Insiders versus short sellers: informed traders' competition around earnings announcements.

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Abstract

This paper studies the interaction between corporate insiders and short sellers after earnings announcements. We show that insiders and short sellers are skilled information processors who compete for trading on publicly available information. For a sample of US firms we find that both types of informed investor trade intensively in the same stocks for about a third of firm-quarters in our sample. In line with competition, speed of information dissemination is significantly higher for stocks with intensive trading by both insiders and short sellers. Insider traders make profit by trading on interpretation of public information. Overall, the evidence suggests that insiders and short sellers tend to accelerate their trades after earnings announcements and make stock prices more efficient.

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1 Introduction

Insider trading regulation has tightened over time and insiders are forced to trade more frequently in the period after earnings announcements and prohibited to trade before earnings announcements (Bettis et al., 2000; Lee et al., 2014). The Sarbanes-Oxley Act, which took effect in August 2002, tightened the reporting requirements associated with insider transactions. Increased scrutiny from investors, media and regulators should also lead to less opportunistic insider trading. This raises a question of whether insiders are still able to use their superior information for profitable trading and what are the consequences of their trading for stock market efficiency.[1] Even though tighter regulatory environment might restrict insiders in using forward looking private information, insiders might rely more heavily on their superior information processing skills and trade on public rather than private information. In this paper we analyze this type of insiders' information advantage.

It is relatively difficult to differentiate whether insiders use information concerning foreknowledge of future earnings news or they rather react to mispricing of their stock after earnings announcements. One way to achieve this is to consider situations where insiders have to compete for information with other investors in the market. Back et al. (2000) show that depending on the correlation between private signals existence of other informed traders can either amplify or reduce the extent of competition. Specifically, if correlation among signals is high and close to one, informed traders tend to trade more aggressively and impound information into prices quicker.

In this paper we analyze insider trading together with short sellers' trading patterns around earnings announcements. Using a sample of US firms from July 2006 until December 2013 we show that insiders and short sellers sell intensively five days after the earnings

[1] Quote from Lee et al. (2014): '[...] it remains unclear whether insiders are still earning abnormal profits from their transactions after their firms' adoption of restriction policies. This is a critical question that needs to be addressed since it determines whether academics should continue to use insider trading as a source of informed transactions in empirical studies, and whether professional investors would be incentivized to revise their active investment strategies based on insider trading. Moreover, the answer to the question would allow regulators and policy makers to evaluate the effectiveness of regulations on insider trading and follow-up enforcements.' Lee et al. (2014) list all the regulatory changes.

news. The higher is the likelihood of short selling, the more intensively insiders and short sellers trade in the same stocks after the earnings announcement date. This suggests that signals that both types of traders possess are highly correlated. Short sellers are informed traders with strong incentives to profit on their information advantage. Engelberg et al. (2012) argue that short-sellers' information advantage around earnings announcements comes from their information processing skills. Moreover, their investment horizon is usually relatively short: Boehmer et al. (2008) estimate the typical short seller's horizon to be 37 trading days, and Gamble and Xu (2017) document similar estimates for retail short sellers. Hence, short sellers are not likely to trade on long-lasting forward looking private information. This together implies that insiders are trading based on superior information processing rather than foreknowledge of future earnings news.

Despite trading predominantly on public information, insiders are able to identify overvalued stocks and trade profitably. We find that aggressive selling by insiders after earnings announcements predicts future negative return. Moreover, when both types of traders sell aggressively, the speed of information dissemination is substantially enhanced. This holds true irrespective of the direction of the earnings news, but price adjustment is concentrated in stocks with large magnitude of earnings surprise. This suggests further that both types of informed trader are trading in stocks in which the market has overreacted to positive news and underreacted to negative news. There is extensive evidence that insiders possess superior information as their trades predict future returns.[2] We show that they are able to enhance market efficiency even in cases when they trade on public information after the earnings announcements.

To rule out possible alternative explanations of our results, we perform a number of robustness checks. We test whether low post earnings returns are due to excessive buying pressure right after the news. We find that irrespective of the level of buying pressure, stocks with high intensity of both types of informed traders together show lower future abnormal returns. Further, we also run the same test using dispersion in analysts' forecasts

[2]See for example Seyhun (1998) and Jeng et al. (2003) for a detailed review of the early evidence on the side of insiders, and Cohen et al. (2007) and Korczak et al. (2010) for a more recent one.

as an alternative measure that captures different levels of overpricing.[3] In line with our findings, even for different levels of dispersion in analysts' forecasts, price adjustment is faster in stocks in which insiders and short sellers compete for trading.

Our results are important as we document that part of the trading advantage of insiders and short sellers comes due to their superior information processing skills. We show that both types of informed traders use their skills to process public news better and trade profitably. This is line with recent evidence studying short sales or insider trades separately.[4] We extend this literature by showing that both types of informed investors compete for trading on the same information. More importantly, as a result of the competition both types of trader tend to accelerate their trading decisions and trade faster making stock prices more efficient.

Massa et al. (2015) are the closest to our analysis. They analyze how the presence of short sellers affects the incentives of the insiders to trade on negative information. They show that higher past short selling potential is positively associated with higher frequency and intensity of insider sales in a given month. They conclude that both types of informed traders compete for trading on the same private information. We are different from them in a number of points. They focus on trading decisions by insiders who possess material information that is not yet disclosed to the market. We instead focus our analysis specifically around earnings announcements where asymmetric information is reduced mainly to interpretation of public information. Hence, we are the first who analyze the trading decisions of insiders and short sellers together in the context of public news announcements. As a result, we show that competition is triggered by public information. Secondly, Massa et al. (2015) fail to take into account situations where insiders' and short sellers' possess different signals (or uncorrelated signals). We are able to show that, in line with Back et al. (2000), when insiders and short sellers disagree on their information processing,

[3]Miller (1977) shows that stocks are more overpriced when investors' opinions about firm's value diverge more, provided that short sales constraints are biding. In line with Miller (1977), Diether et al. (2002a) use dispersion in analysts' forecasts as a measure of investors' disagreement and show that stocks with higher dispersion in analysts' forecasts earn lower future returns.

[4]See Engelberg et al. (2012) for the side of short sellers, and Kolasinski and Li (2010) and Alldredge and Cicero (2015) for the side of insiders.

stocks prices adjust slower than in cases where they share the same information.

Another paper that is closely related to ours is Chakrabarty and Shkilko (2013). They study short selling activity surrounding insider trades to explore the source of short sellers trading advantage. They find that short selling done by non market makers increases by 26% on insider selling days. They also show that short sellers' trading in anticipation of insider sales which is consistent with both types trading on private information and their ability to analyze public signals. We focus primarily on trading around earnings announcements and show that both types of informed traders sell in response to public information only and profit from those trades. More importantly, we are able to extend their findings by showing that not only short sellers but also insiders trade on superior information processing.

We contribute to the insider trading literature in two important ways. First, we contribute to the discussion on whether insider trades are motivated by foreknowledge of future material information (Ke et al., 2003; Cheng et al., 2007) or by their ability to recognize when their stocks are mispriced (Piotroski and Roulstone, 2005; Jenter, 2005). Our results are difficult to reconcile with the first view. This is due to our setup is designed to analyze trading decisions of both informed traders around earnings announcements. We show that both insiders' and short sellers' trades are concentrated on the days immediately after the news and, therefore, their trades are associated with their superior information processing skills rather than foreknowledge of future material information.

Second, the empirical literature finds little evidence that insider sales are profitable (Jeng et al., 2003; Jenter, 2005). The main argument for these findings is that insiders could trade for reasons other than foreknowledge of material information, such as liquidity or diversification (Lakonishok and Lee, 2001; Cheng et al., 2007; Cohen et al., 2012). The evidence by Cohen et al. (2012) is a notable exception. They show that performing simple screening to insider trading frequencies, both insider purchases and sales are profitable. Cohen et al. (2012) conclude that their findings support the view that some insider trades are driven by foreknowledge of future material information. Another exception is Alldredge and Cicero (2015) who study insider trading when firms disclose having concentrated

business relationships with other companies. They show that insiders sell profitably based on public information about their main customers. Alldredge and Cicero (2015) argue that their results are suggestive that insiders are attentive to the information released at public news announcements. Our results support the evidence of Alldredge and Cicero (2015) and demonstrate that insiders sales show strong return predictability.

We also contribute to the debates about the information content of short sellers. Engelberg et al. (2012) and Boehmer and Wu (2013) argue that short sale transactions are driven by their ability to process public information better than other investors. We also show in our setup that short sellers are able to profitably trade on interpretation of public information.

Finally, our paper speaks to the literature on competition between informed traders. Our results are in line with the theoretical predictions of Holden and Subrahmanyam (1992), Foster and Viswanathan (1996) and Back et al. (2000). Back et al. (2000) show that when two or more informed investors have correlated private information (or signal), they tend to trade more aggressively in order to pre-empt the other informed traders from extracting their benefits. Thus, stock prices adjust faster to their trades making them more efficient. In line with their predictions, we show that when insiders and short sellers together after earnings announcements prices adjust faster than in stocks where they trade alone.

The remainder of this paper proceed as follows. Section 2 provides a brief background and discusses our main testable implications. Section 3 describes the databases we use and provides summary statistics. Section 4 shows our main analysis and findings. Section 5 concludes.

