Insider Purchases after Short Interest Spikes: a False Signaling Device?[1]

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Abstract

We study the information contents of the purchases by corporate insiders when their firms experience sharp increases in short interest. The cumulative abnormal returns associated with these insider purchases increase in the short run but fall back to zero afterwards. This hump-shaped pattern in the cumulative abnormal returns is more pronounced in various situations when insiders have more incentive to engage in false signaling. Insiders incur some trading losses from their purchases. However, these losses are largely outweighed by the benefits they gain from increased compensation and extended tenure. Our results suggest corporate insiders, provided with the right incentive, can strategically use open market purchases to boost stock prices, which may lead to disruption of market efficiency.

JEL classification: G14, G30, G34

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Introduction

Despites of the debates about whether it is fair for insiders to earn abnormal profits by taking advantage of their private information, it is commonly argued that a major benefit of insider trading is it brings new and useful information into asset prices, and thus makes the market more efficient.[1] For example, when corporate insiders who possess positive private information about their own firms purchase from the open market, stock prices increase and thus more accurately represent the fundamental values. However, the above argument overlooks the fact that the insider trading can be driven by factors other than trading profits, such as concerns over their compensations and job security. In this paper, we argue that insiders, provided with the right incentive, can strategically use their transactions to shape firm information environments, steer stock prices, and thus disrupt market efficiency.

We study the purchase behavior of corporate insiders in a specific environment, namely, when the short interest of their firms increase sharply. Prior research suggests that stocks with high levels of short interest experience poor future performance (e.g., Aitken et al., 1998; Dechow et al., 2001; Asquith et al., 2005; Cohen et al., 2007; Boehmer et al., 2008; Diether et al., 2009). Short sellers are perceived as informed traders who help incorporate negative information into stock prices. A sharp increase in the quantity of stock shares sold short by investors—a *spike* in short interest—arguably implies a sudden shift in investors' sentiment about a stock. The presence of short sellers thus puts pressure on corporate insiders, who are naturally incentivized to signal and counteract the negative information sent by the short sellers. In particular, insiders can put their own money on the line, purchase the stocks of their own companies, and thus send signals to the market. However, the information contents associated with these insider purchases can be subtle. For instance, when short sellers have false information (i.e., when firms have good prospects), insiders have incentive to purchase since they can earn trading profits and meanwhile signal their confidence. On the other hand, when short sellers have true information (i.e., when firms have bad prospects), insiders may still decide to purchase, hoping to deter negative information from being incorporated into stock prices. The goal of this paper is to characterize corporate insiders' purchase behavior after shock interest spikes by examining the information contents and the underlying incentives of their transactions.

[1] Leland (1992) and Bhattacharya (2014) summarize the commonly argued pros and cons of insider trading.

We first examine the probability of insider purchases when firms experience short interest spikes. We find the probability of insider purchases decrease significantly when firms experience sharp increase in short interest. This result suggests that corporate insiders on average try to avoid trading against short sellers, consistent with the notion that short sellers are in general informed traders. However, the probability of insider purchases shows interesting heterogeneity across contexts. Insiders are more likely to purchase when they have more incentives to maintain high stock prices. For example, we find insiders are more likely to purchase if the short interest spikes occur right before the seasoned equity offering (SEO), when they may want to keep the stock prices high to maximize proceeds. Similarly, insiders are more likely to purchase if the short interest spikes happen right before the end of fiscal year, when they may hope to receive more performance-based compensation. Moreover, insiders are more likely to purchase if the short interest spikes take place before stock-based mergers and acquisitions, but they do not increase their purchase probability prior to cash-based mergers and acquisitions. Collectively, the above results suggest that signaling consideration potentially incentivizes insider purchases after short interest spikes.

Do corporate insiders who purchases after short interest spikes possess positive private information? To address this question, we investigate the information contents of these insider purchases by examining the stock prices and earnings surprises following insiders' transactions. If insider purchases are driven by true positive information, we expect to see an increase in stock prices. Importantly, this increase should be long-lived, because it is backed by the subsequent revelation of positive news such as positive earnings surprises. On the other hand, if insiders do not possess positive information, the stock prices may increase in the short run, because the market may not be able to differentiate these purchases from those with true information. However, the increase in stock prices is likely to be short-lived in this situation. We find the cumulative abnormal returns associated with insiders' purchases increase significantly after insiders' transactions. However, they decay gradually in several months, and become indistinguishable from zero one year after insiders' transactions, suggesting the increase in stock prices is only short-lived. This hump-shaped pattern in stock prices is in stark contrast to the one associated with typical insider purchases, where the cumulative abnormal returns increase continuously, and remain significantly positive one year after insiders' transactions. To confirm our findings of the price pattern, we examine the earnings surprises following insider purchases with and without the presence of short interest spikes. Conditional on the absence of short interest spikes, we find the earnings surprises following insider purchases are significantly positive. In

contrast, conditional on the presence of short interest spikes, the earnings surprises following insider purchases are actually negative, which again suggests these corporate insiders on average do not possess positive information.

To understand the nature of insiders' purchases after short interest spikes, we partition our samples and conduct four different types of heterogeneity tests. First, we find Sarbanes-Oxley Act (SOX), which reduces the disclosure latency of insiders' transactions dramatically,[2] has an unintended consequence. The hump-shaped price pattern is much more pronounced after the adaption of the SOX, when insiders are more likely to false signal knowing outsiders have higher incentive to follow their trades that are disclosed in a more timely fashion. Second, the hump-shaped price pattern is much more pronounced in time periods when the regulation enforcement from SEC is weaker. Third, we find the hump-shaped price pattern is much more pronounced for opportunistic insiders, a group of sophistic traders who time their trades and make large amount of profits from their transactions in normal situations (Cohen et al., 2012; Wu, 2015). Finally, we find insiders purchase more aggressively when the ex-post earnings of the firms are weaker. The above results suggest that insider purchases without true positive information are more likely to take place when force signaling is more likely to have a price impact (i.e., after Sarbanes-Oxley Act), when the potential costs to false signal is low (i.e., weak regulation enforcement), for insiders who are more likely to trade strategically (i.e., opportunistic insiders), and in situations when the urgency of false signal is higher (i.e., weak firm fundamentals). We argue these results collectively suggest that some insiders engage in false signaling with their purchases after short interest spikes. The stock prices go up in the short run as the market could not differentiate these insider from those who truly possess positive information, while the stock prices fall back eventually when more information gets revealed.

If insiders false signal by purchasing after short interest spikes, a puzzling question is why they risk they own money to boost stock prices. To address this question, we investigate insiders' incentive by outlining the costs and benefits associated with their purchases. Insiders indeed lose money from their purchases after short interest spikes, as they cannot unwind their purchase positions fast enough due to the regulation of the short-swing profit rule. However, insiders gain from elsewhere with their purchases. First, their compensation increase significantly following their purchases after short interest spikes. For firms whose insiders purchase after short interest

[2] Prior to SOX, insiders were only required to file with the SEC within 10 days after the close of the calendar month in which the transaction occurred, which could result in a disclosure latency of up to 40 days. Since SOX, insiders are required to file with the SEC within two business days.

spikes, the year-to-year growth rate of the total compensation increases by 18.5% for CEOs, and by 8.2% for top 5 executives (both on absolute terms). The increase in managerial compensation is not driven by insider purchases themselves, as the compensation does not increase following insiders' purchases in the absence of short interest spikes. Besides the increase in compensation, insiders in poorly performing firms also enjoy a reduction in the probability of forced turnover. The forced turnover rates of CEOs whose firms rank in the bottom quintile in ex-post earnings surprises reduce by 1.4%. This reduction is economically significant as the mean forced turnover rate for poorly performed CEOs is around 2.9%. After charactering the costs and benefits that associated with insiders' purchases after short interest spikes, we perform a simple back-of-the-envelope calculation and show that the costs are largely outweighed by the gains, which rationalizes the purchase behavior of insiders.

We next examine the role of corporate governance in influencing insiders' purchase activities. If insiders choose to purchase after short interest spikes hoping to gain from compensations, we expect the incentive of their purchases to decrease significantly in firms with good corporate governance, since well-governed firms are less likely to compensate firm managers based on short lived increase in stock prices. This is indeed what we find in the data. Insiders are much less likely to purchase after short interest spikes when there are more independent directors on the board, when investors sit on the board, and when firms have at least one blockholder who owns more than 5% of the total shares.

We strengthen our results by performing a variety of robustness checks. We confirm that the hump-shaped price pattern is robust across firms with different size. We also show that this price pattern is especially strong in firms with low levels of institutional ownership, where short interest spikes convey more negative information due to lower supply in the lendable shares. Finally, consistent with the analysis of abnormal returns, we find trading strategies that long the stocks purchased by insiders for several months, and subsequently short them can deliver significant alphas.

We discuss three alternative explanations for the hump-shaped price pattern associated with insiders' purchases after short interest spikes. The first alternative explanation is behavioral biases. The main difference between this explanation and our false signaling explanation is insiders' beliefs. The behavioral biases explanation assumes insiders genuinely believe they possess positive information when they actually do not, and their purchase decision is driven by

behavioral bias such as over confidence rather than motivation to manipulate stock prices. Ruling out this alternative explanation is difficult because insiders' beliefs are not observable. However, we argue the behavioral biases explanation seems to have limited scope in rationalizing our findings, as one has to argue the behavior biases are more likely to occur in sophistic opportunistic insiders, in time period with lower intensity of legal enforcement, and after the adaption of SOX. The second alternative explanation is short squeeze. Firms that experience short interest spikes may take aggressive measures to force short sellers to cover their positions (Lamont, 2012), which can lead to an increase in stock prices especially in the short run. We argue that this explanation is unlikely to account for the price pattern in our study, as the levels of short interest show no sign of reduction after insider purchases. The last alternative explanation for the price pattern is earnings management. If managers engage in earnings management in response to the presence of short sellers, we can also observe a short-lived increase in the stock prices. We rule out this explanation by examining the degree of earnings management relative to short interest spikes. We find that the managers in fact reduce the amount of earnings management after short interest spikes, a result that is inconsistent with the earnings management explanation.

Our paper adds to the insider trading literature. One commonly argued benefit of insider trading is it can improve market efficiency by incorporating private information into stock prices (Manne, 1966). However, our paper highlights the possibility that insider trading can disrupt market efficiency in situations when insiders' transactions are driven by considerations of their personal portfolios including future income. In contrast to many studies that document long-lived increase in the cumulative abnormal returns following insider purchases (e.g., Jaffe, 1974; Seyhun, 1986; Jeng et. al., 2003), we find the cumulative abnormal returns increase in the short run but decrease significantly in the long run following insider purchases after short interest spikes, suggesting that insiders may strategically use their purchases to boost stock prices. The possibility that strategic insider trading can impede market efficiency is largely understated in the literature. To the best of our knowledge, our paper is the first that provides empirical evidence regarding this issue. Several theory papers show that informed insiders may sometimes trade in the wrong directions (i.e., buying when they have bad news or selling when they have good news about the firm) in order to increase the noise in the trading process and thus maintain their information superiority over the market for a longer period of time (John and Narayanan, 1997; Huddart et. al., 2001; Chakraborty and Yilmaz, 2004). Consistent with these studies, our paper document contrarian trading behavior of corporate insiders. However, note that the contrarian trading

behavior is driven by considerations of insiders' personal portfolios in our study, while it is driven by the desire to maximize the total trading profits in the above theory papers.

Our paper is also related to a broad literature that studies firms' strategic behavior and incentives to manipulate stock prices. Teoh et al. (1998) show managers engage in earnings management to boost stock prices prior to seasoned equity offerings. Chan et al. (2010) show some managers from firms with low earnings quality use share repurchases as a potential tool to mislead investors. Cohen et al. (2014) find firm managers boost stock prices in the short run by calling on bullish analysts disproportionally during earnings conference calls. Peng and Roell (2014) theoretically shows how stock based compensation can lead managers to engage in costly, short-term price manipulation. Our paper adds to this strand of literature by empirically showing managers can use insider purchase to manipulate stock prices and this behavior is likely driven by considerations of their compensation and job security.

Our paper contributes to the literature that studies the interaction between corporate insiders and short sellers. One strand of literature examines how short sellers affect the trading pattern of corporate insiders. Khan and Lu (2013) provide evidence that short sellers can front-run insider sales. Massa et al. (2015) show short selling activities induce insiders to sell more and faster. Our paper is complementary to these two papers as we investigate the purchase behavior of insiders in response to short sellers. Another strand of literature investigates how corporate insiders use their influence to counteract the short sellers. Lamont (2012) finds firms employ many aggressive methods, such as legal threats, investigations, and lawsuits, to impede short selling and create a short squeeze. These firms exhibit low abnormal returns in the subsequent year, suggesting short-sale constraints allow stocks to be overpriced. Different from Lamont (2012), we focus on the signaling behavior of corporate insiders. The abnormal return pattern in our paper is driven by the market's reaction to insider purchases, instead of short squeeze. Two recent studies show that firm managers may use share repurchases to trade against short sellers (Liu and Swanson, 2016; Campello and Saffi, 2015). The information contents of these share repurchases, however, remains to be examined thoroughly.

Finally, our paper shows results that are consistent with previous studies in the short selling literature (e.g., Asquith and Meulbroek, 1995; Desai et al., 2002; Jones and Lamont, 2002; Cohen et al., 2007; Boehmer et al., 2009). We find that cumulative abnormal returns decrease significantly after short interest spikes. Conditional on the presence of short interest spikes,

corporate insiders are significantly less likely to purchase on the open market. Even when insiders do purchase, the following earnings surprises are on average negative. These results suggest short sellers in general possess true negative information about the firms and their activities help improve price efficiency.

The rest of the paper proceeds as follows. Section 1 describes the data and empirical design; Section 2 examines the probability of insider purchases after short interest spikes; Section 3 investigates the information contents of insiders' purchases; Section 4 shows results of various heterogeneity analysis; Section 5 analyzes insiders' incentive problem; Section 6 performs robustness tests and discusses alternative explanations, and Section 7 concludes.

