9-2010

The Long and Short of It: Evidence of Year-End Price Manipulation by Short Sellers

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Evidence of Year-End Price Manipulation by Short Sellers

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ABSTRACT

We identify a setting in which there is a predictable incentive for short sellers to manipulate prices, and we find patterns consistent with short sellers manipulating prices. Specifically, we find that stocks with high short interest experience abnormally low returns on the last trading day of the year. This effect is strongest among stocks that are easily manipulated and during the last hour of trading. Further, this effect reverses at the beginning of the year, consistent with the temporary nature of price manipulation. We show that hedge funds' portfolios are closely related to market-wide short interest, suggesting that hedge funds, with their convex compensation structures, may generate the patterns we observe. In additional analysis, we find that larger price effects are associated with higher idiosyncratic volatility, offering a potential explanation for why temporary price effects are allowed to persist in the presence of rational arbitrageurs, but we find no evidence to suggest that extended non-trading-day holding periods play a role in the magnitude of the effects. Finally, we provide evidence of mutual funds and short sellers avoiding each other, and we show that downward pressure by short sellers is outweighed by upward pressure by buyers. In other words, since short sellers' incentives are mirrored by buyers' incentives in the opposite direction, our experiment provides evidence that short sellers manipulate prices in much the same way buyers do, and manipulation by short sellers is no stronger than manipulation by buyers.

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In the popular press, short sellers are often accused of manipulating prices.[1] In response to the perceived manipulation, regulators have limited the trading behavior of short sellers in a variety of ways (e.g., the uptick rule or the recent short selling ban on financial stocks). Despite the outcry and the government response, however, beyond a handful of anecdotes there are no academic studies that (1) identify manipulation strategies specific to short sellers and (2) find evidence consistent with manipulation. This paper is the first to do so.

Surprisingly, our evidence of short seller manipulation *does not* justify the singling out of short sellers by regulators and the media. In fact, quite the opposite is true. We find that short sellers manipulate prices in the same way that long-only traders do: in response to period-end incentives. A large body of literature finds that mutual fund managers manipulate closing prices by trading to put upward pressure on closing prices at the end of the year (e.g., Carhart, Kaniel, Musto, and Reed (2002), Bernhardt and Davies (2005), and Zweig (1997)). Even though the resulting price impact is only temporary, top-performing managers have an incentive to make these trades because of the convex relationship between fund performance and flows from new investors (i.e., the flow to performance relationship).[2]

However, while the mutual fund literature finds a strong relationship between *mutual fund holdings* and *high* end-of-year returns, we find a strong relationship between *short interest* and

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[1] See, for example: "Are Short Sellers to Blame for the Financial Crisis?", Bill Saporito, Time, September 18, 2008 or "Did Short Selling Contribute To The Financial Mess?", Wendy Kaufman, National Public Radio, September 19, 2008.

[2] Evidence on responses to incentives includes Brown, Harlow, and Starks (1996) and Busse (1999), among others.

low end-of-year returns. In other words, we find that stocks with large short positions perform poorly on the last trading day of the year. The effect that we document is strongest among firms that are easiest to manipulate (small, illiquid stocks). Moreover, using Regulation SHO intraday data on short sales (as described in Diether, Lee, and Werner (2007)), we find that this effect is strongest in the last hour of trading. We also find strong evidence that stocks with high short interest experience reversals at the beginning of the year, undoing the low returns experienced at year-end with high returns at the beginning of the year. This suggests that the poor returns experienced by high short interest stocks at the end of the year are temporary.

The above results are consistent with trading by short sellers who have strong end-of-year incentives to manipulate prices. Previous literature has shown that hedge fund managers have particularly strong end-of-year incentives (e.g., Agarwal, Daniel, and Naik (2007)), arising out of the convex relationship between returns and performance-driven compensation. Accordingly, we test whether there is a relationship between our proxy for hedge fund holdings and the aggregate short interest. Although data concerning hedge fund short positions are sparse, we find a strong correlation between short interest and the short positions of the hedge funds that we can observe. We also find that our main result – high short interest leads to low year-end returns – is strongest in years in which the hedge fund industry is the largest. These results suggest that hedge funds' convex compensation structure generates incentives that may lead to the price effects we observe. Next, given both time-series and cross-sectional evidence of end-of-year price manipulation by short sellers, we consider why this effect would persist in a market with rational arbitrageurs. In a first investigation, we find that the size of the price effect is positively

associated with stocks' idiosyncratic volatility, indicating that limits to arbitrage may play a significant role in preventing traders from eliminating the price effect. In a second investigation, we note that the end of the year usually corresponds to an extended non-trading holding period, and thus we test the idea that holding period risk may prevent arbitrageurs from taking advantage of manipulative trades. Exploiting differences in the length of the New Year's holiday, we find no evidence to suggest that the length of the market closure is related to the magnitude of the end-of-year pattern that we document.

Finally, we investigate situations in which stocks are subject to upward manipulation pressure by mutual funds and downward pressure by short sellers, a set of stocks that we call "battlefield" stocks. We show that when mutual funds' long positions and short sellers' short positions are of similar size, volume tends to decrease, consistent with the notion that short sellers and mutual fund managers avoid each other's targets for year-end trading, whereas prices tend to show either no pattern or a price increase on year-ends, consistent with the idea that for the average battlefield stock, mutual funds' upward manipulation pressure is relatively strong compared with short sellers' downward manipulation pressure. However, when we focus on differences in holdings in battlefield stocks, we find that downward manipulation pressure is significantly stronger among stocks with high short holdings. This result indicates that when the two sets of traders have large exposures to a stock, downward pressure by short sellers dominates. Furthermore, when we examine stocks with high trading volume in the last half-hour of the day, that is, stocks over which battles between mutual funds and short sellers may have taken place, we find that the returns for high volume stocks are lower than the returns for low

volume stocks. This result suggests that when battles may have taken place among relative matches, downward pressure is stronger than upward pressure.

In sum, we conclude that short sellers are not unique, but rather that flow-based and compensation-based incentives motivate traders regardless of whether their trades are long or short. We also find interesting return and price dynamics when the incentives of long and short traders are in opposition.

The balance of this paper proceeds as follows. Section II describes the existing literature upon which our paper builds, Section III details our hypotheses, Section IV describes our data, Section V reports our findings, and Section VI concludes.

II. Background

The motivation for this paper arises out of three distinct areas of the existing literature: the literature on hedge fund managers' incentives, the literature on period-end trading patterns, and the literature on price manipulation. We summarize the main findings of these areas of the literature in Sections A through C, respectively, below.

A. Incentives

Incentives are central to the hypothesis that hedge fund trading is associated with period-end trading patterns. Incentives may arise from three sources: reporting, flows, and contracts. First, hedge funds may report their returns to databases and investors. To the extent that reporting

makes monthly, quarterly, and annual performance periods more important than other periods, hedge funds have an incentive to manipulate prices at the end of these periods. Second, flows into funds from new investors may reflect past performance over specific periods. For hedge funds, this flow to performance relationship may be more closely tied to quarterly and annual performance because of the existence of redemption periods, which limit investors' ability to withdraw funds between performance measurement periods. Finally, managers' performance contracts -- one of the key distinguishing features of hedge funds -- are functions not only of assets under management, but also of performance (Hodder and Jackwerth (2007)). The fact that managers' contracts are more closely tied to performance increases managers' incentives to manipulate end-of-period prices. In the following paragraphs, we explain these three sources of year-end incentives in more detail.

In the popular press, Eisinger (2005) documents upward spikes in the month-end prices of several stocks, followed by a reversal in the first days of the following period. The article argues that reporting is a key driver of this pattern. In particular, the article argues that the fact that many hedge fund investors get monthly updates, together with recent proliferation of hedge funds, explains a recent increase in the end-of-month return pattern. Ackermann, McEnally, and Ravenscraft (1999) further explain that hedge funds send audited reports to investors that include monthly returns, and that these returns are the same returns the funds supply to the databases.

Similarly, fund flows have been shown to be an important determinant of manager behavior, especially in the area of mutual funds. Brown, Harlow, and Starks (1996) show that mutual fund

managers increase risk when their performance is below that of their peers. Specifically, managers whose mid-year performance is above the median fund's performance have a lower standard deviation over the rest of the year than funds with mid-year performance below the median. Papers such as Brown, Harlow, and Starks (1996) measure risk shifting as a natural outcome of the incentives generated by the convex flow to performance relationship identified in Chevalier and Ellison (1997) and Sirri and Tufano (1998). Despite the fact that hedge fund contracts typically pay benchmark-based performance fees, Brown, Goetzmann and Park (2001) provide evidence that relative performance, or competition among managers, still influences these managers' choice of risk. The paper argues that managerial career concerns are the primary driver of increased risk taking. Fung and Hsieh (1997), however, show that reputational concerns and contractual constraints may reduce the incentive to increase risk.

The existence of subscription and redemption periods may also increase the importance of period-ends (e.g., Ackermann, McEnally, and Ravenscraft (1998) and Aragon (2007)). Unlike mutual funds, hedge fund investors are only allowed to withdraw funds at pre-specified times. Ackermann, McEnally, and Ravenscraft (1999) show that 85% of hedge funds allow multiple redemption periods each year, based on net monthly returns. Interestingly, they show that subscription and redemption periods do not necessarily correspond to incentive fee periods, which are quarterly or annual.