2 Background and testable implications

Presence of different types of informed traders in the market allows us to pin down the nature of information that those traders possess. Back et al. (2000) develop a model with multiple informed traders in the market when traders may have diverse signals and show that the nature of competition depends on the correlation of their signals. In the case

of uncorrelated signals each trader will trade less intensely and, similarly to Kyle (1985) model, private information is incorporated into stock prices gradually. This happens not only because noise traders provide the informed traders with the perfect camouflage for their profitable trades, but also because different informed traders are expected to be on opposite sides of the market. Traders on the opposite side of the market can push the price in a favorable direction, so trades can be made at better prices which creates an incentive to wait to trade. On the other hand, when information becomes less correlated, informed traders expect other market participants to be on the same side of the market more frequently which provides an inducement to trade quickly. This result are in line with Holden and Subrahmanyam (1992) and Foster and Viswanathan (1996). In this case the common private information is incorporated into stock prices almost immediately.

Although all the models described above are framed around trading decisions based on foreknowledge of future material information, the predictions are equally valid in the context of processing public information. However, it is not obvious how to separate cases of highly correlated private material information from commonly observable public information. To do so, we specifically restrict our attention on trading immediately after earnings announcements. The publication of earnings are associated with a reduction in information asymmetry. Hence, insiders can trade on either foreknowledge of future material information (say one quarter ahead or more) or information about interpretation of the public news (see (Diamond and Verrecchia, 1987; Korajczyk et al., 1991; Berkman et al., 2009)).

We separate these two possibilities by considering trading of another type of informed investors – short sellers. As we argued before, short sellers are not likely to trade on long-lasting forward looking private information. Therefore, we can credibly infer that if trading signals of insiders and short sellers are highly correlated, then these signals are based on the public information about earnings announcements. On the other hand, if the signals are not correlated, this implies that insiders are likely to trade based on foreknowledge of future material information.

We start with testing whether presence of short sellers triggers an increase in intensity

in insiders' selling by following Massa et al. (2015). They use the supply of shares available for lending as a measure that captures short selling potential and hence a thread from competitors. In order to be able to condition on information available for the traders, we look at trading intensity of insiders and short sellers immediately after earnings announcements. We expect to observe a positive association between short selling potential before the news and competition between insiders and short sellers after the announcement date. Therefore, we propose

Hypothesis 1: *Insiders and short sellers are more likely to trade intensively in the same stocks after earnings announcements when the supply of lendable shares is higher before the news release.*

We turn now to question of information dissemination and price discovery. Are insiders actually able to profit from information they trade on? The literature is split concerning whether news events, such as earnings announcements, could represent profitable trading opportunities for informed investors. On the one hand, the publication of earnings are associated with a reduction in information asymmetry diminishing the chances of profitable trades by informed investors (Diamond and Verrecchia, 1987; Korajczyk et al., 1991; Berkman et al., 2009). On the other hand, quarterly earnings announcements allow investors to make their own judgements about firm value and, therefore, to generate their own private information (Kim and Verrecchia, 1994; Brown et al., 2009; Engelberg et al., 2012). As investors disagree about interpretation of the public news, information asymmetry increases presenting profitable trading opportunities for informed investors.

When both types of informed traders possess common (or highly correlated) information, namely public information when stocks are mispriced during earnings announcements, this information should get impounded into prices more rapidly. In this case we expect to observe significantly negative future abnormal returns for stocks where both types of informed traders sell intensively. In contrast, if insider trade on private information about future earnings that is weakly correlated with the short sellers' short-term signals, price discovery would happen at a slower rate. This allows us to posit our second hypothesis.

Hypothesis 2: *Post earnings announcements abnormal returns are lower for firms*

with insider sales and/or short sales. Moreover, information is incorporated into prices faster for firms where insiders and short sellers sell intensively together after earnings announcements.

3 Data and Descriptive Statistics

In Section 3.1 we describe the data sources, sample selection and define our main variables used in the analysis. In Section 3.2 we provide some basic descriptive statistics.

3.1 Data and Variables Definition

In this section we describe the sources of our data and the construction of our main variables. Our sample comprises security-level daily information from July, 2006 to December, 2013. We consider US common stocks that are traded on the NYSE, NASDAQ, or AMEX exchanges (we exclude non-US incorporated firms, or ADR, ETF, and REITS). We matched this sample with Securities lending database from Markit, insider data from Thomson Reuters, financial statement data from COMPUSTAT, analysts forecasts data from I/B/E/S and intraday trade and volume data from NYSE Trades and Quotes database (TAQ).

Insider trading data is from Thomsom Financial Insider Filings which contain all insider activity as reported in the forms 3, 4 and 5 specified by the Security Exchange Act of 1934. It covers detailed information about the transactions and the insiders including the trading date, announcement date, insiders name and role in the firm, number of shares traded, transaction price and transaction type (purchase or sale).

Data on equity lending loans and supply is from Markit (who acquired Data Explorers), which collects this information daily from 125 large custodians and 32 prime brokers in the securities lending industry. The data cover more than 85% of the securities lending market. A more detailed description of the data can be found in Saffi and Sigurdsson (2010).

Our analysis is built around earnings announcements, so we aggregate all insider trad-

ing[5] and short selling activity around quarterly earnings announcements. We obtain quarterly earnings announcements from the COMPUSTAT quarterly data file and delete firm-quarters for which no COMPUSTAT data are available. For each earnings announcement, we define three time periods: (i) the earnings announcement period: the period beginning on working day -1 and ending on day +1, (ii) the informed trader response period: the period beginning on working day 0 and ending either after day +5 or day +20. (iii) the future return period, which is closely linked to the informed trader response period ending, and finishes after 6 months. Consequently, the period runs over day +5 up to day +130 or alternatively over +20 until +145. Figure 1 describes the setup graphically.

Insert Figure 1 about here.

We base our analysis on the following two measures. The relative number of shares sold by insiders (*INsales*) and the daily number of stocks on loan (*Onloan*), both scaled by the number of shares outstanding. For the *Onloan* measure, we take shorting transactions with a start date at the most recent business day.[6]

An important feature of our dataset is that it allows to distinguish different trading decisions of insiders and short sellers after earnings announcements. Namely, we are able to identify cases where both types trade intensively together in the same stocks, cases with intensive insider selling and low or no short selling, cases with intensive short selling and low or no insider selling and cases when there is little or no insider or short selling activity. This identification is very relevant to our purposes as we consider firms where both insider and short sellers trade intensively together as a strong indication of competition, but also because in cases where neither of them trade or trade in small quantities constitute very important benchmark categories. Hence, we classify each firm-quarter in our sample as one the following types:

[5]As there could be more than one insider transaction per day, before aggregating the data we merge all insider transactions within one day of the same director in the same direction (purchases/sales), but we keep transactions if in different direction even on the same day.

[6]Markit also have data on the daily number of stocks that are on loan at different start dates, such as at 3, 7 and 30 days. We believe *new* stocks on loan is a better fit to our purposes as we want to analyze short sales that are more likely to be attributed to the earnings announcements.

- *Onloan&INsales* is a firm-quarter with both intensive short selling and intensive insider selling activity during the informed trading response period (see Figure 1). Namely, it is a firm-quarter with short selling activity in the top two terciles and insider selling activity above the median of the number of shares traded by both types after an earning announcement.

- *Only Onloan* is a firm-quarter with intensive short selling and little or no insider selling during the informed trading response period. In particular, is a firm-quarter with short selling activity in the two top terciles of the number of shares shorted and with insider selling activity below the median of the number of shares sold by insiders after earnings announcements.

- *Only INsales* is a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period. More specifically, it is a firm-quarter with insider selling activity above the median of the number of shares sold by insider and with short selling activity in the bottom tercile of the number of shares shorted after an earning announcement.

- *Low informed trading* is a firm-quarter with low or no insider and short selling activity during the informed trading response period. Namely, it is a firm-quarter with insider selling activity below the median of the number of shares sold by insiders and with short selling activity in the bottom tercile of the number of shares shorted after earnings announcements.

We define cut-off points at the median for insider sales and terciles for short sales because selling activity by insiders is much less frequent and intense than short sales. Although the cutoff points may look arbitrary, we believe is a reasonable approximation to capture different levels of trading intensity after earnings announcements.

3.2 Descriptive Statistics

Table 1 describes our sample of firm-quarters and the number of shares traded by insiders and short sellers in each category. In Panel A, we categorize each firm-quarter with the

trading activity during the whole trading response period (0,+20) and in Panel B during the 6 days immediately after the announcement date (0,+5).

Insert Table 1 about here.

In total we have 102,149 firm-quarters. In 28.5% of all firm-quarters insiders and short sellers coincide in their intensive trading. In Panel A, while firm-quarters with intensive short selling only are the most frequent (around 40% of the firm-quarters in our sample), firm-quarters with intensive insider sales only are the least frequent (around 6% of the quarters). Quite striking is the fact that conditional on insiders trading, insiders sell in the same stocks with short sellers in about 83% of the firm-quarters in our sample. Firm-quarters with low intensity of both insider and short sales are relatively high in frequency, representing 25% of the sample. This distribution changes a little in Panel B, where the categories are defined based on trading activity until day +5. While the firm-quarters with *Onloan&INsales* are less frequent compared to Panel A, firm-quarters with *Only Onloan* are higher. These differences comes from the exchange between these two categories in Panels A and B. That is, for example, firm-quarters classified as *Only Onloan* in Panel B (when considering trading activity until day +5), move to *Onloan&INsales* in Panel A (when considering trading activity until day +20) because insiders continue selling after day +5 of the announcement date.