1. Data and Empirical Design

We obtain short interest data from Compustat, which covers monthly short interest data since 1973. Since the coverage of NASDAQ stocks in the Compustat short interest data is limited prior to 2003, we substantiate our data with short interest data from NASDAQ exchange. Short interest is the total number of uncovered shares sold short on the settlement date closest to the 15th of the month.[3] The stock exchanges compile firm-level short interest and then release it by the end of the month. We normalize short interest by total shares outstanding as of the reporting date to form short interest ratios. We merge the short interest data with insider trading data, which come from Thomson Reuters and cover all insider trading activities since 1986. Corporate insiders are defined broadly to include those that have "access to non-public, material, insider information," and thus are required to file SEC forms 3, 4, and 5 when they trade their companies' stocks. Analyst forecasts data come from Thomson Reuters I/B/E/S database; Stock returns data come from the Center of Research in Security Prices (CRSP); Accounting data come from COMPUSTAT; SEC insider trading enforcement data is hand collected from the SEC website; Mergers and acquisitions data come from Thomson ONE; Corporate Governance data come from Institutional Shareholder Services (ISS); Blockholder data come from Thomson Reuters Institutional (13f) Holdings; Seasoned equity offering data come from SDC, and managerial compensation and forced turnover data come from Execucomp.

[3] After 2007, the short interest level at the end of the month is also available. Since our analysis is done at monthly level, we only use the mid-month measures for consistency across sample time periods.

Figure 1 plots out the histogram of the month-to-month change in short interest ratios for all the firms covered by the Compustat short interest data. We define a short interest *spike* as a 1% or larger increase in the short interest ratios. We choose the 1% cutoff as the resulting spike sample contains about 5% of the total observations.[4] One caveat of our approach is we cannot tell whether the increase in the short interest is due to a demand shift (i.e., interest of shorting a stock) or a supply shift (i.e., supply of lendable shares). However, we note that the supply channel explanation will bias against us, as studies have shown that the increase of short interest driven by the supply channel has little price impact.[5] Note that short interest spikes do not happen often in the time series of individual firms. On average, a typical firm in our data experiences one short interest spike in every two years.

[Insert Figure 1 about here]

We categorize the short interest spikes into two groups ("spike with insider purchases" and "spike without insider purchases") based on whether corporate insiders purchase on the open market in a two-week window *after* the short interest spikes.[6] Here, we define the dates of the spikes as the last days of the corresponding months, as the mid-month measures of short interest are released and become public information in the end of each month.

[Insert Figure 2 about here]

Because we are interested in comparing the insider purchases after short interest spikes with insider purchases under normal situations, we construct matched sample with firms that do not experience short interest spikes. Figure 2 illustrates our sample construction procedure. We match each observation in the "spike with insider purchases" sample (e.g., Firm i in Figure 2a) with up to five control firms within the same Fama-French size and book-to-market quintile that do not experience short interest spikes while at the same time have insider purchases in the two-

[4] The results are qualitatively similar if we instead use 0.5% or 2% cutoff.

[5] Using proprietary data on stock loan fees and stock loan quantities, Cohen et al. (2007) show that outward demand shifts in short selling are associated with significantly negative abnormal returns in the future, whereas outward supply shifts are associated with much smaller changes in the abnormal returns. Moreover, Kaplan et al. (2013) suggest that securities lending through the shorting supply channel does not cause any adverse effects on stock prices in a field experiment.

[6] The results are qualitatively similar if we instead use a one-week or a one-month window.

week window after the spike dates (e.g., Firm j in Figure 2b). On the other hand, we match each observation in the "spike without insider purchases" sample (e.g., Firm m in Figure 2b) with up to five control firms within the same Fama-French size and book-to-market quintile that do not experience short interest spikes and do not have insider purchases in the two-week window after the spike dates (such as Firm n in Fig. 2b). Note that we require the control firms to be in the universe of the Compustat short interest data. Thus we are sure these control firms do not experience short interest spikes. Our constructed sample covers 145,326 firm-month observations from 8,685 unique firms and spans 1986 to 2012. We have 53,322 firm-month observations from the spike sample, and 92,004 firm-month observations from the matched non-spike sample.

The main dependent variables in our paper are the cumulative abnormal returns and earnings surprises. The cumulative abnormal returns (CARs) are returns benchmarked by returns of the DGTW portfolios based on firm size, book-to-market ratio, and momentum (Daniel et al., 1997; Wermers, 2004).[7] Earnings surprises are defined as the difference between the realized quarterly EPS and the consensus quarterly EPS normalized by the stock prices. Because the distributions of the earnings surprises exhibit heavy tails, we winsorize them at the 1st and 99th percentiles of their empirical distributions to mitigate the effect of outliers. We also include several control variables that have predictive power over expected returns and earnings surprises. *LnSize* is the natural log of the market cap (in millions) in year t-1, *LnBEME* is the natural log of the book-to-market ratio in year t-1, *LnLeverage* is the natural log of debt-to-equity ratio in year t-1, *Ret12mto2mPrior* is the cumulative raw returns 12 months to two months prior to event dates, and *Ret2mPrior* is the cumulative raw returns two months prior to event dates. Table 1 lists the summary statistics of the dependent variables and the control variables. We can see the control variables are similar for observations in the spike sample and the matched non-spike sample, suggesting that the matching procedure is reasonable.

[Insert Table 1 about here]

Previous studies have shown that negative abnormal returns follow high levels of short interest (Asquith and Meulbroek, 1995; Desai et al., 2002). Consistent with these studies, we find that cumulative abnormal returns decrease significantly after an abrupt increase in the short

[7] The DGTW benchmarks are available via http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.htm.

interest level. Specifically, we evaluate the impact of short interest spikes on cumulative abnormal returns using the following specification:

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Spike_{it} + \gamma' X_{it} + \varepsilon_{it}. \qquad (1)$$

We include both the spike sample and the matched non-spike sample in this test. Here, the dependent variable is the 12-month cumulative abnormal returns benchmarked by the DGTW portfolios (Daniel et al., 1997; Wermers, 2004). The main independent variable of interest is a dummy variable (*Spike*) that equals one if the observation comes from the spike sample, and zero if the observation comes from the matched non-spike sample. We control for a variety of other determinants of cumulative abnormal returns including size, book-to-market ratio, leverage, and past stock returns. To control for cross-sectional and time-series heterogeneity, we also include industry fixed effects and calendar month fixed effects. We cluster standard errors by the Fama-French 48 industry.[8]

[Insert Table 2 about here]

The coefficients of the tests are reported in Table 2. The 12-month cumulative abnormal returns decrease significantly after short interest spikes. This effect survives after including the control variables and fixed effects. The decrease in the cumulative abnormal returns is economically sizable. For example, according to the specification with control variables, industry fixed effects, and calendar month fixed effects, the 12-month cumulative abnormal returns decrease by 3.2% ($p\text{-}value$ <0.01) after short interest spikes. The magnitude in which cumulative abnormal returns decrease is comparable with Dechow et al. (2001), who find the one-year cumulative abnormal returns are 3.5% lower for stocks with high short interest.

The decrease in cumulative abnormal returns following short interest spikes suggests the market on average perceives short interest spikes as negative signals about the firms, consistent with the notion that short sellers are informed traders. Thus short interest spikes provide situations in which corporate insiders have a high incentive to signal in order to prevent sharp decline in stock prices. In this paper, we focus on a particular form of signaling, namely, open-market purchases of corporate insiders.

[8] Standard errors are in general smaller if we instead cluster at the firm level.

2. Probability of Insider Purchases after Short Interest Spikes

We first examine the impact of short interest spikes on the probability of insider purchases. We include both the spike sample and the non-spike sample in the analysis. The dependent variable (*Purchase*) is a dummy variable that equals one if corporate insiders purchase on the open market in the two-week window after short interest spikes, and zero otherwise. In the baseline model, the main independent variable of interest is the dummy variable *Spike*. We include control variables (size, book-to-market ratio, leverage, and past stock returns), industry fixed effects, and calendar month fixed effects in the regressions. Column (1) of Panel A in Table 3 shows that corporate insiders are significantly less likely to purchase on the open market after short interest spikes. The probability of insider purchases decreases by 6.4% after short interest spikes. The decrease in magnitude is sizable, because the average probability of insider purchases in the absence of short interest spikes is 11.8%. This result shows insiders avoid trading against short sellers, which again is consistent with the notion that short sellers on average have true negative information about the firms.

[Insert Table 3 about here]

Despite of the general tendency to avoid trading against short sellers, insiders increase their probability of purchases in various situations in which they have a high incentive to signal. Specifically, we find insiders are more likely to purchase if the short interest spikes happen right before the seasoned equity offering (SEO) when they may want to maximize the issuance proceeds, and if the short interest spikes happen right before the end of the fiscal years, when insiders may have incentive to keep the stock prices high in order to impress board members and shareholders. Columns (2)-(3) of Panel B in Table 3 show that the probability of insider purchases increases by 3.9% if the short interest spikes happen within one month prior to seasoned equity offerings, whereas it increases by 3.4% if the short interest spikes happen within one month prior to the end of fiscal years.[9] Moreover, we find insiders are also more likely to purchase if short interest spikes take place right before the stock-based mergers and acquisitions, while we do not find such an increase for cash-based mergers and acquisitions. Taken together, these results are consistent

[9] These changes are not due to time-series variation in the purchase probability relative to the seasoned equity offering and the end of fiscal year, because we control for the *NearSEO* and *NearYearEnd* dummies in the regressions. In fact, in the absence of short interest spikes, insiders are significantly less likely to purchase prior to these events, because stock prices usually drop after the seasoned equity offering, and regulatory attention is high around fiscal year ends.

with the possibility that insider purchases after short interest spikes are driven by signaling considerations.

3. Information Contents of Insiders' Purchases

The information contents associated with insiders' purchases after short interest spikes can be complicated. If short sellers have false information (i.e., firms have good prospects), insiders are likely to purchase to signal their confidence. However, when short sellers have true information (i.e., firm have bad prospects), insiders may also choose to purchase hoping to boost the stock prices in the short run. To examine the information contents of insiders' purchases, we study the pattern of cumulative abnormal returns and earnings surprises following insiders' transactions.

First, we investigate the pattern of cumulative abnormal returns using the following specification:

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it} \qquad (2)$$

The dependent variables are cumulative abnormal returns ranging from one month to 12 months after the short interest spikes (event dates). The main independent variable of interest is a dummy variable (*Purchase*) that equals one if insiders purchase on the open market within two weeks of short interest spikes, and zero otherwise. We condition the analysis either on the presence of short interest spikes (spike sample) or the absence of short interest spikes (non-spike sample). The coefficients of *Purchase* are presented in Table 4 (Panel A for spike sample; Panel B for non-spike sample), and they represent the difference in cumulative abnormal returns between the cases with insider purchases and the cases without insider purchases.

[Insert Table 4 about here]

In the analysis conditional on the presence of short interest spikes, the coefficients of *Purchase* keep increasing after spikes and reach their peak five months after the event dates. Compared to firms whose insiders do not purchase after short interest spikes, the five-month cumulative abnormal returns of firms whose insiders do purchase are 2.8% higher. These results suggest the market perceives insider purchases after short interest spikes as positive signals.

Interestingly, however, the coefficients of *Purchase* decay gradually after the fifth month and become indistinguishable from zero nine months after the event dates and onward, suggesting the increase in cumulative abnormal returns is only short-lived; that is, purchases after short interest spikes on average contain little positive information in the long run. The pattern of cumulative abnormal returns in the spike sample is in stark contrast to that in the matched non-spike sample. As Panel B of Table 4 shows, conditional on the absence of short interest spikes, the coefficients for *Purchase* plateau five months after the event dates and remain significantly positive throughout the one-year event window, suggesting insider purchases in the absence of short interest spikes contain long-lived positive information about the firms, consistent with many previous studies in the insider trading literature (e.g., Jaffe, 1974; Seyhun, 1986; Jeng et. al., 2003).

[Insert Figure 3 about here]

The coefficients of *Purchases* for both the spike and non-spike samples are plotted in Figure 3. Again, we can see the coefficients in the spike sample resemble those in the non-spike sample in the first several months after the event dates, but decay to zero and are significantly lower than those in the non-spike sample nine months after the event dates. The difference in the pattern of cumulative abnormal returns indicates that insider purchases have different implications about firms' future prospects with and without the presence of short interest spikes. To further test this idea, we next investigate the earnings surprises around insider purchases in both the spike sample and the non-spike sample. The regression specification is the same as the analysis of cumulative abnormal returns except that the dependent variables are now quarterly earnings surprises calculated by the difference between the realized EPS and the consensus EPS normalized by the stock prices at the end of last year. Because the distributions of the earnings surprises exhibit heavy tails, we winsorize them at the 1st and 99th percentiles of their empirical distributions to mitigate the effect of outliers:

$$Surprise_{it} = \alpha_{industry} + \lambda_{calendar\ quarter} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it} \qquad (3)$$

Consistent with previous studies (Ke et al., 2003; Piotroski and Roulstone, 2005), we find that in the non-spike sample, insider purchases are followed by positive earnings, suggesting that corporate insiders possess positive private information when they purchase. As Panel B in Table 5 shows, conditional on the absence of short interest spikes, the earnings surprises of firms with insider purchases in the first quarter after event dates are 12.3 basis points higher than those of

firms without insider purchases. This increase is economically significant, because the difference between the 50th and 75th percentiles of the earnings surprises is 13.5 basis points in our data.

[Insert Table 5 about here]

In sharp contrast to the non-spike sample, insider purchases in the spike sample are not followed by positive earnings surprises. In fact, in the next few quarters after the event dates, the earnings surprises for firms whose insiders purchase after short interest spikes are even significantly lower compared to firms whose insiders do not purchase (Panel A, Table 5). The difference in the dynamics of the earnings surprises in the spike and non-spike sample are illustrated in Figure 4, where we plot the coefficients of *Purchases* in both samples. The analysis of earnings surprises confirms that insider purchases after short interest spikes have different implications about firms' future performance compared to typical insider purchases. On average, typical insider purchases (i.e., purchases in the absence of short interest spikes) predict positive surprises in future earnings, whereas insider purchases after short interest spikes are associated with negative or at least non-positive surprises in future earnings.

