Insider Trading under Short Selling Pressure:

An Incentive Based Story *

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Abstract

Insider trading activities based on private information has drawn the attention of a body of studies. However, a less obvious factor in insiders' loss function, the bonding to the firm, is overlooked. We find that insiders buy and sell their shares more aggressively when short selling pressure is high, implying both informed- and incentivized- trading. Specifically, the top executives and directors, who have the highest level of bonding to the firm, drive the buying activities under short selling pressure. Moreover, the insiders' sensitivity of buying to shorting pressure is higher for higher E-index firms and for family firms. We extend our study to the informativeness of insider trading, finding that when the shorting pressure is high, insider's sales predict negative returns in the near future, but insiders' purchases are more like fake signals followed by hump-shaped return pattern.

JEL Classification: G14, G30, G32, G34, D5, D8

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1. Introduction

A large body of literature suggests that insiders trade on private information (e.g., Lakonishok and Lee, 2001; Marin and Olivier, 2008; Ravina and Sapienza, 2010; Anderson, Reeb, and Zhao, 2012; Cohen, Malloy, and Pomorski, 2012). Unlike the outside investors, insiders have more concerns about their compensation, job security, and benefit of control. Therefore, insiders might trade because of those reasons, in addition to the private information they could exploit for abnormal return. For example, Fidrmuc, Goergen, and Renneboog (2006) find insider trading preceded by news on M&A and CEO replacements contains significantly less information. Such trades are not driven because of information, but because of the ownership and control structure, given change of ownership and control happens after M&A and CEO replacements. Denis and Xu (2013) find that when insider trading becomes more restricted by law, the insiders' total pay and equity incentives increase. That implies the insider trading is not only about profit from private information. Rather, insider trading is partly about insiders' incentive and the incentive should be compensated by other methods, if insider trading is restricted. Fos and Jiang (2015) uncover very interesting behavior that when a proxy contest is coming, CEOs exercise in-the-money options. CEOs' trading action suggests their desire to maintain or strengthen voting rights to defend their valuable private control within the firm when facing challenges.

In this paper, we are going to extend those studies by examining insider trading that is not information driven. The vehicle that we are going to use is short selling. At least two reasons make the study on short selling attractive. First, to a large extent, short sellers share the same spirit as the regulators, both acting as guardians of the market. To regulate insider trading, for instance, Congress passed Sarbanes-Oxley (SOX) in 2002, which reduces the disclosure latency of insiders' transactions dramatically – prior to SOX, the disclosure latency could be up to 40 days, but SOX required to file with the SEC within two business days. One particular mechanism that short sellers could be valid external governance, as discussed in Yermack (2010), is corporate voting. There is no requirement for an investor

who borrows shares to sell them short; the shares could simply be borrowed for voting purposes and then returned to their owners. Therefore, when voting right is needed prior to the proxy record date, institutional investors restrict lendable supply to prevent borrowing from lending market (Aggarwal, Saffi, and Sturgess, 2015). Knowing short sellers' role as external governor, recent studies then examine the effectiveness of such role. Short sellers have been shown to be able to detect misrepresentation in their financial statement (e.g., Karpoff and Lou, 2010; Fang, Huang, and Karpoff, 2015). A manager who faces reputational or pecuniary losses will dare not to act against the shareholders' best interest. One example is Massa et al. (2015b) which documents a significantly negative relationship between the threat of short selling and earnings management. Similarly, Chang, Lin, and Ma (2015) examine the disciplinary effect of short selling threat on deterring managers from conducting value-destroying M&As, where they find increased firm value (Tobin's Q) is followed by increased lending supply.