Looking at the intensity of trading, we see that insiders and short sellers trade more intensively together (*Onloan&INsales*) than in cases when they trade separately. In Panel A, trading together short sellers sell around 0.22% of the company stocks and insiders 0.007%, while when trading separately these figures are 0.17% and 0.006%, respectively. These differences are stronger in Panel B, especially for insiders who sell around 0.009% of their company stocks when short sellers are also selling.

Other variables we use throughout the analysis are the number of shares available for lending scaled by the shares outstanding (*Lendable*) and the positive component of daily order imbalance ($Oimb^{+}$). The former measures short selling potential (Massa et al., 2015) while the latter captures firms' buying pressure (Diether et al., 2009). Buy order

imbalance is computed as the daily buys minus sells scaled by the daily volume.[7] We also use abnormal returns during and after a quarterly earnings announcements. Abnormal returns are calculated as the difference between the buy and hold raw return and its corresponding 5x5 size and book to market portfolio return over a certain period of time $BHAR_{i,t} = [\Pi_{t=t_1}^{t_2}(1+R_{i,t})-1] - [\Pi_{t=t_1}^{t_2}(1+E(R_{i,t}))-1]$, where $R_{i,t}$ is the realized return on day t. Other standard variables we use are firm size, book to market, earnings per share and dispersion in analysts' forecast, which are all defined in the Appendix A.

In Table 2 we summarize the characteristics of our sample. Panel A provides summary statistics for all firms and Panel B summarizes differences across our categorical variable for informed trading. Panel A shows that the average firm in our sample has a market capitalization of 2.97 billion USD, a book-to-market ratio of 0.69 and a negative change in earnings per share of -0.37%. Also, the firms in our sample have on average 18% of its total shares outstanding in the inventory available for borrowing *(Lendable)*, but with a high standard deviation (12%) which indicates an active equity lending market in the US and a significant variation among firms across the years. Moreover, the average firm in our data has 0.002% of its shares outstanding sold by insiders and 0.15% shorted by short sellers.

Insert Table 2 about here.

Panel B shows differences in firm's characteristics across the informed trading categories. Stocks where insiders and short sellers trade intensively together (*Onloan&INsales*) are on average larger in size (4.8 billion USD), more profitable (B/M ratio of 0.46), and have a larger fraction of its total shares outstanding available for borrowing (26.3%) than stocks in the other 3 categories. Stocks with only insider sales (*Only INsales*) share similar characteristics to stocks with *Onloan&INsales*. In particular, these stocks are large on average (4.4 billion USD) and have lower B/M ratio (0.64) relative to stocks with only short sales or stocks with low informed trading. Note that the average *Lendable* for these stocks is the lowest relative to the other categories (15%). In contrast, stocks where short

[7] Buy and sells orders are defined using Lee and Ready (1991)

sellers trade alone are smaller (2.9 billion USD) and less profitable on average relative to *Onloan&INsales* (B/M ratio of 0.65).

4 Empirical Analysis

4.1 Informed trading patterns around earnings announcements

In this section we provide an overview on how insider and short selling trades are distributed around the earnings announcements. Figure 2 plots the relative number of shares sold by insiders (*INsales*) and the relative number of stocks on loan (*Onloan*) in the days surrounding the announcement date. As the size of insider sales is considerably smaller relative to the size of short sales, we place the range of *Onloan* values in the left axis and of *INsales* on the right axis to make trading patterns comparable. We see that the earnings announcement date significantly affects insiders' and short sellers' trading patterns. In line with Engelberg et al. (2012), short sales increase slightly before the announcement date, but rise sharply at day 0 and stay relatively high for a few days. Insider sales, in contrast, show a minor increase on day 0, peak significantly at day +3 and then remains high for several days. Surprisingly, short sellers seem to be faster in timing their sales relatively to insiders. However, the peak in insider sales at day +3 is likely associated with blackout windows, which are firm specific explicit periods when insiders are not allowed to trade (Bettis et al., 2000; Cohen et al., 2012).

Insert Figure 2 about here.

In Figure 3 we partition all earnings announcements into GOOD, BAD and NO news according the earnings announcements abnormal returns. Hence, firms with GOOD, BAD and NO news are firms with a 3-day earnings announcements abnormal return (window (-1,+1)) in the top, lowest and middle tercile of the returns for all the quarters respectively. Figure 3 shows that short sellers increase their trading activity at the announcement date for both GOOD and BAD news stocks. Insiders, in contrast, are much more active sellers after GOOD news relative to BAD news confirming the well known contrarian pattern of insider sales (Sivakumar and Waymire, 1994). Importantly, short sellers seem to trade

before insiders regardless of the direction of the news and the peak for insider sales remains at day +3. This evidence gives more support to the idea that the anticipation of short sellers is driven by the presence of blackout periods.

Insert Figure 3 about here.

Finally, Figure 4 partitions the sample by the informed trading categories: based on trading activity until day +20 in Panel A and until day +5 in Panel B. As in the figures above, short selling activity peaks at day 0 when short sellers trade alone (*Only Onloan*) or together with insiders (*Onloan&INsales*). Still, short sellers trade a little more intensively when insiders are selling intensively at the same time. Similarly, when insiders are selling their sales peak at day +3 regardless of short sellers trading. The decreasing pattern for insider sales is a little more gradual when they trade alone (*Only INsales*) than when trading together with short sellers (*Onloan&INsales*), suggesting that insiders tend to spread their trades when they do not face competition. Furthermore, the fact that insider sales peak at day +3 also when trading together with short sellers and regardless of the direction of the news suggests the presence of blackout periods for insiders. This is because even in cases when they have every reason to trade sooner as they face competition with short sellers, they only start trading on day +3 (on average). This pattern strongly suggest the existence of imposed trading constraints.

In Panel B the categories are based on trading activity until day +5. The patterns just described for insider sales and short sales in Panel A remain very similar to Panel B. However, we observe subtle differences in insider sales patterns. In Panel B, the intensity of trading by insiders in the days following the news is stronger than in Panel A. In particular, while in Panel A the relative number of shares sold by insiders in firms with short sales peak to a little more than 0.01% at day +3, in Panel B this figure is about 0.03%. This is natural as in Panel A the categories are based on trading intensity until day +20, so the lower peak reflects that insider sales continue occurring frequently after day +5, but much less intensively pushing the average intensity until day +5 down. Therefore, the informed trading category based on trading intensity until day +5 depicts a more clear picture about what happens in the first days after the announcement date.

Insert Figure 4 about here.

Clearly Figures 2 to 4 show that short sellers trade before insiders do on average, suggesting that short sellers are faster information processors than insiders. This is quite counterintuitive. Insiders have access to better information easily than outsiders do about the prospects of their firms, and therefore is quite natural to assume that insiders are faster. In fact, one important assumption in Massa et al. (2015) model is that insiders are more informed than short sellers and therefore insiders trade faster in the presence of short sellers. The fact that insiders seem to be following short sellers is surprising even for us, but we strongly believe that this anticipation pattern is driven by the ban periods referred above. Although we are not able to test this formally[8], the graphs provide a suggestive evidence in support of the ban periods.

Furthermore, our results are in line with the evidence by Bettis et al. (2000). They survey 1,915 firms members of the American Society of Corporate Secretaries regarding corporate policies and restrictions on insider trading. They find that 78% of the firms on their sample had explicit blackout periods, and the most common policy establish by these firms was disallowing trading by insiders at all times except during a trading window that is open during the period 3 through 12 trading days after the quarterly earnings announcement.

4.2 Competition for trading.

Section 4.1 shows that both insiders and short sellers trade after earnings announcements the same company's stocks in around 29% of our sample. Also, both insiders and short sellers tend to trade together intensively shortly after the announcement date. Although, this is an indication that both may be competing to trade over the same firms' stocks, this section is oriented to test this evidence more formally.

In order to test our Hypothesis 1, we analyze whether short selling potential trading before earnings announcements predicts insider and short selling activity after the news

[8]Ideally we would have information about firms' policies regarding insider trading, but these policies are firm specific and this information is not publicly available.

release. Following Massa et al. (2015), we use the supply of shares available for lending (*Lendable*) as a measure that captures short selling potential and test if it predicts trading aggressiveness. As we are interested in the relation between *Lendable* and trading activity after earnings announcements, we use our categorization of informed trading as the dependent variable. To do so we estimate the following multinomial logistic regression model. The dependent variable is a categorical variable including the referred outcomes based on trading intensity five days after an earnings announcement.[9] We take *Low informed trading* as the reference category and, therefore, report three sets of regression coefficients. They have to be interpreted relatively to the *Low informed trading* category. In all specifications, we also include year dummies, but we do not report them to save space. We compute robust standard errors and allow them to cluster within firms. In order to determine importance of the individual explanatory variables for each outcome, we standardize the explanatory variables by subtracting their mean and scaling by their standard deviation. The standardization means that the units of the regression coefficients are now the same and therefore are directly comparable across variables. The estimation results are reported in Table 3.

Insert Table 3 about here.

In line with our Hypothesis 1, we find that insiders and short sellers are more likely to trade intensively in the same stocks for firms with higher short selling potential (*Lendable*) relative to firms with low intensity of insider or short sale transactions (*Low informed trading*). Unsurprisingly, *Lendable* also increases the odds of short selling trading intensively alone (*Only Onloan*), reflecting that short sellers trade in firms with lower shorting constraints. Finally, even when *Lendable* increases significantly the relative probability of insider selling intensively alone (*Only INsales*), this probability is significantly lower compared to the other outcomes.[10]

[9] We also run the same specification with the dependent variable based on trading intensity until 20 days after an earnings announcement, but we don't report it to save space. The results remain unchanged.