Finally, contracts are likely to play a strong role in hedge fund managers' incentives at the end of the performance measurement period. As Brown, Goetzmann, and Park (2001) indicate,

there are two components to manager compensation: a fixed percentage of assets under management and a performance-based fee. Ackermann, McEnally, and Ravenscraft (1999) show that the median percentage of assets that is paid annually as a non-performance-based management fee is 1.25%.Goetzmann, Ingersoll, and Ross (2003) note that it is "nearly axiomatic" for managers to seek to increase the size of assets under management. But perhaps the strongest incentive to manipulate prices arises from the performance fee. Carpenter (2000), Goetzmann, Ingersoll, and Ross (1997), Grinblatt and Titman (1989), and Kaniel and Cuoco (2007) all show that hedge fund performance contracts have option-like payoffs that increase the incentive to take risk. McEnally and Ravenscraft (1999) state that in the "overwhelming majority" of cases, fees are calculated on an annual basis. Year-end price manipulation could thus be considered one form of risk taking. Consistent with this view, Agarwal, Daniel, and Naik (2007) explain that "hedge funds are compensated by incentive fees that are paid at the end of the year based on annual performance exceeding pre-specified thresholds. Thus, there exist strong incentives for managers to improve performance as the year comes to a close."

B. End-of-Period Return Patterns

The finance literature has identified several patterns in returns around period-ends. Keim (1983) and Roll (1983) identify excess returns in small stocks over a five-day period starting with the last day of the year. Explanations for this anomaly include tax-loss selling (e.g., Roll (1983) and Ritter (1988)) and window dressing (e.g., Haugen and Lakonishok (1988) and Musto (1997)). However, these explanations relate to the first days in the new year, with no specific

implications for the last day (or especially, the last minutes) of the previous year. Similarly, Ariel (1987) identifies excess returns over a nine-day period starting with the last day of the month. Harris (1989) shows that prices rise at day-ends, and he finds this pattern to be strongest at month-ends.

Carhart, Kaniel, Musto, and Reed (2002), Bernhardt and Davies (2005), Duong and Meschke (2008), and Zweig (1997) show that mutual funds manipulate year-end prices. Abstracting from differences in hedge fund preferences (e.g., Griffin and Xu (2008)), any upward manipulation by mutual funds is likely to be indistinguishable from upward manipulation by hedge funds. However, while everything else being equal we would expect hedge funds to manipulate year-end prices for the same reasons mutual funds do, the manipulation is likely to look different because of the prevalence of short positions in hedge funds. Moreover, because hedge funds are less regulated than mutual funds, we may expect even more manipulation among hedge funds due to the relative lack of supervision, and we may expect some manipulation at the expense of mutual funds as in Chen, Hanson, Hong, and Stein (2008).

A potentially important aspect of market microstructure for our analysis is the calculation of closing prices. Hillion and Suominen (2004) show that closing auctions significantly changed trading patterns associated with manipulation on the Paris Bourse. Consistent with this finding, Duong and Meschke (2008) show that manipulation peaks in the 1997-2001 period. On the NASDAQ, price determination changed from a last-trade mechanism to a closing price auction in April 2004. Smith (2005) documents that this change made it more difficult to manipulate

closing prices (e.g., Comerton-Forde and Putniņš (2008)). Interestingly, we do not find any significant difference when we proxy for this change in our analysis.

An additional way hedge funds could improve period-end performance is to trade in non-equity securities. Aragon and Martin (2008) show that hedge funds have many option positions. Hedge funds could possibly avoid conflict with mutual fund closing trades by trading in non-equity markets such as the options market.

C. Price Manipulation

This work also touches on the theme of enforcement cases in the area of stock price manipulation. Aggarwal and Wu (2006) show that stock characteristics such as exchange listing, market capitalization, and liquidity are related to manipulation. For example, in the sample used by Aggarwal and Wu (2006), there are 17 SEC enforcement actions on NASDAQ listed securities but only 3 enforcement actions on NYSE securities. Similarly, using a model that estimates the likelihood of manipulation based on 160 enforcement cases of closing price manipulation, Comerton-Forde and Putniņš (2008) find that price, volume, and liquidity all play an important role in predicting the likelihood of closing price manipulation.

The literature on the enforcement of manipulation cases echoes the literature on the potential for manipulation. The literature on enforcement actions suggests that more manipulation actually takes places in situations in which manipulation is easier, such as small, illiquid stocks traded on the NASDAQ.

III. Hypothesis Development

We aim to test whether short interest before the end of the period is related to end-of-period returns, and if so, whether this pattern is a result of end-of-period trading by hedge funds. To address these questions we first examine whether short interest is related to end-of-year price movements. Based on the discussion above, we conjecture that high short interest is negatively related to end-of-year returns. More formally,

H1. High short interest is negatively correlated with end-of-year returns.

To assess whether the predicted patterns are the result of intentional manipulation, we examine whether such patterns are more evident in settings where manipulation is likely to be most effective. Aggarwal and Wu (2006) show that manipulation is more likely on the NASDAQ. Accordingly, we conjecture that end-of-period prices are higher for NASDAQ listed stocks:

H2a. End-of-year effects are more evident for NASDAQ than for NYSE listed stocks.

Also following Aggarwal and Wu (2006), we expect end-of-year effects to be higher for stocks with lower liquidity and for smaller stocks:

H2b. End-of-year effects are more evident for low liquidity stocks.

H2c. End-of-year effects are more evident for smaller cap stocks.

Next, we take advantage of the recently released intraday short sales volume data to investigate whether short interest is related to end-of-year short sales volume. The above

discussion suggests that short interest is positively related to end-of-year short sales volume. We thus posit that:

H3. Short interest is positively correlated with end-of-year short sales volume.

Finally, following Carhart, Kaniel, Musto, and Reed (2002), we expect manipulation to be higher at the end of the period.

H4. End-of-year effects are more evident at the end of the last day of trading relative to earlier in the day and relative to other days in the year.

Overall, our hypotheses test the basic idea that hedge funds put downward pressure on prices to increase the value of short positions.

IV. Data

We employ a number of databases to examine short selling around period-ends. In addition to the usual data on stock prices and accounting variables, we use short interest, intraday short sales transaction data, intraday trade and quote data, and a database on hedge fund short positions. In this section we describe each of these databases and the steps we take to construct our sample used in analysis.

We first obtain short interest data for the period from June 1, 1988 to December 31, 2007. Short interest is reported monthly until August 2007, and is reported semi-monthly from September 2007 through the end of 2008. Compustat provides the data from March 2003 to the present, and the older data are from historical releases from the exchanges.

Next, we employ a database of intraday short sales transaction data from January 2005 through July 2007. As described in Diether, Lee, and Werner (2007), our short sales database is a transaction-level record of short sales. The data were made available as part of the Securities and Exchange Commission's Regulation SHO, which required exchanges to make short sales transaction data publicly available. It is worth noting that the short sales volume is only one part of a large collection of databases on short sales. As Boemer, Jones, and Zhang (2008) discuss, one important deficiency of the short sales volume database is the fact that these data are short sale initiations -- this database provides no information on the duration of short positions.

We also employ NYSE Trade and Quote data (TAQ) to examine intraday evidence on closing price patterns. We employ the TAQ data for two reasons. First, the TAQ data show whether trading patterns at the end of the day differ from trading patterns over the rest of the day. Second, given the fact that the short selling transaction data are only available for a relatively short period, the TAQ data allow us to estimate sales volume for a much longer period. All transactions are aggregated into 30-minute intervals over the trading day. Out-of-hours trades are excluded from the sample. Trade volume for an individual interval is dollar weighted at the transaction level.

To obtain accurate measures of price manipulation, we only consider transactions executed on the listing exchange of the respective stock. We obtain monthly data from CRSP, which we compare with the TAQ data. We keep only those transactions that occur on the home exchange.

Institutional ownership data come from the Thomson Reuters s34 database, which provides institutional ownership information for all 13f institutions (we use the term "institutional ownership" to refer to these 13f institutions, not individual mutual funds). To compute excess returns, we employ the value-weighted market return and the benchmark described in Daniel, Grinblatt, Titman, and Wermers (1997). Mutual fund holdings computed for the "battlefield" stocks come from the Thomson Reuters s34 database at a quarterly frequency, and the percentage is computed by aggregating institutional positions in a single stock and dividing by shares outstanding.

Aggregate hedge fund data come from two sources. We obtain net asset value (NAV) and returns from TASS prior to 2006, and we obtain funds under management (FUM) from HedgeFund.net. Data are available by fund along with fund style. We take all fund styles except Fixed Income Arbitrage, Emerging Markets, and Managed Futures as funds of interest for short selling. NAV and FUM are each summed monthly to obtain an aggregate measure of hedge fund growth. We believe NAV to be the more accurate of the two measures and thus we use them separately, creating an aggregate measure where we take NAV first and supplement with FUM only when NAV is not available.

Data on position-level hedge fund holdings come from the Morningstar U.S. Open Ended Funds database. This database allows us to gather holdings of hedge funds from 1988 to 2009. The database, similar to that used by Aragon and Martin (2009), covers hedge funds that qualify as 13f institutions, namely, funds with holdings "having an aggregate fair market value on the

last trading day of any month of any calendar year of at least $100,000,000". Using these data, we construct aggregate hedge fund holdings in each stock. The data frequency is quarterly, though additional observations are available for intervening months for some funds.

We combine these databases with stock price and volume data from CRSP and financial statement data from Compustat. We use different time horizons for each experiment, but in the cross section, our databases cover 16,668 unique equities over the period from 1988 to 2007. Additional summary statistics are provided in Table I.

V. Results

If hedge funds trade to affect the closing prices of their positions, it should be relatively straightforward to find statistical evidence of such actions. In this section we describe our approach to testing for patterns of manipulation and we present our results.

