

# **Selective Information Leakages in Financial Markets: Evidence from Shorting around Insider Sales**

## **Abstract**

We show that a select group of investors has immediate access to information about insider transactions, whereas the rest of market participants receive this information with a two-day lag. The advance access group includes market makers (MMs) and non-market makers (non-MMs). Both open a number of short positions on insider sale days. Whereas MM actions are consistent with forward-looking inventory management, non-MM short selling implies information leakages. Although non-MMs promptly acquire information about the incidence of insider sales, their trades do not reflect a precise knowledge of those insider sale characteristics that have the potential to maximize profits. Nevertheless, non-MM short positions are, likely, profitable due to significant return declines that follow insider sale announcements. In summary, while information about insider sales consistently leaks to privileged investors, the leaked information is not specific, especially in the case of the most impactful insider sales.

## 1. Introduction

In February 2007, the Securities and Exchange Commission (hereafter, the SEC) initiated a fact-finding investigation of several brokerage firms to determine if they had leaked information about client orders to other parties.<sup>1</sup> The investigation was triggered by concerns raised by a group of mutual funds that accused brokers of disclosing information about their orders to hedge funds to reward the latter for higher commissions and frequent trading. While the “passage of information” in the financial services industry has been the focus of several academic and regulatory studies,<sup>2</sup> identifying trades that originate from information leakages is challenging, given the lack of appropriate data.<sup>3</sup>

In this paper, we address the issue of information leakages in the context of insider stock sales. We show that information about insider sales leaks to a select group of non-market makers on the day of execution – several days before the sales are officially reported to the general public. Upon receipt of this information, non-MMs start actively opening short positions. In particular, the number of short trades (short volume) executed by non-market makers on insider sale days increases by 11.79% (10.38%) when compared to the control period. Meanwhile, the number of short trades (short volume) executed by market makers increases by 36.67% (41.20%). Although the percentage increase in non-market maker shorting is not as pronounced as the increase in the market maker short selling, trading volumes originated by these activities are similar, as non-MM short selling comprises about 70% of all shorting activity on a day-to-day basis.

---

<sup>1</sup> “SEC boosts probe for Wall Street leaks,” February 7, 2007, *Wall Street Journal*, C15.

<sup>2</sup> A review of the literature on information leakages is presented in Section 2 of the manuscript.

<sup>3</sup> In a speech titled “US Experience of Insider Trading Enforcement” given in February 2008, the SEC’s Director of Enforcement, Linda Thomsen, listed trading motive identification as one of the main challenges in successfully prosecuting illegal tipping cases. The text of the speech is available at <http://www.sec.gov/news/speech/2008/spch021908lct.htm>.

Distinguishing between MM and non-MM short sales in the context of information leakages is important and has not been done previously. As market makers acquire information about the incidence and the specifics of insider sales when these sales are submitted for execution, MM shorting can be attributed to forward-looking inventory management. In particular, if an insider trade appears to be informationally motivated, market makers will anticipate increased selling pressure to follow a sale announcement and may choose to create temporary inventory shortages to absorb the impending negative order imbalances. Meanwhile, non-market makers should not have access to information on the incidence of insider sales and on their specifics, unless such information is leaked to them.

In an attempt to build a case for leakages, a study by Geczy and Yan (2006) documents abnormal quoting activities that accompany insider stock sales. In particular, the authors observe an increase in ask quote aggressiveness on insider sale days.<sup>4</sup> Geczy and Yan then suggest that brokers may leak the information on insider trading activities to their clients and quote more aggressively while attempting to fill these clients' sell orders. Although this explanation of the results is intriguing, brokers' aggressiveness on the ask side may be alternatively ascribed to their objective to re-balance inventory in anticipation of investors' negative reaction to the insider sale announcement. Due to the lack of disaggregated data, Geczy and Yan cannot separate the inventory management and the information leakage components of the total abnormal activity they document. An advantage of our approach is that we are able to distinguish between, and confirm, both explanations.

Having established that non-MM short selling abnormally increases concurrent with insider sales, we next discuss the possible channels, through which non-MMs may learn about

---

<sup>4</sup> In a study of market makers' quoting behavior around the affiliated analysts' recommendation updates, Heidle and Li (2004) find evidence consistent with information leakages.

insider activities. One source of such information could be the insiders themselves. This suggestion follows Damodaran and Liu (1993), who argue that managers' personal trades are signals to the market. It follows from this argument that insiders may be interested in increasing the speed of the signal dissemination by tipping the market on occurrence of their trades before the official announcement. A second possible source is order and quote flow: non-MM short sellers may observe increased order or quote imbalances that result from insider sales and/or from the MM short sales and mimic these positions. Lastly, the executing market maker may leak insider sale information to favored customers, reflecting the concern of the current SEC investigation.

We suggest that insider-originated leakages are unlikely, because early dissemination of information may adversely affect insider profits, especially in the case of same-insider sale sequences (clusters) that take several days to complete. Such clusters constitute about 43% of all insider sale days in the sample. With an average return decline of more than 1% on the day of insider sale announcement, insiders may lose trading profits if they do not conceal unfinished trades.<sup>5</sup> Thus, we suggest that insiders are unlikely to disclose the information about their activities, particularly when their sales extend over several days. Notably, evidence of information leakages to non-MM short sellers is detectable *only* for the clustered insider trades – those, for which the insider would suffer most revenue losses from information leakage. Therefore, we posit that leakages are not likely to originate directly from insiders.

In addition, it is unclear why insiders would limit their signals to a relatively small group of investors instead of disseminating them to a broader audience. Perhaps, similar to

---

<sup>5</sup> For instance, during a typical two-day cluster, an insider sells 25,000 shares per day. With a share price drop of 1% on the announcement day and with an average sample share price of \$30, potential loss from early information dissemination is \$7,500 ( $=0.01*30*25,000$ ) during the second day.

the argument in the IPO underpricing literature (e.g., Benveniste and Spindt, 1989), insiders use leakages to reward a select group of market participants. Although profiting from such an information transfer may, itself, qualify as insider trading and may defy the spirit of Regulation FD, we recognize it as a possibility. Nevertheless, if leakages are used as rewards, it is puzzling that information relayed to investors does not contain the specifics of insider transactions that may enhance the profitability of short positions. In particular, our multivariate analyses reveal that although non-MM short sellers learn about the incidence of insider sales before the rest of the market, they do not seem to be able to recognize the most profitable insider sales.

Another possibility is that non-market makers learn about insider transactions by observing quotes, order flow, or trade execution reports. If a sophisticated trader is able to recognize insider selling, abnormally active short selling, or quoting on the ask in real time, she may choose to establish her own short positions. This suggestion, however, is not applicable in the trading environment for NASDAQ stocks during our sample period. Non-market makers are, for the most part, unable to identify insider trades and distinguish between long and short sales in real time.<sup>6</sup> Therefore, learning by observing insider and short orders is unlikely. It is also unlikely that non-market makers react to the negative order imbalances, as our data show that insider sales usually execute on days of positive returns. In addition, our results suggest that an insider sale event is a significant determinant of non-MM short selling, even after returns and volume contemporaneous to the event are controlled for. Finally, as SuperMontage and electronic venues that execute the vast majority of sample trades provide

---

<sup>6</sup> Whereas executing market makers are likely to know that a particular order is submitted by an insider, they are less likely to have such information about a short sale. According to Frank Hatheway of NASDAQ, at the time of our study, the short selling flag for orders submitted electronically was masked by execution software. Thus, the only short sales that MMs were able to recognize were those submitted over the phone. On the other hand, non-MMs were unable to recognize either insider or short trades by simply reading the tape.

market participants with an option of full anonymity – both at quote placement and trade clearing – it may not be possible for non-market makers to make quote- or trade-based inferences of other investors' identities. In other words, even though, according to Geczy and Yan (2006), MMs increase their activity on the ask side, the origin of such quotes may be concealed. In summary, the discussion of insider motives and institutional details leads us to suggest that non-MMs are unlikely to learn about insider sales from insiders themselves or by observing order flow and trade executions. Hence, we posit that leakages from market makers are the most likely source of information transfer.

The picture that emerges is not, however one of pervasive leakages from market makers. Rather, MMs attempt to reconcile their objective to reward preferred clients with their duty to stabilize the market after the insider sale announcement. Thus, the decisions of (i) whether to leak insider information and (ii) how much of the specifics to leak become a part of a balancing act. Announcements of informationally rich insider trades are likely to trigger a price reaction that may require greater stabilization efforts by market makers. Therefore, such trades are less likely to be leaked as compared to the less impactful ones, especially before the market maker establishes a sufficient short position. The data confirm this suggestion and show that non-market makers usually receive tips on the less impactful insider sales, and the information leaked to them is not detailed enough to ensure maximum profitability of their short positions. For instance, non-market maker short sellers do not take advantage of information on (i) how many insiders of the same firm are selling on a given day, (ii) what percentage of their holdings the insiders are disposing of, and (iii) the urgency of the sale.

When an insider stock sale is informationally rich, we expect to observe sales of larger fractions of insider holdings, sales by multiple insiders of the same firm and, most importantly, insiders trying to execute the sales promptly. Results of the multivariate models that control for these three factors confirm the balancing act proposition and lead us to conclude that, while non-MMs are informed about the incidence of insider sales, the information that is leaked to them is relatively limited and excludes the most informed insider sales.

We find further support for the balancing act hypothesis by examining the dynamics of stock returns following insider sales. Although non-MM short positions are likely profitable due to the pervasive price drops that follow insider sale announcements, non-market makers, generally, do not recognize insider sales that are followed by the most negative returns. Meanwhile, market makers are, expectedly, knowledgeable about the insider sale details. MM short sales are higher (i) for those insider sales that are executed promptly, (ii) for transactions during which a larger fraction of insider holdings is disposed of, and (iii) on those days, during which multiple insiders of the same firm are selling.

Our results hold after controlling for factors that have been shown to affect day-to-day short selling (e.g., Diether, Lee, and Werner, 2007) and for corporate events associated with insider transactions, such as, for instance, earnings and dividend announcements. Taken together, our results present a complex picture of selective information leakages in financial markets and form our main contribution. Our evidence is consistent with leakages of insider sale information, most likely from the affiliated market makers. Nevertheless, it is also clear that the MM's balance their market-making duties by only leaking the information about those insider sales that are not informationally rich.

Our second contribution is to the short selling literature, as we provide new evidence on short sellers' superior informedness. Christophe, Ferri, and Angel (2004) study shorting activities around earnings announcements during the pre-Reg. FD period and conclude that short sellers are knowledgeable about the content of the upcoming corporate news releases. Nevertheless, according to Daske, Richardson, and Tuna (2005), this result is no longer detectable after the Reg. FD takes effect.<sup>7</sup> Our sample period covers two years in the post-Reg. FD era. While short sellers may no longer be informed about the upcoming corporate news releases, we show that they are able to obtain information about ongoing insider sales.

The rest of the manuscript is organized as follows. Section 2 contains an overview of literature on the information content of insider trades, short sales, and on information transfers in the financial industry. Section 3 describes the data used in the study. Section 4 contains the event study analysis of abnormal short selling on and around insider sale days. Section 5 investigates the ability of short sellers, both MMs and non-MMs, to foresee returns that follow insider sale events. Section 6 concludes.