[10] A wald-test for the difference between the coefficients equals to zero strongly rejects the null at 1% level.

We also compute the marginal effect that our independent variables have over each outcome separately. This not only allows to have the unconditional probability of *Lendable* over each category, but also it gives a better approximation to compare the magnitudes of the probabilities across the outcomes. The results are reported at the bottom in Table 3. We confirm, for example, that *Lendable* increases the odds of insiders and short sellers trading together (*Onloan&INsales*) and this probability is significantly higher than for the other two outcomes. More importantly, note that the average marginal effect of *Lendable* is significantly negative for firms with only insider sales (*Only INsales*). This indicates, in line with our predictions, that low short selling potential is associated with a more monopolistic behavior of insiders. In particular, a one standard deviation increase in the relative number of *Lendable* shares is associated with a 2.3% reduction in the probability of insiders selling alone after the earnings news.

Looking a the remaining control variables we also see interesting results. First, while insiders and short sellers are more likely to trade together in stocks with more positive news than with more negative news, the opposite goes for short sellers trading alone. In particular, while the relative probability of *GOOD news* firms is significantly higher than *BAD news* over the *Onloan&INsales* outcome, the reverse holds for the *Only Onloan* category. The marginal effects confirm these results, as the marginal effect of positive news firms significantly increases the likelihood of *Onloan&INsales*, it significantly reduces the probability of *Only Onloan*. In contrast, the marginal effect of negative news significantly reduces the odds of *Onloan&INsales* and increases the probability of *Only Onloan*.

The results also suggests that when insiders and short sellers trade together, they trade on average as contrarians as opposed to cases where only short sellers trade. The 6-month past return increases the odds of both types trading together (*Onloan&INsales*) and decreases the odds of short sellers trading alone (*Only ITsales*). Also, in line with the contrarian behavior, the negative coefficient for book to market ratio indicates that insiders and short sellers are more likely to sell high valuation stocks (Jenter, 2005), and this probability is higher than for short sellers trading alone (*Only Onloan*). This result is reinforced by the marginal effects. The average marginal effect of book to market is

positive in firms *Only Onloan*, suggesting that short sellers are likely to trade alone in low valuation stocks. Firms with only insider sales tend to mimic the pattern of firms with both insider and short sale transactions. This is in line with the literature surprising as the literature documents insiders contrarian behavior when trading (Sivakumar and Waymire, 1994; Rozeff and Zaman, 1998; Piotroski and Roulstone, 2005; Jenter, 2005).

4.3 Predictability of post earnings announcements returns.

In this section we test our Hypothesis 2. Our first aim is to analyze whether insiders and short sellers are informed traders who can make profitable traders on the earnings announcements. Our second aim is to show that, consistent with insiders and short sellers trading for competition, post earnings returns are negative and larger in magnitude for firms where both trade intensively together than in firms where each of them trade alone.

To test these conjectures we run panel regressions of post-earnings announcements buy and hold abnormal returns *(PostBHAR)* on our categorical variable of informed trading. Returns are adjusted for the corresponding quintile matched size and book to market portfolio return and are compounded over different time horizons after earnings announcements (see Figure 1). The results are reported in Table 4. Panel A includes specifications for all the firms-quarters considering post earnings announcement returns beginning at day +20 (subsequent return period 1 in Figure 1) and Panel B displays post earnings returns starting at day +5 (subsequent return period 2 in Figure 1). We include *Lendable* as a control variable in all the specifications.

Insert Table 4 about here.

Consistent with our Hypothesis 2, Panel A shows that post earnings announcements abnormal returns are significantly lower for all our categories, suggesting that both insiders and short sellers are able to make profitable trades after the news. Furthermore, abnormal returns are more negative in stocks where insiders and short sellers trade intensively together than for firms where both trade alone. In particular, abnormal returns in stocks with both insider and short sales (*Onloan&INsales*) are 7.5% lower than in stocks with *Low informed trading* at the first month after the announcement date (+20,+40), and con-

tinue to be lower after 2, 3 and 6 months. Stocks with *Only Onloan* are also significantly lower after the first month, but the magnitude of the adjustment is smaller relative to *Onloan&INsales*. In contrast, stocks with *Only INsales* are significantly lower only after the second month of the announcement date. Furthermore, *Lendable* is associated with lower future returns in all specifications. The significantly negative coefficient in column 1 of Panel A indicates that a 1% increase in the relative stocks available to lend before the earnings announcement is associated with 4.5% reduction in the post-earnings abnormal returns.

The results in Panel B show even stronger support to our conjectures. In particular, while abnormal returns in *Onloan&INsales* stocks are 5.3% lower immediately after the announcement date, returns in stocks with *Only Onloan* and *Only INsales* start to be significantly lower at the second and at the third month, respectively. Overall, these results suggest that stock prices adjust significantly faster in stocks where both insiders and short sellers compete for trading than in stocks where they don't. Also, in line with Massa et al. (2015), stocks with higher short selling potential before the news, which we show in the previous section leads to higher competition, show lower future returns. We are able to extend their results by showing that in cases where short selling potential do not lead to competition, abnormal returns adjust slowly.

Importantly, the results in Table 4 show consistency with the theoretical predictions of (Back et al., 2000). That is, when insider and short sellers trade intensively in the same stocks (as in stock with *Onloan&INsales* stocks), they share the same opinion about those firm's value, therefore prices adjust faster and stronger than in cases where their opinions diverge (stocks with *Only Onloan* or *Only INsales*).

Next, we extend this analysis further and partition our sample by the direction of the news. For brevity purposes we only report results considering subsequent abnormal returns after day +5, but the results hold the same measuring returns after day +20. The results are reported in Table 5. Abnormal returns are significantly lower in stocks with intensive trading by both insider and short sellers (*Onloan&INsales*) irrespective of the direction of the news. However, the strong price adjustment is concentrated mainly in

stocks with positive and negative news, and in a minor level in stocks with no news. This suggests that when trading together insiders and short sellers seem to be trading in stocks with a strong market reaction to earnings announcement.

Insert Table 5 about here.

Moreover, as stock prices are significantly lower afterwards indicates that insiders and short sellers are likely to be trading in stocks that experience an overreaction to positive news and underreaction to negative news. Finally, in line with our predictions, abnormal returns are lower faster in stocks with (*Onloan&INsales*) than in stocks with *Only Onloan* or *Only INsales*) for both *GOOD news* and *BAD news* stocks.

4.4 Robustness and alternative explanations.

In the previous section we show that stock prices adjust faster in firms where insiders and short sellers trade intensively together, suggesting that they compete for trading on the same information. However, one could argue that the large price adjustment could be driven by the level of overpricing rather than by competition. In particular, if some firms become more overpriced, it's natural to expect that price correction should be stronger for these firms irrespective of whether insiders and short sellers trade intensively together or not. In contrast, if insiders and short sellers compete because they share similar private information (signal), then regardless of the level of mispricing, their trading together should lead to post earnings announcements abnormal returns being more negative sooner.

Controlling for different levels of overpricing is not simple, but we approach the challenge in two ways. First, following Diether et al. (2009), we distinguish different levels of overpricing using the positive component of order imbalance shortly after the earnings news ($Oimb^{+}(0,+5)$). This measure captures temporary buying pressure: the larger the buying pressure the higher market sentiment and, therefore, the larger overpricing potential. Second, we take dispersion in analyst forecast derived from the Institutional Brokers Estimates System (I/B/E/S) as a measure of divergence in investors' opinions. Diether et al. (2002a) show that stocks with higher dispersion in analysts' forecasts earn significantly lower future returns. This is because with high divergence in investors' opinions,

stock prices reflect valuations of the most optimistic investors who push the demand for the stock up and so cause overpricing. By using both measures ($Oimb^{+}(0,+5)$ and $DISP$), we expect to find that the low future abnormal returns in firms where insiders and short sellers trade together sustain across different levels of $Oimb^{+}(0,+5)$ and $DISP$.

We compute $Oimb^{+}(0,+5)$ as the average buy order imbalance of a firm from day 0 to day 5 after the earnings announcements. Buy order imbalance is computed as the daily volume of buys scaled by the daily total volume.[11] In Panel A of Table 6 we show the distribution of post earnings announcement abnormal returns by quartiles of $Oimb^{+}(0,+5)$. We see that, future abnormal returns are consistently lower for higher levels of $Oimb^{+}(0,+5)$, except for the 1st quartile. This is because the first quartile of $Oimb^{+}(0,+5)$ contains stocks with the smallest buying pressure and, therefore, the selling pressure for these stocks is high, which is naturally associated with negative future abnormal returns.

In Panel B of Table 6 we regress post earnings announcements abnormal returns on our categorical variable for informed trading by quartiles of $Oimb^{+}(0,+5)$. The dependent variable is the cumulative abnormal returns from 5 until 46 days after the announcement and therefore this results are directly comparable to column (2) in Panel B of Table 4. The results confirm our conclusions in section 4.3. Abnormal returns are more negative in quarters where insiders and short sellers compete, and this is irrespective of the initial mispricing. In particular, abnormal returns are significantly more negative in *Onloan&INsales* quarters for quartiles 2, 3 and 4 of $Oimb^{+}(0,+5)$. Also, abnormal returns are negative, but insignificant for quartile 1, where stocks are less subject to overpricing. In contrast, the negative abnormal returns for *Only INsales* and *Only Onloan* are mainly concentrated at the highest $Oimb^{+}(0,+5)$ quartile, suggesting that the large price adjustment in firms with only insider sales or short sales is due to stocks that are more prone of overpricing.