[Insert Figure 4 about here]

4. Heterogeneity Analysis

From the analysis of the previous section, we find insiders' purchases after short interest spikes do not have a long-lived price impact. The price pattern associated with insiders' purchases is consistent with a false signaling explanation: insiders who do not possess positive information mimic the insiders who do by purchasing on the open market in order to boost stock prices. The stock prices increase in the short run as the market could not differentiate the two types of insiders, while they fall back eventually when more information gets revealed. In this section, we present results from four different heterogeneity tests, which collectively provide strong evidence supporting this false signaling explanation.

4.1. Impact of the Sarbanes-Oxley (SOX) Act

The passage of the Sarbanes-Oxley (SOX) Act in August 2002 reduced the disclosure latency of insiders' transactions dramatically. Prior to SOX, insiders were only required to file

with the SEC within 10 days after the close of the calendar month in which the transaction occurred, which could result in a disclosure latency of up to 40 days. Since SOX, insiders are required to file with the SEC within two business days. The main motivation for this policy change is to reduce the economic rent insiders can extract prior to the disclosure of their transactions. After the adaption of SOX, studies show that the information contents of insiders' transactions indeed get incorporated into stock prices in a more timely fashion (e.g., Brochet, 2010).

However, an unintended consequence of the policy change is it makes insiders who do not possess any true positive information more likely to false signal (John and Narayanan, 1997). This is because it is easier for insiders to manipulate stock prices as outsiders have more incentive to follow their transactions after the reduction of disclosure latency. Thus, if insiders' purchases after short interest spikes are driven by false signaling considerations, we expect to observe a more pronounced hump-shaped price pattern after the adaption of SOX. This is indeed what we find in our analysis. Table 6 examines the cumulative abnormal returns associated with insiders' purchases after short interest spikes in full sample period (1986-2012), before SOX (1986- Aug. 2002), and after SOX (Sep. 2002-2012). We observe a robust hump-shaped price pattern in the subsample after SOX. The cumulative abnormal returns increase by 3.3% in the first four months, and subsequently decrease by 2.9% in the next eight months. On contrast, the magnitude of the coefficients is smaller and not statistically significant in the subsample before SOX. [10] Moreover, we further sort the insider purchases prior to the adaption of SOX based on the average reporting gap between insider trading dates and filing dates. We reason that if insiders try to false signal, they will choose to report sooner in order to attract outside investors. Thus, we should see a hump-shaped price pattern for insider purchases that are disclosed with a shorter latency. This is indeed what we find in the data. For insider purchases with shorter than average reporting gaps, we find a significant hump-shaped price pattern prior to the adaptation of SOX.

[Insert Table 6 about here]

4.2. Heterogeneity across the Intensity of Legal Enforcement

[10] Our results cannot be explained by the impact of SOX on corporate governance. SOX has put stringent regulations on the corporate governance of US public firms (Holmstrom and Kaplan, 2003). If anything, we would have expected fewer opportunistic insider transactions and hence a less pronounced hump-shaped return pattern after SOX.

Manipulation of stock prices is prohibited in the United State and it is under close scrutiny by the SEC. If insiders engage in false signaling, they should worry about the potential litigation risks. In time periods with high intensity of legal enforcement, we expect insiders who false signal to be more conservative in their trades. This is indeed what we find in the data. Following Cohen et al. (2012), we proxy the intensity of SEC enforcement by the number of SEC enforcement cases of insider trading (with one month lag).[11] As shown by Table 7, when the intensity of SEC enforcement is strong, we observe little movement in the cumulative abnormal returns.[12] On the other hand, when the intensity of SEC enforcement is weak, we observe pronounced hump-shaped return pattern, suggesting insiders who purchase without positive information actively time their trades based on the intensity of legal enforcement.

[Insert Table 7 about here]

4.3. Heterogeneity across Insiders' Trading Patterns

Cohen et al. (2012) sort corporate insiders into routine insiders and opportunistic insiders based on their trading patterns. Opportunistic insiders are a group of sophistic insiders who time their trades strategically and earn much higher abnormal profits from their transactions. They also actively engage in exploiting their informational advantage when firms' informational environment becomes more opaque (Wu, 2015). On the other hand, routine insiders show forecastable pattern in the timing of their transactions and the abnormal returns of their trades are much lower. If insiders' purchases after short interest spikes are mainly driven by false signaling considerations, we would expect the hump-shaped price pattern to be more pronounced for opportunistic insiders. To test this hypothesis, we construct two measures to identify opportunistic purchases based on insiders' trading behavior.

Our first measure is similar to Cohen at el. (2012). For each short interest spike followed by insider purchases, we assign a "routine" dummy that equals one for each insider who trades in the same calendar month in the preceding three years. We then calculate the average "routine" index for each short interest spike and sort the insider purchases after short interest spikes into two groups based on the average "routine" index. The sorting is performed on a yearly basis and

[11] We hand collected the SEC enforcement data from the SEC website. The data start from October 2003.

[12] Note that calendar time fixed effect is not included in the regression because our analysis exploits time series variation in the intensity of SEC enforcement of insider trading.

is orthogonal to firm institutional ownership (double-sort approach to control for the supply of the lendable shares). The insider purchases with "routine" index below the median value are categorized as opportunistic purchases. The insider purchases with "routine" index above the median value are categorized as non-opportunistic purchases. Consistent with our previous reasoning, we find the hump-shaped price pattern is mainly driven by the opportunistic purchases. The cumulative abnormal returns associated with opportunistic purchases increase by 3.0% in the first four months after short interest spikes, and decrease by 5.3% in the following eight months. In contrast, the decline in the cumulative abnormal returns from the fifth month to the twelfth month is much smaller in magnitude and statistically insignificant for non-opportunistic purchases.

[Insert Table 8 about here]

Our second measure to identify opportunistic purchases is the historical purchase frequency. We reason if insiders rarely buy the stocks of their companies' but start buying after short interest spikes, their purchases are more likely to be opportunistic. We then use a similar sorting procedure to the one we use for the first measure. For each short interest spike followed by insider purchases, we compute the historical (five years prior to the event dates) purchase frequency for all the insiders who purchase in the two-week window after the spike. We then calculate the average historical purchase frequency of the insiders for each event and sort the insider purchases after short interest spikes into two groups based on the average historical purchase frequency. The sorting is performed on a yearly basis and is orthogonal to firm institutional ownership (double-sort approach to control for the supply of the lendable shares). The insider purchases with historical purchase frequency below the median value are categorized as opportunistic purchases. The insider purchases with historical purchase frequency above the median value are categorized as non-opportunistic purchases. Again, we find a strong hump-shaped price pattern associated with the opportunistic purchases, but not the non-opportunistic purchases.

4.4. Heterogeneity across Ex-post Earnings

If we had perfect information about insiders' information set, we can test whether they engage in false signaling by examining their trading behavior. Unfortunately, it is nearly impossible for econometricians to observe insiders' beliefs. In this section, we proxy insiders'

beliefs using the average ex-post earnings surprises in the one year time window after insiders' purchases. We make the assumption that corporate insiders possess private knowledge about the earnings results of their own firms in the next year.[13] We then sort insiders' purchases after short interest spikes into below and above median earnings surprises groups on a yearly basis, and compare insiders' trading behavior and the associated price patterns.

If the hump-shaped price pattern is driven by false signaling, we expect this price pattern should be more pronounced for insiders who have bad information of their own firms. This is indeed what we find in the data. Panel A of Table 9 presents the cumulative abnormal returns for the two subgroups of insider purchases. For the subgroup with below median earnings surprises, the cumulative abnormal returns increase by 3.6% in the first four months after insiders' purchases, while the gain in cumulative abnormal returns disappears entirely in the next eight months. For the subgroup with above median earnings surprises, however, the cumulative abnormal returns do not exhibit a hump-shaped pattern. The cumulative abnormal returns increase by 1.8% four months after insider purchases and keep increasing by 0.8% (although not statistically significant) from the fifth month to the 12th month.

[Insert Table 9 about here]

Since we proxy insiders' information set by ex-post measures, one may argue that the drop of stock prices in the subgroup with below median earnings surprises is not surprising. To substantiate our analysis, we also examine insiders' trading behavior conditional on the ex-post earnings. If insider purchases after short interest spikes are mainly motivated by false signaling considerations, we would expect insiders to purchase more aggressively when they have bad private information. To test the above hypothesis, we create a dummy variable, *WeakEarnings*, to denote observations belonging to the subgroup with below median earnings surprises. We first regress the *Purchases* dummy on *WeakEarnings*, along with control variables and the fixed effects. As shown by Panel B of Table 7, the probability of insider purchases after short interest spikes is 0.86% higher when the average earnings surprises one year after event dates are below the median values, a 13.6% increase in the average probability of insider purchases in the spike sample. The change in the probability of insider purchases, however, is not significantly different from zero in the non-spike sample. If anything, the probability of insider purchases decreases

[13] This assumption is supported by empirical evidence. Ke et al. (2003) show that corporate insiders trade upon knowledge of forthcoming accounting disclosures as long as 2 years prior to the disclosure.

slightly in firms with below median ex-post earnings surprises in the non-spike sample. We also examine the intensity of insider purchases by regressing the natural log of the total shares purchased (normalized by the total number of shares outstanding) on the *WeakEarnings* dummy. The intensity of insider purchases after short interest spikes increases by 25.4% for the subgroup with below median earnings surprises. In the non-spike sample, however, the change in the intensity of insider purchases is not significantly different from zero.

Taken together, the results from the above four heterogeneity tests suggest that insider purchases without true positive information (indicated by the hump-shaped price pattern) are more likely to take place when force signaling is more likely to have a price impact (i.e., after Sarbanes-Oxley Act), when the potential costs to false signal is low (i.e., weak regulation enforcement), for insiders who are more likely to trade strategically (i.e., opportunistic insiders), and in situations when the urgency of false signal is higher (i.e., weak firm fundamentals). We argue these results collectively provide strong evidence supporting the false signaling hypothesis: some insiders try to prevent negative information from getting incorporated into stock prices by purchasing on the open market after short interest spikes.

5. Insiders' Incentives

One puzzling question that we have not addressed is why insiders risk their own money to boost stock prices by purchasing on the open market after short interest spikes. In this section, we tackle this question by analyzing the costs and benefits of insiders' transactions. We first assess whether insiders incur trading losses by examining their trading positions around short interest spikes. We then study whether insiders can benefit from non-trading aspects such as compensation and tenure length. Finally, we provide a back-of-the-envelope calculation for the net outcomes.

5.1. Insiders' Trading Positions around Short Interest Spikes

We have shown that insider purchases after short interest spikes can only boost stock prices in the short run. If they cannot unwind their positions before the revelation of negative news, they lose money from their purchases. To examine whether insiders incur trading losses, we examine the dynamics of insider trading around short interest spikes using the following specification:

$$y_{it} = \alpha_{industry} + \lambda_{calendar\ quarter} + \beta_1 Spike_{it} + \gamma' X_{it} + \varepsilon_{it} \qquad (4)$$

We condition our analysis on insider purchases within two weeks after the event dates. Both the spike sample and non-spike sample are included in this regression. The dependent variables are the amount of insider purchases (normalized by total shares outstanding) and the amount of insider sales (normalized by total shares outstanding) in different quarters relative to the spike dates. We put the *Spike* dummy as the main independent variable. We also include control variables, time (calendar quarter) fixed effects and industry fixed effects in the regressions. The coefficients of the *spike* dummy hence capture insiders' additional purchase (or sales) amounts around short interest spikes on top of their typical trading positions.

[Insert Table 10 about here]

Panel A of Table 10 presents the regression results for insider purchases. The amount of insider purchases peaks after the short interest spikes and then decays significantly in the next few quarters. Coupled with the finding that the cumulative abnormal returns peak roughly five months after insider purchases after short interest spikes, this result suggests that insiders reduce their purchases before stock prices decline and thus avoid further losses. Panel B of Table 10 presents the regression results for insider sales. Although the amount of sales also increases slightly after short interest spikes, the amount of insider sales are much smaller compared to the amount of insider purchases, suggesting that insiders in general do not unwind their positions in the one-year window after short interest spikes. This trading pattern is likely due to regulatory constraints as insiders are prohibited from "short-swing" transactions (i.e., purchases and sales of company stock within a 6-month period) according to SEC section 16(b) rules. It is also consistent with insiders' desire of not sending out sell signals before the revelation of negative information. Since insiders do not unwind most of their positions before stock prices drop, they can incur trading losses from their purchases after short interest spikes, because short interest spikes lead to negative future stock returns as shown by Table 2.

5.2. Impact of Insiders' Purchases on Their Compensation and Forced Turnover Rate

Khanna and Mathews (2012) model the blockholders' actions in battling with short sellers, and demonstrate that blockholders have incentive to prop up stock prices via open market

purchases as long as the firm prospects are not too negative. They argue that excessive stock-price declines due to short selling can make existing (or potential) creditors or other counterparties lose confidence in the firm. The main benefit in propping up stock prices is thus to stop the feedback effects of stock prices on the real decisions of the firm's counterparties. Because the subjects we focus on in this paper are corporate insiders, we move our investigation beyond the firm level and instead examine the benefits directly applied to the insiders. Specifically, we examine whether insiders gain benefits through the increase in compensation and the decrease in forced turnover rate.

We merge our data on short interest and insider purchases with ExecuComp data, and construct a new dataset at the manager-year level. We condition our analysis on the presence of short interest spikes, and examine change in managerial compensation using the following specification:

$$Pct_{it} = \alpha_{industry} + \lambda_{fiscal\ year} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it} \quad (5)$$

Here the dependent variables (*Pay1_Pct*, *Pay2_Pct* and *Pay3_Pct*) are the year-to-year percentage change in compensation. *Pay1_Pct* is the year-to-year percentage change in total current compensation which includes both salary and bonus. *Pay2_Pct* is the year-to-year percentage change in compensation that includes salary, bonus, restricted stock grants, and option grants. *Pay3_Pct* is the year-to-year percentage change in total compensation (Execucomp data item TDC1) which includes salary, bonus, restricted stock grants, option grants, and long-term incentive payouts. The main independent variable of interest, *Purchase*, is a dummy variable that equals one if corporate insiders purchase on the open market within two weeks after *any* short interest spike that takes place in a given year. We also include control variables, industry fixed effects, and fiscal year fixed effects in the regressions. To study the dynamics of the relation between insider purchases and managerial compensation, we examine the changes in managerial compensation in the year before short interest spikes ($Year_{-1}$), in the year right after short interest spikes ($Year_1$) and in the following fiscal year ($Year_2$).