Second, the interaction between short sellers and insiders enables us to examine insiders' trading incentive other than profit of insider information. On one hand, it has been documented that short sellers are well informed (e.g., Christophe, Ferri, and Hsieh, 2010; Engelberg, Reed, and Ringgenberg, 2012). When more than one party are informed, those informed parties are in competition to trade out and trade faster of the negative information (Massa et al., 2015a; Khanna and Mathews, 2012). Though the consequence of the insider trading could still be abnormal profit, the incentive of trading is no longer merely inside information, but preempting the other informed parties. On the other hand, the downward price pressure (short selling pressure measure is an ex ante measure) resulted from short sellers can damage insiders' personal interests, such as reduced stock-based compensation, increased likelihood of hostile takeover, and failure to meet market expectation. More severely, excessive stock price declines due to short selling pressure can have feedback effect on the real decisions of firm's stakeholders, which

leads to permanent damage of firm value (Grullon, Michenaud, and Weston, 2015). Therefore, insiders might have the tendency either to avoid the attention of short sellers or to deter the short sellers in advance.

We hypothesize that the insiders' activities under short selling pressure can be twofold, if insider trading is driven because of both information and non-information reasons. One common action of insiders is to sell more. Regardless of the level of short selling pressure, the conventional studies on insider trading suggest that insider selling could be purely information driven. Massa et al. (2015a) in addition show that with short selling pressure, insiders are incentivized to sell more and trade faster to preempt the potential competition from short sellers. The other action of insiders, though less common, is to buy more under short selling pressure. It seems counter-intuitive that informed insiders do not take advantage of private information by selling on corporate bad news. However, as discussed in the theory paper of Khanna and Mathews (2012), we often overlook the potentially critical role of blockholders who maintain long positions in the firm's stock. A blockholder, who has large stake within a firm, has powerful natural incentive to prevent the impact of short selling (on both price and firms' real finance and investment policies) by buying enough shares to keep prices high enough. In that sense, a blockholder's purchase behavior is not unrealistic, from his/her job security, reputation, compensation purposes, and from the firm's price and real value purposes.

In this paper, we empirically test whether or not insiders will sell more under high short selling pressure, and whether or not insiders will buy more as well under high short selling pressure. We start with a conditional logit analysis of how short selling pressure would affect insiders' tendency to trade, finding that last month's short selling pressure will lead to both more insider selling activity and more insider buying activity in current month. In fact, the insiders not only have more tendency to trade, they also trade more inter of dollar value of trading and number of shares of trading. We interpret our main results as with high short selling pressure, insiders sell more and buy more at the same time, showing both

their concern of information competition with short sellers and their concern of supporting the firm and their personal stake at the firm. In such a sense, we confirm Massa et al. (2015a)'s information competition story between short sellers and insiders, and provide new insights to insider behavior that is consistent with Khanna and Mathews (2012)'s theory.

To better understand the puzzling pattern of insiders' buying and selling, we further explore in multiple directions. We categorize all the corporate insiders into *HighBonded* insiders and *LowBonded* insiders based on the insiders' incentive aligned with the firm. Specifically, following Massa et al. (2015a) and Cohen, Malloy, and Pomorski (2012), we group officers and directors together as the more aligned insiders (*HighBonded)* and the rest (e.g., Secretary, Controller, Indirect Shareholder, Retired, etc) as the less aligned insiders (*LowBonded*). Those more aligned parties are assumed to have more private information about the firm, and meanwhile, have more incentive to take care of their personal interest in the firm and the firm's interest. This is in line with Ravina and Sapienza (2010) that insiders' action depends on the level of insider information they could obtain and their monitoring role playing in the firm. We find that both types of insiders have more selling following high short selling pressure, thus, we confirm that insider, regardless of a more aligned or less aligned insider, sell more because of private information. More interestingly, only the *HighBonded* buy more, whilst the *LowBonded* do not buy more. We conclude as more aligned insiders buy and sell because of both information and their personal incentive reasons, while the less aligned insiders sell because of information reason and do not buy because of lack of incentive.