Insert Table 6 about here.

Table 7 reports the results for dispersion in analysts' forecast ($DISP$). Panel A shows the distribution of post earnings announcement abnormal returns by quartiles of $DISP$.

[11] Buy and sells orders are defined using Lee and Ready (1991)

Although stocks in quartile 4 display lower future abnormal returns than the rest of the quartiles, the pattern is not monotonic as expected from the evidence of Diether et al. (2002b). However, our results are not directy comparable to Diether et al. (2002b) findings, as their setup is not based on earnings announcements and they take a monthly frequency of returns to test their predictions. In constrast, we take a much shorter term view when compounding returns which could diminish the possibility of getting the same results.

Insert Table 7 about here.

In addition, there are important disadvantages associated to the use dispersion in analysts' forecasts. First, small firms are generally not covered by many analysts, which might imply important biases of the measure. In fact, smaller firms suffer higher information asymmetries, thus, earnings announcements in smaller firms might be associated with stronger investors' reaction and divergence of opinions. And second, the measure does not allow to capture divergence in investors' opinions during the short window of earnings announcements. Analysts' forecasts reflect expectations concerning the earnings news and so the measure captures analysts' divergence before the earnings announcement rather than the effect on investors' disagreement as a result of the news publication. We are more interest in the latter rather than the former.

In spite of the drawbacks of using *DISP*, its disadvantages should lower our chances of finding a significant relationship between insiders' and short sellers' intensive trading and lower future returns. However, if this association holds even at different levels of *DISP*, it must be rather strong. The results in Panel B confirm these conjectures.[12] In particular, abnormal returns are more negative in quarters where insiders and short sellers trade together, and this holds for all the quartiles of *DISP* but the first.

5 Conclusions

We study the interation between 2 types of informed traders, corporate insiders and short sellers, around earnings announcements. For a quarterly sample of U.S. firms from 2006

[12]Note that the sample size shrinks significantly relative to the results in Panel B of Table 6.

until 2013, we show that both are skillful information processors who better interpret the new information embedded in earnings announcements and trade profitable. Also, both traders compete for trading on their processing skill and trade the same stocks very frequently. As result of the competition, stock prices adjust faster to their trades than in cases where they do not compete.

Our analysis has 4 branches. First, we show that insiders and short sellers trade intensively shortly after the announcement date in the same stocks very frequently (around 29% of the firm-quarters in our sample). When both trade together, short sellers tend to anticipate insider sales. However, this anticipation ocurrs because insiders face blackout periods during when they are not allowed to trade. Second, in line with Massa et al. (2015) model, high short selling potential increases competition between insiders and short sellers. In a multinomial logistic regression, we show that a high supply of shares available for lending significantly increases the likelihood of insiders and short sellers trading intensively the same stocks shortly after the earnings announcement date. In contrast, short selling potential decreases the likelihood of insiders selling when short sellers do not trade or trade very little. Third, future abnormal returns are more negative faster in stocks with intensive insider and short selling. Finally, this price adjustment is not concentrated in more overpriced stocks.

Overall, our evidence show that both insiders and short sellers make profitable trades based on analyzing publicly available information better than other investors. Both types of informed traders their skills about interpreting new public information better and exploit situation when the market misintepret this information. Importantly, insiders and short sellers compete for trading on their superior information processing skills and their trading influences stock prices.

Appendix A Variable definitions

Variable	Definition	Source
BAD news	Dummy variable that is equal to 1 for all firm-quarters in the lowest (top) tercile of the 3-day earnings announcements abnormal return (EA abnormal returns) and 0 otherwise	CRSP, French's web site
B/M	Book value of equity corresponding to the previous quarter over the market cap 2 days before the earnings announcement.	COMPUSTAT
DISP	Dispersion of analysts forecasts. Corresponds to the standard deviation of quarterly earnings per share (EPS) forecasts for the current earnings announcements that are issued in the period between the last earnings announcements and two days prior to the current earnings announcement date, divided by the absolute value of the median analyst forecast.	I/B/E/S
ΔEPS	Net earnings before extraordinary items per share less the earnings per share in the same quarter 1 year before scaled by the share price 2 days before the earnings announcements.	COMPUSTAT
EA abnormal returns	Buy and Hold abnormal stock return over 3 days around the last earnings announcement date $(-1, +1)$. The abnormal returns are estimated as the difference between the observed return and the returns of a benchmark at that date. The 4 factors model is used as a benchmark which take into account the market risk along with size and book to market risk factors (Fama and French, 1992), and also includes momentum as risk factor (Cahart, 1997). Abs(EXRET) corresponds to the absolute value of EXRET	CRSP, French's web site
GOOD news	Dummy variable that is equal to 1 for all firm-quarters in the top tercile of the 3-day earnings announcements abnormal return (EA abnormal returns) and 0 otherwise	CRSP, French's web site
INsales	Average number of shares sold by insiders scaled by the number of shares outstanding. INsales is averaged over the two informed trading response periods, namely (0,+5) and (0,+20)	Thomsom Financial
Lendable	Average daily number of shares available for lending before earnings announcements (trading days -30 to -3) scaled by the number of shares outstanding.	Markit(Dataexplorers).
Low informed trading	Category indicating a firm-quarter with low or no insider and short selling activity during the informed trading response period (see Figure 1). So, it's a firm-quarter with insider selling activity below the median of the number of shares sold by insider and with short selling activity in the bottom tercile of the number of shares shorted after an earning announcement.	Markit(Dataexplorers) and Thomsom Financial

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Variable	Definition	Source
NO news	Dummy variable that is equal to 1 for all firm-quarters in the middle tercile of the 3-day earnings announcements abnormal return (EA abnormal returns) and 0 otherwise	CRSP, French's web site
$\text{Oimb}^{+}(0,+5)$	Daily buy order imbalance averaged over the informed trading response period between day 0 and day +5 after an earnings announcement. Buy order imbalance is computed as the daily buys scaled by the daily volume. Buy and sells orders are defined using Lee and Ready (1991).	TAQ data
Onloan	Average number of shares shorted within 1 business day scaled by the number of shares outstanding. Onloan is averaged over the two informed trading response periods, namely (0,+5) and (0,+20)	Markit(Dataexplorers)
Onloan&INsales	Category indicating a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period (see Figure 1). It corresponds to a firm-quarter with short selling activity in the top 2 terciles and insider selling activity above the median of the number of shares traded by both types after an earning announcement.	Markit(Dataexplorers) and Thomsom Financial
Only INsales	Category indicating a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period (see Figure 1). More specifically, it's a firm-quarter with insider selling activity above the median of the number of shares sold by insider and with short selling activity in the bottom tercile of the number of shares shorted after an earning announcement.	Markit(Dataexplorers) and Thomsom Financial
Only Onloan	Category indicating a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period (see Figure 1). In particular, it's a firm-quarter with short selling activity in the 2 top terciles of the number of shares shorted and with insider selling activity below the median of the number of shares sold by insiders after an earning announcement.	Markit(Dataexplorers) and Thomsom Financial
PastRET(6m)	Market adjusted stock return over 6 months ending 1 month before an earnings announcement. Returns are adjusted using the corresponding value weighted portfolio as downloaded from CRSP database.	CRSP, French's web site
PostBHAR(t_1,t_2)	The raw buy and hold stock return beginning t_1 and ending t_2 days after earnings announcement date adjusted for the corresponding 5x5 size and book to market portfolio return as downloaded from the Kenneth French web site or the market portfolio return.	CRSP, French's web site
Size	The logarithm of the Market capitalization. The market cap is the stock price times the number of shares outstanding 2 days before the earnings announcement date.	COMPUSTAT

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Table 1: Distribution of insider sales and short sales in our sample per type of informed trading activity.

Distribution of trading activity for insiders and short sellers across all the firm quarters in our sample. In Panel A we consider trading activity from day 0 until 20 days after the earnings announcement date (0,+20), and in Panel B until 5 days (0,+5). *Onloan&Insales* is a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period. *Only Onloan* is a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period. *Only INsales* is a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period. *Low informed trading* is a firm-quarter with low or no insider and short selling activity during the informed trading response period.

	Firm quarters		Relative shares traded	
	# firm quarters	% of total	Insider sales	Short sales
Panel A: Trading activity from day 0 to day +20				
Onloan&INsales	29,062	28.5%	0.007%	0.220%
Only Onloan	41,296	40.4%	0.000%	0.197%
Only INsales	5,976	5.9%	0.006%	0.019%
Low informed trading	25,815	25.3%	0.000%	0.012%
Total	102,149			
Panel B: Trading activity from day 0 to day +5				
Onloan&INsales	14,921	14.6%	0.009%	0.221%
Only Onloan	55,426	54.3%	0.001%	0.198%
Only INsales	2,392	2.3%	0.007%	0.030%
Low informed trading	29,410	28.8%	0.001%	0.018%
Total	102,149			

Table 2: Average firm characteristic by type of informed trading activity.

This table reports summary statistics for all the firms in our sample and partitioned by our category of informed trading. The informed trading category is based on trading activity from day 0 until day +5. *Onloan&Insales* is a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period. *Only Onloan* is a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period. *Only INsales* is a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period. *Low informed trading* is a firm-quarter with low or no insider and short selling activity during the informed trading response period. All variables are defined in the Appendix A. ***, ** and * indicate significance at the one-, five- and ten-percent levels.