## **2. Background**

### *2.1 Information content of insider trades*

Researchers generally agree that company insiders are informed and, even in the presence of trading restrictions, are able to profit from their superior knowledge of the company prospects. Early studies (e.g., Jaffe, 1974; Seyhun, 1986; Rozeff and Zaman, 1988; and Lin and Howe, 1990) document that insiders can foresee returns as far as several years into the future. More recently, Rozeff and Zaman (1998) and Lakonishok and Lee (2001)

---

<sup>7</sup> Mac (2003) also investigates the effects of the Reg. FD and suggests that the Regulation effectively curtailed information leakages, although the leakages had been subsiding even prior to the Regulation taking effect.

discover that insider trading patterns resemble those of sophisticated contrarians. Piotroski and Roulstone (2005) prove that insiders are both contrarian and superiorly informed about their companies' future prospects, although contrarian traits are considerably more pronounced.

Bettis, Coles, and Lemmon (2000) document that most companies restrict trading by corporate officers and institute blackout periods (usually from several weeks before to several days after corporate news announcements), during which insiders are encouraged not to trade. The authors find that such restrictions successfully suppress insider activity around corporate events and reduce the likelihood of insider trading-related law suits. Huddart, Ke, and Shi (2007) extend this finding by showing that insiders are still able to make profits, if they trade after blackout periods and before the subsequent filings of 10-K or 10-Q forms. The authors explain that these forms often contain detailed information on the origin of earnings changes and may substantially alter investors' perception of the company performance.

## *2.2 Information content of short sales*

Support for short sellers' being informed includes the theoretical framework of Diamond and Verrecchia (1987) as well as a number of empirical studies based on monthly short interest (e.g., Dechow, Hutton, Meulbroek, and Sloan, 2001, and Desai, Ramesh, Thiagarajan, and Balachandran, 2002) and order data (Boehmer, Jones, and Zhang, 2008). Dechow et al. (2001) show that short sellers are able to identify overvalued firms and short stock in these firms, with subsequent covering after book-to-market ratios mean-revert. Desai et al. (2002) find that heavily shorted firms experience negative abnormal future returns, and that the absolute value of these negative returns increases in short interest.

Boehmer et al. (2008) discover that portfolios of heavily shorted stocks considerably underperform those of lightly shorted ones, after controlling for the factors described by Fama and French (1992). Diether et al. (2007) investigate short sellers' ability to anticipate return changes over short horizons: from one to five days. Their results, derived from a cross-section of stock returns, suggest that short sellers are mostly contrarian and trade on transient market overreactions. In particular, short selling intensifies on days with positive returns and is relatively low on days with negative returns. Diether et al. attribute such behavior to short sellers' ability to recognize temporary valuation inefficiencies and profit from return reversals that follow. Ignoring transaction costs, short sellers are able to make profits on their contrarian strategies, as mean abnormal returns of long-short portfolios formed similarly to those of Boehmer et al. (2008) are significantly positive during several days following formation.

### *2.3 Information transfers in the financial industry*

Existence of information transfers within the financial industry is supported by Heidle and Li (2004) who report evidence consistent with information leakages and front-running before revisions in analyst recommendations. They examine the quoting behavior of the market makers affiliated with the same brokerage house as the recommending analyst. In the hour and a half before upgrades, the proportion of time that the affiliated market makers quote at the inside bid significantly increases, whereas their quoting behavior at the ask does not change. On the other hand, three hours before downgrades, the affiliated market makers' quoting at the inside ask increases, whereas their quoting at the bid does not change.

Irvine, Lipson, and Puckett (2007) continue the investigation of the information transfer from the analysts and show that institutions receive tips regarding the content of the upcoming analyst initial buy recommendations. Abnormal institutional buying in the authors' sample begins as early as five days prior to the analyst report releases and is, generally, profitable.

Whereas information transfers between the analysts and the affiliated brokers or institutions may be regarded as unethical, as they take away from the level playing field and equal access to information by all the market participants; it is difficult to identify a party that directly suffers from such transfers. In our study, such party is clearly defined, as the trading revenues of the insiders who have not finished selling may decrease if information leakages disseminate to the general market.

In this study, we shed additional light on these three areas of research. We show that insider sales possess distinct contrarian characteristics, as insider sale days conclude price run-ups, with sharper subsequent price declines evident for insider sales completed expeditiously. By isolating inventory management trades, we show that about one half of the abnormal short volume concurrent with insider sales is attributable to information leakages. Finally, we document that although information transfer occurs, it is not pervasive and excludes the most informationally rich insider sales. In the following section, we describe our data and the sample selection procedure.

### **3. Data and sample**

We investigate short selling around insider sales during the two-year period from January 2005 through December 2006. The data for this study come from multiple sources.

Insider transactions are collected from the Thomson Financial Insider Filings database (hereafter, TFN) that contains all insider activities as reported to the SEC via Forms 3, 4, 5, and 144.<sup>8</sup> Corporate insiders, defined by the Securities and Exchange Act of 1934 as those who have “access to non-public, material, insider information,” are required to file at least one of the aforementioned forms when they trade their own company stock. The Sarbanes-Oxley act of 2002 requires insiders to submit the forms to the SEC no later than two business days following a transaction.<sup>9</sup> The SEC usually makes the information from the forms immediately available on its website. As in Geczy and Yan (2006), we restrict the sample to insider sales from Form 4 only, as well as only to the records with the cleanse indicators “R” and “H.”<sup>10</sup>

Short sales data for all NASDAQ securities are collected from the six market centers – the American Stock Exchange, the ArcaEx, the Chicago Stock Exchange, the NASD Alternative Display Facility, the NASD SuperMontage, and the National Stock Exchange.<sup>11</sup> Upon collection, trade records are aggregated into daily datasets for each sample stock.

The Reg. SHO datasets identify two types of short sales based on the applicability of shorting restrictions: exempt, *E*, and non-exempt, *S*. Short sales qualify for an exemption

---

<sup>8</sup> Form 3 is used for initial filings, Form 4 reports a change in insider’s ownership of the firms securities, Form 5 is used for transactions with delayed reporting, whereas Form 144 reports transactions in restricted securities.

<sup>9</sup> An insider may file multiple Form 4s if he transacts over a multi-day period. In other words, if an insider intends to dispose of 100,000 shares, and the first 40,000 shares sell on days 1 and 2, he may file a Form 4 after day 2, declaring the 40,000 shares sold. If the remaining 60,000 shares sell in the next 2 days, he may file again. The filing before or concurrently with a sale is only required for insiders who sell restricted stock (Form 144). To ensure that the effects we document are not contaminated by the immediate public release of information, we do not use insider sales that require filing of a Form 144.

<sup>10</sup> Thomson Financial verifies the accuracy of figures reported by insiders by referencing external sources. Transaction prices and acquisition/disposition indicators that appear erroneous or unreasonable are corrected when possible. The cleanse indicator represents Thomson’s level of confidence in the accuracy of a particular record. “R” indicator denotes data that are verified through the cleansing process. “H” indicator denotes data that are cleansed with a very high level of confidence.

<sup>11</sup> The abovementioned trading venues were required to disseminate trade-by-trade short selling datasets in compliance with the Regulation SHO Pilot. The SEC adopted regulation SHO on June 23, 2004. In the Rule 202T of the Regulation, the SEC established a Pilot Program to study the effects of elimination of short selling restrictions. This program required self-regulatory organizations to make trade-by-trade short selling data publicly available.

from the restrictions (the bid test in the case of NASDAQ stocks) if they are executed as part of bona fide market making.<sup>12</sup> All other short sales have to comply with the bid test and are identified as non-exempt. Throughout the manuscript, we refer to transactions with an *E* and an *S* indicators as those of, respectively, market makers and non-market makers. At the beginning of the Pilot period, the SEC issued several no-action letters that allowed market makers to ignore short sale type identification for Pilot stocks. Although present in the data, *E* and *S* indicators for these stocks may be unreliable. Hence, we restrict our sample to only non-Pilot stocks.<sup>13</sup> As the Pilot took full effect in May 2005, we also restrict our main analysis to a period from May 2005 through December 2006, using the period from January to May 2005 for robustness checks.<sup>14</sup>

We restrict the analysis to regular trading hours (9:30 a.m. – 4:00 p.m.) and eliminate stocks with prices lower than \$5 per share. Five dollar cutoff is chosen due to excessive margin requirements that exist for stocks with prices below \$5. Such margins reduce supply of borrowable shares and increase the capital needed to sell short.<sup>15</sup>

To separate the effects of information leakages and inventory management from the effects of corporate events that often accompany insider activities, we use Compustat and CRSP databases to identify days of earnings and dividend announcements. Most of our univariate analyses are performed for insider sales surrounded by a [-10; 10]-day window

---

<sup>12</sup> NASD Notice to Members 06-53, September 2006.

<sup>13</sup> This restriction reduces our sample size by 439 stocks. Since the Pilot stocks were chosen randomly from a sample of Russell 3000 securities (see <http://www.sec.gov/rules/other/34-50104.htm>), we do not expect that excluding these securities subjects our sample to any biases unrelated to short selling. Nevertheless, we conduct several robustness checks (described further in the manuscript) to insure that the results remain unchanged when the pilot stocks are included in the sample.

<sup>14</sup> We thank the SEC's Amy Edwards and Victoria Crane clarifying the applicability of the Pilot and the content of the no-objection letters.

<sup>15</sup> As an extreme example, during our sample period, E\*TRADE imposed a 100% margin on short selling for stocks with prices below \$5. In addition, some brokerages treated all securities with prices less than \$5 as non-marginable and thus non-shortable.

devoid of corporate announcements. For the multivariate tests, corporate news announcements are included as one of the determinants that may affect short selling. We also use CRSP to obtain statistics on daily stock and value-weighted NASDAQ market returns, numbers of shares traded, and trading volume.

From the universe of all NASDAQ stocks, we first select all ordinary common shares (CRSP share codes 10 or 11). We then eliminate stocks that do not have CRSP daily data available during the entire sample period, retaining 2,609 stocks. These stocks are matched to the Reg. SHO non-pilot securities and then to the stocks with available insider data. Only 2,151 non-pilot securities have "clean" insider sale records in the TFN data. Panel A of Table 1 contains descriptive characteristics of the full sample of insider sales; Panel B provides statistics on short sales.

An average stock has close to 21 days with insider sale activities during our 20-month (May 2005-December 2006) sample period, with an average of 3.67 insider sale transactions executed during an insider sale day (Panel A of Table 1). Insider sales are quite large, with a mean of 50,601 shares and a range from 100 to 4.5 million shares. Most often, only one insider sells during a given insider sale day, disposing of 25.02% of his holdings.<sup>16</sup>

Short sales, on the other hand, are considerably more frequent and have smaller sizes (Panel B of Table 1). Short selling occurs, on average, during 334 out of 421 trading days included in the sample. An average stock has 513 short sale transactions per trading day, with 70.76% of these transactions executed by non-market makers. An average short sale size is 328.53 shares, with market maker short sales being larger than those of non-market makers.

---

<sup>16</sup> The latter figure is computed from a reduced sample of insider transactions (78.84% of the main sample of 2,151 securities), for which the percentage of holdings being disposed of is available in the data.

Since our goal is to examine the possibility of information leakages related to insider sales, we carefully distinguish the effects of such leakages from the effects of other events that may convey firm- or insider activity-specific information. Such events include, for instance, insider sale reports as well as earnings and dividend announcements. Table 2 contains statistics on the periodicity of insider sales and their timing in relation to the aforementioned information events. Panel A shows that insider sales are reported, on average, within 1.9 trading days, suggesting compliance with the Sarbanes-Oxley Act. The average number of trading days between two consecutive insider sales is 34.69 (Panel B); whereas the average number of trading days between an insider sale and an earnings announcement that precedes (succeeds) the sale is 46 (23) (Panel C). The average number of trading days between an insider sale and a dividend distribution announcement that precedes (succeeds) the sale is 52 (54) (Panel D). Figures 1 and 2 provide graphic representations of the number of days separating insider sales and corporate announcements. In general, the data confirm the results of Bettis et al. (2000), showing that insiders honor the blackout periods, particularly previous to and on the day of corporate announcements. To isolate the informational effect of insider sales that is not contaminated by the presence of other corporate events, we exclude insider sale events that occur in close proximity to corporate announcements from our univariate analyses.