A. Patterns in Prices

In our first set of experiments, we look for patterns in closing prices. Our hypotheses are distinct from the "marking the tape" hypothesis in that we focus on short positions rather than long positions. In this sense, our paper is the first to identify the use of closing price trading strategies by short sellers. We know from Carhart, Kaniel, Musto, and Reed (2002) that there are positive abnormal returns for long positions of mutual funds on the last day of the year, so our approach is to look for return patterns in stocks where there are substantial short positions. Short

interest is just such a measure, so as a first pass we look at the effect of short interest on end-of-year returns.

Figure 1, Panel A depicts the end-of-year return pattern for the full sample. We plot excess returns in 30-minute intervals for year-ends and non-year-ends. On days that are not year-ends (dashed lines), the returns are relatively flat, and returns for stocks with high short interest and low short interest are close to one another. This indicates that these two sets of stocks have relatively similar return patterns on non-year-end days. On year-end days (solid lines), however, short interest plays a large role in the return pattern, especially at the end of the day. The grey solid line shows that for stocks with low short interest, returns increase 61 basis points in the last half-hour. This is in line with the return pattern documented in Carhart, Kaniel, Musto and Reed (2002), that is, it is consistent with mutual fund managers trading to increase the closing price. In contrast, the black solid line shows that for stocks with high short interest, returns fall by 24 points in the last half-hour. The dramatic difference between the two sets of stocks, primarily in the last half-hour of the day, is consistent with institutional managers trading to improve the annual performance of their portfolios, albeit in different directions depending on whether their portfolio positions are short or long.

When we turn our attention to stocks predicted to be more easily manipulated (NASDAQ stocks, illiquid stocks, or small cap stocks) in Panel B of Figure 1, we see that there is even stronger evidence for the marking the tape hypothesis: stocks with low short interest observe a 95 basis point increase in returns at the end of the year, whereas stocks with high short interest

have a less dramatic decrease. As we explore in Section E.3 below, the smaller difference in return effects for this subsample of stocks relative to the full sample may be due to "battlefield" stocks (where both long- and short-position holders are trading to change prices) comprising a larger proportion of easy to manipulate stocks.

Our first approach to testing the statistical significance of the end-of-period return pattern is to run pooled time-series and cross-sectional regressions. The regressions have daily risk-adjusted returns for individual stocks on the left hand side, and indicator variables for period-ends and short interest on the right hand side. Specifically, *Month End* is an indicator for month-ends that are not quarter- or year-ends, *Quarter End* is an indicator for quarter-ends that are not year-ends, *Year End* is the last trading day of the year, and *Short Interest* is the number of open short positions normalized by the number of shares outstanding. To ensure that possible correlation between short interest and mutual fund holdings is not driving the results, we control for institutional ownership to capture the distinct effect of short interest on end-of-period returns. To test whether *Short Interest* is a good proxy for hedge funds engaged in short selling, we also employ *Hedge Funds,* the monthly aggregate net asset value of hedge fund styles likely to engage in short selling. Hypothesis H1, which posits that short interest is negatively related to returns at year-ends, predicts a statistically positive coefficient estimate on the interaction between *Short Interest* and *Year End*.

Table II presents the results. The coefficient estimates on the period-end indicator variables are mixed for the full sample, but show a strong positive relationship between returns and *Year*

End in the later portion of the sample, as expected from Carhart, Kaniel, Musto, and Reed (2002). However, this relationship does not condition on the degree of long or short holdings. When we focus attention on stocks with a large amount of short interest, we find a negative and statistically significant coefficient estimate of -106.091 for the full sample (first column), which indicates that year-end returns are significantly negative for high short interest stocks. Economically, this coefficient is relatively large: while on average a one-standard deviation increase in short interest is associated with a 1 basis point decrease in the daily return, on the last day of the year a one-standard deviation increase in short interest leads to a 7 basis point decrease in returns. Looking at the sub-sample results (second through fourth columns), we find that the effect of high short interest on end-of-year returns is particularly strong for the 2001 to 2007 sub-sample (a period associated with a dramatic increase in hedge fund assets), with a coefficient estimate of -220.806. In this case, while a one-standard deviation increase in short interest is associated with a 1 basis point decline in the daily return, on the last day of the year a one-standard deviation increase in short interest leads to a 13 basis point decrease in returns. Finally, the last column of the table shows that, again using the full sample, our proxy for hedge fund activity, *Hedge Funds*, enters the regression negatively, significant at the 10% level. Taken together, these findings suggest that hedge funds contribute to an end-of-year price effect, and that the Carhart, Kaniel, Musto, and Reed (2002) result reverses for stocks with high short interest.

To verify that the movement in prices we observe is due to manipulation rather than information-based trading, we determine whether prices reverse in the first trading day in the

next period. To do so, we first employ a leading return measure, *Excess Return*, as our dependent variable, with the contemporaneous return added to our standard set of independent variables. The results are presented in Table III. Similar to our main result, we see a reversal using the full sample (coefficient of -0.361, significant at the 10% level), evidence of which is stronger when we limit the sample to the 2001 to 2007 sub-period (coefficient of -0.679, significant at the 5% level). For robustness, we also use *Raw Returns* as our dependent variable. The results are reported in Table IV. In this case we do not find a significant result using the full sample, but we continue to find strong evidence of reversals for the 2001 to 2007 sub-sample (coefficient of -1.015, significant at the 1% level). In sum, these results provide further evidence that hedge funds play a role in end-of-year manipulation, particularly with the tremendous growth in hedge funds since 2001.

B. Manipulable Stocks

As Aggarwal and Wu (2006) demonstrate, manipulation is not equally likely across all stocks. Specifically, Aggarwal and Wu (2006) show that manipulation is more likely among NASDAQ stocks, illiquid stocks, and small stocks. Accordingly, in Hypotheses H2a through H2c we posit that end-of-year effects are more pronounced for NASDAQ, illiquid, and small stocks, respectively. In Table V we test these hypotheses by running the above regression for stocks separated by exchange (NYSE and NASDAQ), level of liquidity (low, medium, and high), and size (small, medium, and large). We find that, consistent with H2a, the year-end return pattern obtains among NASDAQ but not NYSE traded equities. Specifically, we find a

statistically significant coefficient estimate of -316.607 on NASDAQ stocks, compared with an insignificant estimate on NYSE stocks. Next, we find that, consistent with H2b, the end-of-year effect is concentrated in illiquid stocks. In particular, the year-end return pattern is statistically significant for the lowest two terciles of illiquidity as measured by Amihud (2002), and is especially strong for the lowest tercile, which has a coefficient estimate of -622.974. Finally, we find that, consistent with H2c, the end-of-year effect is concentrated in small stocks (stocks with an average market cap of $41MM), with these stocks taking a statistically significant coefficient estimate of -456.523. When we pool all stocks (Table VI), we find that the indicators for stocks in the lowest tercile of Amihud (2002) liquidity and for stocks in the lowest tercile of market capitalization are significantly negative when interacted with *Short Interest* and *Year-End*. Overall, we find that the end-of-year price effect is significantly more pronounced among stocks traded on the NASDAQ, illiquid stocks, and small stocks, consistent with Aggarwal and Wu (2006). We discuss the result on *Idiosyncratic Volatility* later in Section E.1.

C. Patterns in Volume

Figure 2 depicts the relationship between short interest and volume. Following Carhart, Kaniel, Musto, and Reed (2002), we define abnormal short selling volume as short selling volume relative to short selling volume in the surrounding, symmetric 120-day window. We calculate this measure for distinct 30-minute intervals throughout each day. We then compare abnormal short selling volume of stocks with high short interest to that of stocks without high

short interest. As Panel A shows, on non-year-end days (the dashed lines), volume is flat and of similar magnitude for both low short interest and high short interest stocks. This indicates that these two sets of stocks are relatively similar in terms of short sales volume on a typical day. However, on year-end days (the solid lines), short volume for stocks with high short interest (black line) is higher than that for stocks with low short interest (grey line), particularly during the last hour of the day. In other words, the trading patterns of stocks with high short interest are normally similar to other stocks, but on the last day of the year, there is substantially more short-selling among stocks with high short interest, especially at the end of the day. Of course, while the pattern in Panel A is striking, it includes stocks regardless of whether manipulation is feasible. When we limit attention to small stocks on the NASDAQ exchange (Panel B), we find that the pattern is similar, but more dramatic.

To test the statistical significance of the pattern illustrated in Figure 2, we turn to a regression framework in which the dependent variable is abnormal volume in each of the last four hours of the day. That is, the dependent variable is the natural logarithm of each hour's short selling volume minus the natural logarithm of short selling volume from 9:30 A.M. to 12:00 P.M. on the same day.[3] The fact that each hour's normalization comes from an early period in the same day not only controls for cross-stock and cross-day differences in trading patterns, but it also allows us to include one observation per day in a regression framework similar to that in Table II. The

[3] We obtain qualitatively similar results when we use percent changes rather than log differences for the dependent variable.

results are presented in Table VII. The coefficient estimates show that short selling volume is not abnormally high from 12:00 P.M. through 3:00 P.M., but from 3:00 P.M. to 4:00 P.M., there is a significant increase in short selling among stocks that have high short interest on the last day of the year. Thus, consistent with Hypotheses H3 and H4, short selling volume is positively related to short interest, and is abnormally high only in the last hour of trading, which is consistent with short sellers trading in an effort to influence the closing price.

D. The Role of Hedge Funds

The patterns described in the preceding sections of this paper are based on short interest data, and as such, they cover various types of market participants, including individuals, proprietary trading desks, and hedge funds. In this section, we provide some evidence that hedge funds do in fact contribute to the observed patterns.