Panel A: summary stats for all firms

Variables	# obs.	mean	standard dev.	p25	p50	p75
Onloan	102,149	0.149%	0.192%	0.025%	0.086%	0.196%
INsales	102,149	0.002%	0.008%	0.000%	0.000%	0.001%
Lendable	102,149	18.571%	12.098%	7.808%	18.796%	27.979%
Size (millions)	102,149	2,967.45	7,246.55	133.14	530.58	2,096.18
B/M	96,945	0.685	0.534	0.316	0.562	0.907
ΔEPS	101,759	-0.37%	8.05%	-0.82%	0.07%	0.71%
oimb$^+$	100,746	8.63%	7.59%	3.57%	6.15%	11.06%
DISP	63,474	0.259	0.549	0.042	0.087	0.210
PastRET(6m)	102,149	0.01%	4.58%	-2.46%	-0.11%	2.38%
EA abnormal returns	102,149	0.142%	9.830%	-3.903%	-0.094%	3.862%
PostBHAR(+5,+25)	93,382	-0.512%	9.961%	-5.780%	-0.526%	4.543%
PostBHAR(+5,+46)	93,382	-0.390%	14.205%	-8.149%	-0.545%	6.913%
PostBHAR(+5,+67)	93,382	-0.659%	17.769%	-10.667%	-0.897%	8.635%
PostBHAR(+20,+40)	93,382	0.011%	10.151%	-5.432%	-0.176%	5.103%
PostBHAR(+20,+61)	93,382	-0.128%	14.448%	-8.027%	-0.299%	7.234%
PostBHAR(+20,+82)	93,382	-0.598%	18.140%	-10.830%	-0.847%	8.777%

Panel B: means by informed trading category

Variables	All firms	Onloan&Insales	Only Onloan	Only INsales	Low informed trading
Lendable	18.571%	26.297%	22.262%	15.007%	7.994%
Size (millions)	2,967.45	4,810.25	2,910.64	4,448.09	2,003.01
B/M	0.685	0.461	0.650	0.637	0.877
ΔEPS	-0.37%	0.22%	-0.50%	0.28%	-0.51%
Oimb$^+$	8.630%	5.633%	6.431%	10.909%	13.966%
DISP	0.259	0.201	0.271	0.183	0.305
PastRET(6m)	0.008%	1.264%	-0.084%	0.883%	-0.532%
EA abnormal returns	0.142%	2.295%	-0.432%	1.863%	-0.007%
PostBHAR(+5,+25)	-0.512%	-0.188%	-0.202%	-0.311%	-1.246%
PostBHAR(+5,+46)	-0.390%	0.207%	0.067%	0.117%	-1.560%
PostBHAR(+5,+67)	-0.659%	-0.016%	-0.275%	-0.277%	-1.693%
PostBHAR(+20,+40)	0.011%	0.463%	0.358%	0.254%	-0.880%
PostBHAR(+20,+61)	-0.128%	0.350%	0.151%	0.207%	-0.902%
PostBHAR(+20,+82)	-0.598%	0.096%	-0.310%	-0.225%	-1.484%

Table 3: Multinomial logistic regression: insider and short selling activity after earnings announcements.

This table reports a multinomial logistic regression of insiders and short sellers trading patterns right after an earnings announcement. The dependent variable is categorical variable based on short and insider selling intensity 5 days after the earnings announcement date. Hence, this variable is equals to 0 for a firm-quarter with low or no insider and short selling activity during the informed trading response period *Low informed trading*; is equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period *Onloan&INsales*, equals to 2 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period *Only Onloan*, and equals to 3 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period *Only INsales*. The remaining variables are defined in Appendix A. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. Standard errors are reported in parentheses. ***, ** and * indicate significance at the one-, five- and ten-percent levels.

VARIABLES	Onloan&INsales		Only Onloan		Only INsales	
	coeff.	s.e.	coeff.	s.e.	coeff.	s.e.
Lendable	1.920***	(0.035)	1.510***	(0.030)	0.772***	(0.042)
BAD news	0.083**	(0.035)	0.438***	(0.026)	-0.292***	(0.060)
GOOD news	0.710***	(0.033)	0.294***	(0.025)	0.328***	(0.052)
Size	0.827***	(0.037)	0.489***	(0.030)	0.371***	(0.040)
B/M	-0.790***	(0.033)	-0.265***	(0.019)	-0.226***	(0.033)
PastRET(6m)	0.239***	(0.015)	-0.037***	(0.011)	0.196***	(0.022)
ΔEPS	-0.020	(0.016)	-0.037***	(0.011)	-0.003	(0.025)
Constant	-1.451***	(0.057)	0.252***	(0.041)	-1.633***	(0.067)
# Observations	95,855					
Firm FE	yes					
Year FE	yes					
χ^2	9547					
PseudoR^2	0.243					
Average marginal effects on each outcome						
Lendable	0.121***	(0.003)	0.073***	(0.003)	-0.023***	(0.002)
BAD news	-0.029***	(0.004)	0.080***	(0.004)	-0.021***	(0.002)
GOOD news	0.039***	(0.004)	-0.007***	(0.004)	-0.001	(0.002)
Size	0.069***	(0.003)	-0.005	(0.004)	0.003*	(0.002)
B/M	-0.089***	(0.004)	0.045***	(0.004)	0.008***	(0.001)
PastRET(6m)	0.035***	(0.002)	-0.040***	(0.002)	0.006***	(0.001)
ΔEPS	0.004*	(0.002)	-0.009***	(0.002)	0.002**	(0.001)

Table 4: Panel regressions: Post earnings announcement abnormal returns.

This table reports panel regressions of post earnings announcements abnormal returns on the trading activity of insiders and short sellers. The dependent variable for all columns is size and book to market adjusted abnormal returns. Panel A includes abnormal returns during subsequent returns period 2 and Panel B during period 1 (see Figure 1). Returns are adjusted for the corresponding 5x5 size and book to market portfolio return as downloaded from the Kenneth French web site. Abnormal returns are computed starting 5 days after the announcement date and cumulated over 1, 3 and 6 month later. *Onloan&INsales* is a dummy variable equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the corresponding trading response period ((0,+20) in Panel A and (0,+5) in Panel B)) and 0 otherwise. *Only Onloan* is a dummy variable equals to 1 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period ((0,+20) in Panel A and (0,+5) in Panel B)) and 0 otherwise. *Only INsales* is a dummy variable equals to 1 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period ((0,+20) in Panel A and (0,+5) in Panel B)) and 0 otherwise. GOOD (BAD) news is a dummy variable that is equal to 1 for all firm-quarters in the top (lowest) tercile of the 3-day earnings announcements abnormal return (window (-1,+1)) and 0 otherwise. *Lendable* is the average daily number of shares available for lending before earnings announcements (trading days -30 to -3) scaled by the number of shares outstanding. All variables are winsorized at the 1^{st} and 99^{th} percentiles. Standard errors are reported in parentheses. ***, ** and * indicate significance at the one-, five- and ten-percent levels.

	Panel A: Future returns period 1			
VARIABLES	PostBHAR (+20,+40)	PostBHAR (+20,+61)	PostBHAR (+20,+82)	PostBHAR (+20,+145)
Onloan&INsales	-0.075***	-0.131***	-0.162***	-0.232***
	(0.013)	(0.013)	(0.013)	(0.014)
Only Onloan	-0.028***	-0.067***	-0.078***	-0.124***
	(0.011)	(0.011)	(0.011)	(0.011)
Only INsales	0.001	-0.047**	-0.085***	-0.119***
	(0.019)	(0.020)	(0.020)	(0.021)
GOOD news	0.038***	0.043***	0.020**	0.026***
	(0.008)	(0.008)	(0.008)	(0.008)
BAD news	-0.013	-0.004	0.008	0.019**
	(0.008)	(0.008)	(0.008)	(0.008)
Lendable	-0.045***	-0.086***	-0.117***	-0.158***
	(0.009)	(0.010)	(0.010)	(0.012)
Constant	-0.021	0.023*	0.070***	0.051***
	(0.013)	(0.013)	(0.014)	(0.016)
Observations	92,913	92,913	92,913	92,913
R-squared	0.004	0.009	0.011	0.016
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

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	Panel B: Future returns period 2			
Variables	PostBHAR (+5,+25)	PostBHAR (+5,+46)	PostBHAR (+5,+67)	PostBHAR (+5,+130)
Onloan&INsales	-0.052***	-0.096***	-0.153***	-0.215***
	(0.013)	(0.013)	(0.013)	(0.013)
Only Onloan	0.007	-0.032***	-0.065***	-0.106***
	(0.011)	(0.011)	(0.011)	(0.011)
Only INsales	-0.031	-0.028	-0.086***	-0.115***
	(0.020)	(0.019)	(0.020)	(0.020)
GOOD news	0.035***	0.049***	0.039***	0.034***
	(0.008)	(0.008)	(0.008)	(0.008)
BAD news	-0.043***	-0.035***	-0.011	0.001
	(0.008)	(0.008)	(0.008)	(0.008)
Lendable	-0.069***	-0.092***	-0.125***	-0.176***
	(0.009)	(0.010)	(0.010)	(0.012)
Constant	0.086***	0.032**	0.072***	0.073***
	(0.013)	(0.013)	(0.014)	(0.016)
Observations	92,913	92,913	92,913	92,913
R-squared	0.006	0.009	0.012	0.020
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

Table 5: Panel regressions: Post earnings announcement abnormal returns by earnings news.