We continue our exploration by incorporating a firm's internal corporate governance. As discussed before, short seller act as external governance. Its effect on insider trading might be distorted because of the existence of strong or weak internal governance. We thus follow Bebchuk, Cohen, and Ferrell (2008) to construct E-index as proxy of internal governance quality. With weaker internal governance, both the

more aligned and less aligned insiders take advantage of that by selling more, which lends support to Ravina and Sapienza (2010) that insiders profit the most from their insider information when internal governance is the weakest. Moreover, with weaker internal governance, the more aligned insiders also lose their incentive to support the firm via buying. We interpret the results as weaker internal governance provides insiders more protection on their personal stake within the firm, creating shelters for them to act not in the best interest of the firm. We confirm our analysis on internal governance by identifying family firms and non-family firms (Anderson and Reeb (2003), Anderson, Reeb, and Zhao (2012)). We hypothesize that given insiders of family firms have stronger long-term incentive than non-family firms, those insiders should exhibit stronger tendency to support their family firms. Indeed, we find family insiders buy more and sell more under short selling pressures, consistent with both information story and incentive story.

Our incentive story about insiders' trading behavior is well sustained by the fact that insiders buy even when bad news is coming (we compare following month's earnings versus analyst' consensus). Our results are also robust after following Cohen, Molloy, and Pomorski (2012) to separate insider trading into opportunistic trading and routine trading. According to Cohen, Molloy, and Pomorski (2012), the opportunistic trading is information driven while routine trading is not. We find out that both opportunistic buying and selling increases following higher short selling pressure, but routine buying is not responsive to short selling pressure. This at least precludes the possibility that insiders trade purely because of non-information reason.

To our best knowledge, we are the first paper studying insiders' buying behavior under short selling pressure, which provides important evidence on insiders' underlying incentives that are behind the observed insiders' trades. This provides new insights for regulators and policy makers in terms of the interaction between insider trading rules and restrictions on short-selling activities. More specifically, we

contribute to different strands of the literature. First, this paper is related to insider trading, especially the non-information driven trading. Second, this paper is related to the literature on short selling. Short sellers serve as a double-edged sword to firms-- a "threat" to firm price and fundamentals, and a "guard" providing external governance. We unfold a complete picture of how insiders would react, looking at both purchase and sale of insider transactions. Our results imply more private information will be released from selling, and at the same time, more purchase occur from the insiders that have highest incentive to protect their interests attached with the firm. Finally, we offer new understanding on the interaction between internal governance and external governance. The two types of governance are not isolated. Their interplay determines information environment and distort insiders' incentive, which result in different insider trading behaviors.

The remainder of our paper is organized as follows. The data source and measurement construction are listed in Section 2. In Section 3, we present our main tests on whether insiders buy more when short selling pressure is high, as well as who are the insiders driving this pattern. In Section 4, we provide additional evidence for incentive story from the cross-section of firms. In Section 5, we show the how informative is the insider trading activity under high and low short selling pressure. Section 6 provides robustness tests with alternative definition of insider trading, and Section 7 concludes the paper.

2. Data and variable construction

In this section, we describe the sample selection process and how each variable is constructed. We also summarize our sample statistics.

2.1. Data source and sample selection

The time frame for this study is July 2006 to December 2011. We begin with the public companies in the US, traded on the NYSE, Nasdaq, or AMEX exchanges. We retain only common stocks (share codes 10 and 11 in the CRSP database). The sample is then matched with short selling information from the North American equity loan market from Markit (formerly Data Explorers), insider trading data from Thomson Reuters, institutional investors' holdings from Thomson 13F, corporate governance data from ISS ("Institutional Shareholder Services", formerly "Risk Metrics"), family firm data from Professor Anderson's website (http://www.ronandersonprofessionalpage.net/), and other corporate information from COMPUSTAT/CRSP.

We obtain short selling data from Markit, a company that collects data from lending desks of most of the large firms in the securities lending industry. It includes data from 125 large custodians and 32 prime brokers in securities lending industry. The data coverage is quite large, accounting for about 80% of US equities and 85% of the securities lending market. The dataset provides detailed information on each stock's number of shares and value of shares that are on loan, number of shares and value of shares that are available to be lent to short sellers, demand of the those shares, and the cost of borrowing those shares. Though the security-level information is available from May 2002, in our study, we focus on the period beginning from July 2006 because prior to that coverage is less comprehensive and only monthly or weekly in frequency.