Table VIII presents the estimates from regressions of short interest on hedge fund holdings from Morningstar from 2001 to 2009. Each observation in the regression represents aggregate hedge fund holdings for a given stock on a given reporting date, where we identify the market-wide short interest for a stock that is most closely matched in calendar time. Short interest, hedge fund holdings, and institutional ownership are normalized by shares outstanding.

We find that the relationship between hedge fund ownership and short interest is positive and significant, even after controlling for institutional ownership and market capitalization. Specifically, the coefficient estimate in the first column (2001 to present) is 2.279, which

indicates that for a 10% increase in shares held by hedge funds, short interest increases by 22.79%. The regression thus indicates that market-wide short positions are closely related to holdings by hedge funds, but that hedge funds comprise only a fraction of the market's overall short positions.

Ideally, we would study hedge fund behavior more closely by looking at holdings data in much the same way that Carhart, Kaniel, Musto, and Reed (2002) look at mutual funds' holding data, that is, we would use stock-level hedge fund holdings to predict year-end patterns in prices.[4] However, this potential experiment suffers from two shortcomings. First, the $100,000,000 cutoff significantly restricts the sample of hedge funds: our sample comprises 110 unique hedge funds whereas the Lipper/TASS database indicates that there are at least 3,863 unique hedge funds over the sample period. Second, we suspect that those funds that do report returns information may be modifying their behavior because of the reporting itself. We see a significant amount of cash holdings in the holdings database, 26% on average (with a median of 16%), whereas sources such as Lipper/TASS indicate that the average hedge fund has a leverage ratio of over 50%. This difference may a result of window dressing.

[4] In unreported results, we replicate Table II with hedge fund holdings instead of short interest. We find insignificant results. We attribute some of the difference between the results of Tables II and VIII to a lack of power. The number of observations falls from 6.2M with short interest to 739K with hedge fund holdings.

In sum, despite the limitations of using the Morningstar database, these data give an unprecedented view into hedge fund holdings.[5] We find that the short positions of hedge funds for which we do have data are closely correlated with market-wide short interest.

E. Why Does the Pricing Pattern Persist?

Given that the manipulation pattern we observe above pushes prices away from their long-run equilibrium value, one may ask: why does the mispricing persist in a market populated by rational traders? In what follows, we explore three possible explanations. First, we ask whether traders trying to profit from short sellers' manipulation face an increase in holding period risk through the channel of idiosyncratic volatility. Second, we ask whether traders face the risk of relatively long non-trading-day holding periods over which bad news could be released with no ability to unwind the position. Finally, we ask whether the interaction between upward manipulation by mutual funds and downward manipulation by short sellers influences the size of the effect.

E.1. Idiosyncratic Volatility

Mispricing would exist in the presence of rational traders is if there exist limits to arbitrage. We should thus see the most mispricing among stocks for which the limits to arbitrage are greatest.

[5] Several recent papers, e.g., Aragon and Martin (2008) and Griffin and Xu (2007), use similar databases for this reason.

According to Pontiff (2006), "the literature demonstrates that idiosyncratic risk is the single largest cost faced by arbitrageurs." If limits to arbitrage allow short sellers to push prices away from fundamental values, we should find the end-of-year effect to be more pronounced among stocks with high idiosyncratic volatility. This is exactly what we find in column 4 of Table VI. Recall that Table VI takes the standard specification in Table II and adds a cross-sectional variable as an additional interaction term. The triple interaction (*Idio Vol Ind.. * Year End * Short Int*) is large at -460 and statistically significant. This suggests that the end-of-year short interest effect is much more pronounced for firms in the highest tercile of idiosyncratic volatility, consistent with a limits to arbitrage explanation for mispricing.

E.2. Information, New Year's, and Holding Periods

Chen and Singal (2003) find that traders are less likely to have open positions on Fridays, and one of the explanations they offer is that, as in Damodaran (1989), Penman (1987), and Slezak (1994), information may be released over weekends without an opportunity to trade in response to that information. Since end-of-year trading days are always followed by the New Year's holiday market closure, traders may be less willing to take positions to profit from year-end manipulative trades.

To test this potential explanation we exploit differences in the length of market closures. Over the New Year's holiday, the market is always closed at least one day; usually it is closed three days, and in one case it is closed four days. We conduct a regression of New Year's closure returns on a variable measuring the length of the closure. Specifically, the dependent variable is

the return from the close on the last day of the year to the close on the first trading day of the following year, and the holding period indicator is defined as the number of calendar days over which the market is closed.

Table IX reports the results. To investigate long holiday closures, we split the sample at two or more days of closure, three or more days of closure, and four days of closure. Within each of these sample definitions, the holding period indicator still has some cross-sectional variation because it is defined as the number of days in that year's closure. The coefficient estimates on the holding period indicator suggest that there is no significant difference in holding period returns among closures of different lengths. This result indicates that traders interested in taking advantage of manipulative trades likely don't face disproportional information risk over the New Year's holiday.

E.3. Long Short Wars: The Opposing Incentives of Fund Managers

Carhart, Kaniel, Musto, and Reed (2002) show that fund managers trade to increase year-end prices, and the evidence presented here indicates that short sellers trade to decrease year-end prices. Is it possible that the interaction between the upward and downward manipulation plays a role in the inability of other traders to take advantage of the manipulative trades and thereby counteract the effect? For instance, traders may be unwilling to take the other side of manipulative trades if there is uncertainty about whether upward or downward manipulative

trades will have the largest effect on the closing price. In this section, our goal is to understand what happens when both types of managers are trading in the same stock.

To address this question we analyze stocks where mutual fund managers and hedge fund managers both have a strong interest in year-end prices, stocks that we call battlefield stocks. We identify such stocks by comparing short interest to institutional ownership on a stock-by-stock basis. To get an accurate gauge of holdings without including shares bought and sold on the last day of the quarter, we take institutional ownership and the last short interest report in the previous quarter. We then calculate two measures for each stock, namely, institutional ownership scaled by shares outstanding and short interest scaled by shares outstanding, and we identify stocks where these measures are roughly equal based on two notions of equality: relative and absolute. Our relative measure identifies stocks where the percentile ranking of institutional ownership is equivalent to the percentile ranking of short interest. In other words, we round each percentile ranking to the nearest percentage point, and we look for stocks where the rounded percentages are equal. We call this our "rank" measure. Our absolute measure is similar, except we do not rank institutional ownership or shares outstanding to get a measure that captures matches on a number-of-shares-held basis. In other words, the absolute measure identifies stocks where the number of shares held by mutual fund managers matches the number of shares held by hedge fund managers. We call this our "size" measure.

We conjecture that in one or both of these situations, if there is opposing competition to manipulate the same stock, we should see an increase in abnormal volume at the end of the day,

as opposing buy and sell orders simply cancel each other out repeatedly with no price change. On the other hand, if there exists a Nash-style equilibrium where mutual fund managers and hedge fund managers avoid each other, we should find no change in abnormal volume, but varying changes in price.

The results of a Wilcoxon test of means are presented in Table X, where we consider volume effects. We use two measures of volume over the last half-hour of the day, *Excess Volume* and *Excess Dollar Weighted Volume*, which is defined as the increase in volume in the last half-hour of trading on quarter-ends over the 120-day moving average for that half-hour. As seen in the rank match for the full sample, we do not see a statistical difference in our rank match measure of battles, though we continue using it for comparison purposes. In the size match, however, we get very large and negative Z scores of -23.44 and -24.78 for our two measures of volume, indicating that this is a significant division, but with less abnormal volume, not more.

The matching definition allows matches for which short interest and institutional ownership are equal and *low* as well as matches for which short interest and institutional ownership are equal and *high*, but we have little reason to expect end-of-quarter trading when these variables are low as trading will have a relatively small effect on overall performance when holdings are low. To examine differences between high matches and low matches, we form groups for both types of matches. Specifically, we define a low match as a match where the relative ranking percentile is in the lowest tercile of matched battle stocks, which is less than the 25^{th} percentile, or where the number of absolute shares is below 1%, and we define a high match as a match where the relative ranking percentile is in the highest tercile, which is greater than the 70^{th}

percentile, or where the absolute number of shares is above 4%. We then compare volume for high matches and low matches in rows 2 and 4 of Table IX. Interestingly, we get opposing results. Under the rank matching measure, we see that *High Holdings* lead to lower excess volume (Z score -4.21). However, when the absolute number of shares is matched in our size measure, the significant Z-score of 7.39 indicates that these stocks have significantly more volume. In other words, the overall results show that hedge funds and mutual funds generally stay away from each other's territory, but when both groups have large positions, volume increases significantly, indicating that hedge funds may have high enough incentives to push prices downward or perhaps just prevent mutual funds from moving prices up against hedge funds' large short positions. Our last comparison is on *Not Year End* (*Quarter End*) versus *Year End*. We find that with the rank match measure, volume generally decreases at year-end; the decrease is insignificant under the size measure.

In multivariate analysis presented in Table XI, we obtain similar results, with the rank match correlating *High Holdings* with lower volume, whereas the size match correlates *High Holdings* with higher volume. The rank match again shows a decrease in volume at year-end, indicating avoidance, which in this test is corroborated by the size match when we interact *Year End* with *High Holdings*.