[Insert Table 11 about here]

We first restrict our analysis to CEOs. Panel A of Table 11 indicates the percentage change in CEO compensation increases in the first year after insider purchases after short interest spike. The percentage change in total compensation increases by 18.5% ($p\text{-}value < 0.01$) in the year

when insiders purchase after short interest spikes. The performance-sensitive portion, such as stock and option grants, is the main driver for the changes in total compensation, while the changes in current compensation (salary and bonus) are smaller in magnitude (4.9% and not statistically significant). The increase in CEO compensation takes place in the year of insider purchases but not in the previous year. We also find no sign of reversal, because we do not observe a significant decrease in the CEO compensation in the second year after insider purchases. We also verify that the increase of CEO compensation only shows up in the spike sample. As shown by Panel B of Table 11, the compensation of CEO does not increase after insider purchases in time periods without the presence of short interest spikes.

Next, we extend our analysis to all top five executives in the Execucomp data. Similar patterns show up. The growth rates of managerial compensation increase significantly in the years when insiders purchase after short interest spikes (Panel C, Table 11). The increased compensation growth rates show no sign of reversal in the following year, and they do not show up in the non-spike sample. Collectively, the above evidence suggests insiders gain higher compensation after their purchases after short interest spikes.

[Insert Table 12 about here]

Besides compensation, managers are also concerned about their job security during short interest spikes. Insider purchases can send positive signals to the market and delay the revelation of negative news, which may in turn strengthen managers' job security. This effect may be particularly strong when managers face a real possibility of dismissal, namely, when firm performance is far below expectations. To test this hypothesis, we examine the forced turnover rate of CEOs conditional on the presence of short interest spikes using the following linear probability model[14]:

$$ForcedTurnover_{it} \times 100 = \alpha_{industry} + \lambda_{fiscal\ year} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it} \quad (6)$$

Here the dependent variable *ForcedTurnover* is a dummy variable that equals one if a CEO resigns in a given year. The independent variables are the same as those in the compensation

[14] Following Jenter and Kanaan (2015), we also examine the impact of insider purchases on CEO forced turnover rate using Cox's (1972) proportional hazard model. The results are very similar to those from the linear probability model.

analysis. Panel A of Table 12 presents the regression results. The impact of insider purchases on the CEO forced turnover rate in the full sample (Columns 1-3) is not statistically significant. However, when we focus on the subsample with bad firm performance (lowest quintile sorted on the average earnings surprises) in which CEOs are facing real threat of dismissal, the CEO forced turnover rate is reduced significantly in the first year after insider purchases after short interest spikes. In terms of magnitude, the mean CEO forced turnover rate is 2.9% in this subsample, whereas insider purchases reduced it by 1.4%. The reduction in the forced turnover rate is unique to the spike sample. Conditional on the absence of short interest spikes, insider purchases do not have an impact on the forced turnover rate (Panel B of Table 12).

5.3. Back-of-the-Envelope Calculation of the Net Outcomes

In this section, we provide a rough estimate of the potential benefits and costs in using purchases as a signaling device after short interest spikes for a typical CEO in our dataset. First, we estimate the potential trading losses. As shown in the previous section, insider purchases after short interest spikes are concentrated in [-6m, 6m] window relative to the spikes. The median total amount of purchase for a CEO within this window is $0.44M. As shown in Table 2, short interest spikes can lead to 3.2% reduction in 1-year cumulative abnormal returns. To be conservative in estimating the net benefits, we assume insiders can on average incur as large as a 10% loss for their trading value, which translates to $0.044M. Next, we estimate the gain from compensation. The median total compensation (TDC1) for a CEO in our dataset is $2.5M. Thus an 18.5% increase in TDC1 corresponds to $0.463M. Finally, we estimate the gain from a reduction in the forced turnover rate. We simply assume dismissal leads to zero compensation of the current year. Because insider purchases on average reduce forced turnover rates by 1.4%, the gain in cash flow is roughly $0.035M (1.4% × $2.5M/year). Taken together, for a representative CEO in our dataset, the net benefits of his purchases after short interest spike are thus $0.45M for firms with bad performance and 0.42M otherwise. Both estimates are economically sizable. Of course, the above calculation is a crude approximation. We may underestimate the benefits, because avoiding forced dismissal can save reputation losses and thus prevent damage to the future cash flow. Moreover, CEO compensation may show downward rigidity (Shue and Townsend, 2016); thus an increase in compensation can have a long-run impact on future compensation. It is also possible that we underestimate the costs, since opportunistic purchases can come with regulatory risks. Nonetheless, our back-of-the-envelope

calculation suggests insiders have reasonable incentive to purchase after short interest spikes even when they may incur some trading losses.

5.4. Impact of Corporate Governance

If insiders choose to purchase after short interest spikes hoping to gain from compensations, we expect the incentive of their purchases to decrease significantly in firms with good corporate governance, as well-governed firms are less likely to compensate firm managers based on short lived increase in stock prices. Table 13 examines the probability of insider purchases after short interest spikes for firms with different intensity of corporate governance. Consistent with our hypothesis, we find insiders are much less likely to purchase after short interest spikes when there are more independent directors on the board, when investors sit on the board, and when firms have at least one blockholder who owns more than 5% of the total shares.

[Insert Table 13 about here]

6. Robustness Checks and Alternative Explanations

6.1. Robustness Checks

We perform several robustness checks to verify the price pattern associated with insiders' purchases after short interest spikes. We confirm that the hump-shaped price pattern is robust across firms with different size, and it is especially pronounced in firms with low levels of institutional ownership, where short interest spikes convey more negative information due to lower supply of lendable shares. Moreover, we find consistent results using portfolio analysis approach.

Firm Size. One potential concern about our analysis is we may have captured a phenomenon that is unique to small stocks, whose prices are more subject to manipulations. To test this hypothesis, we sort firms into two size groups based on NYSE market cap breakpoints (Quintile 1 and the Quintile 2-5). As shown by Appendix A, we find the hump-shaped price pattern in both size groups, suggesting the pattern of cumulative abnormal returns is not unique to small firms.

Institutional Ownership. We define a short interest spike as a 1% or larger increase in the month-to-month change in the short interest ratio (shares sold short, normalized by the total number of shares outstanding). However, a 1% increase in short interest can have different economic meanings across stocks. In particular, as pointed out by previous studies (e.g., Asquith et al., 2005; Cohen et al., 2007), the same change in short interest ratio is economically more meaningful for stocks with lower institutional ownership, because the supply of the lendable shares is scarcer for them. Thus, for firms with lower institutional ownership, we expect the cumulative abnormal returns to exhibit a more pronounced hump-shaped pattern, as more negative information is conveyed by the same amount of increase in the short interest level. To test this hypothesis, we sort firms into tertiles based on their institutional ownership. The sorting is carried out annually and is orthogonal to firm size (double-sort approach). Consistent with our prediction, Appendix B shows the hump-shaped pattern is indeed more pronounced in firms with low institutional ownership, where short interest spikes convey more negative information.

Portfolio Analysis. We verify our analysis of the cumulative abnormal returns by employing a calendar-time portfolio approach (Jaffe, 1974). Specifically, we examine the alphas for insider mimicking portfolios with different holding horizons. If the abnormal returns exhibit a hump-shaped pattern, we expect to see the alphas decrease over the holding periods and become insignificant after a few months.[15] This is indeed what we find in the results. Panel A of Appendix C presents the annualized alphas for insider portfolios with different holding periods. The alphas of the insider purchases portfolio are significantly positive for portfolios with short holding periods, such as one month. However, when the holding periods are six months and longer, the alphas become indistinguishable from zero.

Given the hump-shaped pattern in the cumulative abnormal returns, trading strategies that exploit both the initial ramp up and subsequent decline of the cumulative abnormal returns should deliver positive alphas. Based on this rationale, we construct long-short portfolios that long the stocks purchased by insiders after short interest spikes for two months, long risk free assets in the third and fourth months, and subsequently short the same stocks in the fifth and sixth months after the purchase dates (denoted as 2L2W2S). As shown by Panel B in Appendix C,

[15] The alphas are estimated using Carhart's four-factor model. Note we do not expect to see a hump-shaped pattern in the alphas. Heuristically speaking, the alphas with different holding horizons are the slopes in the plots of the cumulative abnormal return at different time points. Thus, with a hump-shaped pattern in the cumulative abnormal returns, the alphas should be significantly positive with short holding horizons, but indistinguishable from zero with long holding horizons.

these long-short strategies deliver positive alphas with low exposure to market and other risk factors. The annualized alpha is 9.3% for the equal-weighted portfolio, and it magnitude is even higher if we construct the long-short portfolios based on transactions from the opportunistic insiders.

6.2. Alternative Explanations

In this section, we discuss three alternative explanations that may explain the hump-shaped price pattern. The first alternative explanation we discuss here is behavioral biases. We have argued that the hump-shaped return pattern suggests that some insiders may strategically false signal in order to boost stock prices after short interest spikes. This explanation assumes that insiders know they do not possess positive information when they purchase the stocks. A competing hypothesis is insiders genuinely believe that they have positive private information when they trade. Their purchases may be driven by behavioral biases such as over confidence. We cannot rule out this alternative explanation directly as insiders' beliefs are not observable. However, we argue that in order for the behavioral biases explanation to rationalize our empirical findings, we have to somehow argue the behavior biases are more likely to occur in sophistic opportunistic insiders, in time period with lower intensity of legal enforcement, and after the adaption of SOX, which is rather counterintuitive.

The second alternative explanation is short squeeze. As documented by Lamont (2012), firms may employ a variety of methods to battle with short seller, such as legal threats, investigations and lawsuits. These actions create a short squeeze and short sale constraints which lead to decrease of abnormal returns in the future (Jones and Lamont, 2002; Asquith et al., 2005; Diether et al., 2009). This explanation is different from our signaling explanation as the change of the abnormal returns is driven by the existence of short sale constraints instead of by the market's reaction to insider purchases. If firms conduct short squeeze successfully, we would expect to see a reduction in the level of short interest. However, as Column 1 in Appendix D shows, the level of short interest remains at a high level for at least five months before it decays, suggesting short sellers are firm with their positions and do not cover their short until the cumulative abnormal returns start falling back. Thus, although short squeeze can potentially lead to a hump-shaped price pattern, it is unlikely to be the main mechanism for our findings.

The last alternative explanation we discuss here is earnings management. Previous studies have shown earnings management can lead to decrease in cumulative abnormal returns in the long run (e.g. Sloan, 1996)[16]. Thus it is possible that the hump-shaped return pattern is driven by earnings management coinciding with insider purchases after short interest spikes. To test this hypothesis, we measure the discretionary accruals for the earnings announcements around short interest spikes.[17] If the earnings management story is the correct explanation, we would expect the level of the discretionary accruals of firms with insiders purchase to increase after short interest spikes. However, as Panel A of Appendix E shows, the level of discretionary accruals actually decreases significantly after short interest spikes. Interestingly, the level of discretionary accruals in the quarter *prior* to the short interest spikes is significantly higher in firms whose insiders purchase on the open market, which is reminiscent of the findings in Hirshleifer et al. (2011), who document that short sellers tend to target high-accrual firms and subsequently help correct overpricing. The pattern of discretionary accruals around short interest spikes are unique to the spike sample as the level of discretionary accruals does not change significantly in the non-spike sample (Panel B of Appendix E). The above results are consistent with the following hypothesis: high accrual-based earnings management triggers spikes of short seller activities; insiders of these firms then use purchases as a signaling device to prevent negative information from being incorporated into stock prices; meanwhile they reduce the practice of earnings management after short interest spikes as these firms are watched closely by the market. Thorough test of this hypothesis remains an interesting topic for future research. However, since the level of earnings management actually decreases after short interest spikes, the earnings management channel is unlikely to explain the hump-shaped return pattern after the short interest spikes.

7. Conclusion

We investigate corporate insiders' purchase behavior after short interest spikes. We find while insiders in general avoid trading against short sellers, the probability of their purchases increase significantly if the short interest spikes take place before the seasoned equity offering, the stock-based M&As, and the end of the fiscal year, where insiders have high incentive to keep high stock prices.

[16] Also see Healy and Wahlen (1999) and Graham et al. (2005) for reviews of the extensive literature on earnings management.

[17] We estimate discretionary accruals following Rangan (1998).

We next study the information contents of insiders' purchases by examining the cumulative abnormal returns and earnings surprises associated with these transactions. In sharp contrast to typical insider purchases, the cumulative abnormal returns increase in the short run but decrease significantly in the long run. Moreover, insider purchases after short interest spikes are on average followed by negative rather than positive earnings surprises. We perform a list of heterogeneity tests and find the hump-shaped price pattern are more pronounced when force signaling is more likely to have a price impact (i.e., after Sarbanes-Oxley Act), when the potential costs to false signal is low (i.e., weak regulation enforcement), for insiders who are more likely to trade strategically (i.e., opportunistic insiders), and in situations when the urgency of false signal is higher (i.e., weak firm fundamentals). These results collectively suggest that some insiders try to prevent negative information from getting incorporated into stock prices by purchasing on the open market after short interest spikes.

Finally, we analyze insiders' incentive problem by examining the potential benefits and costs associated with the insider purchases after short interest spikes. We find insiders' compensation increases significantly, and their forced turnover rate decreases substantially especially when firms have weak fundamentals. Although insiders may incur some trading losses, our simple back-of-the-envelope calculation shows the gain is sizable enough to cover the losses and hence motivates insider purchases after short interest spikes.

To summarize, we find evidence suggesting insiders, provided with the right incentive, may strategically use purchases as a signaling device to prop up stock prices temporarily and deter negative information from being incorporated into prices. Our paper highlights the possibility that insider trading can disrupt market efficiency in situations when insiders' transactions are driven by considerations of their personal portfolios including future income, a point that is largely underemphasized in the previous studies.