The data on insider trading comes from Thomson Reuters Insider Filing (Form 4). Thomson Reuters defines insiders broadly to include those that have "access to non-public, material, insider information" and insiders are required to file SEC form 4 when they trade in their company stock. The data contain information on each insider's transactions and each insider's relationship to the firm. For the purpose of our study, we focus on insiders' open market purchases and sales, excluding private or

derivative related transaction. To better understand the incentive story behind insider trading, we refer to the literature (Cohen, Malloy and Pomorski, 2012; Massa et al., 2015a) and further divide the insiders to more aligned and less aligned insiders, which we call *HighBonded* and *LowBonded* insiders respectively. Specifically, directors and executive officers are defined as *HighBonded* insiders. The rest insiders, including other officers, affiliates, beneficial owners, and other insiders, are defined as *LowBonded* insiders. To better understand the insiders' trading pattern, we follow Cohen, Malloy, and Pomorski (2012) and classified the non-information driven insider trading as "routine" trades and information or incentive driven trading as "opportunistic" trades.

We merge Compustat/CRSP data with our equity lending data and insider trading data. We also merge institutional holding data from the Thomson 13F database. We finally merge corporate governance data from ISS and family firm data from Professor Anderson's website. Our final combined data have an average 4,696 stocks per month, which is comparable to Massa et al (2015a)'s 4,168 stocks per month.

2.2. Main Variables

To investigate the impact of short selling on insiders' behavior, we focus on the *ex ante* "short selling pressure" (SSP) – i.e., the maximum potential impact that short sellers may have on firm or on stock prices. The main proxy for SSP is the total supply of shares that are available to be lent for short seller (hereafter, *Lendable*). Massa et al. (2015a) are using this same variable. Though prior literature suggest *ex post* measure of short selling activity contains valuable information [Anderson, Reeb, and Zhao, 2012; Asquith, Pathak, and Ritter, 2005], our usage of *ex ante* measure of short selling activities has the following features different from *ex post* measure. First, the *ex ante* measure is a better measure of how much "threat" insiders are facing. Insiders respond to the existing short selling pressure, not vice versa. The *ex post* measure, however, might capture the short sellers' reaction to insider trading, which goes beyond of the scope of our research question (Laksanabunsong and Wu (2015) is one of the example that

studies the short sellers' reaction to insider purchases). Second, insider trading can be impacted by short selling because short-sale constraints reduce informative trades and the speed of adjustment to private information (Diamond and Verrecchia, 1987). As in Saffi and Sigurdsson (2011), a limited supply of lendable shares imposes short-sale constraints. Prior to Saffi and Sigurdsson (2011), research in lending market use loan fees or short interest (D'Avolio, 2002; Asquith, Pathak, and Ritter, 2005) to proxy for short-sale constraints. However, high short interest and loan fees might result from increased borrowing demand, which reflects investors' negative views about the stock and it is not truly related to short-sale constraints. In other words, the *ex ante* measure (short selling pressure) is better related to short-sale constraints that affect insider trading. Third, as shown in Prado, Saffi, and Sturgess (2016), more active shareholder are less likely to lend shares to short sellers. Therefore, our *ex ante* measure is more about the passive supplies of lendable shares. As discussed in Massa et al (2015b), the passive supply is an instrument to control for the spurious impact of internal monitoring. In comparison, the conventional short interest might have both the passive and active components, making it harder to disentangle the insiders trading influenced by the presence of short selling pressure or by the presence of activists

We have a battery of key variables related to the insider trading decision. We firstly define a set of dummy variables, indicating whether or not insider trading happens. *BuyDummy* equals to 1 if there is an open market purchase in the current month by any insiders (as recorded in Form 4 of the Insider Filing); *BuyDummy* equals to 0 if there is no insider trading in the current month. Similarly, we define *SellDummy* equals to 1 if there is an open market purchase in the current month by any insiders, and 0 if there is no insider trading in the current month. Following the same fashion, we define *Routine BuyDummy*, *Rountine SellDummy*, *Opportunistic BuyDummy*, *Opportunistic SellDummy*. In addition to those dummy variables, we also examine the value of shares selling or buying, as well as the number of shares selling or buying in the open market, which are designed to capture the size of insiders' trades. *DollarBuy* and *DollarSell*

are defined as the natural logarithm of one plus the value of shares that insiders trade in the current month[1], while *ShareBuy* and *ShareSell* are defined as the natural logarithm of one plus the number of shares that insiders trade in the current month. The dollar value (and the number of shares) of opportunistic and routine trading are defined as well.