Finally, in Panel E, we show that 55.33% of all insider sales occur in sequences (clusters) that usually last for 4.89 days, with the longest cluster extending over 108 days. As such clusters are often comprised from sales by different insiders, we also compute the length of an average same-insider cluster. Same-insider clusters constitute about 78% of all clusters and usually extend over 3.5 days, with the longest same-insider cluster lasting 86 days.

Due to the Sarbanes-Oxley reporting requirement, insiders who anticipate a strong market reaction to the announcement of their trades may wish to limit executions to two-day windows. If this is the case, two-day insider clusters may have different information loads compared to longer clusters. Alternatively, if the size of an informed insider transaction is too large to be executed in under two days, insiders may attempt to sell a greater fraction of the total volume during the first two days. In Table 3 we examine the characteristics of same-insider clusters in detail. The results, however, tell a different story.<sup>17</sup> In particular, it appears that cluster length is directly proportional to the number of shares sold, with a total volume of 53,085 shares executed during a typical two-day cluster gradually increasing to 798,683 shares in the clusters that last longer than 5 days. In addition, differences in transacted portions are statistically insignificant in the 2- and 3-day clusters and sufficiently similar in the clusters of 4 days and longer. In summary, larger insider sales take more trading days to execute, and the transacted volumes are relatively evenly distributed among the execution days, implying that cluster lengths are determined at the outset of the transaction.

#### **4. Insider sales and abnormal short selling**

##### *4.1. Short and non-short activity*

To capture the investors' reaction to insider trading activities, we adopt an event study methodology similar to those of Lee, Ready, and Seguin (1994) and Corwin and Lipson (2000). In particular, we compute short and non-short activity statistics during a [-10; 10]-day event window that is centered around a standalone insider sale or around the first insider sale date in a same-insider cluster, day  $t$ . Event window statistics are then compared to those

---

<sup>17</sup> We investigate the informedness of clusters directly in Section 5.

computed during a control period that spans days  $t-20$  to  $t-11$ . An abnormal statistic for stock  $i$  is defined as:

$$100 \times [(Event\ Day\ Value_i - Mean\ Control\ Period\ Value_i) / Mean\ Control\ Period\ Value_i] \quad (1)$$

For the event study analysis, we first compute the abnormal number of non-short trades and non-short volume, respectively,  $atr$  and  $avol$ . Next, we separate short sales into those initiated by market makers and non-market makers and compute the following statistics for each group: abnormal number of short trades (volume),  $ashtr$  ( $ashvol$ ) and abnormal short trade (volume) ratios,  $ashtr$  ( $ashvol$ ). The latter are computed as ratios of the number of short and non-short trades (short and non-short volume) and adjusted according to equation (1).<sup>18</sup>

Table 4 contains the abnormal activity statistics on and about insider sale days. In Panel A, we partition the event window into three sub-periods: (i) ten days preceding the event day,  $t \in [-10; -1]$ , (ii) the event day  $t=0$ , and (iii) ten days following the event day,  $t \in [1; 10]$ . All event day statistics are positive and statistically significant. Generally, after a period of relatively low activity that extends over  $[-10; -1]$ -day window, both short and non-short selling increase on day  $t$ , with short selling increasing more substantially.<sup>19</sup> In particular, the number of MM short sales (short volume) increases by 36.67% (41.20%), the number of non-MM short sales (short volume) increases by 11.79% (10.38%), whereas the number of non-short trades (non-short volume) increases by 7.76% (2.08%) as compared to the control period. Since, on day  $t$ , the number of short trades (short volume) increases more than the

---

<sup>18</sup> The non-short trade (non-short volume) statistics are computed as the difference between (i) the total TAQ-reported number of trades (volume), (ii) the Reg. SHO-reported number of short trades (short volume), and (iii) TFN-reported number of insider trades (insider volume).

<sup>19</sup> Relatively low abnormal activity during the  $[-10; -1]$ - and  $[1; 10]$ -day windows is attributable, in part, to our measurement procedure. As mentioned in the previous section, the event window is restricted to insider sales that are not accompanied by major corporate announcements, whereas the control window is not restricted. Hence, responses to corporate events may moderately increase control statistics. Such an approach adds conservatism to our event window results.

number of non-short trades (volume), the abnormal short trade (volume) ratios are positive for MM and non-MM shorts.

Although non-MM short sales increase only by about one third of the MM short sales, economically the two activities are of comparable significance, as non-market maker short sales constitute about 70% of all shorts on a regular trading day (Table 1). Panel B provides the daily statistics for the event window. The data reveal that significant abnormal short selling by market makers extends into day  $t+1$ , perhaps as a result of continuing inventory management. Although present, positive abnormal short selling by non-market makers on days subsequent to day  $t$  is relatively low. In summary, the significant increase in the number of short and non-short trades as well as short and non-short volume on day  $t$  indicates that certain market participants learn about the insider events on the day the events occur and immediately act on this knowledge.

Next, we inquire whether short sellers react differently to the same-insider clusters. In Panel A of Table 5, we partition the 21-day event window into four sub-periods: (i) ten days preceding the first day of a cluster, (ii) the first day of a cluster, (iii) five days following the first day of a cluster, and (iv) five remaining days. We present daily statistics for the event day and the following five days and aggregate the statistics for the remaining two periods. All event day statistics with the exception of non-short volume and the non-MM short trade ratio are positive and statistically significant. Notably, economically significant abnormal MM short selling continues for at least three days following the first day in a cluster, whereas abnormal non-MM short selling continues for at least one day.

In Panel B of Table 5, we test the event study results for robustness to excluding insider sale events that are reported on the day of execution. The check is performed to

examine whether the abnormal activities that we observe on day  $t$  are caused by the insider sales that are immediately reported. Abnormal shorting remains significant after the same-day reports are taken out of consideration. Finally, Panel C contains the results of an additional robustness check, performed for a sample that includes the 4-month period from January to May 2005, during which reporting of the Reg. SHO mandated data was not enforced in its entirety. The results remain robust to this extension of the sample period.

#### *4.2. Return reaction to insider sales and insider sale announcements*

Thus far, the results show that market participants increase shorting activity on insider sale days and, in cases of same-insider sale clusters, continue opening short positions for several days following the event day. Whereas MMs may be opening short positions for the purposes of subsequent inventory management, non-market makers' likely goal is profitability. As short positions become profitable only if returns fall; we inquire what happens to returns subsequent to the insider sale days.

In Figure 3a, we show that market-adjusted returns begin to decline on the day after the event day, suggesting potential profitability of short positions. In addition, Figure 3b reveals that the market's reaction to insider sales occurs mainly on the announcement day, when market-adjusted returns decline by more than 1%. Thus, we conclude that the leakages are confined to a relatively small group of traders who are either unwilling or unable to affect market returns before the announcement day.

### 4.3. Determinants of Short Selling Activity

In the previous sub-section, we showed that short sellers are abnormally active on days of insider stock sales. This pattern is pronounced for both market maker and non-market maker short sales. Nevertheless, our univariate results do not allow us to directly conclude that insider selling is the only determinant of abnormal short selling activity. Separating the impact of insider sales from that of other factors that have an effect on short selling is important in the light of recent evidence documented by Diether et al. (2007).

For instance, according to Diether et al., daily short selling is positively related to daily returns. The return data in Figure 3a reveal that market-adjusted returns on insider sale days are positive, with the first negative return observed only on day  $t+1$ . Thus, it is imperative to disentangle the relationship between returns and short selling from that between insider selling and short selling.

The results of this analysis are presented in Table 6 that contains coefficient estimates from panel regressions with the number of non-MM short sales on days  $t$ ,  $t+1$ , and  $t+2$  as dependent variables.<sup>20</sup> Following Diether et al. (2007), we model daily short selling activity for each sample stock  $i$ , on each sample day  $t$ , as a function of a set of determinants that includes contemporaneous returns,  $ret_t$ ; lagged returns,  $ret_{[t-1; t-5]}$ ; lagged short selling activity expressed as the number of short trades,  $shtr_{[t-1; t-5]}$ , and lagged non-short activity expressed as the number of non-short trades,  $tr_{[t-1; t-5]}$ . We also control for non-short activity on day  $t$ ,  $tr_t$ , and for short sellers' reaction to corporate announcements via an indicator  $corp$  that is equal to 1, if the [-10; 10]-day window that surrounds day  $t$  contains a corporate news announcement and equal to 0 otherwise.

---

<sup>20</sup> We conduct a similar analysis of MM short sale determinants in the Table 7 that follows.

To isolate the effects of insider trading, we use the following vector of independent variables: (i) an indicator *ins*, in specification [1], [4] – [7], that equals to 1 on insider sale (in specification [7] – on insider purchase) days and equals to zero otherwise; (ii, iii) two interaction indicators *ins×clust\_2* and *ins×clust\_2+*, in specifications [4] through [6], computed by multiplying *ins* by 1, if an insider sale day begins, respectively, a two-day and a more than two-day same-insider cluster and by multiplying *ins* by 0 otherwise;<sup>21</sup> (iv, v) two indicator variables that capture the smallest and the largest quintiles of percentage insider holdings that are disposed of during the sale, respectively, *perc\_sold\_low* and *perc\_sold\_high*; and (vi, vii) two indicator variables that capture the smallest and the largest quintiles of the number of insiders executing on day *t*, respectively, *few\_insiders* and *mult\_insiders*. The models are adjusted, pursuant to a Hausman test, for stock and day fixed effects.

The results show that insider trading is a relevant and significant determinant of non-MM short selling. In particular, the coefficient on *ins* indicator in specification [1] suggests that an insider sale on day *t* increases non-market maker short selling by an average of 29 trades.<sup>22</sup> Thus, insider sale events cause increased short selling, even when other known determinants are controlled for.

Next, in specifications [2] and [3], we inquire whether non-MM short selling changes with certain characteristics of an insider sale that may not be directly observable from order flow. In particular, we suggest that short sellers who benefit from detailed information leakages may increase their activity on days when an insider is disposing of a large portion of

---

<sup>21</sup> Coefficients of the interaction indicators, if statistically significant, measure incremental effects of insider sale clusters on the main effect of the insider sale.

<sup>22</sup> Table 6 and the subsequent Table 7 provide coefficients estimated from models with the number of short trades as a dependent variable. In addition, we estimate a similar set of models, in which we replace the number of short trades with short volume. Qualitatively, the regression outcomes are similar, and we report only the former set of results.

his holdings or on days when several insiders execute simultaneously. The data, however, do not support this suggestion, as non-market makers' reaction to percentage of holdings sold is statistically trivial, whereas their reaction to the number of insiders transacting simultaneously is opposite to our expectations. In particular, non-MM short sellers open more positions on days when only one insider sells (upon review, *few\_insiders* indicator captures the days with only one active insider). Whereas this effect could be due to the fact that multiple insider days are relatively rare,<sup>23</sup> it could also be attributable to the market makers' concealment of the insider sale events that have a potential to significantly affect announcement day returns and, hence, create a need for market stabilization. We investigate the issue of returns as a function of leakages in the following section.

