$

The dependent variables include the CRSP raw return during month *m+1* (columns [1] through [3]), the three-factor risk-adjusted return during month *m+1* (columns [4] through [6]), and the four-factor risk-adjusted return during month m+1 (columns [7] through [9]). The independent variables are the monthly market capitalization ($Size_{i,m}$), the monthly price volatility ($Pvolt_{i,m}$), the monthly turnover ($Turn_{i,m}$), the monthly short turnover ($Sh\_turn_{i,m}$), and the monthly relative short interest ($RSI_{i,m}$). Each of the independent variables are measured in month *m*. We compare the return predictability of short turnover and relative short interest using a standard *F*-test. The *F*-test tests for equality between the two estimates. In response to a Hausman test, we estimate the equation above using two-way fixed effects. Qualitatively similar results are obtained when using pooled OLS while controlling for conditional heteroskedasticity and clustering in the error terms. *P*-values are reported in parentheses. *,**,*** denote statistical significance at the 0.10, 0.05, and the 0.01 levels.

	$Ret_{i,m+1}$			3-Factor $Ret_{i,m+1}$			4-Factor $Ret_{i,m+1}$		
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
Intercept	0.1056***	0.1258***	0.1145***	0.0383***	0.0423***	0.0394***	0.0437***	0.0476***	0.0449***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Size_{i,m}$	-0.0059***	-0.0070***	-0.0064***	-0.0031***	-0.0033***	-0.0031***	-0.0033***	-0.0035***	-0.0033***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Pvolt_{i,m}$	-0.0144	-0.0501	-0.0239	0.2734***	0.2655***	0.2721***	0.2102***	0.2026***	0.2089***
	(0.672)	(0.279)	(0.483)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Turn_{i,m}$	0.0350***	0.0158***	0.0437***	0.0057	-0.0002	0.0069	0.0068	0.0012	0.0079
	(0.000)	(0.000)	(0.000)	(0.317)	(0.952)	(0.224)	(0.198)	(0.748)	(0.132)
$Sh\_turn_{i,m}$	-0.1973***		-0.1816***	-0.0482***		-0.0462***	-0.0463***		-0.0442***
	(0.000)		(0.000)	(0.002)		(0.003)	(0.003)		(0.005)
$RSI_{i,m}$		-0.0007***	-0.0006***		-0.0001*	-0.0001		-0.0001*	-0.0001
		(0.000)	(0.000)		(0.097)	(0.436)		(0.098)	(0.426)
$F\text{-}Stat_{RSI=Sh\_turn}$			54.11***			8.76***			8.03***
			(0.000)			(0.003)			(0.005)
Adj R^2	0.0560	0.0480	0.0520	0.0420	0.0400	0.0420	0.0340	0.0330	0.0350
Stock FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Month FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Table 4
Event Study –Daily Short Turnover Surrounding Short Interest Announcements

The table reports the daily short turnover around short interest announcements. We partition the announcements into "Good" and "Bad" announcements. We calculate the change in relative short interest from the last month and sort announcements into quartiles based on the change in RSI. "Good" announcements are those that are in the lowest quartile while "Bad" announcements are those that are in the highest quartile. To calculate statistical significance we use an abnormal measure of short turnover and a standardized measure of short turnover. The abnormal short turnover is the daily short turnover on a particular day during the event window less a benchmark, which we define as the average daily short turnover from day *t-20* to *t-11*. The standardized short turnover is calculated following Lakonishok and Vermaelen (1986) and Koski and Scruggs (1998). We take the difference between short turnover on a particular day less the mean short turnover during the entire sample time period. The difference is then divided by the standard deviation of daily short turnover during the entire sample time period. The standardization procedure allows the measure for each stock to be similarly distributed with a zero mean and a unit variance. *,**,*** denote statistical significance at the 0.10, 0.05, and the 0.01 levels.