In Table XII, we turn our attention to prices. Consistent with the above results, we find that in general, prices move upward at year-end, indicating that mutual fund managers are actively competing and winning among these battlefield stocks. However, when we look at high holdings

– when the stakes are at the highest – we see prices moving downward, indicating that hedge funds are winning. This gives further credence to the idea of a Nash-style equilibrium where fund managers avoid each other's territory. From the perspective of a rational arbitrageur, the apparent separation between upward and downward manipulations may actually make it easier to take advantage of the manipulative trades, provided that arbitrageurs can identify the separation. Thus, competing manipulation does not appear to explain why the mispricing is allowed to persist.

To summarize, when both institutional ownership and short interest are approximately the same percent of shares outstanding (rank match), there is more likely an increase in abnormal volume, indicating that mutual funds and hedge funds are fighting to push prices in different directions. Looking at the full sample, we generally see downward pressure on prices, but at year-end the movement changes to upward pressure, indicating that the mutual funds are winning when it matters the most.

VI. Conclusion

In this paper, we find evidence of trading patterns consistent with price manipulation by hedge funds. In particular, we find that year-end returns are significantly lower for stocks associated with high short interest, that is, stocks for which hedge funds have strong incentives to manipulate prices because of their large aggregate short positions. This effect is significantly stronger since 2001 and for stocks that are more easily manipulated. We also look at end-of-day short sales volume and find that an increase in short sales may be responsible for the return

pattern. Specifically, when there are relatively large short interest positions, we see a significant increase in short selling in the last half-hour of trading. Overall, we find that hedge funds respond to annual performance incentives in much the same way mutual funds do, but their trades take the opposite direction: instead of buying shares to increase portfolio values, hedge funds short sell to decrease end-of-year prices of stocks for which they hold short positions.

In rational markets, arbitrageurs should eliminate any temporary mispricing. Why, then, does the mispricing above persist? We investigate this question by analyzing three possible explanations. We show that idiosyncratic volatility is associated with the temporary mispricing, suggesting that arbitrageurs are unable to take advantage of manipulative trades without taking on increased risk. We further show that the increased holding period risk over the non-trading New Year's holiday is unable to explain the end-of-year pattern. Finally, we ask whether uncertainty regarding the direction of the manipulation can be a possible explanation. We show that when mutual funds' long positions and hedge funds' short positions are of similar size, there are decreases in volume consistent with hedge funds and mutual funds avoiding each other's target stocks. However, when both groups have similarly large positions, volume increases significantly. In other words, if both groups have equal-sized holdings and their incentives are relatively strong, then there is an increase in trading volume. When we turn our attention to prices, we see that, on average, upward manipulation pressure by mutual funds is relatively strong compared with downward pressure by hedge funds. However, downward manipulation pressure is significantly stronger among stocks with high holdings, with returns for high volume stocks below returns for low volume stocks. Thus, upward manipulation dominates on average,

but when incentives are especially strong, or when there is a lot of volume, downward pressure is stronger than upward pressure. We therefore show that competing manipulation does not appear to explain why the mispricing persists.

This paper makes a novel contribution to our understanding of short selling. We present evidence consistent with the idea that short sales are used in two ways. First, we show that a significant portion of short interest is likely held by hedge fund managers who hold the short positions overnight and are subject to the same incentives as other, better understood, institutional investors such as mutual fund managers. Second, we show that the convex relationship between performance and remuneration leads hedge fund managers to use short selling to temporarily decrease prices, especially in easily manipulated stocks.

This paper also shows that short sellers manipulate prices. Whereas previous literature (e.g., Securities and Exchange Commission (2006) and Shilko, Van Ness, and Van Ness (2008)) identifies potential manipulation based on price and volume patterns, this paper uses one of the few situations in which there are clear, ex-ante predictions about how short sellers manipulate prices. We find that short sellers do indeed manipulate prices. However, the results in this paper do not indicate that short sellers manipulate prices more than buyers; rather, the results suggest that short sellers manipulate prices in much the same way buyers do. If anything, we find that when both short sellers and buyers are likely to be manipulating prices, the upward pressure from buyers outweighs the downward pressure from sellers on average.

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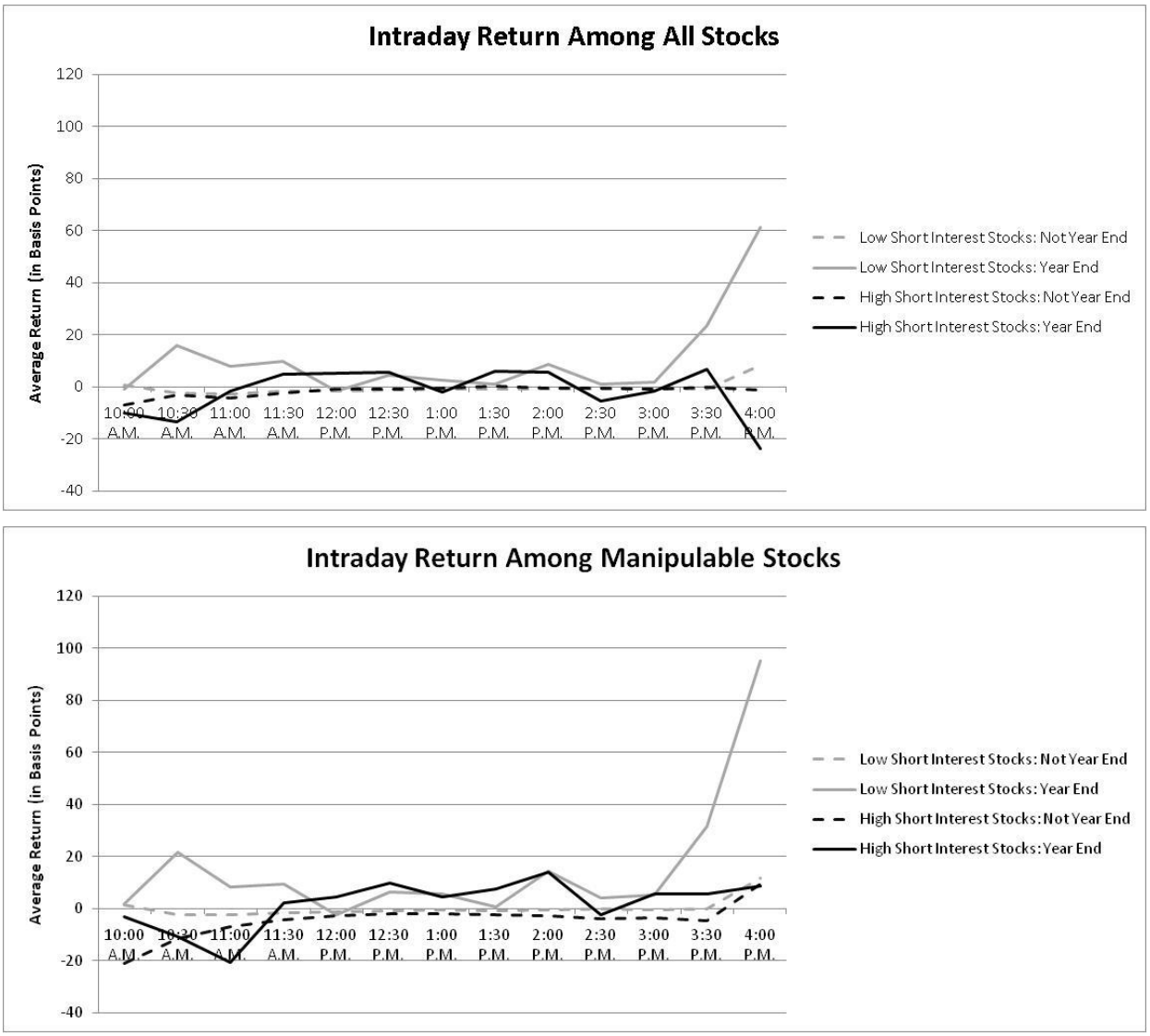

Figure 1: Intraday Return

Both panels plot the average excess half-hour return (excess is with respect to the value-weighted market return) for year-end and non-year-end days. Excess returns are winsorized at the 1st and 99th percentile. The top panel plots these for stocks sorted into high/low quintiles based on short interest. The bottom panel plots the same but is restricted to "manipulable" stocks. Manipulable stocks are those that trade on NASDAQ and have market capitalizations that are in the bottom tercile of our sample. The data cover the period of January 2001 – December 2007.