Specifications [4] through [6] shed light on non-MM short sellers' reaction to the same-insider clusters. Our initial discussion suggests that, if an insider anticipates a significant market response to his sale, he may attempt to execute the entire sale in fewer than two days, before the sale has to be publicly reported. The results on the distribution of shares sold during same-insider clusters of different lengths (Table 3) introduces an amendment to this initial suggestion, implying (although indirectly) that even the two-day clusters may be, largely, uninformed. Putting this result together with the balancing act hypothesis, we anticipate that the most informed one-day insider sales will be concealed by MMs, whereas the less informed clustered sales will be leaked. In summary, we expect that non-MM short sellers who have access to leaked information would mostly react to the less informed insider sale clusters.

---

<sup>23</sup> The relative rarity of the multiple insider trade events does not prevent the *mult\_insider* indicator from being significant in the MM short selling model presented in Table 7.

The regression results confirm this expectation, with the coefficient of the  $ins \times clust\_2+$  indicator in specification [4] suggesting that the most significant increases in non-MM short selling accompany the first days of the longer clusters. In particular, non-market makers execute about 130 more short sales on the first day of a longer cluster than on an average day. Two-day clusters are also accompanied by a number of abnormal short trades, although the effect is twice as small as that observed for the longer clusters. Most importantly, one-day insider sales are not accompanied by a significant increase in non-MM shorting. This result is consistent with the notion of leakages being limited to the less informed insider sales.

Next, we inquire whether non-MM short selling activates on days subsequent to the day of the insider sale. If information leakages take time to reach non-MM short sellers, we may observe an increased reaction to insider sales during the days following the sale. In specification [5], we use non-MM short sales on day  $t+1$  as the dependent variable to test this suggestion. The results are qualitatively similar to those in specification [4], confirming our previous conclusions. In specification [6], we run a similar analysis for non-MM short selling during the second day after the event day. Since, on day  $t+2$ , some of the insider sales will have been publicized via the SEC web-site, an observed increase in short selling, represented by a positive coefficient on the  $ins$  indicator may not be suggestive of leakages, but rather of learning from the SEC reports. In specification [7], we conduct an analysis of insider purchases, and observe that non-MM short sellers seem to be aware about the incidence of purchases. Although consistent with our suggestion that leakages exist, the latter finding does not disprove our conclusion that non-MM short sellers only obtain limited information about those insider sales that have potential to move the market.

When it comes to short selling determinants not related to insider trades, the estimated coefficients generally confirm expectations and corroborate the results of the extant studies. In particular, similar to the findings in Diether et al. (2007), short selling by non-market makers increases on days of positive returns, as well as after periods of positive returns that last for several days. Short selling on day  $t$  also positively depends on short selling during days  $t-5$  to  $t-1$ . Short selling increases with contemporaneous volume and decreases with lagged volume. Corporate news announcements are associated with an increase in non-MM short selling.

In Table 7, we conduct an analysis of market maker short selling similar to that in the previous table. The coefficient on the *ins* indicator, in specification [1], suggests that MMs execute about 106 more trades on their own account on an insider sale day than on an average day. Specifications [2] and [3] reveal that market maker short selling is positively related to the percentage of holdings being disposed of and to the number of insiders that trade on the same day. This finding is consistent with our earlier suggestion that market makers' inventory management will be more active concurrent with the more informed insider sales. Finally, the coefficient of the *ins* indicator in specification [7] is negative, consistent with lower shorting on days of insider purchases.

Market makers' behaviour with respect to clusters is drastically opposite to that of non-market makers. In particular, specification [4] suggests that market makers extensively open new short positions concurrent with the one-day insider sales; however, their abnormal shorting is negative on the first days of insider sale clusters. This result is consistent with our earlier suggestion that the clusters are less informative than the one-day insider sales and that their announcements do not require extensive market stabilization. This result remains

unchanged in specifications [5] and [6], in which we model MM short selling on days  $t+1$  and  $t+2$ .

Market maker short selling also differs from non-MM short selling in a sense that the former are less active around corporate announcements and mostly open new positions on days of negative returns and after periods of negative returns. In addition, MM short selling positively depends on its own lagged values and contemporaneous volume. Finally, market makers open fewer positions following sequences of high volume days.

In summary, market maker and non-market maker short selling activities around insider sale days are notably different. Whereas market makers extensively open new positions concurrently with standalone insider sales, active short selling by non-market makers is detected only during the less informed insider sale clusters. Notably, market makers ignore insider sale clusters. Non-market makers do not react to the specifics of insider sales such as the percentage of holdings sold and the number of insiders executing simultaneously. Meanwhile, these two factors significantly affect MM positions, leading us to conclude that non-MMs do not receive full information on the insider sale specifics. Such behaviour is consistent with market makers' attempts to balance their market stabilization obligations with the need to reward preferred clients. In the following section, we explore the issue of returns and market stabilization in detail.

## **5. Insider sales, short sales, and returns**

In the previous sections, we showed that a select group of non-market makers receives timely tips on the occurrence of insider sales and attempts to use this information for profit, by opening short positions. Profitability is achieved if, following an insider sale, the stock price

decline is sufficient to cover the costs of opening, maintaining, and covering the positions. Figures 3a and 3b confirm that, on average, stock prices decline following insider sales, with most of the decline occurring on the announcement days. Nevertheless, since our data do not include information on short covering, we are only able to draw conclusions about *potential* profitability of short positions instead of directly estimating the profitability of these trades. In this section, we explore how successful non-MM short sellers are at exploiting leakages. In addition, we seek to confirm our hypothesis of lower informedness of insider clusters.

In Table 8, we provide the results from a series of models of returns similar to those in Diether et al. (2007), with market-adjusted returns on the insider sale day,  $ret$ ; returns on the report day,  $ret_{rep}$ ; cumulative returns between day  $t+1$  and the report day,  $ret_{cum\_rep}$ ; and cumulative returns over 10 days following the insider sale day,  $ret_{t+10}$ , as dependent variables. The following set of independent variables is used: (i) the number of market maker short sales (short volume) executed on insider sale day,  $mm_t$ ; (ii) the number of non-market maker short sales (short volume) executed on insider sale day,  $nmm_t$ ; (iii) an indicator variable that is equal to 1, if an insider sale begins a two-day cluster,  $cluster\_2$ ; (iv) an indicator variable equal to 1, if the insider sale day begins a cluster that is longer than two days,  $cluster\_2+$ ; (v) an indicator variable equal to 1, if the [-10; 10]-day window that surrounds the insider sale day contains a corporate news announcement, and equal to 0 if it does not contain such an announcement,  $corp$ ; (vi, vii) contemporaneous and lagged market-adjusted returns, respectively,  $ret_t$  and  $ret_{[t-1; t-5]}$ ; (viii, ix) contemporaneous and lagged numbers of non-short trades or non-short volume on day  $t$ , respectively,  $tr_t$  or  $vol_t$  and  $tr_{[t-1; t-5]}$  or  $vol_{[t-1; t-5]}$ ; (x, xi) lagged numbers of short sales or short volume,  $shtr_{[t-1; t-5]}$  or  $shvol_{[t-1; t-5]}$ . Models for each of

the four dependent variables are estimated twice: once with the number of trades,  $tr$ , in all the relevant independent variables and the second time – with volume,  $vol$ .

Overall, the results corroborate our earlier suggestions and provide additional evidence on the quality of information leaked to non-market makers. The intercepts in specifications [1] and [2] confirm that insiders time their sales to days of positive returns. Specifications [3] and [4] contain a similar analysis for the returns on the insider sale report days. The intercept is negative, suggesting an overall negative return reaction to the reports close to -1.1%. The associations between the report day returns and day  $t$  MM and non-MM short selling are both positive. This result is suggestive of successful price stabilizing activities by market makers and imperfect information sets of non-market makers. In other words, by opening short positions on the insider sale days, market makers enhance their ability to absorb negative order imbalances on the announcement days; whereas, consistent with the balancing act suggestion, non-MMs open more positions concurrently with the less informed insider sales, resulting in less significant announcement day price drops subsequent to active non-MM short selling on day  $t$ . Overall, non-market makers are, likely, making profits on their positions because of the significant pervasive return declines on report days reflected in the intercepts. Although statistically significant, the positive coefficients of  $nmm$  variables are relatively small economically and, therefore, do not significantly undermine our conclusion on potential profitability of non-MM short positions.

In specifications [5] and [6], we inquire whether cumulative event-report returns,  $ret_{cum\_ret}$ , and the set of independent variables have associations different from those identified for the report day returns. Such a suggestion is warranted, considering that leakages may disseminate to different groups of market participants with varying speeds. Although most

independent variables retain their signs from specifications [3] and [4], the *cluster* indicators acquire significantly positive signs, suggesting that returns may continue to rise temporarily following the first trading day in a cluster as compared to the standalone sales. Finally, specifications [7] and [8] contain the determinants of ten-day cumulative returns,  $ret_{t+10}$ , that follow an insider sale day. Qualitatively, the coefficients in these specifications match those in specifications [5] and [6].

Overall, the results suggest that (i) the negative returns that accompany insider sale announcements may be somewhat moderated by the price-stabilizing activities of market makers and that (ii) non-market makers, although informed about the occurrence of insider sales, are, generally, unable to foresee the most negative returns. In addition, the fact that an insider sale belongs to a cluster, mitigates the negative effect on returns, especially over the period of 10 days following the first sale.

## **6. Conclusion**

This study provides new evidence on information leakages in financial markets. We document considerable increases in short selling by a select group of market participants on days when company insiders sell their stock. These market participants include both market makers and non-market makers. The abnormal short selling often occurs before insider activities are officially reported to the public and before insiders have completed selling.

While previous research (e.g., Geczy and Yan, 2006) has provided evidence of abnormal market-wide quoting activities on insider sale days and attempted to link these activities to information leakages, we show that about one half of the abnormal short volume on insider sale days is attributable to inventory management carried out by market makers.

The remainder of abnormal short selling is, however, ascribed to market participants who should not have early access to the information about the incidence of insider activities, unless the information is leaked to them.

While non-MMs are aware of the incidence of insider sales and open new short positions that have profit potential, they do not appear to be knowledgeable about those insider sale characteristics that may increase profitability of the short positions. In particular, non-MMs' response to insider sales is not consistent with their knowledge of (i) the number of insiders selling on a given day, (ii) the percentage of insider holdings sold, and (iii) the duration of the sale. At the same time, market makers' actions are consistent with the knowledge of these insider sale specifics. Non-MM short positions are, likely, profitable, due to consistent return declines that follow insider sales; although non-MMs are not able to foresee the most negative returns. Overall, although information about insider sales consistently leaks to certain market participants, leakages are more evident for insider sales that are less likely to be informationally motivated.

We discuss the various possible channels of information transfer and argue that selective leakages, most likely, originate from the executing market makers who wish to reward their preferred clients. We suggest that selective disclosure is a rational decision by MMs for the following reason. Disclosing the most informed sales may accelerate price declines, thereby requiring earlier and greater price stabilization efforts from the MMs. Meanwhile, active opening of non-MM short positions triggered by the leakage may complicate opening of similar positions by the market makers. Thus, the picture that emerges is of a balancing act by MMs – they leak insider sale information, but exclude the most informed insider sales.

## References

Benveniste, L. and P. Spindt, 1989, How investment bankers determine the offer price and allocation of initial public offerings, *Journal of Financial Economics* 24, 343-362.

Bettis, J., J. Coles, and M. Lemmon, 2000, Corporate policies restricting trading by insiders, *Journal of Financial Economics* 57, 191-220.