This table reports panel regressions of post earnings announcements abnormal returns on the trading activity of insiders and short sellers. The dependent variable for all columns is size and book to market adjusted abnormal returns. Returns are adjusted for the corresponding 5x5 size and book to market portfolio return as downloaded from the Kenneth French web site or the market portfolio return. Abnormal returns are computed starting 5 days after the announcement date and cumulated over 1, 3 and 6 month later. *Onloan&INsales* is a dummy variable equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period (0,+5) and 0 otherwise. *Only Onloan* is a dummy variable equals to 1 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period (0,+5) and 0 otherwise. *Only INsales* is a dummy variable equals to 1 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period (0,+5) and 0 otherwise. GOOD (BAD) news is a dummy variable that is equal to 1 for all firm-quarters in the top (lowest) tercile of the 3-day earnings announcements abnormal return (window (-1,+1)) and 0 otherwise. *Lendable* is the average daily number of shares available for lending before earnings announcements (trading days -30 to -3) scaled by the number of shares outstanding. All variables are winsorized at the 1^{st} and 99^{th} percentiles. Standard errors are reported in parentheses. ***, ** and * indicate significance at the one-, five- and ten-percent levels.

	GOOD news			NO news			BAD news		
VARIABLES	PostBHAR (+5,+25)	PostBHAR (+5,+46)	PostBHAR (+5,+67)	PostBHAR (+5,+25)	PostBHAR (+5,+46)	PostBHAR (+5,+67)	PostBHAR (+5,+25)	PostBHAR (+5,+46)	PostBHAR (+5,+67)
Onloan&INsales	-0.066***	-0.123***	-0.208***	-0.036*	-0.059***	-0.079***	-0.038	-0.089***	-0.147***
	(0.024)	(0.024)	(0.024)	(0.020)	(0.020)	(0.019)	(0.027)	(0.027)	(0.027)
Only Onloan	-0.028	-0.062***	-0.124***	0.001	-0.024	-0.037**	0.030	-0.031	-0.050**
	(0.022)	(0.021)	(0.021)	(0.016)	(0.017)	(0.016)	(0.022)	(0.022)	(0.021)
Only INsales	-0.011	0.011	-0.095***	-0.050*	-0.033	-0.069**	-0.032	-0.069	-0.106**
	(0.037)	(0.036)	(0.036)	(0.029)	(0.029)	(0.029)	(0.049)	(0.047)	(0.047)
Lendable	-0.077***	-0.117***	-0.158***	-0.036**	-0.053***	-0.084***	-0.089***	-0.100***	-0.126***
	(0.016)	(0.017)	(0.018)	(0.016)	(0.016)	(0.017)	(0.018)	(0.018)	(0.019)
Constant	0.135***	0.078***	0.139***	0.080***	0.018	0.030	0.072***	0.037	0.092***
	(0.026)	(0.026)	(0.026)	(0.018)	(0.019)	(0.019)	(0.026)	(0.025)	(0.026)
Observations	30,969	30,969	30,969	30,878	30,878	30,878	31,066	31,066	31,066
R-squared	0.009	0.011	0.018	0.003	0.004	0.006	0.006	0.008	0.013
Firm FE	yes	yes	yes	yes	yes	yes	yes	yes	yes
Year FE	yes	yes	yes	yes	yes	yes	yes	yes	yes

Table 6: Summary statistics and panel regression of post earnings returns on buy order imbalance.

This table reports an analysis of post earnings announcements abnormal returns conditional on different levels of buy order imbalance *Oimb^{+}(0,+5)*. Panel A displays the distribution of post earnings announcement abnormal returns by quartiles of *Oimb^{+}(0,+5)*. In Panel B we regress post earnings announcements abnormal returns on our categorical variable for informed trading by quartiles of *Oimb^{+}(0,+5)*. *Oimb^{+}(0,+5)* is the buy order imbalance of a firm averaged from day 0 to day 5 after the earnings announcement date. *Onloan&INsales* is a dummy variable equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period (0,+5) and 0 otherwise. *Only Onloan* is a dummy variable equals to 1 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period (0,+5) and 0 otherwise. *Only INsales* is a dummy variable equals to 1 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period (0,+5) and 0 otherwise. GOOD (BAD) news is a dummy variable that is equal to 1 for all firm-quarters in the top (lowest) tercile of the 3-day earnings announcements abnormal return (window (-1,+1)) and 0 otherwise. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. Standard errors are reported in parentheses. $^{*}**$, $^{*}*$ and * indicate significance at the one-, five- and ten-percent levels.

Panel A: Posterior return per Oimb quartiles

Oimb^{+}(0, +5)	PostBHAR(+5,+25)	PostBHAR(+5,+46)	PostBHAR(+5,+67)	PostBHAR(+5,+130)
quartile 1	-0.71%	-0.57%	-0.71%	-0.82%
quartile 2	-0.36%	-0.09%	-0.28%	-0.17%
quartile 3	-0.32%	-0.02%	-0.49%	-0.78%
quartile 4	-0.58%	-0.77%	-0.98%	-1.87%
Total	-0.49%	-0.36%	-0.61%	-0.90%

Panel B: Panel regressions for each Oimb^{+}(0,+5) quartile

	quartile 1	quartile 2	quartile 3	quartile 4
VARIABLES	PostBHAR(+5,+46)	PostBHAR(+5,+46)	PostBHAR(+5,+46)	PostBHAR(+5,+46)
Onloan&INsales	-0.017	-0.097***	-0.092***	-0.091***
	(0.028)	(0.028)	(0.028)	(0.032)
Only Onloan	0.017	-0.042*	-0.021	-0.054**
	(0.025)	(0.025)	(0.023)	(0.023)
Only INsales	0.052	0.023	-0.002	-0.089**
	(0.044)	(0.046)	(0.045)	(0.037)
BAD news	-0.018	-0.004	-0.027	-0.071***
	(0.017)	(0.016)	(0.018)	(0.020)
GOOD news	0.036**	0.045***	0.023	0.090***
	(0.017)	(0.016)	(0.017)	(0.018)
Lendable	-0.071***	-0.066***	-0.101***	-0.156***
	(0.021)	(0.020)	(0.020)	(0.026)
Constant	-0.008	0.033	0.016	-0.068**
	(0.039)	(0.035)	(0.028)	(0.031)
Observations	23,282	23,405	22,631	21,815
R-squared	0.007	0.009	0.007	0.012
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

Table 7: Summary statistics and panel regression of post earnings returns on dispersion in analysts' forecasts.

This table reports an analysis of post earnings announcements abnormal returns conditional on different levels of dispersion in analysts' forecasts (*DISP*). Panel A displays the distribution of post earnings announcement abnormal returns by quartiles of *DISP*. In Panel B we regress post earnings announcements abnormal returns on our categorical variable for informed trading by quartiles of *DISP*. *DISP* is the standard deviation of quarterly earnings per share (EPS) forecasts for the current earnings announcements that are issued in the period between the last earnings announcements and two days prior to the current earnings announcement date, divided by the absolute value of the median analyst forecast. *Onloan&INsales* is a dummy variable equals to 1 for a firm-quarter with high intensity of insider sales together with short sales during the informed trading response period (0,+5) and 0 otherwise. *Only Onloan* is a dummy variable equals to 1 for a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period (0,+5) and 0 otherwise. *Only INsales* is a dummy variable equals to 1 for a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period (0,+5) and 0 otherwise. GOOD (BAD) news is a dummy variable that is equal to 1 for all firm-quarters in the top (lowest) tercile of the 3-day earnings announcements abnormal return (window (-1,+1)) and 0 otherwise. All variables are winsorized at the 1^{st} and 99^{th} percentiles and standardized by subtracting the mean and dividing by the standard deviation. Standard errors are reported in parentheses. $^{*}**$, $^{*}*$ and * indicate significance at the one-, five- and ten-percent levels.

Panel A: Posterior return per DISP quartiles

DISP	PostBHAR(+5,+25)	PostBHAR(+5,+46)	PostBHAR(+5,+67)	PostBHAR(+5,+130)
quartile 1	0.01%	0.27%	-0.11%	0.00%
quartile 2	-0.05%	0.22%	0.13%	0.42%
quartile 3	-0.19%	0.37%	0.50%	0.77%
quartile 4	-0.35%	0.01%	-0.37%	-0.46%
Total	-0.15%	0.22%	0.04%	0.18%

Panel B: Panel regressions on each DISP quartile

Variables	quartile 1 PostBHAR(+5,+46)	quartile 2 PostBHAR(+5,+46)	quartile 3 PostBHAR(+5,+46)	quartile 4 PostBHAR(+5,+46)
Onloan&INsales	0.013	-0.069**	-0.112***	-0.112**
	(0.023)	(0.031)	(0.035)	(0.043)
Only Onloan	0.014	-0.018	-0.038	-0.003
	(0.023)	(0.028)	(0.031)	(0.037)
Only INsales	-0.033	-0.034	0.015	0.018
	(0.032)	(0.049)	(0.057)	(0.079)
BAD news	0.002	0.000	-0.008	-0.054**
	(0.015)	(0.019)	(0.022)	(0.026)
GOOD news	0.008	0.008	0.049**	0.024
	(0.015)	(0.018)	(0.022)	(0.026)
Lendable	-0.059***	-0.039*	-0.102***	-0.155***
	(0.021)	(0.022)	(0.026)	(0.031)
Constant	0.016	0.055	0.062	0.024
	(0.024)	(0.035)	(0.043)	(0.056)
Observations	14,488	14,428	14,225	14,145
R-squared	0.011	0.004	0.010	0.017
Firm FE	yes	yes	yes	yes
Year FE	yes	yes	yes	yes

Figure 1: Timings of earnings announcements and related abnormal returns

The figure shows the exact timings of earnings announcements, informed trading response and related abnormal returns. We establish three important periods: (i) the earnings announcement period: the period beginning on day -1 and ending on day +1 working days, (ii) the informed trader response period: the period beginning on working day 0 and ending either after day +5 or +20. (iii) The subsequent return period: the period runs over day +5 up to day +130 or alternatively over +20 until +145.