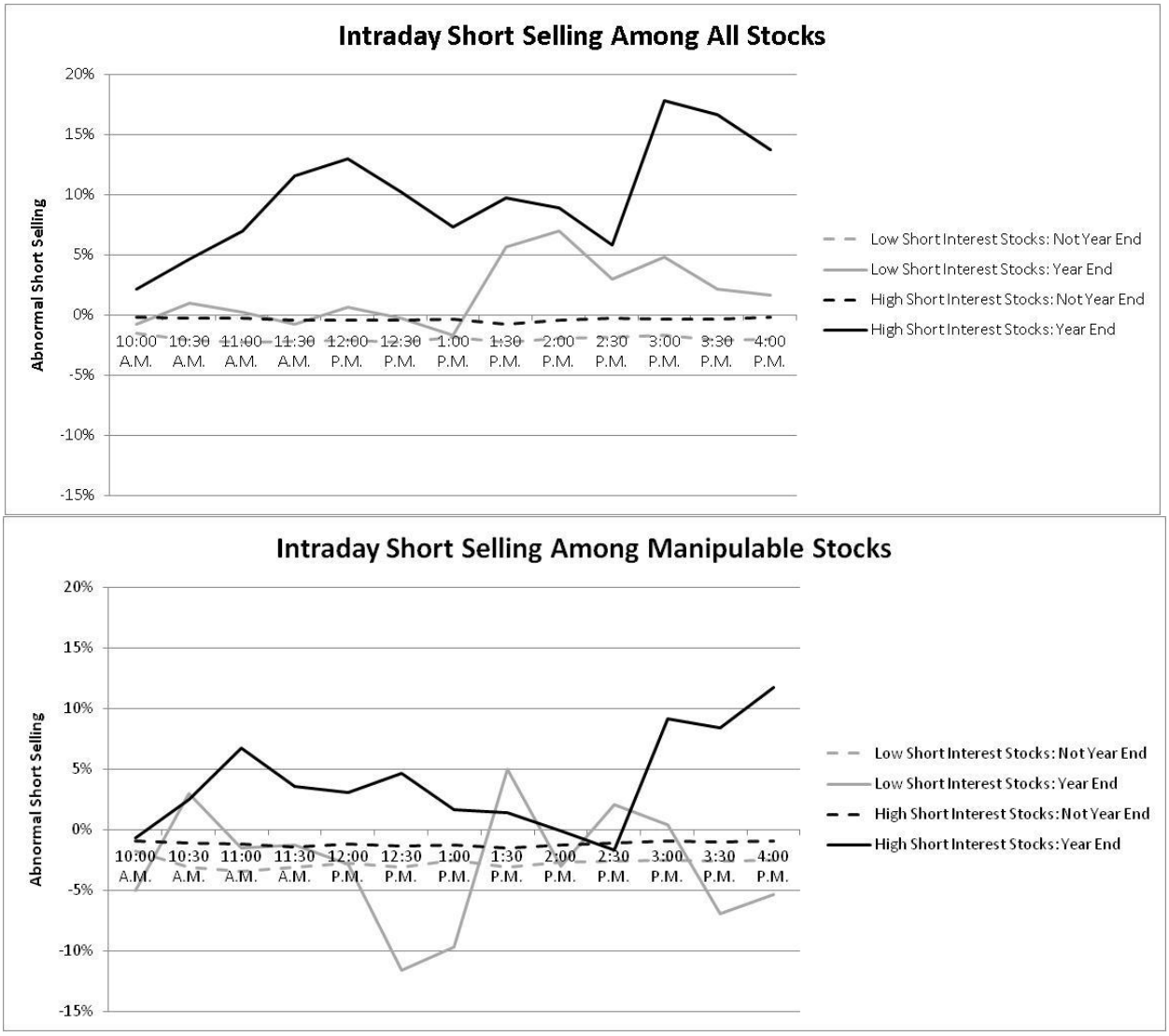

Figure 2. Intraday Short-Selling.

The top panel plots excess short-sales volume for stocks sorted into high/low quintiles based on short interest. Excess Short-Sales Volume is defined as Short-Sales Volume less its 120 day symmetric moving average over that moving average. The bottom panel plots the same but is restricted to "manipulable" stocks. Manipulable stocks are those that trade on NASDAQ and have market capitalizations that are in the bottom tercile of our sample. The data cover the Regulation SHO period of January 2005 – May of 2007 where we have intraday short-selling data. Excess Short-Sales Volume is winsorized at the 1st and 99th percentile.

Table I
Summary Statistics

Short Interest over Shares Outstanding is referred to as *Short Interest* and Institutional Ownership over Shares Outstanding is called *Institutional Ownership*. All data is for 1988 through 2008 except short sales volume which is January 2005 through July 2007. Unique stocks are unique tickers across the entire data period. Total data set is 26.5M unique stock-days. Mean is reported with Median in parentheses underneath except where otherwise indicated.

	Overall	NASDAQ	NYSE
Short Interest	0.027	0.018	0.037
	(0.0026)	(0.0013)	(0.0065)
Institutional Ownership	0.38	0.32	0.51
	(0.29)	(0.23)	(0.51)
Normal Volume	329 M	260 M	469 M
	(28 M)	(17 M)	(72 M)
Short Sales Volume	8.7 M	7.7 M	9.3 M
	(2.3 M)	(1.3 M)	(3.4 M)
Number of Unique Stocks	16,668	10,245	4,835

Table II
Year-End Short Interest Effects by Period

The dependent variable in each regression is the DGTW characteristic-adjusted return, computed daily. All data are daily observations except as follows: *Short Interest* is normalized by shares outstanding observed mid-month contemporaneously with *Short Interest*. "Daily" short interest amounts are for the month in which they were reported mid-month. *Institutional ownership* is reported quarterly and duplicated daily for the entire previous quarter in which it was reported, also normalized by shares outstanding. *Hedge Funds* is aggregate hedge fund NAV from TASS. White standard errors are in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% level.

	Dependent Variable: Abnormal Return				
	1988 - 2007	1988 - 1993	1994 - 2000	2001 - 2007	1988 - 2007
Intercept	2.577***	6.127***	3.101***	2.055***	3.701***
	(0.208)	(0.731)	(0.712)	(0.160)	(0.465)
Short Interest	-21.399***	-30.338***	-10.899*	-24.614***	-16.007**
	(5.619)	(10.458)	(5.792)	(3.013)	(7.625)
Institutional Ownership	-0.057**	-8.187***	-1.401	-0.028***	-1.612**
	(0.025)	(1.585)	(1.340)	(0.007)	(0.713)
Month End Dummy	1.707**	-2.742	2.351*	3.355***	1.482
	(0.848)	(2.083)	(1.423)	(1.179)	(0.906)
Quarter End Dummy	0.461	-6.147*	1.466	2.058	0.055
	(1.401)	(3.439)	(2.283)	(2.109)	(1.513)
Year End Dummy	3.481	-7.900	-1.019	14.680***	-4.265
	(2.837)	(6.091)	(5.056)	(2.948)	(4.224)
*Short Interest * Month End*	-18.895	2.890	-13.761	-37.779**	-15.852
	(14.493)	(68.848)	(22.367)	(17.566)	(16.268)
*Short Interest * Quarter End*	24.515	110.312	-4.756	29.968	24.815
	(18.610)	(149.651)	(22.662)	(27.604)	(21.251)
*Short Interest * Year End*	-106.091*	-16.585	-51.381	-220.806***	-54.733
	(54.859)	(112.794)	(110.703)	(34.927)	(112.029)
Hedge Funds					-0.001***
					(0.000)
*Short Interest * Hedge Funds*					0.003
					(0.005)
*Year End * Hedge Funds*					0.012***
					(0.003)
*Short Int * YrEnd * Hedge Funds*					-0.121*
					(0.067)
Observations	13,571,010	2,303,227	5,039,227	6,228,556	11,842,700
Clusters (Firms)	10,744	3,292	6,548	6,484	10,148
R-Square	0.000008867	0.000022	0.000003718	0.000024	0.0000092

Table III
Reversals using Excess Return Measure

RETURN is Excess Return over DGTW benchmark as in Table II. The dependent variable is the same return measure, one day ahead of the independent variable, such that it will be the first day of the year when T = Year End. White standard errors are in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% level.

	Dependent Variable: 1 Day Lead Excess Return			
	1988 – 2007	1988 – 1993	1994 – 2000	2001 – 2007
RETURN	-0.165***	-0.255***	-0.166***	-0.097***
	(0.006)	(0.005)	(0.005)	(0.003)
Inst Ownership	-0.066**	-10.296***	-2.117	-0.026***
	(0.033)	(1.994)	(1.564)	(0.007)
Month End	-0.906	-3.596*	-0.748	0.564
	(0.809)	(2.071)	(1.270)	(1.068)
Qtr End	-1.368	0.343	-6.132***	2.037
	(1.273)	(2.884)	(2.093)	(1.848)
Year End	-0.722	4.280	-3.154	-2.320
	(2.478)	(5.435)	(4.503)	(2.870)
Short Interest	-22.991***	-48.008***	-12.076	-24.709***
	(7.824)	(9.996)	(8.923)	(2.660)
*RETURN *Month End*	-0.014**	0.010	-0.017*	-0.038***
	(0.007)	(0.021)	(0.010)	(0.010)
*RETURN *Qtr End*	-0.061***	0.008	-0.077***	-0.101***
	(0.012)	(0.021)	(0.017)	(0.022)
*RETURN *Year End*	-0.021	-0.040	-0.002	-0.011
	(0.016)	(0.026)	(0.023)	(0.022)
*Month End*Short Int*	-10.597	244.477***	21.100	-59.417***
	(13.955)	(66.162)	(14.141)	(15.644)
*Qtr End*Short Int*	-69.757***	-43.926	-69.794**	-83.228***
	(20.390)	(116.747)	(30.817)	(25.806)
*Year End*Short Int*	-59.221	-114.667	20.359	-66.077
	(50.533)	(101.658)	(93.480)	(47.115)
*RETURN *Short Int*	0.692**	1.470***	0.411	0.707***
	(0.288)	(0.273)	(0.260)	(0.040)
*RETURN *Month End*Short Int*	-0.338***	0.394	-0.310**	0.075
	(0.070)	(0.411)	(0.154)	(0.101)
*RETURN *Qtr End*Short Int*	-0.149	-1.254***	-0.148	0.267
	(0.290)	(0.394)	(0.301)	(0.227)
*RETURN *Year End*Short Int*	-0.361*	0.163	-0.296	-0.679**
	(0.185)	(0.541)	(0.209)	(0.304)
Observations	13,571,009	2,303,227	5,039,227	6,228,555
Clusters (Firms)	10,744	3,292	6,548	6,484
R-Square	0.02551	0.06291	0.0268	0.008173

Table IV
Reversals using Raw Return Measure

Same as in previous table, but *RETURN* is a raw return in basis points. White standard errors are in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% level.