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Figure 1. Short Interest Spikes

This figure plots the histogram of the month-to-month change in short interest ratio for all the firms covered by the short interest data (8,738 unique firms, monthly data from 1986). The short interest ratio is calculated as shares sold short normalized by the total number of shares outstanding. We define a spike as a 1% or larger increase in the month-to-month change in the short interest ratio. The resulting spike sample contains about 5% of all the observations in the short interest data.

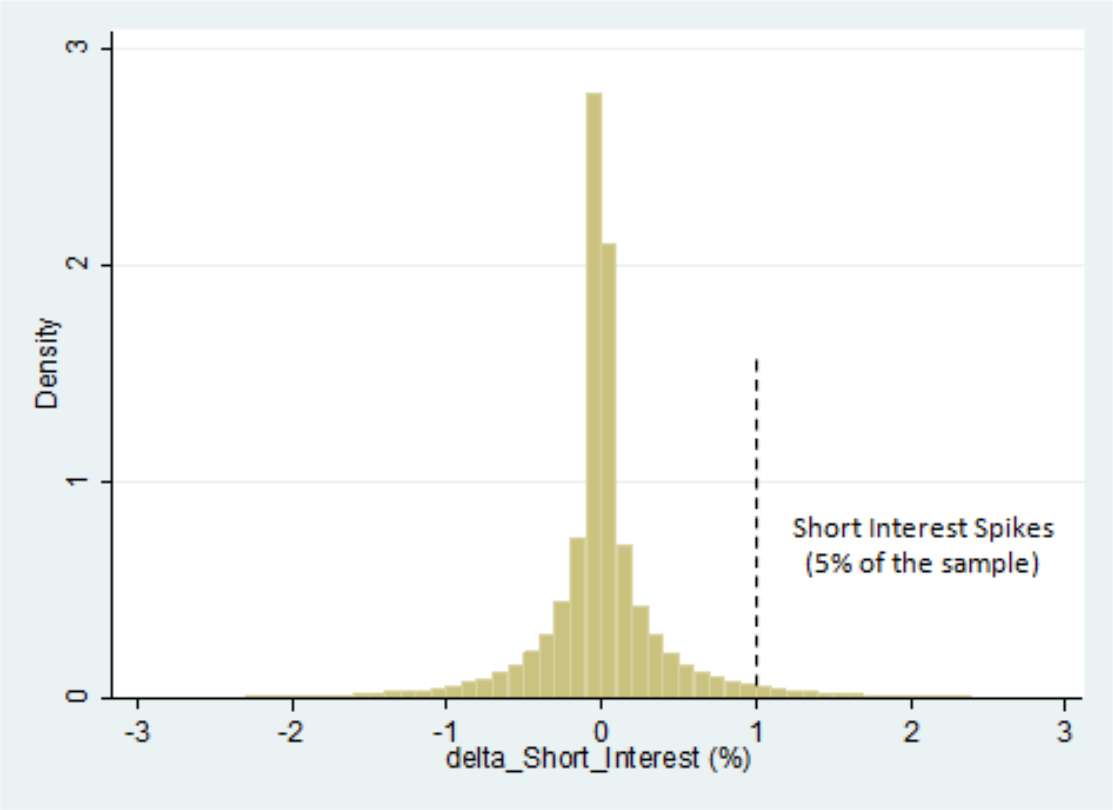

Figure 2. Sample Construction Methodology

This figure illustrates the methodology to construct our sample. We first identify all of the spikes in the short interest data. A short interest spike is defined as a 1% or larger month-to-month change in the short interest ratio (shares sold short normalized by the total shares outstanding). We then categorize short interest spikes into two groups based on whether there are open market insider purchase within two weeks after the disclosure dates of the short interest (settlement dates). For each observation in the "spike with insider purchases" sample (such as Firm i in Fig. 2a), we match it with up to five control firms within the same Fama-French size and book-to-market quintile, that do not experience short interest spikes around the settlement dates but with insider purchases within two weeks after the settlement dates (such as Firm j in Fig. 2b). For each observation in the "spike without insider purchases" sample (such as Firm m in Fig. 2b), we match it with up to five control firms within the same Fama-French size and book-to-market quintile, that do not experience short interest spikes around the settlement dates and without insider purchases within two weeks after the settlement dates (such as Firm n in Fig. 2b). Our constructed sample spans 1986 to 2012.

Figure 2a. Samples with insider purchases within 2 weeks of the settlement dates

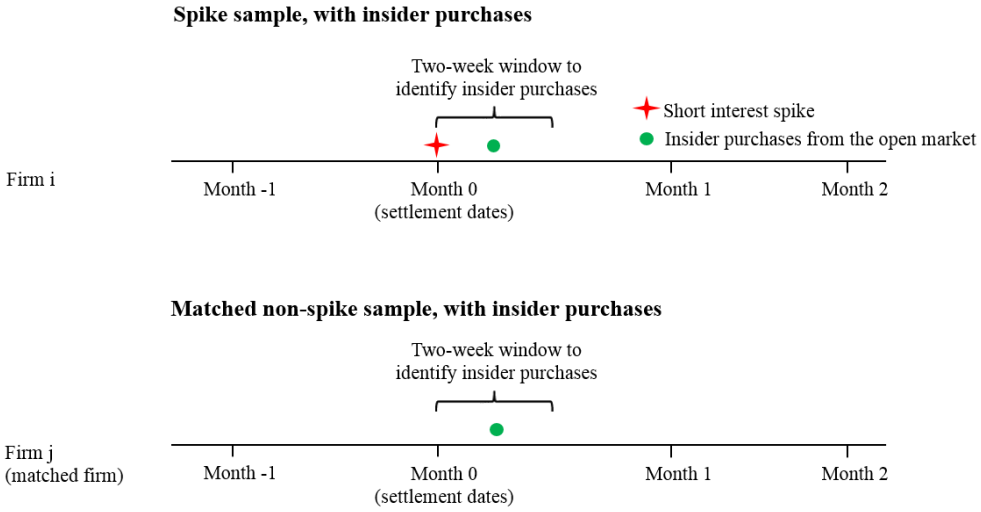

Figure 2b. Samples without insider purchases within 2 weeks of the settlement dates

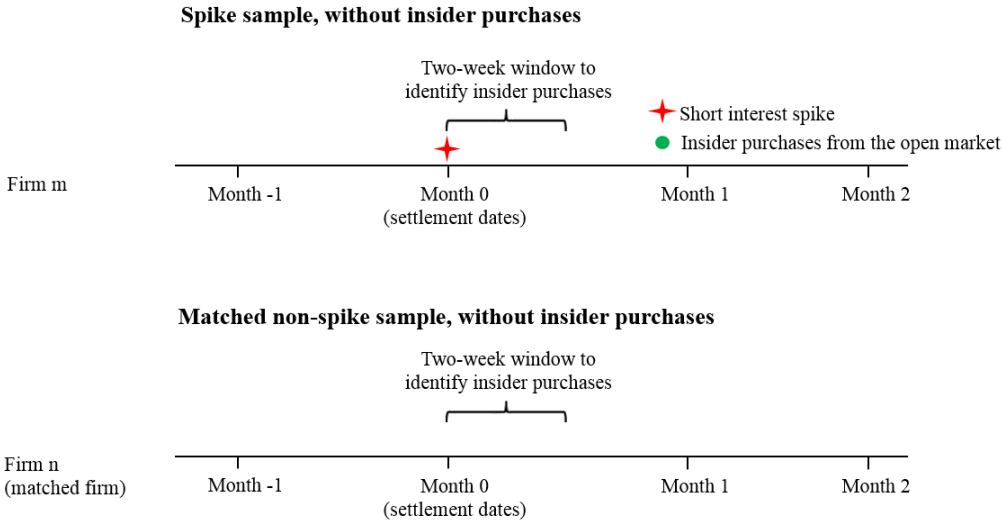

Figure 3. Cumulative Abnormal Returns associated with Insider Purchases

This figure plots the coefficients β_1 in Table 4, which represents the cumulative abnormal returns associated with the insider purchases conditional on the presence (red line) and the absence (green line) of short interest spikes. Cumulative abnormal returns are benchmarked by the returns of the corresponding DGTW portfolios.

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

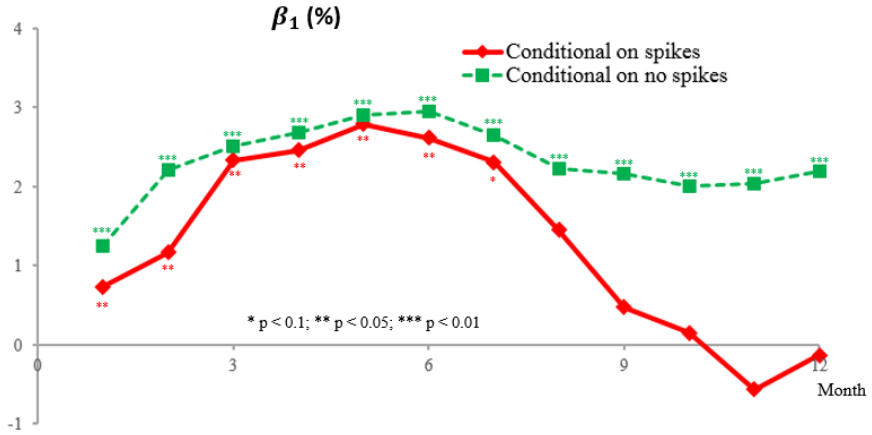

Figure 4. Earnings Surprises around Insider Purchases

This figure plots the coefficients β_1 in Table 5, which represents the earnings surprises associated with the insider purchases conditional on the presence (red bars) and the absence (green bars) of short interest spikes. Earnings surprises are normalized by stock prices in the end of year t-1.

$$Surprise_{it} = \alpha_{industry} + \lambda_{calendar\ quarter} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

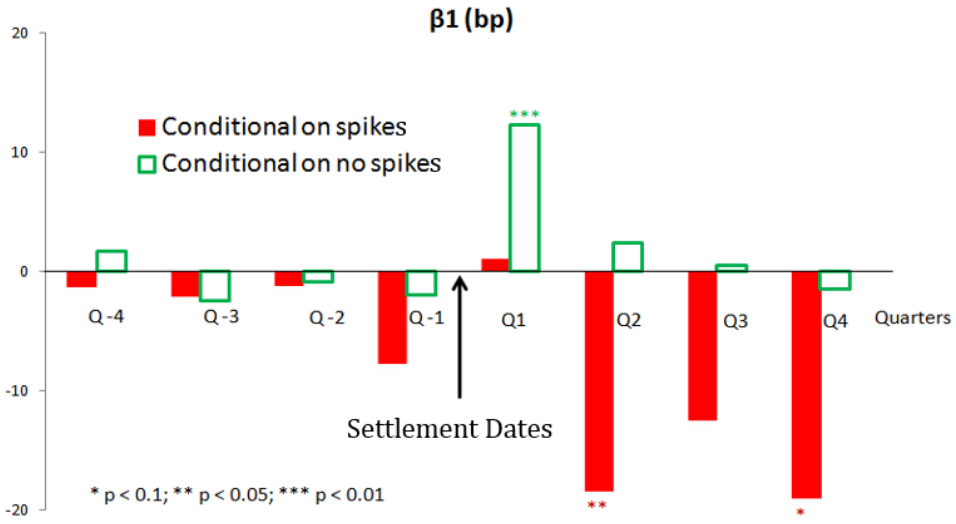

Table 1. Summary Statistics

This table presents summary statistics for both the spike sample and the matched non-spike sample. The spike sample contains firms that experience short interest spikes. Each firm in the spike sample is matched with up to five control firms within the same Fama-French size and book-to-market quintile. *CAR4m* are cumulative abnormal returns benchmarked by returns of the DGTW portfolios (Daniel et al., 1997; Wermers, 2004) from month 1 to month 4 after the short interest spikes. *CAR5mto12m* are cumulative abnormal returns benchmarked by returns of the DGTW portfolios from month 5 to month 12 after the short interest spikes. *Surprise* are earnings surprises calculated as the difference between the realized EPS and the consensus EPS normalized by the stock prices at the end of the year t-1, and are winsorized at the 1st and 99th percentiles of their respective empirical distributions. *LnSize* is the natural log of the market cap (in millions) in year t-1, *LnBEME* is the natural log of the book-to-market ratio in year t-1, *LnLeverage* is the natural log of debt-to-equity ratio in year t-1, *Ret12mto2mPrior* is the cumulative raw returns from 12 months to 2 months prior to the short interest spikes, and *Ret2mPrior* is the cumulative raw returns 2 months prior to the short interest spikes.