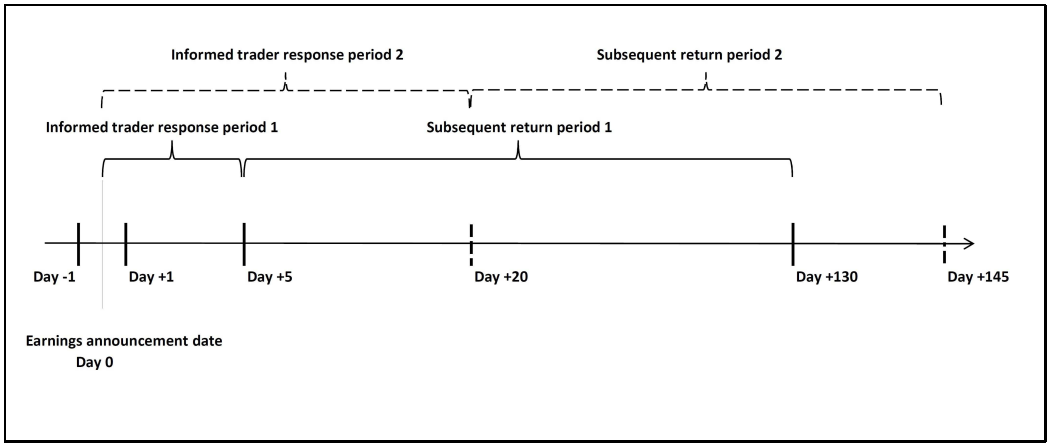


Figure 2: Daily shares sold by insiders and short sellers around earnings announcements.

The figure shows the number of shares sold by insiders (*INsales*) and the number of shares shorted (*Onloan*) around earnings announcements scaled by the number of shares outstanding.

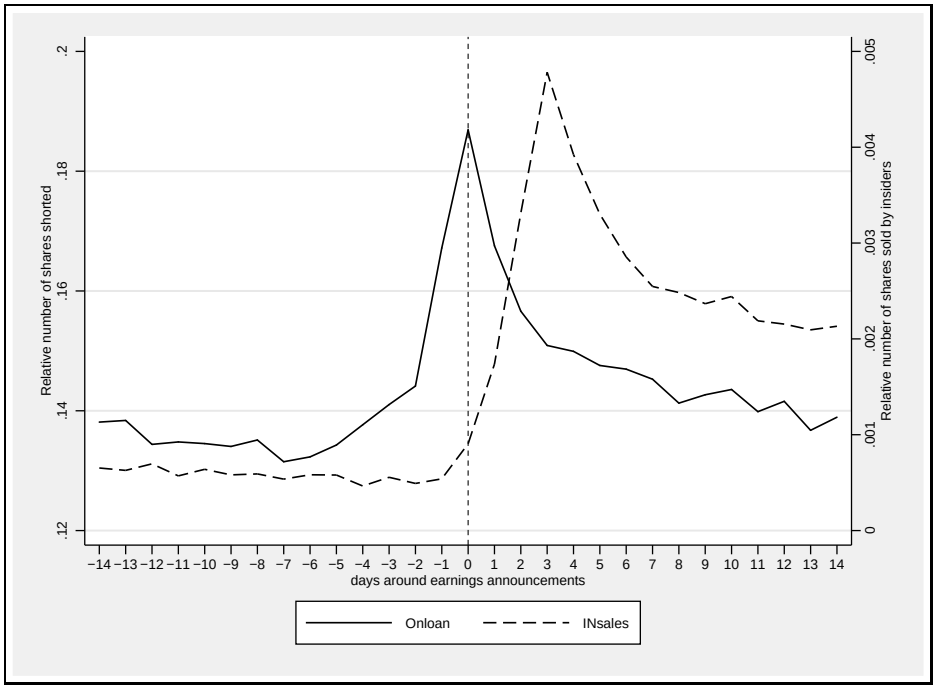


Figure 3: Daily shares sold by insiders and short sellers around earnings announcements categorized by earnings news.

The figure shows the number of shares sold by insiders (*INsales*) and the number of shares shorted (*Onloan*) around earnings announcements scaled by the number of shares outstanding. GOOD, BAD and NO news are firms with a 3-day earnings announcements abnormal return (window (-1,+1)) in the top, lowest and middle tercile of the returns for all the quarters respectively.

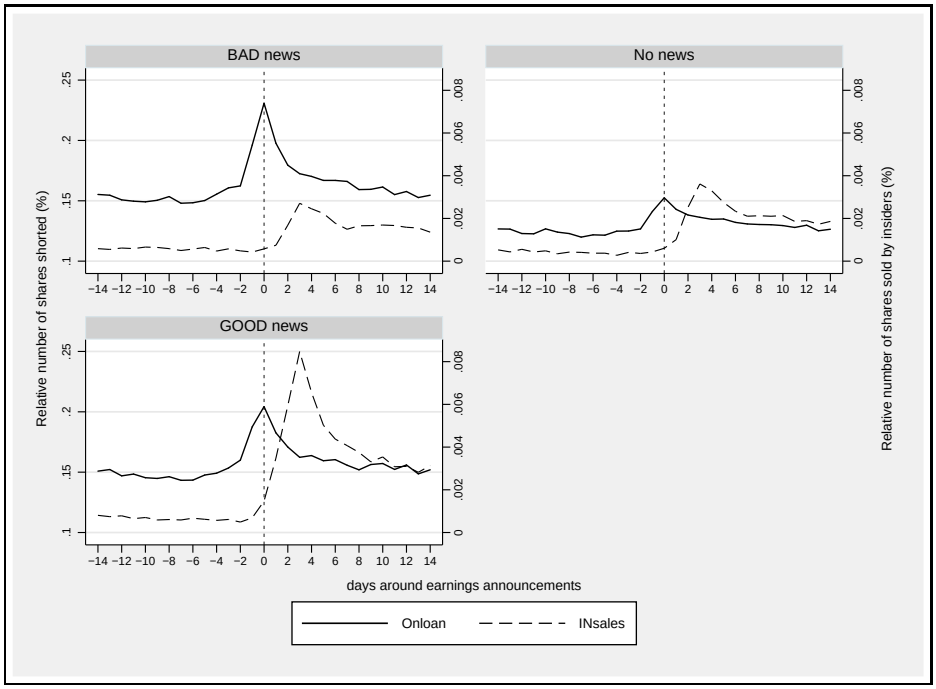
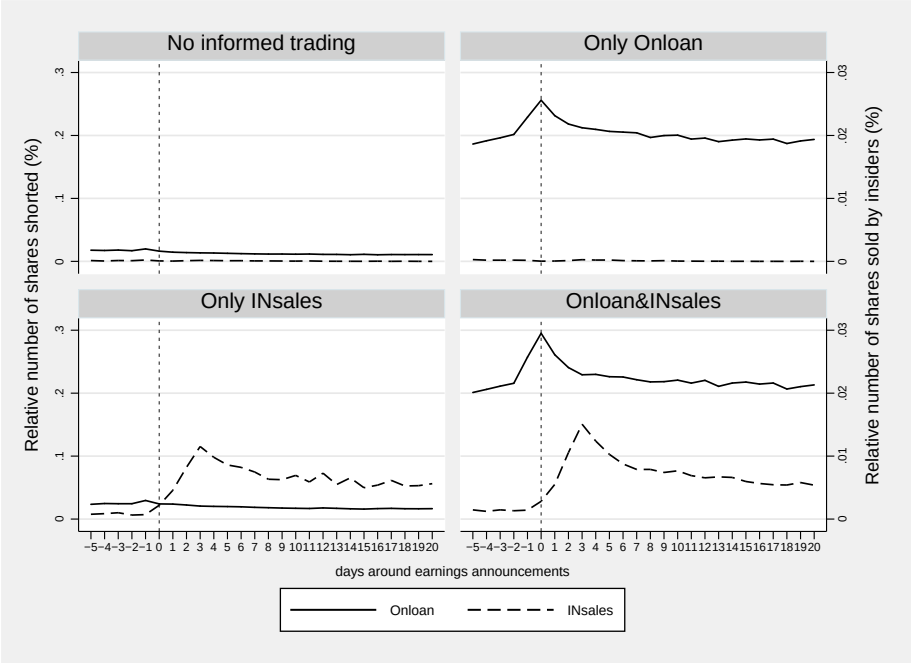


Figure 4: Daily shares sold by insiders and short sellers around earnings announcements categorized by informed trading type.

The figure shows the number of shares sold by insiders (*INsales*) and the number of shares shorted (*Onloan*) around earnings announcements scaled by the number of shares outstanding. *Onloan&INsales* is a firm-quarter with intensive short selling and insider selling activity during the informed trading response period (see Figure 1). *Only Onloan* is a firm-quarter with intensive short selling activity and little or no insider sales during the informed trading response period. *Only INsales* is a firm-quarter with intensive insider selling and little or no short sales during the informed trading response period. *Low informed trading* is a firm-quarter with low or no insider and short selling activity during the informed trading response period.

Panel A



Panel B