Boehmer E., C.M. Jones, and X. Zhang, 2008, Which shorts are informed? *Journal of Finance* 63, 491-527.

Corwin, S. and M. Lipson, 2000, Order flow and liquidity around NYSE trading halts, *Journal of Finance* 55, 1771-1801.

Christophe, S., M., Ferri, and J. Angel, 2004, Short-selling prior to earnings announcements, *Journal of Finance* 59, 1845-1875.

Damodaran, A. and C. Liu, 1993, Insider trading as a signal of private information, *Review of Financial Studies* 6, 79-119.

Daske, H., S. Richardson, and I. Tuna, 2005, Do short sale transactions precede bad news events? Working paper, University of Frankfurt.

Dechow, P., A. Hutton, L. Meulbroek, and R. Sloan, 2001, Short-sellers, fundamental analysis, and stock returns, *Journal of Financial Economics* 61, 77-106.

Desai, H., K. Ramesh, S. Thiagarajan, and B. Balachandran, 2002, An investigation of the informational role of short interest in the Nasdaq market, *Journal of Finance* 57, 2263-2287.

Diamond, D. and R. Verrecchia, 1987, Constraints on short-selling and asset price adjustment to private information, *Journal of Financial Economics* 18, 277-311.

Diether, K., K.-H. Lee, and I. Werner, 2007, Short-sale strategies and return predictability, *Review of Financial Studies*, forthcoming.

Fama, E. and K. French, 1992, The cross-section of expected stock returns, *Journal of Finance* 46, 427-466.

Geczy, C. and J. Yan, 2007, Who are the beneficiaries when insiders trade? An examination of piggybacking in the brokerage industry, Working Paper, University of Pennsylvania.

Heidle, H. and X. Li, 2004, Information leakage and opportunistic behavior before analyst recommendations: An analysis of the quoting behavior of Nasdaq market makers, Working Paper, University of Notre Dame.

Huddart, S., B. Ke, and C. Shi, 2007, Jeopardy, non-public information, and insider trading around SEC 10-K and 10-Q filings, *Journal of Accounting and Economics* 43, 3-36.

Irvine P., M. Lipson, and A. Puckett, 2007, Tipping, *Review of Financial Studies* 20, 741-768.  
Jaffe, J., 1974, Special information and insider trading, *Journal of Business* 47, 410-428.

Ke, B., S. Huddart, and K. Petroni, 2003, What insiders know about future earnings and how they use it: Evidence from insider trades, *Journal of Accounting and Economics* 35, 315-346.

Lakonishok, J. and Lee, I., 2001, Are insider trades informative? *Review of Financial Studies* 14, 79-111.

Lee, Charles M. C., Mark J. Ready, and Paul J. Seguin, 1994, Volume, volatility, and New York Stock Exchange trading halts, *Journal of Finance* 49, 183-214.

Lin, J.-C. and J. Howe, 1990, Insider trading in the OTC market, *Journal of Finance* 45, 1273-1284.

Mac, C., 2003, The effects of Regulation Fair Disclosure on information leakage, Working Paper, Columbia University.

Piotroski, J. and D. Roulstone, 2005, Do insider trades reflect both contrarian beliefs and superior knowledge about future cash flow realizations? *Journal of Accounting and Economics* 39, 55-81.

Rozeff, M. and M. Zaman, 1988, Market efficiency and insider trading: New evidence, *Journal of Business* 61, 25-44.

Rozeff, M. and M. Zaman, 1998, Overreaction and insider trading: Evidence from growth and value portfolios, *Journal of Finance* 53, 701-716.

Scannell, K. and R. Smith, 2007, SEC Boosts probe for Wall Street Leaks, *The Wall Street Journal*.

Seyhun, H. N., 1986, Insiders' profits, costs of trading, and market efficiency, *Journal of Financial Economics* 16, 189-212.

Scott, J. and H. Xu, 2004, Some Insider sales are positive, *Financial Analysts Journal* 60, 44-51.

**Table 1**  
**Sample statistics**

Presented are summary statistics on insider sales (Panel A) and short sales (Panel B), executed during the sample period. For stocks with insider sales, we compute the following statistics: the number (#) of *insider days per stock* during the sample period - this figure represents the number of days with reported insider sales; the number (#) of *transactions per stock-day* - the number of insider sales on an insider trading day; the number (#) of *insiders per stock-day* - the number of insiders who sell on an insider trading day; *trade size* - the average number of shares that change hands during an insider sale; percentage (%) of *holdings traded* - the share of insider's holdings of the company stock that changes hands as a result of an insider sale. The latter statistic is estimated from a reduced sample of sales, 78.84% of the original sample, due to partial data availability. In Panel B, we provide similar statistics for short sales. The number of short sellers per trading day and the percentage of holdings sold short cannot be estimated due to the absence of a seller identifier in the short sale data. Here and further in the manuscript, we omit Reg. SHO pilot stocks. Short sales are separated into market maker and non-market maker sales.

|  | Mean   | St. dev. | Min | 25%   | 50%    | 75%    | Max    |
|--|--------|----------|-----|-------|--------|--------|--------|
| <i>Panel A: Insider sales</i>          |        |          |     |       |        |        |        |
| <i># of insider days per stock</i>     | 20.95  | 27.05    | 1   | 4     | 12     | 27     | 308    |
| <i># of transactions per stock-day</i> | 3.67   | 6.02     | 1   | 1     | 2      | 4      | 156    |
| <i># of insiders per stock-day</i>     | 1.22   | 0.51     | 1   | 1     | 1      | 1      | 8      |
| <i>Trade size, shares</i>              | 50,601 | 200,146  | 100 | 5,817 | 14,511 | 34,057 | 4.5M   |
| <i>% holdings traded (on 78.84%)</i>   | 25.02  | 19.89    | 0   | 9.64  | 20.12  | 36.00  | 99.53  |
| <i>Panel B: Short sales</i>            |        |          |     |       |        |        |        |
| <i># of days per stock</i>             | 333.71 | 128.31   | 1   | 264   | 417    | 421    | 421    |
| <i># of transactions per stock-day</i> | 513.00 | 1,622.75 | 1   | 16    | 99     | 416    | 35,150 |
| - non-market maker                     | 363.11 | 1,209.54 | 1   | 12    | 70     | 283    | 29,781 |
| - market maker                         | 153.26 | 483.92   | 1   | 7     | 30     | 113    | 11,244 |
| <i>Trade size, shares</i>              | 328.53 | 259.76   | 100 | 191   | 246    | 354    | 3,678  |
| - non-market maker                     | 309.41 | 266.64   | 100 | 182   | 226    | 319    | 3,441  |
| - market maker                         | 428.29 | 299.76   | 100 | 258   | 343    | 478    | 3,872  |

**Table 2**  
**Periodicity of insider sales**

The table contains summary statistics on the number of calendar and trading days between insider sale days and report days (Panel A) and adjacent sales (Panel B). We also compute the number of days between the earnings announcements and the closest preceding, *pre*, or following, *post*, insider sales (Panel C) as well as the number of days between the dividend announcements and the closest preceding, *pre*, or following, *post*, insider sales (Panel D). Finally, we estimate the length (in consecutive trading days) of insider sale clusters and of insider trade clusters that involve the same insider (Panel E).

|  |                             | Mean  | St. dev. | Min | 25% | 50% | 75% | Max |
|--|-----------------------------|-------|----------|-----|-----|-----|-----|-----|
| <i>Panel A: Days between insider sales and sale report days</i>                          |                             |       |          |     |     |     |     |     |
| <i>Calendar</i>  |                             | 2.63  | 3.04     | 0   | 2   | 2   | 3   | 58  |
| <i>Trading</i>   |                             | 1.90  | 2.51     | 0   | 1   | 2   | 2   | 42  |
| <i>Panel B: Days between consecutive insider sales</i>                                   |                             |       |          |     |     |     |     |     |
| <i>Calendar</i>  |                             | 48.55 | 66.05    | 1   | 15  | 27  | 55  | -   |
| <i>Trading</i>   |                             | 34.69 | 47.17    | 1   | 11  | 19  | 40  | -   |
| <i>Panel C: Days between insider sales and earnings announcements</i>                    |                             |       |          |     |     |     |     |     |
| <i>Calendar</i>  | <i>Pre</i>                  | 64.91 | 25.09    | 1   | 53  | 64  | 73  | 579 |
|  | <i>Post</i>                 | 31.90 | 16.15    | 1   | 21  | 30  | 41  | 190 |
| <i>Trading</i>   | <i>Pre</i>                  | 46.35 | 17.93    | 1   | 38  | 46  | 52  | 414 |
|  | <i>Post</i>                 | 22.81 | 11.54    | 1   | 15  | 21  | 29  | 136 |
| <i>Panel D: Days between insider sales and dividend announcements</i>                    |                             |       |          |     |     |     |     |     |
| <i>Calendar</i>  | <i>Pre</i>                  | 73.15 | 64.55    | 2   | 40  | 56  | 75  | 522 |
|  | <i>Post</i>                 | 75.39 | 86.50    | 1   | 34  | 49  | 71  | 737 |
| <i>Trading</i>   | <i>Pre</i>                  | 52.24 | 46.10    | 2   | 29  | 40  | 54  | 373 |
|  | <i>Post</i>                 | 53.85 | 61.76    | 1   | 24  | 35  | 51  | 526 |
| <i>Panel E: Insider sale cluster length, # of days (55.33% of all insider sale days)</i> |                             |       |          |     |     |     |     |     |
| <i>All clusters</i>  |                             | 4.89  | 5.71     | 2   | 2   | 3   | 6   | 108 |
| <i>Same insider</i>  |                             | 3.52  | 4.01     | 2   | 2   | 2   | 4   | 86  |
|  | <i>(78.19% of clusters)</i> |       |          |     |     |     |     |     |

**Table 3**  
**Distribution of shares sold in same-insider clusters**

The table contains proportions of total shares sold by the same insider during the days that belong to a same-insider cluster. We report such distributions for the same-insider clusters with lengths of 1 to 5 days, with clusters of more than 5 days aggregated into the 5+ category. *p*-Values indicate the results of *F* tests for significance of differences among the reported proportions. In addition, the table reports the percentage of same-cluster events and an average [median] overall transaction size in each category.

| Day                              | Cluster length, days |          |          |          |          |             |
|----------------------------------|----------------------|----------|----------|----------|----------|-------------|
|                                  | non-cluster          | 2        | 3        | 4        | 5        | 5+          |
| 1                                | 1.000                | 0.499    | 0.330    | 0.261    | 0.232    | 0.125       |
| 2                                |                      | 0.501    | 0.340    | 0.227    | 0.216    | 0.125       |
| 3                                |                      |          | 0.330    | 0.252    | 0.163    | 0.124       |
| 4                                |                      |          |          | 0.260    | 0.182    | 0.116       |
| 5                                |                      |          |          |          | 0.207    | 0.119       |
| cumulative 5+                    |                      |          |          |          |          | 0.391       |
| # of shares sold                 | 27,979               | 53,085   | 89,109   | 116,432  | 116,177  | 798,683     |
|                                  | [11,116]             | [20,000] | [35,900] | [43,156] | [50,350] | [1,681,000] |
| % of events                      | 0.567                | 0.253    | 0.068    | 0.043    | 0.024    | 0.044       |
| <i>F</i> test ( <i>p</i> -value) | N/A                  | 0.831    | 0.632    | 0.011    | 0.000    | 0.001       |