	Dependent Variable: 1 Day Lead Raw Return			
	1988 - 2007	1988 - 1993	1994 - 2000	2001 - 2007
RETURN	-0.150***	-0.246***	-0.151***	-0.084***
	(0.006)	(0.006)	(0.006)	(0.003)
Inst Ownership	-0.148	-15.423***	-6.269***	-0.060***
	(0.103)	(2.071)	(1.581)	(0.020)
Month End	17.306***	17.645***	23.125***	13.232***
	(0.859)	(2.264)	(1.431)	(1.186)
Qtr End	-10.256***	2.902	-34.881***	4.195*
	(1.532)	(3.229)	(2.413)	(2.239)
Year End	24.816***	73.028***	24.950***	1.946
	(2.922)	(6.823)	(5.433)	(2.943)
Short Interest	-44.532***	-53.361***	-16.602	-56.311***
	(15.068)	(10.467)	(11.523)	(3.581)
*RETURN *Month End*	-0.022***	0.004	-0.027***	-0.047***
	(0.007)	(0.021)	(0.010)	(0.010)
*RETURN *Qtr End*	-0.084***	0.004	-0.084***	-0.149***
	(0.013)	(0.020)	(0.017)	(0.024)
*RETURN *Year End*	-0.004	-0.038	0.020	-0.009
	(0.015)	(0.027)	(0.021)	(0.022)
*Month End*Short Int*	3.606	271.079***	74.465**	-74.890***
	(13.485)	(73.447)	(36.487)	(17.034)
*Qtr End*Short Int*	20.585	-12.608	-105.323***	78.392***
	(27.710)	(121.489)	(38.792)	(29.500)
*Year End*Short Int*	-302.929***	-760.720***	-347.242***	-107.625**
	(55.841)	(204.406)	(120.447)	(49.792)
*RETURN *Short Int*	0.725**	1.627***	0.431	0.712***
	(0.297)	(0.297)	(0.277)	(0.037)
*RETURN *Month End*Short Int*	-0.455***	0.149	-0.371*	0.126
	(0.093)	(0.420)	(0.196)	(0.103)
*RETURN *Qtr End*Short Int*	-0.268	-1.418***	-0.056	-0.045
	(0.311)	(0.409)	(0.309)	(0.265)
*RETURN *Year End*Short Int*	-0.184	0.037	0.118	-1.015***
	(0.199)	(0.537)	(0.208)	(0.313)
Observations	13,571,009	2,303,227	5,039,227	6,228,555
Clusters (Firms)	10,744	3,292	6,548	6,484
R-Square	0.02133	0.05832	0.02253	0.006496

Table V
Year-End Short Interest Effects sorted by Easiest-to-Manipulate Characteristics

The dependent variable in each regression is the DGTW characteristic-adjusted return and the sample is restricted to the 2001 – 2007 time period. Data is the same as in Table II. The Amihud illiquidity measure is calculated as in Amihud (2002) by taking the yearly average of absolute daily return divided by volume. White standard errors are in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% level.

	Dependent Variable: Abnormal Return							
	Exchanges		**Liquidity**			**Size**		
	NYSE	NASDAQ	Low	Medium	High	Small	Medium	Large
Intercept	0.387	2.428***	3.911***	1.680***	-1.965**	-0.577*	9.394***	3.298***
	(0.604)	(0.221)	(0.411)	(0.366)	(0.780)	(0.303)	(0.486)	(0.500)
Short Interest (Normalized)	-18.926***	-28.473***	-3.796	-24.100***	-26.910***	-151.959***	-36.642***	35.265***
	(4.998)	(4.162)	(9.937)	(5.796)	(4.798)	(15.246)	(5.638)	(4.516)
Institutional Ownership	1.751**	-0.030***	-4.409***	-0.022**	4.885***	-0.040**	-8.515***	-2.401***
	(0.843)	(0.005)	(1.088)	(0.011)	(1.071)	(0.018)	(0.841)	(0.710)
Month End Dummy	4.688***	3.305**	3.910*	3.230	4.927***	4.947**	-0.445	5.397***
	(1.329)	(1.657)	(2.261)	(2.522)	(1.675)	(2.275)	(1.745)	(1.338)
Quarter End Dummy	7.854***	-0.302	-6.929*	-0.780	15.457***	-8.597**	10.798***	10.027***
	(2.172)	(3.103)	(3.677)	(4.641)	(2.860)	(4.059)	(3.271)	(2.491)
Year End Dummy	-1.336	20.328***	22.520***	13.986**	-0.273	39.854***	-6.524*	-0.989
	(2.622)	(4.063)	(6.160)	(5.434)	(2.730)	(6.232)	(3.648)	(1.944)
*Short Interest * Month End*	8.314	-72.537***	25.431	-41.248	-49.893*	-79.165	-1.113	-64.196**
	(26.143)	(23.690)	(62.294)	(34.147)	(25.465)	(63.506)	(20.911)	(25.894)
*Short Interest * Quarter End*	-58.912*	71.985*	95.854	15.670	-83.656***	178.267*	-43.820	-60.353
	(30.804)	(39.758)	(158.602)	(53.594)	(31.660)	(97.842)	(32.234)	(49.787)
*Short Interest * Year End*	10.642	-316.607***	-622.974***	-255.690***	-49.465	-456.523***	-48.888	-100.698***
	(46.194)	(43.988)	(132.975)	(68.782)	(42.010)	(149.028)	(43.775)	(35.876)
Observations	2070251	3781834	1649671	1556909	1801299	2070448	2062766	2095342
Clusters (Firms)	1712	4246	2724	2786	2157	3707	3435	2355
R-Square	0.000043	0.000032	0.000025	0.000022	0.000073	0.000145	0.000197	0.00007

Table VI
Comparison of "Manipulable" Variables

Data are as in Tables II and III, adding idiosyncratic volatility. *ManipInd* is how each column header variable is used in each regression. *Illiquid* is the most illiquid tercile as reported in Table III. *Small* is the smallest tercile of market capitalization. *Idiosyncratic Volatility* is computed as the standard deviation of excess return over the DGTW benchmark, and the indicator is for top tercile idiosyncratic volatility. The intercept is included but not reported.

	Dependent Variable: Abnormal Return			
	NASDAQ	Illiquid	Small	Idiosyncratic Volatility
Short Interest (Normalized)	-24.446***	-20.911***	-43.818***	-25.231***
	(3.007)	(3.111)	(3.640)	(3.083)
Manipulation Dummy	0.617**	1.485***	-6.766***	6.741***
	(0.240)	(0.320)	(0.337)	(0.341)
Institutional Ownership	-0.026***	-0.021*	-0.063*	-0.002
	(0.009)	(0.012)	(0.035)	(0.031)
Month End Dummy	2.816*	3.128**	1.230	-4.267***
	(1.492)	(1.304)	(1.117)	(0.747)
Quarter End Dummy	5.821**	7.015***	9.363***	-5.072***
	(2.338)	(2.558)	(2.000)	(1.341)
Year End Dummy	4.091	10.818***	-4.935**	-6.730***
	(3.801)	(3.006)	(2.164)	(1.757)
*Short Interest * Month End*	28.380	-41.540**	-4.115	28.638**
	(25.534)	(18.021)	(16.995)	(13.038)
*Short Interest * Quarter End*	-34.198	-13.161	-29.747	16.270
	(32.309)	(28.792)	(26.569)	(20.834)
*Short Interest * Year End*	-43.349	-171.606***	-47.232	-14.915
	(50.372)	(35.258)	(31.409)	(29.128)
*ManipInd * Month End*	0.625	0.682	4.919*	21.768***
	(2.231)	(2.604)	(2.521)	(2.986)
*ManipInd * Quarter End*	-5.987	-14.044***	-16.758***	21.741***
	(3.871)	(4.450)	(4.503)	(5.497)
*ManipInd * Year End*	16.373***	11.609*	45.990***	57.946***
	(5.557)	(6.811)	(6.608)	(7.493)
*ManipInd * Month End * Short Int*	-104.957***	78.734	-183.114***	-162.633***
	(35.091)	(66.645)	(64.642)	(35.173)
*ManipInd * Qtr End * Short Int*	102.142**	120.613	99.951	31.197
	(50.448)	(157.256)	(98.601)	(61.051)
*ManipInd * Year End * Short Int*	-277.297***	-441.142***	-517.392***	-459.463***
	(66.325)	(140.144)	(150.191)	(73.334)
Observations	6228556	6228556	6228556	6228556
Clusters (Firms)	6484	6484	6484	6484
R-Square	0.00003	0.000032	0.000115	0.000174

Table VII
Incentive-Driven Intraday Short-Selling

The dependent variable in each regression is the natural logarithm of that hour's short-selling volume minus the natural logarithm of the morning's short-selling volume (9:30 A.M. to 12:00 P.M.). See Table III for a description of the other variables. Abnormal short selling is Excess Short Sales Volume as defined in Figure 2. Note that independent variables are all daily observations, while dependent are intraday intervals. White standard errors are in parentheses. *, ** and *** represents significance at the 10%, 5% and 1% level.