Panel A. Sample with insider purchases within 2 weeks of short interest spikes

	Spike sample (with insider purchases within 2 weeks after short interest spikes)				Matched non-spike sample (with insider purchases within 2 weeks after the spike dates)			
	median	mean	sd	count	median	mean	sd	count
CAR4m (%)	1.50	1.78	31.46	2437	1.86	2.63	29.30	6188
CAR5mto12m (%)	-1.16	-2.20	43.01	2313	1.08	1.21	37.84	5976
SurpriseQ1 (bp)	-1.21	-93.79	384.32	2524	0.92	-42.58	272.14	6278
SurpriseQ2 (bp)	-1.59	-119.19	431.25	2513	0.87	-47.24	287.39	6250
SurpriseQ3 (bp)	-1.41	-126.83	480.71	2466	0.95	-51.08	303.09	6194
SurpriseQ4 (bp)	-0.49	-125.02	470.85	2439	0.80	-47.08	288.91	6122
LnSize	6.60	6.55	1.38	2954	5.83	5.91	1.92	8763
LnBEME	-0.74	-0.79	0.86	2745	-0.60	-0.66	0.83	8482
LnLeverage	0.87	1.18	0.93	2744	0.86	1.15	0.85	8438
Ret12mto2mPrior (%)	5.75	8.04	57.24	2885	11.50	11.75	45.76	7055
Ret2mPrior (%)	-6.48	-7.67	29.82	2885	-2.23	-3.31	22.66	7053

Panel B. Sample without insider purchase within 2 weeks of short interest spikes

	Spike sample (without insider purchase within 2 weeks after short interest spikes)				Matched non-spike sample (without insider purchase within 2 weeks of the spike dates)			
	median	mean	sd	count	median	mean	sd	count
CAR4m (%)	-0.87	-1.04	28.67	38589	-0.10	-0.17	23.62	45397
CAR5mto12m (%)	-0.14	-0.42	39.64	34825	-0.23	0.47	34.80	42141
SurpriseQ1 (bp)	2.36	-46.06	290.44	39355	0.98	-41.06	264.00	42967
SurpriseQ2 (bp)	2.16	-47.93	292.96	38471	1.11	-32.98	235.93	42341
SurpriseQ3 (bp)	2.03	-57.60	335.14	37016	1.09	-37.44	261.78	41676
SurpriseQ4 (bp)	2.04	-56.45	328.37	35935	1.02	-34.84	248.52	41078
LnSize	6.52	6.44	1.43	48911	5.60	5.78	2.09	69550
LnBEME	-0.77	-0.82	0.90	45020	-0.48	-0.53	0.82	66097
LnLeverage	0.68	0.89	0.77	44975	0.78	1.03	0.81	65274
Ret12mto2mPrior (%)	15.73	20.19	59.44	47765	13.36	14.17	44.05	53316
Ret2mPrior (%)	2.75	4.23	30.62	47765	2.36	2.59	19.86	53313

Table 2. Stock Returns after Short Interest Spikes

This table quantifies the changes of cumulative abnormal returns after short interest spikes. The dependent variables are cumulative abnormal returns benchmarked by returns of the DGTW portfolios over 12 months (*CAR12m*) after the short interest spikes. *Spike* is a dummy variable that equals 1 if the short interest ratio (shares sold short normalized by the total number of outstanding shares) increases by at least 1% compared to the one in the previous month. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior*, which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions when indicated. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Spike_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: this analysis include both the spike sample and the matched non-spike sample.

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR12m (%)					
Spike	-2.135**	-2.301**	-1.663*	-2.801***	-1.943*	-3.197***
	[0.765]	[0.869]	[0.955]	[0.626]	[0.981]	[0.696]
LnSize		-0.650**	-0.948***	-0.999***	-0.988***	-1.087***
		[0.270]	[0.339]	[0.357]	[0.326]	[0.363]
LnBEME		0.310	0.811	0.777	1.274**	1.147**
		[0.604]	[0.641]	[0.605]	[0.607]	[0.575]
LnLeverage		-1.445	-2.060	-2.023	0.042	0.334
		[1.604]	[1.605]	[1.705]	[1.257]	[1.270]
Ret12mto2mPrior			-0.076***	-0.066***	-0.079***	-0.068***
			[0.011]	[0.011]	[0.011]	[0.011]
Ret2mPrior			-0.070***	-0.058***	-0.076***	-0.063***
			[0.021]	[0.020]	[0.020]	[0.020]
Constant	0.740	7.081***	11.089***			
	[0.701]	[1.195]	[1.358]			
Calendar month FE	N	N	N	Y	N	Y
Industry FE	N	N	N	N	Y	Y
# of observations	83931	83288	83257	83257	83257	83257
R-squared	0.003	0.004	0.012	0.032	0.017	0.037

Table 3. Probability of Insider Purchase after Short Interest Spikes

Panel A. Probability of insider purchases across different contexts

This table studies the probability of insider purchases on the open market after short interest spikes. The dependent variable (*Purchase*) is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. *Spike* is a dummy variable that equals 1 if there is a short interest spike. *NearSEO* is a dummy variable that equals 1 if the short interest spikes are within one month prior to the announcement dates of seasoned equity offerings. *NearYearEnd* is a dummy variable that equals 1 if the short interest spikes are within one month prior to the end of the fiscal years. *NearStock-basedMA* is a dummy variable that equals 1 if the short interest spikes are within one month prior to the announcement dates of stock-based mergers and acquisitions. *NearCash-basedMA* is a dummy variable that equals 1 if the short interest spikes are within one month prior to the announcement dates of cash-based mergers and acquisitions. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$Purchase_{it} \times 100 = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Spike_{it} \times D_{it} + \beta_2 D_{it} + \beta_3 Spike_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: this analysis includes both the spike sample and the matched non-spike sample.

	(1)	(2)	(3)	(4)	(5)
			Purchase × 100		
Mean	9.180	9.773	9.193	9.928	9.928
	Baseline		Across different contexts		
Spike × NearSEO		3.920*			
		[2.342]			
NearSEO		-4.937***			
		[1.917]			
Spike × NearYearEnd			3.443***		
			[0.542]		
NearYearEnd			-3.790***		
			[0.557]		
Spike × NearStock-basedMA				6.509**	
				[2.780]	
NearStock-basedMA				-2.677	
				[3.228]	
Spike × NearCash-basedMA					1.282
					[4.156]
NearCash-basedMA					-1.752
					[3.259]
Spike	-6.376***	-9.923***	-6.637***	-6.177***	-6.154***
	[0.392]	[2.192]	[0.402]	[0.506]	[0.511]
Controls	Y	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y
# of observations	100252	28232	99396	43100	43100
R-squared	0.075	0.08	0.075	0.088	0.088

Table 3. Probability of Insider Purchase after Short Interest Spikes (continued)

Panel B. Probability of insider purchases across firms with different information environment

This panel examines the impact of firms' information environments on the probability of insider purchases after short interest spikes. The dependent variable (*Purchase*) is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. *Spike* is a dummy variable that equals 1 if there is a short interest spike. *HighSpread* is a dummy variable that equals 1 if a firm's average bid-ask spreads are larger than the median value. *LowCoverage* is a dummy variable that equals 1 if the number of analyst coverage of a firm is lower than the median value. Note that the median values of bid-ask spreads, and number of analyst coverage are computed each year across firms in the sample. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$Purchase_{it} \times 100 = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Spike_{it} \times D_{it} + \beta_2 D_{it} + \beta_3 Spike_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: this analysis includes both the spike sample and the matched non-spike sample.

	(1)	(2)	(3)
		Purchase × 100	
Mean	9.180	9.666	9.701
	Baseline	Across firms with different information environments	
Spike × HighSpread		2.338***	
		[0.519]	
HighSpread		-0.700	
		[0.398]	
Spike × LowCoverage			1.511***
			[0.556]
LowCoverage			-0.568
			[0.479]
Spike	-6.376***	-8.078***	-8.133***
	[0.392]	[0.380]	[0.444]
Controls	Y	Y	Y
Calendar month FE	Y	Y	Y
Industry FE	Y	Y	Y
# of observations	100252	86283	73609
R-squared	0.075	0.075	0.085

Table 4. Cumulative Abnormal Returns Associated with Insider Purchases

This table quantifies the cumulative abnormal returns associated with insider purchases. Panel A presents the results in the spike sample, while panel B presents results for the matched non-spike sample. The dependent variables are cumulative abnormal returns benchmarked by returns of the DGTW portfolios over one month (*CAR1m*) to twelve months (*CAR12m*) after the short interest spikes. *Purchase* a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Panel A. Conditional on the presence of short interest spikes

Cumulative Abnormal Returns (%)	(1) CAR1m	(2) CAR2m	(3) CAR3m	(4) CAR4m	(5) CAR5m	(6) CAR6m	(7) CAR7m	(8) CAR8m	(9) CAR9m	(10) CAR10m	(11) CAR11m	(12) CAR12m
Purchase	0.735**	1.470**	2.330**	2.458**	2.794**	2.614**	2.308*	1.452	0.478	0.154	-0.564	-0.132
	[0.357]	[0.592]	[0.907]	[1.050]	[1.240]	[1.240]	[1.248]	[1.249]	[1.066]	[1.199]	[1.206]	[1.236]
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of observations	31581	31566	31478	31340	31169	30971	30633	30237	29953	29711	29407	29120
R-squared	0.031	0.034	0.033	0.032	0.032	0.034	0.036	0.037	0.043	0.048	0.051	0.056

Panel B. Conditional on the absence of short interest spikes

Cumulative Abnormal Returns (%)	(1) CAR1m	(2) CAR2m	(3) CAR3m	(4) CAR4m	(5) CAR5m	(6) CAR6m	(7) CAR7m	(8) CAR8m	(9) CAR9m	(10) CAR10m	(11) CAR11m	(12) CAR12m
Purchase	1.254***	2.213***	2.510***	2.689***	2.906***	2.945***	2.650***	2.228***	2.169***	2.011***	2.039***	2.200***
	[0.183]	[0.382]	[0.430]	[0.472]	[0.543]	[0.490]	[0.515]	[0.555]	[0.490]	[0.482]	[0.470]	[0.484]
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of observations	50780	50379	50041	49836	49588	49364	48919	48577	48249	47940	47665	47322
R-squared	0.022	0.029	0.030	0.031	0.031	0.033	0.035	0.036	0.039	0.040	0.040	0.040

Table 5. Earnings Surprises around Insider Purchases

This table quantifies the earnings surprises associated around insider purchases. Panel A presents the results in the spike sample, while panel B presents results for the matched non-spike sample. The dependent variables (*Surprise*) are earnings surprises calculated by the difference between the realized EPS and the consensus EPS normalized by the stock prices, and are winsorized at the 1st and 99th percentiles of their respective empirical distributions. *Purchase* a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the corresponding earnings announcement dates. Calendar quarter fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$Surprise_{it} = \alpha_{industry} + \lambda_{calendar\ quarter} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Panel A. Conditional on the presence of short interest spikes

Quarterly Earnings Surprises (bp)	(1) Surprise Q_{-4}	(2) Surprise Q_{-3}	(3) Surprise Q_{-2}	(4) Surprise Q_{-1}	(5) Surprise Q_1	(6) Surprise Q_2	(7) Surprise Q_3	(8) Surprise Q_4
Purchase	-1.257	-2.103	-1.171	-7.737	1.101	-18.428**	-12.443	-19.033*
	[6.681]	[4.735]	[4.299]	[10.646]	[7.502]	[7.599]	[8.840]	[11.231]
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
# of observations	35120	35846	36827	37759	37841	37395	36518	36005
R-squared	0.114	0.109	0.130	0.142	0.148	0.166	0.173	0.154

Panel B. Conditional on the absence of short interest spikes

Quarterly Earnings Surprises (bp)	(1) Surprise Q_{-4}	(2) Surprise Q_{-3}	(3) Surprise Q_{-2}	(4) Surprise Q_{-1}	(5) Surprise Q_1	(6) Surprise Q_2	(7) Surprise Q_3	(8) Surprise Q_4
Purchase	1.743	-2.486	-0.871	-1.965	12.268***	2.360	0.503	-1.459
	[2.360]	[2.865]	[2.451]	[2.659]	[3.458]	[4.279]	[3.099]	[3.468]
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
# of observations	37070	37574	38283	38899	38401	37878	37259	36961
R-squared	0.103	0.118	0.118	0.122	0.122	0.111	0.113	0.107

Table 6. Impact of the Sarbanes-Oxley Act

This table presents the cumulative abnormal returns associated with the insider purchases after short interest spikes both before and after the adaptation of the Sarbanes-Oxley Act (SOX). *CAR4m* is the cumulative abnormal returns in the first four months after short interest spikes. *CAR5mto12m* is the cumulative abnormal returns from the fifth month to the twelfth month after short interest spikes. The cumulative abnormal returns are benchmarked by returns of the DGTW portfolios. *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes. We sort insider purchases prior to the adaptation of the SOX into two groups based on the average reporting gap between the trading dates and the filing dates after a given interest spike. The sorting is performed on yearly basis. *LongReportingGap* is a dummy variable that equals 1 if the average reporting gap is larger than the median value. *ShortReportingGap* is a dummy variable that equals 1 if the average reporting gap is smaller than the median value. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: this analysis is conditional on the presence of short interest spikes.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	CAR4m (%)				CAR5mto12m (%)			
	Full Sample (1986 - 2012)	Before SOX (1986 - Aug. 2002)	Before SOX (1986 - Aug. 2002)	After SOX (Sep. 2002- 2012)	Full Sample (1986 - 2012)	Before SOX (1986 - Aug. 2002)	Before SOX (1986 - Aug. 2002)	After SOX (Sep. 2002- 2012)
Purchase	2.611**	1.322		3.281***	-2.426**	-0.931		-2.853***
	[1.080]	[0.958]		[1.220]	[0.974]	[1.536]		[1.024]
Purchase × LongReportingGap			0.295				1.357	
			[1.400]				[2.711]	
Purchase × ShortReportingGap			2.335*				-3.219**	
			[1.260]				[1.620]	
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
# of observations	38461	8208	8288	30460	35935	8023	8023	28119
R-squared	0.033	0.059	0.060	0.030	0.049	0.079	0.079	0.048

Table 7. Heterogeneity across Intensity of Legal Enforcement

This table presents the cumulative abnormal returns associated with the insider purchases after short interest spikes in time periods with different intensity of legal enforcement. Insider purchases after short interest spikes are sorted into two groups (*StrongSEC_Purchase* and *WeakSEC_Purchase*) based on the intensity of SEC enforcement of insider trading one month prior to the insider purchases. The dependent variables are cumulative abnormal returns benchmarked by returns of the DGTW portfolios over the first four months (*CAR4m*), and from the fifth month to the twelfth month (*CAR5mto12m*) after the short interest spikes. *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Fama-French 48 industry fixed effects are included in the regressions. Note that calendar time fixed effect is not included in the regression because our analysis in this table exploits the time series variation in the intensity of SEC enforcement. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$CAR_{it} = \alpha_{industry} + \beta_1 StrongSEC\_Purchase_{it} + \beta_2 WeakSEC\_Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: this analysis is conditional on the presence of short interest spikes.