**Table 4**

**Abnormal trading activity around insider sales: An event study**

The table reports trends in short and non-short trading activity during a 21-day trading window, centered on an insider stock sale date. Panel A aggregates abnormal activity measures into the following three windows: (i) ten days to one day before the insider sale day; (ii) insider sale day; and (iii) one day to ten days after the insider sale day. Panel B contains statistics similar to those in Panel A, but without aggregation. We use the following abnormal activity measures: abnormal number of non-short trades, *atr*; abnormal non-short volume, *avol*; abnormal number of short trades, *ashtr*; abnormal short ratio, *ashtr*, defined as an abnormal ratio of short to non-short trades; abnormal short volume, *ashvol*; and abnormal short volume ratio, *ashvol*, defined as an abnormal ratio of short to non-short volume. Short activity measures are divided into market maker and non-market maker. All abnormal statistics are computed as  $100 * [(Event\ Day\ Value_i - Mean\ Control\ Value_i) / Mean\ Control\ Value_i]$ , where the event window extends from ten days before an insider sale day (days  $t-10$  to  $t-1$ ) to ten days after (days  $t+1$  to  $t+10$ ) the insider sale day. The control period spans ten trading days before the event window, i.e., days  $t-20$  to  $t-11$ . Asterisks \*\*\*, \*\*, and \* indicate statistical significance at the 1, 5, and 10% levels.

|  | Non-short  |             | Market maker short |              |               |               | Non-market maker short |              |               |               |
|--|------------|-------------|--------------------|--------------|---------------|---------------|------------------------|--------------|---------------|---------------|
|  | <i>atr</i> | <i>avol</i> | <i>ashtr</i>       | <i>ashtr</i> | <i>ashvol</i> | <i>ashvol</i> | <i>ashtr</i>           | <i>ashtr</i> | <i>ashvol</i> | <i>ashvol</i> |
| <b>Panel A: Abnormal shorting and non-shorting activities around insider sales</b>   |            |             |                    |              |               |               |                        |              |               |               |
| [-10; -1]  | -4.07***   | -5.43***    | -3.02**            | -3.10**      | -5.24***      | -6.56***      | -2.92***               | -1.20        | -6.10***      | -5.17***      |
| 0  | 7.76***    | 2.08***     | 36.67***           | 21.37***     | 41.20***      | 29.35***      | 11.79***               | 1.22**       | 10.38***      | 5.50***       |
| [1; 10]  | -3.91**    | -5.30***    | 1.37               | 1.72         | -1.18         | -2.13*        | 0.11                   | 3.04***      | -4.26***      | -1.77*        |
| <b>Panel B: Abnormal non-short and short activities around insider sales, by day</b> |            |             |                    |              |               |               |                        |              |               |               |
| -10  | -2.54***   | -4.23***    | -5.89***           | -7.94***     | -5.86***      | -9.06***      | -3.87***               | -4.75***     | -6.36***      | -8.24***      |
| -9   | -1.09**    | -2.71***    | -2.32***           | -5.91***     | -2.20**       | -7.43***      | -2.03***               | -4.33***     | -4.47***      | -7.68***      |
| -8   | -0.27      | -1.25**     | -0.56              | -3.62***     | -2.24**       | -7.67***      | -0.67                  | -3.06***     | -2.51***      | -5.99***      |
| -7   | -2.80***   | -4.63***    | -1.79*             | -3.52***     | -3.61***      | -6.33***      | -2.45***               | -2.40***     | -5.49***      | -5.65***      |
| -6   | -4.48***   | -5.57***    | -5.18***           | -4.05***     | -6.49***      | -7.00***      | -3.33***               | -1.38***     | -6.08***      | -4.79***      |
| -5   | -4.49***   | -6.02***    | -1.22              | -1.28        | -4.20***      | -5.24***      | -3.26***               | -0.72        | -7.33***      | -4.87***      |
| -4   | -4.28***   | -7.09***    | -3.22***           | -1.98**      | -5.24***      | -5.64***      | -3.98***               | -0.67        | -7.19***      | -4.67***      |
| -3   | -4.50***   | -7.42***    | -2.30**            | -0.05        | -5.03***      | -3.88***      | -4.04***               | 0.06         | -7.42***      | -3.95***      |
| -2   | -5.13***   | -7.10**     | -3.71***           | -1.47        | -6.29***      | -5.35***      | -2.78***               | 1.19**       | -6.81***      | -3.77***      |
| -1   | -6.26***   | -8.27***    | -7.62***           | -3.98***     | -11.20***     | -8.02***      | -3.50***               | 2.77***      | -7.30***      | -2.07***      |
| 0  | 7.76***    | 2.08***     | 36.67***           | 21.37***     | 41.20***      | 29.35***      | 11.79***               | 1.22**       | 10.38***      | 5.50***       |
| 1  | -0.48      | 1.04        | 10.67***           | 8.57***      | 10.24***      | 6.56***       | 2.64***                | 3.14***      | -0.01         | -3.13***      |
| 2  | -3.57***   | -3.62***    | 3.01***            | 3.75***      | 0.32          | -1.56*        | 1.87***                | 3.53***      | -1.83***      | -1.93***      |
| 3  | -5.01***   | -6.74***    | 0.69               | 2.29**       | -1.29         | -0.44         | -0.36***               | 3.57***      | -4.09***      | -0.55         |
| 4  | -4.86***   | -6.39***    | -1.35              | 1.71*        | -3.56***      | -2.12**       | -0.10                  | 3.80***      | -5.01***      | -1.55***      |
| 5  | -5.35***   | -6.91***    | -0.95              | 0.74         | -3.96***      | -3.16***      | -1.76***               | 2.03***      | -6.19***      | -2.45***      |
| 6  | -5.26***   | -7.15***    | -1.52              | -0.20        | -4.47***      | -3.94**       | -0.31                  | 3.36***      | -5.72***      | -1.45**       |
| 7  | -6.57***   | -8.60***    | -0.87              | 2.56***      | -5.32***      | -0.95         | -1.31**                | 3.51***      | -6.47***      | -1.92***      |
| 8  | -5.40***   | -6.94***    | -1.64              | -0.70        | -4.68***      | -4.66***      | 0.38                   | 3.76***      | -5.11***      | -1.60***      |
| 9  | -4.29***   | -6.60***    | 0.14               | 0.56         | -1.66         | -1.23         | 0.52                   | 2.40***      | -3.68***      | -1.03         |
| 10   | 1.25***    | -0.11       | 1.94*              | 1.01         | -1.41         | -3.30***      | 0.50                   | 1.74***      | -4.47***      | -3.64***      |

**Table 5**

**Abnormal short selling around same-insider clusters**

The table reports on the trends in trading activity during a 21-day trading window, centered on an insider stock sale date. Panel A reports abnormal statistics identified in Table 4 for a sub-sample of same-insider sale clusters. We aggregate the daily results into the following four periods: (i) a pre-sale period, (ii) the sale date, (iii) the partial 5-day post-sale period, and (iv) the remainder of the post-sale period. The sale-day and the 5-day post-sale period statistics are reported on a daily basis, whereas pre-sale and the remainder of the post-sale period statistics are aggregated. Panels B and C aggregate abnormal activity measures into the following three windows: (i) ten days to one day before the sale day; (ii) sale day; and (iii) one day to ten days after the sale day. Panel B reports aggregate results only for the insider sales that are not reported on the day of the sale. Panel C adds the three-month period from January 2005 till May 2005, during which reporting requirements for exempt and non-exempt short sales were not strictly enforced, to the main sample period. We use the following abnormal activity measures: abnormal number of non-short trades, *atr*; abnormal non-short volume, *avol*; abnormal number of short trades, *ashtr*; abnormal relative short ratio, *relshtr*, defined as an abnormal ratio of short to non-short trades; abnormal short volume, *ashvol*; and abnormal short volume ratio, *ashvol*, defined as an abnormal ratio of short to non-short volume. Short activity statistics are separated into those of market makers and non-market makers. All abnormal statistics are computed as  $100 * [(Event\ Day\ Value_i - Mean\ Control\ Value_i) / Mean\ Control\ Value_i]$ , where the event window extends from ten days before an insider sale day (days  $t-10$  to  $t-1$ ) to ten days after (days  $t+1$  to  $t+10$ ) the insider sale day. The control period spans ten trading days before the event window, i.e., days  $t-20$  to  $t-11$ . Asterisks \*\*\*, \*\*, and \* indicate statistical significance at the 1, 5, and 10% levels.

|  | Non-short  |             | Market maker |              |               |               | Non-market maker |              |               |               |
|--|------------|-------------|--------------|--------------|---------------|---------------|------------------|--------------|---------------|---------------|
|  | <i>atr</i> | <i>avol</i> | <i>ashtr</i> | <i>ashtr</i> | <i>ashvol</i> | <i>ashvol</i> | <i>ashtr</i>     | <i>ashtr</i> | <i>ashvol</i> | <i>ashvol</i> |
| <b>Panel A: Abnormal shorting and non-shorting activities around insider sales, same-insider clusters only</b>     |            |             |              |              |               |               |                  |              |               |               |
| [-10; -1]  | -3.38**    | -4.50***    | -2.00        | -2.36**      | -3.35*        | -5.31***      | -2.04**          | -0.74        | -5.12***      | -4.22***      |
| 0  | 8.61***    | -0.44       | 43.94***     | 33.38***     | 40.76***      | 40.05***      | 11.53***         | 0.85         | 10.74***      | 8.95***       |
| 1  | 7.41***    | 0.64        | 46.78***     | 37.39***     | 43.16***      | 43.88***      | 7.40***          | 0.38         | 9.51***       | 11.01***      |
| 2  | 1.64       | -2.72**     | 17.80***     | 14.09***     | 11.50***      | 10.08***      | 4.64***          | 1.19         | 0.11          | -0.66         |
| 3  | 0.35       | -3.08***    | 6.99***      | 7.89***      | 7.88***       | 8.64***       | 1.81             | 1.26         | 0.24          | 1.52          |
| 4  | -0.71      | -3.06***    | 7.51***      | 5.29**       | 4.82*         | 3.24          | 1.41             | 2.00         | -2.78*        | -0.83         |
| 5  | -2.27      | -1.87       | 3.26         | 2.96         | 2.29          | -1.54         | 1.00             | 1.32         | -2.97*        | -3.08**       |
| [6; 10]  | 0.52       | -1.75       | 4.78***      | 1.69         | 1.41          | -1.30         | 0.94             | 2.13*        | -0.86         | 1.45          |
| <b>Panel B: Abnormal shorting and non-shorting activities around insider sales, same-day reports excluded</b>      |            |             |              |              |               |               |                  |              |               |               |
| [-10; -1]  | -4.13***   | -5.35***    | -2.74**      | -2.88**      | -4.91***      | -6.48***      | -2.95***         | -1.29        | -6.18***      | -5.17***      |
| 0  | 7.31***    | 1.73***     | 37.78***     | 22.67***     | 42.00***      | 30.34***      | 11.79***         | 1.02*        | 10.06***      | 5.62***       |
| [1; 10]  | -3.95***   | -5.25***    | 1.68         | 2.18*        | -0.87         | -0.83         | 0.12             | -3.13***     | -4.26***      | -1.58*        |
| <b>Panel C: Abnormal shorting and non-shorting activities around insider sales, January 2005-May 2005 included</b> |            |             |              |              |               |               |                  |              |               |               |
| [-10; -1]  | -3.50**    | -4.88***    | 3.31**       | -3.25***     | -5.38***      | -6.46***      | -3.07***         | -0.99        | -6.07***      | -4.58***      |
| 0  | 7.08***    | 2.60***     | 34.59***     | 20.60***     | 39.38***      | 29.06***      | 11.79***         | 1.49***      | 10.74***      | 6.48***       |
| [1; 10]  | -4.03**    | -5.76***    | -0.43        | 1.29         | -2.96**       | -1.97*        | -0.50            | 2.96***      | -4.79***      | -1.51*        |