	All Announcements			*Announcements for Lowest Change in RSI*			*Announcement for Highest Change in RSI*		
	Sh_turn	*Abnormal*	*Stand*	*Sh_turn*	*Abnormal*	*Stand*	*Sh_turn*	*Abnormal*	*Stand*
	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]
t-10,t-6	0.1748	-0.0073***	-0.0169***	0.1818	0.0009	-0.0339***	0.2242	-0.0203***	0.1040***
t-5	0.2116	0.0295***	0.0442***	0.2446	0.0636***	0.0735***	0.2479	0.0034	0.1318***
t-4	0.1818	-0.0003	0.0093**	0.1921	0.0111***	0.0153*	0.2264	-0.0182***	0.1045***
t-3	0.1729	-0.0093***	-0.0230***	0.1832	0.0023	-0.0280***	0.2178	-0.0268***	0.0872***
t-2	0.1669	-0.0153***	-0.0486***	0.1760	-0.0050**	-0.0562***	0.2098	-0.0348***	0.0509***
t-1	0.2035	0.0214***	0.0196***	0.1932	0.0122***	0.0173**	0.2864	0.0418***	0.1690***
Announce	0.1677	-0.0144***	-0.0457***	0.1756	-0.0054***	-0.0612***	0.2098	-0.0347***	0.0470***
t+1	0.1727	-0.0094***	-0.0173***	0.1796	-0.0014	-0.0407***	0.2172	-0.0274***	0.0821***
t+2	0.1777	-0.0044***	0.0159***	0.1859	0.0050**	0.0017	0.2237	-0.0208***	0.1253***
t+3	0.1877	0.0056***	0.0611***	0.1963	0.0153***	0.0471***	0.2349	-0.0097**	0.1757***
t+4	0.1786	-0.0035**	0.0111**	0.1906	0.0096***	0.0191**	0.2177	-0.0268***	0.0982***
t+5	0.1815	-0.0007	0.0221***	0.1938	0.0128***	0.0249***	0.2229	-0.0216***	0.1145***
t+6,t+10	0.1799	-0.0073***	0.0011	0.1889	0.0009	-0.0036	0.2192	-0.0203***	0.0905***

Table 5
Panel Regressions

The table reports the results from estimating the following equation using pooled daily data.

$$Sh\_turn_{i,t\text{-}3,t\text{-}1} = \beta_0 + \beta_1 pvolt_{i,t\text{-}3,t\text{-}1} + \beta_2 turn_{i,t\text{-}3,t\text{-}1} + \beta_3 ret_{i,t\text{-}3,t\text{-}1} + \beta_4 pvolt_{i,t\text{-}8,t\text{-}4} + \beta_5 turn_{i,t\text{-}8,t\text{-}4} + \beta_6 ret_{i,t\text{-}8,t\text{-}4} + \beta_7 ANN_{i,t} + \varepsilon_{i,t\text{-}3,t\text{-}1}$$

The dependent variable is the average daily short turnover from day *t-3* to *t-1*, where day t is the current trading day. We include contemporaneous price volatility ($Pvolt_{t\text{-}3,t\text{-}1}$), turnover ($Turn_{t\text{-}3,t\text{-}1}$), and return ($Ret_{t\text{-}3,t\text{-}1}$) as well as lagged price volatility ($Pvolt_{t\text{-}8,t\text{-}4}$), turnover ($Turn_{t\text{-}8,t\text{-}4}$), and return ($Ret_{t\text{-}8,t\text{-}4}$). The variable of interest is the dummy variable *ANN*, which is equal to unity if day *t* is the short interest announcement day; zero otherwise. As before, we partition the announcements into "Good" and "Bad" announcements depending on the change in relative short interest from the previous month. A Hausman test again supports the use of fixed effects. However, when controlling for the dummy variable *ANN*, including day fixed effects violates the full rank assumption required for consistent estimates. Therefore, we only control for stock fixed effects. Qualitatively similar results are obtained when using pooled OLS while controlling for conditional heteroskedasticity and clustering in the error terms. *P*-values are reported in parentheses. *,**,*** denote statistical significance at the 0.10, 0.05, and the 0.01 levels.

	All Announcements		*Announcements for Lowest Change in RSI*		*Announcement for Highest Change in RSI*	
	[1]	[2]	[3]	[4]	[5]	[6]
Intercept	-0.0081	-0.0116	-0.0257*	-0.0305**	0.0323**	0.0414***
	(0.575)	(0.246)	(0.076)	(0.028)	(0.038)	(0.003)
$Pvolt_{t\text{-}3,t\text{-}1}$	0.7187***	0.8649***	0.7431***	0.9048***	2.2149***	2.0711***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Turn_{t\text{-}3,t\text{-}1}$	0.1314***	0.1268***	0.1308***	0.1278***	0.1008***	0.1072***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Ret_{t\text{-}3,t\text{-}1}$	0.0131	0.0205	0.2244***	0.2433***	-0.4524***	-0.4895***
	(0.351)	(0.144)	(0.000)	(0.000)	(0.000)	(0.000)
$Pvolt_{t\text{-}8,t\text{-}4}$		-0.2040***		-0.1839***		0.1206**
		(0.000)		(0.000)		(0.021)
$Turn_{t\text{-}8,t\text{-}4}$		0.0074***		0.0053***		-0.0106***
		(0.000)		(0.000)		(0.000)
$Ret_{t\text{-}8,t\text{-}4}$		-0.1726***		0.2115***		-0.6269***
		(0.000)		(0.000)		(0.000)
ANN	0.0060***	0.0058***	0.0020	0.0024	0.0130***	0.0133***
	(0.000)	(0.000)	(0.411)	(0.334)	(0.000)	(0.000)
Adj R^2	0.6017	0.6019	0.6672	0.6672	0.5716	0.5728
Stock FE	Yes	Yes	Yes	Yes	Yes	Yes
Day FE	No	No	No	No	No	No