	(1)	(2)	(3)	(4)
	CAR4m (%)		CAR5mto12m (%)	
Purchase	3.191**		-2.359**	
	[1.211]		[0.932]	
StrongSEC_Purchase		0.095		-0.529
		[1.153]		[1.769]
WeakSEC_Purchase		5.225***		-3.560***
		[1.585]		[1.234]
Controls	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
# of observations	28668	28668	26388	26388
R-squared	0.013	0.014	0.021	0.021

Table 8. Heterogeneity across Insiders' Trading Patterns

This table presents the cumulative abnormal returns associated with the insider purchases after short interest spikes in firms with insiders who exhibit different historical trading behaviors. In Column (1) and (2), we sort insider purchases after a given short interest spike into two groups based on the percentage of purchases from opportunistic insiders. Opportunistic insiders are insiders who do not trade in the same calendar month in the preceding three years (Cohen et. al., 2012). The sorting is performed on a yearly basis and is orthogonal to firm institutional ownership (double-sort approach to control for the supply of the lendable shares). *Opportunistic_Buyers_Purchase* is a dummy variable that equals one if the percentage of purchases from opportunistic insiders is higher than the median values. *Non-opportunistic_Buyers_Purchase* is a dummy variable that equals one if the percentage of purchases from opportunistic insiders is lower than the median values. In Column (3) and (4), we sort insider purchases after a given short interest spike into two groups based on the average historical (five years prior to the short interest spikes) purchase frequency for all the insiders who purchase in the two-week window after the spike. The sorting is performed on a yearly basis and is orthogonal to firm institutional ownership (double-sort approach to control for the supply of the lendable shares). *Infrequent_Buyers_Purchase* is a dummy variable that equals one if the average historical purchase frequency is lower than the median values. *Frequent_Buyers_Purchase* is a dummy variable that equals one if the average historical purchase frequency is higher than the median values. The dependent variables are cumulative abnormal returns benchmarked by returns of the DGTW portfolios from month 1 to month 4 (*CAR4m*) and from month 5 to month 12 (*CAR5mto12m*) after short interest spikes. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Opportunistic\_Purchase_{it} + \beta_2 Non\_Opportunistic\_Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: the analysis is conditional on the presence of short interest spikes.

	(1)	(2)	(3)	(4)
	Ex-ante Measure Based on Historical Trading Pattern		Ex-ante Measure Based on Historical Purchase Frequency	
	CAR4m (%)	CAR5mto12m (%)	CAR4m (%)	CAR5mto12m (%)
Opportunistic_Buyers_Purchase	3.000**	-5.317***		
	[1.495]	[1.399]		
Non-opportunistic_Buyers_Purchase	2.917***	-1.059		
	[0.976]	[1.242]		
Infrequent_Buyers_Purchase			3.902***	-6.917***
			[1.234]	[1.747]
Frequent_Buyers_Purchase			2.351*	-1.516
			[1.198]	[0.983]
Controls	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
# of observations	38461	35935	38461	35935
R-squared	0.033	0.049	0.033	0.049

Table 9. Heterogeneity across Ex-post Earnings

Panel A. Cumulative Abnormal Returns

This panel presents the cumulative abnormal returns associated with the insider purchases after short interest spikes in firms with different ex-post performance. We sort the sample with short interest spikes into two groups on a yearly basis based on the average earnings surprises within one year after the spike. The dependent variables are cumulative abnormal returns benchmarked by returns of the DGTW portfolios from month 1 to month 4 (*CAR4m*) and from month 5 to month 12 (*CAR5mto12m*) after the short interest spikes. *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

	(1)	(2)	(3)	(4)
	Conditional on *below* median earnings surprises within one year after short interest spikes		Conditional on *above* median earnings surprises within one year after short interest spikes	
	CAR4m (%)	CAR5mto12m (%)	CAR4m (%)	CAR5mto12m (%)
Purchase	3.558***	-3.882***	1.785*	0.821
	[1.338]	[1.329]	[0.948]	[1.067]
Controls	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
# of observations	15032	14464	14949	14511
R-squared	0.080	0.089	0.057	0.055

Panel B. Probability and Intensity of Insider Purchases

This panel presents the relation between ex-post firm performance and insiders' purchase behavior. Column (1) and (2) examine the purchase probability of insiders (extensive margin). Column (3) and (4) examine the purchase amount (intensive margin). The dependent variable (*Purchase*) is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. *LnShares* is the natural log of the total shares purchased on the open market within two weeks of the short interest spikes. *LnShares* is normalized by the total number of share outstanding. *WeakEarnings* is a dummy variable that equals 1 if a firm's average ex-post earnings surprise within one year after short interest spikes is below the median value (computed on a yearly basis).

$$y_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 WeakEarnings_{it} + \gamma' X_{it} + \varepsilon_{it}$$

	(1)	(2)	(3)	(4)
	Purchase × 100		LnShares	
	Spike Sample (mean = 6.360)	Non-spike Sample (mean = 13.859)	Spike Sample (conditional on purchase)	Non-spike Sample
WeakEarnings	0.862***	-0.277	0.254**	0.076
	[0.274]	[0.355]	[0.121]	[0.081]
Controls	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
# of observations	33618	34779	2138	4820
R-squared	0.057	0.099	0.342	0.407

Table 10. Insiders' Aggregate Trading Positions around Short Interest Spikes

This table presents the aggregate amount of insider purchases (Panel A) and sales (Panel B) around short interest spikes. The dependent variables *Normalized Purchases (Sales) Amount* are the amount of insider purchases (sales) normalized by total shares outstanding. *Normalized Purchases (Sales) Amount* in different quarters are winsorized at the 1st and 99th percentiles of their respective empirical distributions. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the starting date of each time window. Calendar quarter fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$y_{it} = \alpha_{industry} + \lambda_{calendar\ quarter} + \beta_1 Spike_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Panel A: Aggregate amount of insider purchases. This analysis includes both the spike with insider purchases sample and non-spike with insider purchases sample.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Normalize Insider Purchases Amount ($\times 10^{-4}$)						
Quarters	Q_{-3}	Q_{-2}	Q_{-1}	Q_1	Q_2	Q_3	Q_4
Spike	0.394	1.357***	4.534***	16.667***	4.017***	1.616***	0.490
	[0.393]	[0.451]	[0.614]	[1.729]	[0.849]	[0.520]	[0.583]
Controls	Y	Y	Y	Y	Y	Y	Y
Calendar quarter FE	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y
# of observations	35846	36827	37759	37842	37397	36519	36005
R-squared	0.014	0.018	0.026	0.072	0.028	0.032	0.032

Panel B: Aggregate amount of insider sales. This analysis includes both the spike with insider purchases sample and non-spike with insider purchases sample.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Normalize Insider Sales Amount ($\times 10^{-4}$)						
Quarters	Q_{-3}	Q_{-2}	Q_{-1}	Q_1	Q_2	Q_3	Q_4
Spike	0.407	1.180	1.353	2.815**	1.482	2.418**	3.443***
	[0.944]	[1.469]	[1.421]	[1.142]	[0.902]	[1.154]	[1.241]
Controls	Y	Y	Y	Y	Y	Y	Y
Calendar quarter FE	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y
# of observations	35846	36827	37759	37842	37397	36519	36005
R-squared	0.015	0.017	0.031	0.036	0.033	0.029	0.024

Table 11. Impact of Insiders' Purchases on Managerial Compensation

This table quantifies the impact of insiders' purchases on managerial compensation. Panel A presents the changes in CEO compensation conditional on the presence of short interest spikes; Panel B presents the changes in CEO compensation conditional on the absence of short interest spikes; Panel C presents the changes in the compensation of top five executives conditional on the presence of short interest spikes; Panel D presents the changes in the compensation of top five executives conditional on the absence of short interest spikes. *Pay1_Pct* is the year-to-year percentage change in total current compensation which includes salary and bonus. *Pay2_Pct* is the year-to-year percentage change in compensation that includes salary, bonus, restricted stock grants, and option grants. *Pay3_Pct* is the year-to-year percentage change in total compensation (Execucomp data item TDC1) which includes salary, bonus, restricted stock grants, option grants, and long-term incentive payouts. *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the end of the fiscal years. Fiscal year fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Compensation data come from Compustat and span 1992 to 2012.

Panel A. Year-to-year percentage change in CEO compensation, spike sample

$$Pct_{it} = \alpha_{industry} + \lambda_{fiscal\ year} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Pay1_Pct (salary+bonus)			Pay2_Pct (salary+bonus+stocks+options)			Pay3_Pct (total pay)		
	Year$_{-1}$	Year$_1$	Year$_2$	Year$_{-1}$	Year$_1$	Year$_2$	Year$_{-1}$	Year$_1$	Year$_2$
Purchase	-0.558	4.946	-1.998	-5.001	23.340**	-2.245	-5.399	18.482**	2.502
	[3.087]	[3.379]	[1.678]	[10.479]	[8.850]	[6.643]	[7.263]	[7.125]	[5.187]
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fiscal year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of obs	6084	7517	6231	6091	7520	6231	5960	7385	6191
R-squared	0.065	0.035	0.040	0.023	0.028	0.030	0.020	0.037	0.031

Panel B. Year-to-year percentage change in CEO compensation, non-spike sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	% change in Pay1 (salary+bonus)			% change in Pay2 (salary+bonus+stocks+options)			% change in Pay3 (total pay)		
	Year$_{-1}$	Year$_1$	Year$_2$	Year$_{-1}$	Year$_1$	Year$_2$	Year$_{-1}$	Year$_1$	Year$_2$
Purchase	2.632	1.113	0.957	-8.540*	-7.617	-5.871	-4.061	-3.945	-3.423
	[2.655]	[1.681]	[1.663]	[4.553]	[4.636]	[3.764]	[3.487]	[4.477]	[3.432]
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fiscal year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of obs	6453	8052	6628	6453	8052	6628	6323	7904	6582
R-squared	0.032	0.042	0.036	0.023	0.023	0.029	0.022	0.027	0.029

Table 11. Impact of Insiders' Purchases on Managerial Compensation (continued)

Panel C. Year-to-year percentage change in the compensation of top five executives, spike sample

$$Pct_{it} = \alpha_{industry} + \lambda_{fiscal\ year} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Pay1_Pct (salary+bonus)			Pay2_Pct (salary+bonus+stocks+options)			Pay3_Pct (total pay)		
	$Year_{-1}$	$Year_1$	$Year_2$	$Year_{-1}$	$Year_1$	$Year_2$	$Year_{-1}$	$Year_1$	$Year_2$
Purchase	-0.070	3.983*	0.842	-3.261	14.738***	3.612	-2.198	8.238**	-0.042
	[1.671]	[2.275]	[1.471]	[3.310]	[4.785]	[3.714]	[2.408]	[3.421]	[3.026]
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fiscal year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of obs	30877	39110	35490	30879	39103	35472	26097	33689	31107
R-squared	0.042	0.023	0.020	0.033	0.033	0.030	0.023	0.040	0.027

Panel D. Year-to-year percentage change in the compensation of top five executives, non-spike sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	% change in Pay1 (salary+bonus)			% change in Pay2 (salary+bonus+stocks+options)			% change in Pay3 (total pay)		
	$Year_{-1}$	$Year_1$	$Year_2$	$Year_{-1}$	$Year_1$	$Year_2$	$Year_{-1}$	$Year_1$	$Year_2$
Purchase	2.064	2.647	2.086	-1.104	-1.932	-1.629	0.502	-0.119	-0.896
	[1.664]	[2.025]	[1.457]	[3.027]	[2.995]	[3.084]	[2.469]	[2.291]	[2.109]
Controls	Y	Y	Y	Y	Y	Y	Y	Y	Y
Fiscal year FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y	Y
# of obs	34278	43218	39493	34267	43198	39475	28102	36076	33167
R-squared	0.024	0.022	0.018	0.021	0.023	0.021	0.019	0.029	0.019

Table 12. Impact of Insiders' Purchases on the Forced Turnover Rates of CEOs

This table quantifies the impact of insiders' purchases on the force turnover rates of CEOs. Panel A presents the results conditional on the presence of short interest spikes, while Panel B presents the results conditional on the absence of short interest spikes. In Column (4) to (6) of both panels, we further limit our analysis on bad ex-post earnings surprises (lowest quintile sorted on a yearly basis). *ForcedTurnover* is a dummy variable that equals 1 if a CEO resigns in a given year. *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the end of the fiscal years. Fiscal year fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively. Data is at the CEO-year level and span 1992 to 2012.

$$ForcedTurnover_{it} \times 100 = \alpha_{industry} + \lambda_{fiscal\ year} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Panel A. Forced turnover rate analysis, conditional on the presence of short interest spikes

	(1)	(2)	(3)	(4)	(5)	(6)
	Forced Turnover × 100 (full sample, mean = 1.154)			Forced Turnover × 100 (with bad ex-post earnings, lowest quintile; mean = 2.896)		
	$Year_{-1}$	$Year_1$	$Year_2$	$Year_{-1}$	$Year_1$	$Year_2$
Purchase	0.700	-0.004	0.445	0.131	-1.398**	-0.434
	[0.611]	[0.358]	[0.339]	[1.536]	[0.646]	[0.515]
Controls	Y	Y	Y	Y	Y	Y
Fiscal year FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
# of CEO-year	7731	7868	7839	1087	1097	1076
R-squared	0.020	0.021	0.022	0.092	0.076	0.120

Panel B. Forced turnover rate analysis, conditional on the absence of short interest spikes

	(1)	(2)	(3)	(4)	(5)	(6)
	Forced Turnover × 100 (full sample, mean = 1.042)			Forced Turnover × 100 (with bad ex-post earnings, lowest quintile; mean = 1.634)		
	$Year_{-1}$	$Year_1$	$Year_2$	$Year_{-1}$	$Year_1$	$Year_2$
Purchase	0.110	-0.267	0.472	1.058	-0.118	0.472
	[0.391]	[0.265]	[0.290]	[1.399]	[0.681]	[0.697]
Controls	Y	Y	Y	Y	Y	Y
Fiscal year FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
# of CEO-year	8330	8438	8432	1149	1163	1154
R-squared	0.022	0.018	0.016	0.069	0.064	0.068

Table 13. Impact of Corporate Governance

This table studies the impact of corporate governance on the probability of insider purchases after short interest spikes. The dependent variable *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. Corporate governance measures include fraction of independent directors, a dummy variable that equals 1 if any director in the board represents investors, a dummy variable that equals 1 if a firm has higher than median G-index (Gompers, Ishii, and Metrick, 2003), and a dummy variable that equals 1 if a firm has at least one block investors in quarter prior to the short interest spikes. *Spike* is a dummy variable that equals 1 if there is a short interest spike. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$Purchase_{it} \times 100 = \alpha_{industry} + \lambda_{fiscal\ year} + +\beta_1 Spike_{it} \times Gov_{it} + \beta_2 Gov_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: this analysis includes both the spike sample and the matched non-spike sample.