**Table 6**  
**Non-Market Maker Short Sale Determinants**

The table contains coefficient estimates from several specifications of the model of daily non-MM short selling. Shorting activity by non-market makers is measured as the number of short trades in stock  $i$  on day  $t$ . The model is estimated for days of insider sales, day  $t$ , *non-MM sales<sub>t</sub>*; as well as on days  $t+1$  and  $t+2$ , respectively, *non-MM sales<sub>t+1</sub>* and *non-MM sales<sub>t+2</sub>*. In addition, we estimate a control specification for days of insider purchases, *non-MM purch<sub>t</sub>*. The vector of regressors includes (i) an indicator that equals to 1 on insider trading days, *ins*; (ii, iii) interaction indicators that equal to 1 if an insider sale day begins a two-day or more than a two-day same-insider cluster, respectively, *ins*×*cluster\_2* and *ins*×*cluster\_2+*; (iv, v) two indicators that capture the smallest and the largest quintiles of percentage insider holdings that change hands during an insider transaction, *perc\_sold\_low* and *perc\_sold\_high*; (vi, vii) two indicators that capture the smallest and the largest quintiles of the number of insiders executing on an event day, *mult\_ins* and *few\_ins*; (viii) an indicator variable that has a value of 1 if a corporate event occurs in the [-10; 10]-day period surrounding an insider sale, *corp*; (ix, x) contemporaneous return, *ret*, and return lagged over one-to-five days, *ret*<sub>[t-1; t-5]</sub>; (xi) lagged short volume, *shtr*<sub>[t-1; t-5]</sub>, and (xii, xiii) contemporaneous and lagged trading volumes, *tr<sub>t</sub>*, *tr*<sub>[t-1; t-5]</sub>. The models are adjusted, pursuant to a Hausman test, for stock and day fixed effects. *p*-Values are in parentheses.

|                                   | <i>non-MM sales<sub>t</sub></i> |                      |                      |                      | <i>non-MM sales<sub>t+1</sub></i> | <i>non-MM sales<sub>t+2</sub></i> | <i>non-MM purch<sub>t</sub></i> |
|-----------------------------------|---------------------------------|----------------------|----------------------|----------------------|-----------------------------------|-----------------------------------|---------------------------------|
|                                   | [1]                             | [2]                  | [3]                  | [4]                  | [5]                               | [6]                               | [7]                             |
| <i>ins</i>                        | 29.329**<br>(0.048)             |                      |                      | -3.378<br>(0.502)    | 4.209<br>(0.542)                  | 25.678***<br>(0.001)              | -36.027***<br>(0.000)           |
| <i>ins</i> × <i>clust_2</i>       |                                 |                      |                      | 61.59***<br>(0.000)  | 90.891***<br>(0.000)              | 8.998<br>(0.685)                  |                                 |
| <i>ins</i> × <i>clust_2+</i>      |                                 |                      |                      | 130.20***<br>(0.000) | 139.81***<br>(0.000)              | 173.74***<br>(0.000)              |                                 |
| <i>perc_sold_low</i>              |                                 | -9.218<br>(0.276)    |                      |                      |                                   |                                   |                                 |
| <i>perc_sold_high</i>             |                                 | 20.362<br>(0.222)    |                      |                      |                                   |                                   |                                 |
| <i>few_insiders</i>               |                                 |                      | 14.352***<br>(0.005) |                      |                                   |                                   |                                 |
| <i>mult_insiders</i>              |                                 |                      | -21.726<br>(0.296)   |                      |                                   |                                   |                                 |
| <i>corp</i>                       | 45.188***<br>(0.000)            | 45.190***<br>(0.000) | 45.193***<br>(0.000) | 44.892***<br>(0.000) | 46.443***<br>(0.000)              | 45.378***<br>(0.000)              | 45.289***<br>(0.000)            |
| <i>ret</i>                        | 491.75***<br>(0.000)            | 492.64***<br>(0.000) | 491.61***<br>(0.000) | 491.48***<br>(0.000) | 159.72***<br>(0.000)              | -165.57***<br>(0.000)             | 493.25***<br>(0.000)            |
| <i>ret</i> <sub>[t-1; t-5]</sub>  | 48.931***<br>(0.004)            | 43.103***<br>(0.004) | 48.750***<br>(0.004) | 48.834***<br>(0.004) | -22.441<br>(0.331)                | -48.962*<br>(0.053)               | 49.073***<br>(0.004)            |
| <i>shtr</i> <sub>[t-1; t-5]</sub> | 0.179***<br>(0.000)             | 0.179***<br>(0.000)  | 0.179***<br>(0.000)  | 0.179***<br>(0.000)  | 0.110***<br>(0.000)               | 0.090***<br>(0.000)               | 0.179***<br>(0.000)             |
| <i>tr<sub>t</sub></i>             | 0.380***<br>(0.000)             | 0.380***<br>(0.000)  | 0.380***<br>(0.000)  | 0.380***<br>(0.000)  | 0.342***<br>(0.000)               | 0.322***<br>(0.000)               | 0.380***<br>(0.000)             |
| <i>tr</i> <sub>[t-1; t-5]</sub>   | -0.063***<br>(0.000)            | -0.063***<br>(0.000) | -0.063***<br>(0.000) | -0.063***<br>(0.000) | -0.077***<br>(0.000)              | -0.073***<br>(0.000)              | -0.063***<br>(0.000)            |
| <i>Intercept</i>                  | 4.813***<br>(0.000)             | 5.078***<br>(0.000)  | 4.806***<br>(0.000)  | 4.747***<br>(0.000)  | 46.250***<br>(0.000)              | 67.458***<br>(0.000)              | 5.371***<br>(0.000)             |
| <i>R</i> <sup>2</sup>             | 0.811                           | 0.810                | 0.810                | 0.811                | 0.645                             | 0.573                             | 0.745                           |

**Table 7**  
**Market Maker Short Sale Determinants**

The table contains coefficient estimates from several specifications of the model of daily MM short selling. Shorting activity by market makers is measured as the number of short trades in stock  $i$  on day  $t$ . The model is estimated for days of insider sales, day  $t$ ,  $MM\ sales_t$ ; as well as on days  $t+1$  and  $t+2$ , respectively,  $MM\ sales_{t+1}$  and  $MM\ sales_{t+2}$ . In addition, we estimate a control specification for days of insider purchases,  $MM\ purch_t$ . The vector of regressors includes (i) an indicator that equals to 1 on insider trading days,  $ins$ ; (ii, iii) interaction indicators that equal to 1 if an insider sale day begins a two-day or more than a two-day same-insider cluster, respectively,  $ins \times cluster\_2$  and  $ins \times cluster\_2+$ ; (iv, v) two indicators that capture the smallest and the largest quintiles of percentage insider holdings that change hands during an insider transaction,  $perc\_sold\_low$  and  $perc\_sold\_high$ ; (vi, vii) two indicators that capture the smallest and the largest quintiles of the number of insiders executing on an event day,  $mult\_ins$  and  $few\_ins$ ; (viii) an indicator variable that has a value of 1 if a corporate event occurs in the [-10; 10]-day period surrounding an insider sale,  $corp$ ; (ix, x) contemporaneous return,  $ret$ , and return lagged over one-to-five days,  $ret_{[t-1; t-5]}$ ; (xi) lagged short volume,  $shtr_{[t-1; t-5]}$ , and (xii, xiii) contemporaneous and lagged trading volumes,  $tr_t$ ,  $tr_{[t-1; t-5]}$ . The models are adjusted, pursuant to a Hausman test, for stock and day fixed effects.  $p$ -Values are in parentheses.

|                        | $MM\ sales_t$         |                       |                       |                       | $MM\ sales_{t+1}$     | $MM\ sales_{t+2}$     | $MM\ purch.$          |
|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|-----------------------|
|                        | [1]                   | [2]                   | [3]                   | [4]                   | [5]                   | [6]                   | [7]                   |
| $ins$                  | 105.68***<br>(0.000)  |                       |                       | 132.12***<br>(0.000)  | 120.26***<br>(0.000)  | 121.39***<br>(0.000)  | -20.732***<br>(0.000) |
| $ins \times clust\_2$  |                       |                       |                       | -164.14***<br>(0.000) | -146.08***<br>(0.000) | -179.53***<br>(0.000) |                       |
| $ins \times clust\_2+$ |                       |                       |                       | -216.43***<br>(0.000) | -194.16***<br>(0.000) | -191.50***<br>(0.000) |                       |
| $perc\_sold\_low$      |                       | 63.61***<br>(0.000)   |                       |                       |                       |                       |                       |
| $perc\_sold\_high$     |                       | 157.71***<br>(0.000)  |                       |                       |                       |                       |                       |
| $few\_insiders$        |                       |                       | 85.121***<br>(0.000)  |                       |                       |                       |                       |
| $mult\_insiders$       |                       |                       | 259.39***<br>(0.000)  |                       |                       |                       |                       |
| $corp$                 | -87.774***<br>(0.000) | -87.176***<br>(0.000) | -87.728***<br>(0.000) | -87.172***<br>(0.000) | -85.930***<br>(0.000) | -86.894***<br>(0.000) | -87.803***<br>(0.000) |
| $ret$                  | -55.200***<br>(0.000) | -55.018***<br>(0.001) | -55.134***<br>(0.001) | -55.189***<br>(0.000) | -142.12***<br>(0.000) | -136.27***<br>(0.000) | -45.278***<br>(0.001) |
| $ret_{[t-1; t-5]}$     | -46.238***<br>(0.000) | -46.183***<br>(0.000) | -46.414***<br>(0.000) | -46.107***<br>(0.000) | -30.423***<br>(0.010) | -15.106<br>(0.223)    | -44.646***<br>(0.000) |
| $shtr_{[t-2; t-5]}$    | 0.151***<br>(0.000)   | 0.151***<br>(0.000)   | 0.151***<br>(0.000)   | 0.151***<br>(0.000)   | 0.093***<br>(0.000)   | 0.073***<br>(0.000)   | 0.151***<br>(0.000)   |
| $tr_t$                 | 0.150***<br>(0.000)   | 0.150***<br>(0.000)   | 0.150***<br>(0.000)   | 0.150***<br>(0.000)   | 0.134***<br>(0.000)   | 0.127***<br>(0.000)   | 0.150***<br>(0.000)   |
| $tr_{[t-1; t-5]}$      | -0.020***<br>(0.000)  | -0.021***<br>(0.000)  | -0.020***<br>(0.000)  | -0.021***<br>(0.000)  | -0.025***<br>(0.000)  | -0.026***<br>(0.000)  | -0.021***<br>(0.000)  |
| $Intercept$            | 47.665***<br>(0.000)  | 47.637***<br>(0.000)  | 47.501***<br>(0.000)  | 47.655***<br>(0.000)  | 65.422***<br>(0.000)  | 72.822***<br>(0.000)  | 50.011***<br>(0.000)  |
| $R^2$                  | 0.663                 | 0.663                 | 0.661                 | 0.664                 | 0.520                 | 0.469                 | 0.424                 |