Comparing ANN column 6 to ANN column 4 – F = 15.65, p-value = 0.000
Comparing ANN column 5 to ANN column 3 – F = 15.01, p-value = 0.000

Table 6
Panel Regressions

The table reports the results from estimating the following equation using pooled daily data.

$$Sh\_turn_{i,t-3,t-1} = \beta_0 + \beta_1 pvolt_{i,t-3,t-1} + \beta_2 turn_{i,t-3,t-1} + \beta_3 ret_{i,t-3,t-1} + \beta_4 pvolt_{i,t-8,t-4} + \beta_5 turn_{i,t-8,t-4} + \beta_6 ret_{i,t-8,t-4} + \beta_7 ANN_{i,t} + \varepsilon_{i,t-3,t-1}$$

The dependent variable and the independent variables are defined the same as those in Table 5. We include two new variables. The first is the four-factor risk-adjusted return from day *t* to *t+1*. We also include an interaction variable $ANN \times Ret_{t,t+1}$. The purpose for doing so is to determine whether the common negative relation between shorting activity and future returns is stronger or weaker when conditioning on the short interest announcement. As before, we partition the announcements into "Good" and "Bad" announcements depending on the change in relative short interest from the previous month. A Hausman test again supports the use of fixed effects. However, when controlling for the dummy variable *ANN*, including day fixed effects violates the full rank assumption required for consistent estimates. Therefore, we only control for stock fixed effects. Qualitatively similar results are obtained when using pooled OLS while controlling for conditional heteroskedasticity and clustering in the error terms. *P*-values are reported in parentheses. *,**,*** denote statistical significance at the 0.10, 0.05, and the 0.01 levels.

	All Announcements		*Announcements for Lowest Change in RSI*		*Announcement for Highest Change in RSI*	
	[1]	[2]	[3]	[4]	[5]	[6]
Intercept	-0.0117	-0.0117	-0.0303**	-0.0304**	0.0407***	0.0407***
	(0.240)	(0.240)	(0.029)	(0.028)	(0.003)	(0.003)
$Pvolt_{t-3,t-1}$	0.8676***	0.8676***	0.9073***	0.9069***	2.0788***	2.0793***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Turn_{t-3,t-1}$	0.1268***	0.1268***	0.1277***	0.1277***	0.1072***	0.1072***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Ret_{t-3,t-1}$	0.0161	0.0161	0.2404***	0.2401***	-0.4960***	-0.4960***
	(0.251)	(0.251)	(0.000)	(0.000)	(0.000)	(0.000)
$Pvolt_{t-7,t-3}$	-0.2023***	-0.2023***	-0.1829***	-0.1828***	0.1240**	0.1237**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.018)	(0.018)
$Turn_{t-7,t-3}$	0.0074***	0.0074***	0.0053***	0.0053***	-0.0106***	-0.0106***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Ret_{t-7,t-3}$	-0.1753***	-0.1753***	0.2091***	0.2094***	-0.6301***	-0.6304***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
ANN	0.0059***	0.0058***	0.0024	0.0023	0.0130***	0.0127***
	(0.000)	(0.000)	(0.321)	(0.357)	(0.000)	(0.000)
$Ret_{t,t+1}$	-0.0641***	-0.0643***	-0.0381***	-0.0428***	-0.1241***	-0.1187***
	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)	(0.000)
$ANN \times Ret_{t,t+1}$		0.0032		0.0944**		-0.1255*
		(0.916)		(0.039)		(0.059)
$Adj\ R^2$	0.6020	0.6020	0.6674	0.6674	0.5729	0.5729
Stock FE	Yes	Yes	Yes	Yes	Yes	Yes
Day FE	No	No	No	No	No	No