	Dependent Variable: Abnormal Short Selling			
	12:00 P.M. - 1:00 P.M.	1:00 P.M. - 2:00 P.M.	2:00 P.M. - 3:00 P.M.	3:00 P.M. - 4:00 P.M.
Intercept	-1.363***	-1.375***	-1.175***	-0.607***
	(0.006)	(0.007)	(0.007)	(0.009)
Short Interest (Normalized)	-0.413***	-0.459***	-0.391***	0.183**
	(0.038)	(0.042)	(0.044)	(0.072)
Institutional Ownership	0.000	0.000	0.001	0.002
	(0.000)	(0.000)	(0.001)	(0.002)
Month End Dummy	0.016***	0.016***	0.074***	0.148***
	(0.006)	(0.006)	(0.006)	(0.007)
Quarter End Dummy	0.009	0.009	0.045***	0.321***
	(0.009)	(0.010)	(0.009)	(0.011)
Year End Dummy	0.078***	0.124***	0.214***	0.403***
	(0.018)	(0.018)	(0.018)	(0.018)
*Short Interest * Month End*	-0.102	-0.069	0.047	0.126
	(0.065)	(0.071)	(0.070)	(0.094)
*Short Interest * Quarter End*	0.359***	0.062	0.029	0.337***
	(0.107)	(0.122)	(0.104)	(0.131)
*Short Interest * Year End*	-0.167	-0.325	0.285	0.815***
	(0.213)	(0.223)	(0.211)	(0.215)
Monthly Fixed Effects	YES	YES	YES	YES
Observations	2,148,189	2,150,970	2,192,232	2,361,858
Clusters (firms)	5,820	5,829	5,834	5,880
R-Square	0.001385	0.001372	0.002288	0.004619

Table VIII
Hedge Fund Holdings on Short Interest

The dependent variable is *Short Interest*, and it is represented as a percentage of short interest. *HF Own* is hedge fund ownership from Morningstar normalized as a percent of shares outstanding. *Inst Own* is the same measure, but for all institutions based on Thomson Reuters. Ln(MktCap) is not normalized in column 3. Data is winsorized at the 1st and 99th percentile, White standard errors are in parentheses, and *, ** and *** represents significance at the 10%, 5% and 1% level..

	2001 to Present		***2004 to Present***	
Intercept	*0.275***	*0.060***	0.305***	0.064***
	(0.012)	(0.001)	(0.013)	(0.001)
HF Own	1.049***	2.279***	0.951***	2.117***
	(0.119)	(0.130)	(0.125)	(0.137)
Inst Own	0.095***		0.096***	
	(0.005)		(0.005)	
Ln(Mkt Cap)	-0.013***		-0.015***	
	(0.001)		(0.001)	
Observations	38319	38319	30135	30135
Clusters	3154	3154	2997	2997
R-Square	0.2551	0.04002	0.263	0.03755

Table IX
Test of the Weekend Effect

The dependent variable is the DGTW Excess Return in basis points from the close on the last trading day of the year to the close of the first trading day of the next year. *Short interest* and *institutional ownership* are normalized by shares outstanding in basis points. The *Holding Period Indicator* changes for each model based on the specified number of days the market is closed. The full sample includes all securities, but only on the first trading day of the year since 2001. *, ** and *** represents significance at the 10%, 5% and 1% level.

	DGTW Excess Return Over Holiday Holding Period					
	4 Days or more	3 Days or more	2 Days or more	4 Days or more	3 Days or more	2 Days or more
Intercept	40.160***	40.160***	38.788***	40.493***	40.493***	38.992***
	(5.210)	(5.210)	(5.579)	(5.341)	(5.341)	(5.811)
Short Interest	149.760*	149.760*	149.001*	135.705	135.705	138.953
	(87.409)	(87.409)	(87.219)	(107.176)	(107.176)	(133.369)
Inst Own	-97.589***	-97.589***	-97.588***	-97.747***	-97.747***	-97.650***
	(9.358)	(9.358)	(9.361)	(9.238)	(9.238)	(9.244)
Holding Period Indicator	-2.596	-2.596	0.195	-3.207	-3.207	-0.099
	(4.562)	(4.562)	(4.566)	(5.144)	(5.144)	(5.171)
*HP Ind * Short Int*				29.963	29.963	15.388
				(80.673)	(80.673)	(102.877)
Observations	50014	50014	50014	50014	50014	50014
Clusters (Firms)	9589	9589	9589	9589	9589	9589
R-Square	0.002949	0.002949	0.002943	0.002951	0.002951	0.002943

Table X
The Battlefield: Volume Differences – Test of Means

Each section tests whether a battle exists on quarter-end data by two different measures. The Rank Match creates a percentile rank on Mutual Fund Holding % vs Short Interest normalized by Shares Outstanding. The Size Match performs a comparison of integer percentages of the same values. *High Holdings* vs. *Low Holdings* is based on a tercile rank of matched battle stocks only. For the Size Match, the *Low Group* all have a value of 0, and the *High Group* are greater or equal than 4%. *Year End* is an indicator, *Not Year End* are quarter ends that are not Q4. *Excess Volume* is the sum of volume during the last half hour of trading less the 120-day symmetric moving average of last half hour volume over that same moving average. *, ** and *** represents significance at the 10%, 5% and 1% level. All tests use the nonparametric Wilcoxon Two-Sample test of means because a test for normality reveals that the samples are all non-normal.

	Excess Volume			**Excess Dollar Weighted Volume**		
Rank Match						
Whole Sample	*Non-Battle*	*Battle*	*Z Score*	*Non-Battle*	*Battle*	*Z Score*
	0.5754	0.6115	1.32	0.5618	0.6011	1.2
Within Battle Stocks	*Low Holdings*	*High Holdings*	*Z Score*	*Low Holdings*	*High Holdings*	*Z Score*
	0.6758	0.3805	-4.21***	0.6598	0.3787	-4.82***
	Not Year End	*Year End*	*Z Score*	*Not Year End*	*Year End*	*Z Score*
	0.7251	0.3208	-3.34***	0.7029	0.3406	-3.11***
Size Match						
Whole Sample	*Non-Battle*	*Battle*	*Z Score*	*Non-Battle*	*Battle*	*Z Score*
	0.5938	0.3443	-23.44***	0.5802	0.3318	-24.78***
Within Battle Stocks	*Low Group*	*High Group*	*Z Score*	*Low Group*	*High Group*	*Z Score*
	0.234	0.766	7.39***	0.1328	0.3991	7.53***
	Not Year End	*Year End*	*Z Score*	*Not Year End*	*Year End*	*Z Score*
	0.3847	0.24	0.49	0.3703	0.2323	0.27

Table XI
The Battlefield: Regression Analysis of Volume Effects

The dependent variable is Last Half Hour Excess Volume or Dollar Weighted Volume which is the sum of volume during the last half hour of trading less the 120-day symmetric moving average of last half hour volume over that same moving average. *High Holdings* is an indicator variable for the highest group for each matching measure. For the Rank Match, it is the top tercile, for the Size Match, it is the *High Group* which represents matches at 4% or greater. The dataset only includes quarterly observations so *Year End* is Q4. *, ** and *** represents significance at the 10%, 5% and 1% level.

	Rank Match		**Size Match**	
	Volume	D-W Vol	Volume	D-W Vol
Intercept	0.944***	0.921***	0.352***	0.334***
	(0.193)	(0.195)	(0.062)	(0.064)
High Holdings	-0.508**	-0.507**	0.552**	0.622**
	(0.205)	(0.206)	(0.246)	(0.261)
Year End	-0.561**	-0.540**	-0.115	-0.102
	(0.237)	(0.243)	(0.079)	(0.083)
*High Holdings * Year End*	0.327	0.390	-0.502	-0.615*
	(0.284)	(0.294)	(0.305)	(0.318)
Observations	1,242	1,242	4,670	4,670
Clusters (Firms)	1,009	1,009	1,743	1,743
R-Square	0.009011	0.007859	0.00174	0.001899

Table XII
The Battlefield: Price Differences

Each section tests whether a battle exists on quarter-end data by two different measures. The Rank Match creates a percentile rank on Mutual Fund Holding % vs Short Interest normalized by Shares Outstanding. The Size Match performs a comparison of integer percentages of the same values. *High Holdings* vs. *Low Holdings* is based on a tercile rank of matched battle stocks only. For the Percentage Match, the *Low Group* all have values of 0, and the *High Group* are greater or equal than 4%. *Year End* is an indicator, *Not Year End* are quarter ends that are not Q4. *Afternoon return* is the price at 4pm with respect to the price at noon. *Late Afternoon Return* is the price at 4pm with respect to the price at 2:30pm. *, ** and *** represents significance at the 10%, 5% and 1% level. All tests use the nonparametric Wilcoxon Two-Sample test of means because a test for normality reveals that the samples are all non-normal.

	Afternoon Return			Late Afternoon Return		
Rank Match						
Whole Sample	*Non-Battle*	*Battle*	*Z Score*	*Non-Battle*	*Battle*	*Z Score*
	0.0035	0.0052	0.47	0.0013	0.0017	-1.92*
Within Battle Stocks	*Low Holdings*	*High Holdings*	*Z Score*	*Low Holdings*	*High Holdings*	*Z Score*
	0.0135	0.0014	4.03***	0.0074	-0.0018	6.88***
	Not Year End	*Year End*	*Z Score*	*Not Year End*	*Year End*	*Z Score*
	0.0042	0.0083	-1.266*	0.0015	0.0022	-3.16***
Size Match						
Whole Sample	*Non-Battle*	*Battle*	*Z Score*	*Non-Battle*	*Battle*	*Z Score*
	0.0029	0.0105	7.47***	0.0006	0.0082	17.29***
Within Battle Stocks	*Low Group*	*High Group*	*Z Score*	*Low Group*	*High Group*	*Z Score*
	0.0117	0.0012	-2.29**	0.0095	-0.0007	-5.73***
	Not Year End	*Year End*	*Z Score*	*Not Year End*	*Year End*	*Z Score*
	0.0037	0.0267	7.06***	0.0022	0.0228	4.92**