**Table 8**  
**Post-insider sale returns**

The table contains coefficients estimated from a set of regression models with returns on the insider sale day,  $ret$ ; returns on the report day,  $ret_{rep}$ ; cumulative returns between the insider sale and the report day,  $ret_{cum\_rep}$ ; and cumulative returns over 10 days following an insider sale day,  $ret_{t+10}$ , as dependent variables. Independent variables include: (i) the number of market maker short sales (short volume) executed on insider sale day,  $mm_t * 1K (*IM)$ ; (ii) the number of non-market maker short sales (short volume) executed on insider sale day,  $nmm_t * 1K (*IM)$ ; (iii, iv) indicator variables equal to 1, if an insider sale begins a two-day or a more than two-day cluster,  $cluster\_2$  or  $cluster\_2+$ ; (v) an indicator variable equal to 1, if the [-10; 10]-day window that surrounds the insider sale contains a corporate news announcement,  $corp$ ; (vi, vii) contemporaneous and lagged market-adjusted returns, respectively,  $ret_t$  and  $ret_{[t-1; t-5]}$ ; (viii, ix) contemporaneous and cumulative lagged number of non-short trades or non-short volume on day  $t$ , respectively,  $tr_t * 1K$  or  $vol_t * 1M$  and  $tr_{[t-1; t-5]} * 10K$  or  $vol_{[t-1; t-5]} * 10M$ ; (x, xi) lagged numbers of short sales and short volume,  $shtr_{[t-1; t-5]} * 10K$  or  $shvol_{[t-1; t-5]} * 10M$ . Models for each of the dependent variables are run twice: once with the number of shares in all the relevant independent variables,  $tr$ , and the second time – with volume executed in all the relevant variables,  $vol$ .  $p$ -Values are in parentheses.

|  | $ret$                |                     | $ret_{rep}$          |                      | $ret_{cum\_rep}$     |                      | $ret_{t+10}$         |                      |
|--|----------------------|---------------------|----------------------|----------------------|----------------------|----------------------|----------------------|----------------------|
|  | $tr$                 | $vol$               | $tr$                 | $vol$                | $tr$                 | $vol$                | $tr$                 | $vol$                |
|  | [1]                  | [2]                 | [3]                  | [4]                  | [5]                  | [6]                  | [7]                  | [8]                  |
| $mm_t$                                   | 0.001***<br>(0.000)  | 0.000***<br>(0.000) | 0.000***<br>(0.000)  | 0.000***<br>(0.000)  | 0.000***<br>(0.000)  | 0.001***<br>(0.000)  | 0.000***<br>(0.000)  | 0.000***<br>(0.000)  |
| $nmm_t$                                  | 0.001***<br>(0.000)  | 0.003***<br>(0.000) | 0.000***<br>(0.000)  | 0.001***<br>(0.000)  | 0.000***<br>(0.000)  | 0.001***<br>(0.000)  | 0.000***<br>(0.000)  | 0.001***<br>(0.000)  |
| $cluster\_2$                             | 0.000<br>(0.764)     | 0.000<br>(0.947)    | -0.001<br>(0.131)    | -0.001<br>(0.128)    | 0.003***<br>(0.001)  | 0.003***<br>(0.001)  | 0.006***<br>(0.000)  | 0.006***<br>(0.000)  |
| $cluster\_2+$                            | 0.000<br>(0.725)     | 0.000<br>(0.876)    | 0.000<br>(0.891)     | 0.000<br>(0.887)     | 0.002*<br>(0.064)    | 0.002*<br>(0.068)    | 0.002*<br>(0.056)    | 0.002*<br>(0.593)    |
| $corp$                                   | 0.001<br>(0.370)     | 0.000<br>(0.449)    | -0.001***<br>(0.000) | -0.001***<br>(0.000) | -0.001*<br>(0.076)   | -0.001*<br>(0.062)   | -0.001*<br>(0.089)   | -0.001*<br>(0.070)   |
| $ret_t$                                  |                      |                     | -0.005<br>(0.185)    | -0.005<br>(0.187)    | -0.043***<br>(0.000) | -0.043***<br>(0.000) | -0.046***<br>(0.000) | -0.046***<br>(0.000) |
| $ret_{[t-1; t-5]}$                       | 0.026***<br>(0.000)  | 0.026***<br>(0.000) | -0.012***<br>(0.000) | -0.011***<br>(0.000) | -0.021***<br>(0.000) | -0.020***<br>(0.000) | -0.007<br>(0.172)    | -0.006<br>(0.208)    |
| $tr_t / vol_t$                           | -0.000***<br>(0.000) | 0.000***<br>(0.000) | -0.000***<br>(0.000) | -0.000***<br>(0.000) | -0.000***<br>(0.000) | -0.000***<br>(0.000) | -0.000***<br>(0.000) | -0.000***<br>(0.000) |
| $tr_{[t-1; t-5]} / vol_{[t-1; t-5]}$     | 0.000***<br>(0.000)  | 0.003***<br>(0.000) | -0.000***<br>(0.000) | -0.001***<br>(0.000) | -0.001***<br>(0.000) | -0.002***<br>(0.000) | -0.000***<br>(0.000) | -0.002***<br>(0.000) |
| $shtr_{[t-1; t-5]} / shvol_{[t-1; t-5]}$ | -0.001***<br>(0.000) | 0.006***<br>(0.000) | 0.000***<br>(0.000)  | 0.001***<br>(0.000)  | 0.004***<br>(0.000)  | 0.006***<br>(0.000)  | 0.002***<br>(0.000)  | 0.000***<br>(0.000)  |
| <i>Intercept</i>                         | 0.003***<br>(0.000)  | 0.003***<br>(0.000) | -0.011***<br>(0.000) | -0.011***<br>(0.000) | -0.006***<br>(0.000) | -0.006***<br>(0.000) | -0.001***<br>(0.007) | -0.001***<br>(0.014) |

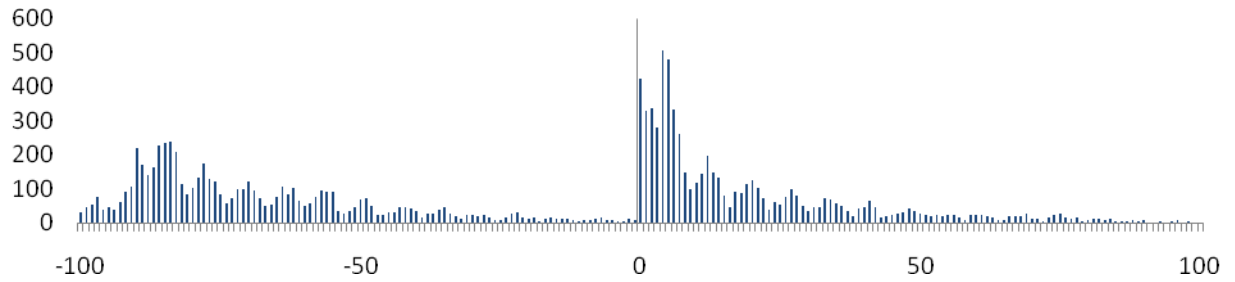


Figure 1: Insider sales around earnings announcements.  
 The figure contains a histogram of a number of insider sale events in relation to the earnings announcement days, day zero. Horizontal axis represents distance from day zero, whereas vertical axis denotes the number of insider sale events.

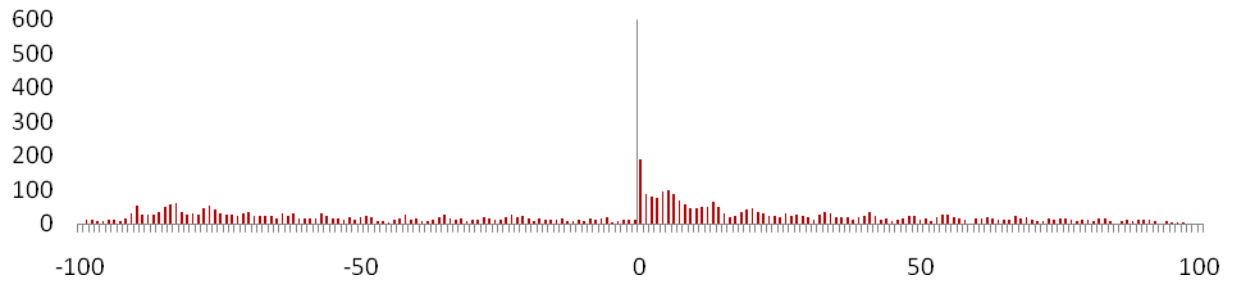
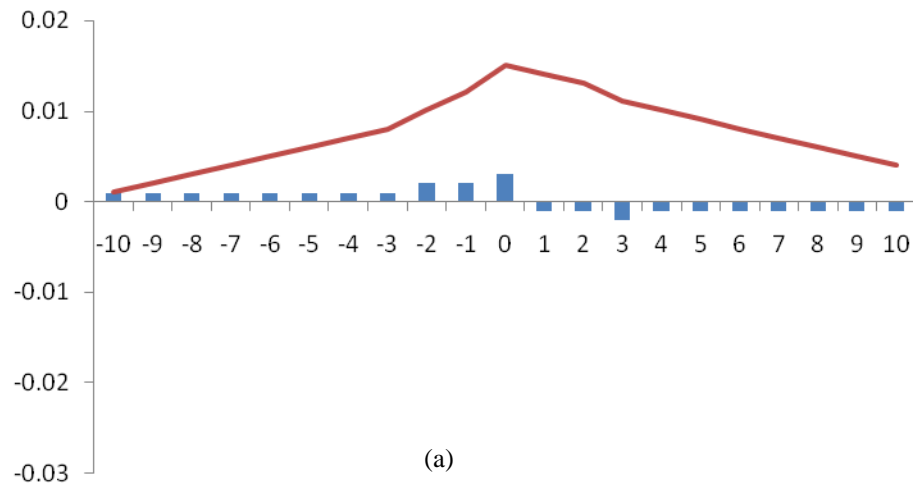
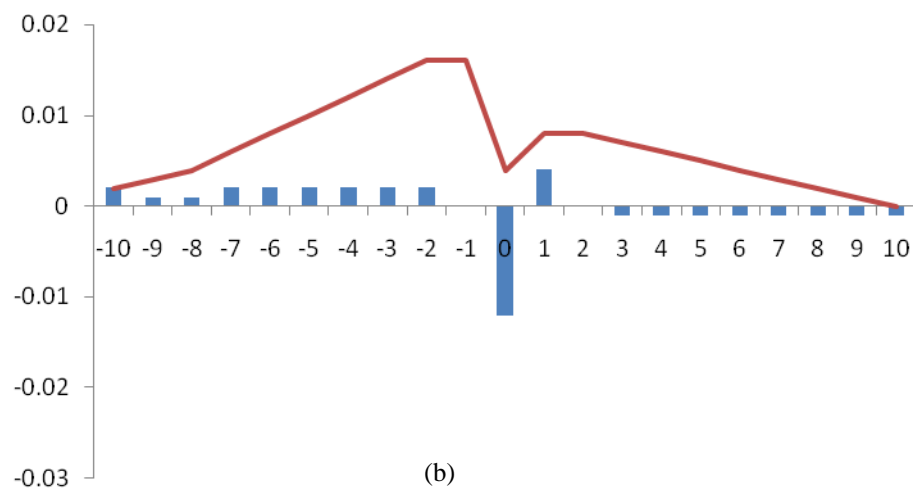


Figure 2: Insider sales around dividend declarations.  
 The figure contains a histogram of a number of insider sale events in relation to the dividend declaration days, day zero. Horizontal axis represents distance from day zero, whereas vertical axis denotes the number of insider sale events.



ret cum\_ret



ret cum\_ret

Figure 3: Market-adjusted returns about insider sale days and insider sale announcement days. The figure contains statistics for the daily and the cumulative market-adjusted returns during the [-10; 10]-day window surrounding insider sales (a) and insider sale announcements (b).