	(1)	(2)	(3)	(4)
	Purchase × 100			
Mean	9.64	9.65	9.95	9.18
Spike × independent director fraction	-2.329			
	[2.182]			
Independent director fraction	2.406			
	[1.848]			
Spike × (investors on the board)		-2.080***		
		[0.707]		
(investors on the board)		1.693**		
		[0.715]		
Spike × High G-index			1.099*	
			[0.652]	
High G-index			-0.411	
			[0.373]	
Spike × (# of blockholder>=1)				-2.710***
				[0.429]
(# of blockholder>=1)				1.908***
				[0.270]
Spike	-6.367***	-6.972***	-7.995***	-4.408***
	[1.715]	[0.515]	[0.499]	[0.519]
Controls	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y
Observations	39280	39319	43553	100252
R-squared	0.089	0.090	0.084	0.075

Internet Appendix

Appendix A

Robustness Check: Firm Size

This table examines the cumulative abnormal returns associated with insider purchases after short interest spikes across firms with different size. The size quintiles are constructed based on the NYSE breakpoints. The dependent variables are cumulative abnormal returns benchmarked by returns of the DGTW portfolios over the first four months (*CAR4m*), and from the fifth month to the twelfth month (*CAR5mto12m*) after short interest spikes. *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after short interest spikes. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: this analysis is conditional on the presence of short interest spikes.

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR4m (%)			CAR5mto12m (%)		
	Full Sample	Size Q1	Size Q2~Q5	Full Sample	Size Q1	Size Q2~Q5
Purchase	2.611**	2.999**	2.422**	-2.426**	-2.513**	-2.470**
	[1.080]	[1.262]	[1.209]	[0.974]	[1.253]	[1.075]
Controls	Y	Y	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
# of observations	38461	12958	25503	35935	12022	23913
R-squared	0.033	0.060	0.043	0.049	0.083	0.055

Appendix B

Robustness Check: Institutional Ownership

This table examines the cumulative abnormal returns associated with insider purchases after short interest spikes across firms with different levels of institutional ownership. The level of institutional ownership is sorted into tertiles based on the number of shares of the common stock held by institutions (normalized by the total shares outstanding). The sorting is performed on a yearly basis and is orthogonal to firm size (double sort approach). The dependent variables are cumulative abnormal returns benchmarked by returns of the DGTW portfolios over the first four months (*CAR4m*), and from the fifth month to the twelfth month (*CAR5mto12m*) after the short interest spikes. *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the dates of short interest spikes. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$CAR_{it} = \alpha_{industry} + \lambda_{calendar\ month} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Note: this analysis is conditional on the presence of short interest spikes.

	(1)	(2)	(3)	(4)	(5)	(6)
	CAR4m (%)			CAR5mto12m (%)		
	Full Sample	Institutional Ownership (Tertile1)	Institutional Ownership (Tertile2,3)	Full Sample	Institutional Ownership (Tertile1)	Institutional Ownership (Tertile2,3)
Purchase	2.611**	4.109**	2.412**	-2.426**	-5.133***	-0.719
	[1.080]	[1.646]	[1.115]	[0.974]	[1.446]	[1.163]
Controls	Y	Y	Y	Y	Y	Y
Calendar month FE	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y
# of observations	38461	6765	26374	35935	6238	24511
R-squared	0.033	0.106	0.038	0.049	0.102	0.063

Appendix C

Robustness Check: Portfolio Analysis

Panel A of this table presents the performance-evaluation results for portfolios consisted of open market insider purchases within two weeks after short interest spikes. The holding periods of the insider transactions are one month, three months, six months, nine months, and twelve months. Panel B presents the results of a trading strategy that longs the stocks purchased by insiders after short interest spikes for two months, closes the long position in the third and fourth month, and then subsequently shorts the same stocks in the fifth and sixth month after the purchase dates (denoted as 2L2W2S). Panel B also presents results by limiting the choice of the portfolio to the opportunistic purchases defined by our ex-ante measures. The results of the trading strategy of longing insider purchases for six months are also included in Panel B for comparison. Insider transactions are either equally-weighted or value-weighted. The dependent variables are daily excess portfolio returns. *MKTRF*, *SMB*, *HML* and *MOM* are daily factors downloaded from Kenneth French's website. α is the regression intercept. *Annualized* α = 252*α. Standard errors are robust to heteroskedasticity. ***, ** and * indicate statistical significance at 1%, 5% and 10% levels, respectively. The sample is from 1989/1/1 to 2011/12/30 (a common period shared by all portfolios).

$$R_{pt} - R_{ft} = \alpha_p + \beta_p(R_{mt} - R_{ft}) + s_p SMB_{pt} + h_p HML_{pt} + m_p MOM_{pt} + \varepsilon_{pt}$$

Panel A. Portfolio analysis for different holding periods.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	EW Daily Excess Portfolio Returns (%)					VW Daily Excess Portfolio Returns (%)				
	1-month	3-month	6-month	9-month	12-month	1-month	3-month	6-month	9-month	12-month
MKTRF	1.143***	1.153***	1.124***	1.123***	1.127***	1.195***	1.212***	1.161***	1.165***	1.174***
	[0.022]	[0.018]	[0.013]	[0.011]	[0.011]	[0.030]	[0.022]	[0.014]	[0.012]	[0.012]
SMB	0.696***	0.770***	0.804***	0.812***	0.805***	0.418***	0.383***	0.402***	0.387***	0.382***
	[0.048]	[0.037]	[0.029]	[0.025]	[0.024]	[0.056]	[0.040]	[0.029]	[0.025]	[0.024]
HML	0.436***	0.464***	0.484***	0.521***	0.533***	0.407***	0.531***	0.506***	0.556***	0.589***
	[0.053]	[0.041]	[0.030]	[0.025]	[0.023]	[0.055]	[0.048]	[0.033]	[0.027]	[0.025]
MOM	-0.329***	-0.340***	-0.307***	-0.266***	-0.236***	-0.423***	-0.467***	-0.434***	-0.399***	-0.357***
	[0.034]	[0.026]	[0.019]	[0.017]	[0.016]	[0.036]	[0.026]	[0.019]	[0.017]	[0.017]
Constant	0.076***	0.033**	0.003	-0.007	-0.013	0.055**	0.026	0.016	0.010	0.006
	[0.025]	[0.017]	[0.013]	[0.011]	[0.011]	[0.024]	[0.016]	[0.013]	[0.012]	[0.011]
Annualized α (%)	19.17	8.34	0.65	-1.70	-3.36	13.78	6.54	4.04	2.53	1.63
Annualized Raw Ret (%)	29.68	18.96	11.43	9.53	8.18	23.53	16.34	13.72	12.67	12.27
# of trading days	5799	5799	5799	5799	5799	5799	5799	5799	5799	5799
R-squared	0.360	0.572	0.692	0.739	0.750	0.410	0.618	0.703	0.737	0.755

Appendix C

Robustness Check: Portfolio Analysis (continued)

Panel B. Different trading strategies with a 6-month holding period

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Weighting Method		EW Daily Excess Portfolio Returns (%)				VW Daily Excess Portfolio Returns (%)		
Sample	Full Sample	Full Sample	Opportunistic Purchases (purchase frequency)	Opportunistic Purchases (trading pattern)	Full Sample	Full Sample	Opportunistic Purchases (purchase frequency)	Opportunistic Purchases (trading pattern)
Trading Strategy	6L	2L2W2S	2L2W2S	2L2W2S	6L	2L2W2S	2L2W2S	2L2W2S
MKTRF	1.124***	0.058**	0.094***	0.039	1.150***	0.078***	0.157***	0.048
	[0.013]	[0.028]	[0.035]	[0.033]	[0.033]	[0.025]	[0.033]	[0.033]
SMB	0.804***	0.033	0.019	-0.088*	0.250***	0.025	0.017	-0.027
	[0.029]	[0.039]	[0.051]	[0.051]	[0.053]	[0.042]	[0.067]	[0.055]
HML	0.484***	-0.207***	-0.224***	-0.286***	0.484***	-0.229***	-0.240**	-0.314***
	[0.030]	[0.045]	[0.078]	[0.064]	[0.061]	[0.051]	[0.103]	[0.077]
MOM	-0.307***	-0.029	-0.071	-0.017	-0.420***	-0.041	-0.052	-0.020
	[0.019]	[0.027]	[0.046]	[0.037]	[0.037]	[0.031]	[0.060]	[0.044]
Constant	0.003	0.037**	0.048*	0.062***	0.018	0.020	0.057**	0.029
	[0.013]	[0.016]	[0.025]	[0.023]	[0.022]	[0.017]	[0.027]	[0.023]
Annualized α (%)	0.65	9.32	12.18	15.69	4.04	4.79	14.24	7.25
Annualized Raw Ret (%)	11.43	12.5	15.25	18.57	13.72	7.97	17.86	10.14
# of observations	5799	5799	5799	5799	5799	5799	5799	5799
R-squared	0.692	0.015	0.010	0.011	0.479	0.020	0.016	0.013

Appendix D

Alternative Explanation: Short Squeeze

This table examines the level of short interest around insider purchases in both the spike sample (Column 1) and non-spike sample (Column 2). The analysis is performed conditional on insiders purchase on the open market within two weeks after short interest spikes (or the same time window in the non-spike sample). The dependent variable *SI* is the level of short interest ratio within [-3, 12] months around the short interest spikes. (*Month -2*), (*Month -1*), ..., and (*Month 12*) are dummy variables for different time windows relative to short interest spikes. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the settlement dates of each month. Calendar month fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$SI_{itk} = \alpha_{industry} + \lambda_{calendar\ month} + \sum_{k=-2}^{12} \beta_k \times (Month)_{itk} + \gamma' X_{itk} + \varepsilon_{itk}$$

	(1)		(2)	
	Short Interest Ratio around Insider Purchases (%)			
	Spike Sample		Non-spike Sample	
	Coefficients	Standard Errors	Coefficients	Standard Errors
(Month -2)	0.172***	[0.055]	-0.004	[0.017]
(Month -1)	0.432***	[0.105]	-0.054**	[0.024]
(Month 0)	2.607***	[0.126]	-0.185***	[0.038]
(Month 1)	2.826***	[0.188]	-0.120***	[0.040]
(Month 2)	2.770***	[0.192]	-0.135***	[0.039]
(Month 3)	2.612***	[0.198]	-0.144***	[0.039]
(Month 4)	2.336***	[0.161]	-0.107***	[0.037]
(Month 5)	2.042***	[0.143]	-0.128***	[0.034]
(Month 6)	1.889***	[0.133]	-0.140***	[0.036]
(Month 7)	1.727***	[0.121]	-0.127***	[0.039]
(Month 8)	1.569***	[0.150]	-0.102**	[0.041]
(Month 9)	1.408***	[0.161]	-0.05	[0.044]
(Month 10)	1.388***	[0.174]	0.002	[0.046]
(Month 11)	1.239***	[0.180]	0.018	[0.047]
(Month 12)	1.196***	[0.203]	0.068	[0.051]
Controls	Y		Y	
Calendar month FE	Y		Y	
Industry FE	Y		Y	
# of observations	43100		108318	
R-squared	0.255		0.187	

Appendix E

Alternative Explanation: Earnings Management

Panel A of this table presents estimates of the difference in the discretionary accruals between the cases in which corporate insiders purchase stocks on the open market within two weeks after short interest spikes, and the cases in which corporate insiders do not purchase. Panel B presents results for the matched non-spike sample. The dependent variables (*Disc*) are discretionary accruals normalized by asset size, and are estimated using same method as Rangan (1998). *Purchase* is a dummy variable that equals 1 if corporate insiders purchase on the open market within two weeks after the short interest spikes in the spike sample or within two weeks after the matched settlement dates in the non-spike sample, and 0 otherwise. Control variables include *LnSize*, *LnBEME*, *LnLeverage*, *Ret12mto2mPrior*, and *Ret2mPrior* which are defined in Table 1. The values of the control variables are taken at the corresponding earnings announcement dates. Calendar quarter fixed effects and Fama-French 48 industry fixed effects are included in the regressions. Standard errors are clustered by the Fama-French 48 industry and are reported in brackets. ***, **, and * indicate statistical significance at the 1%, 5%, and 10% levels, respectively.

$$Disc_{it} = \alpha_{industry} + \lambda_{calendar\ quarter} + \beta_1 Purchase_{it} + \gamma' X_{it} + \varepsilon_{it}$$

Panel A. Conditional on the presence of short interest spikes

Discretionary accruals (%)	(1) Disc Q_{-4}	(2) Disc Q_{-3}	(3) Disc Q_{-2}	(4) Disc Q_{-1}	(5) Disc Q_1	(6) Disc Q_2	(7) Disc Q_3	(8) Disc Q_4
Purchase	-0.142	0.390	0.182	0.439**	-0.389**	0.287	-0.124	-0.011
	[0.215]	[0.239]	[0.203]	[0.213]	[0.195]	[0.176]	[0.166]	[0.171]
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Calendar quarter FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
# of observations	26044	26302	26654	26969	27016	26360	25454	24753
R-squared	0.018	0.021	0.020	0.016	0.018	0.017	0.020	0.019

Panel B. Conditional on the absence of short interest spikes

Discretionary accruals (%)	(1) Disc Q_{-4}	(2) Disc Q_{-3}	(3) Disc Q_{-2}	(4) Disc Q_{-1}	(5) Disc Q_1	(6) Disc Q_2	(7) Disc Q_3	(8) Disc Q_4
Purchase	0.125	-0.218	0.144	0.126	-0.052	0.030	0.054	-0.086
	[0.107]	[0.149]	[0.106]	[0.145]	[0.146]	[0.145]	[0.108]	[0.091]
Controls	Y	Y	Y	Y	Y	Y	Y	Y
Calendar quarter FE	Y	Y	Y	Y	Y	Y	Y	Y
Industry FE	Y	Y	Y	Y	Y	Y	Y	Y
# of observations	25913	26033	26268	26523	26237	25596	24974	24621
R-squared	0.017	0.016	0.015	0.015	0.015	0.016	0.015	0.015