The literature suggests that certain firm characteristics may affect the insiders' trading behavior. Primarily following Massa et al. (2015a), we construct a set of control variables. *Ln(Market Size)* is the natural logarithm of the market capitalization of the firm; *Market-to-Book* is market capitalization divided by book value of the firm; *PastRet* is the stock's past 12 month cumulative return; *Idiosyncratic Volatility* is calculated as the standard deviation of the stock's past 12 month return; *Turnover* is the sum of monthly trading volumes divided by shares outstanding; *Leverage* is long-term debt plus current liability, divided by total assets; *IO* is institutional ownership, defined as institutional ownership shares divided by shares outstanding; *Ln(Sale)* is the natural logarithm of gross sales.

More detailed variable definitions can be found in Appendix A. We provide summary statistics for the variables used in Table 1. Panel A reports summary statistics of stock- and firm-level characteristics in the full sample, and Panel B reports the insider trading activities conditional on non-zero insider transactions. An average firm has 15% of its total shares outstanding in the inventory available for borrowing (Lendable). More importantly, the standard deviation in the lendable shares (13%) indicates a significant amount of variation among firms across the years. In our sample, 24% of the firms have an open market insider selling, and 14% of the firms have an open market insider buying.

3. Main Results

[1] Because of the existence of zero trading shares in our sample, we take nature logarithm of one plus shares instead of original shares.

In this section, we test the trading activities of insiders in response to the existence of short selling pressure. Insiders are considered as all together and as *HighBonded* or *LowBonded* insiders separately. Moreover both tendency and size of insider trading are studied.

3.1. Do insiders buy and sell more aggressively when short selling pressure is high?

Similar to Massa et al. (2015a), we start with testing how the short selling pressure affects insiders' trading tendency in the subsequent month. All control variables are lagged for one month to avoid forward looking problem. We report the results in Panel A of Table 2.

[Insert Table 2 Here]

In Panel A, we estimate a logistic regression with $BuyDummy_{i,t}$/$SellDummy_{i,t}$ as dependent variable and $Lendable_{i,t-1}$ as independent variable. $BuyDummy_{i,t}$ ($SellDummy_{i,t}$) is a variable equals one if insiders of firm i has an open market buying (selling) at month t, and equals zero when there is no insider transactions. By construction, insider buying and selling have the common benchmark as no insider transaction. The results for *BuyDummy* and *SellDummy* are reported in Columns (1) and (2) respectively. The Column (2) of Panel A is consistent with the information competition theory from Massa et al. (2015a). Under higher short selling pressure, insiders have higher tendency to sell in the near future. The coefficient is 1.68 significant at 1% level, indicating that for a one-standard-deviation increase in lendable shares (13%) the relative probability of insider sales is increased by 21.8%. According to Column (1) of Panel A, the higher short selling pressure also drives insiders' tendency to buy the firm shares in the next month. The coefficient is 1.24, significant at 1%, meaning that for one-standard-deviation increase in lendable shares, the relative probability of insider buying is increased by 16.1%. This is consistent with the incentive story we postulate.

Altogether, we find that under higher short selling pressure, insiders have higher tendency to both buy and sell the firm shares. Our results are consistent with Massa et al. (2015a) and Khanna and Mathews (2012). Given that both insiders and short sellers have access to negative private information of the firm, short selling pressure forces insiders to sell more aggressively to preempt the trading profit of short sellers. Interestingly insiders also have higher tendency to buy firm shares more aggressively as well. Such action cannot be explained if insiders simply want to profit from their inside negative information. We therefore conjecture that insiders' buying activity could be motivated by reasons other than trading profit from private information. We will further explore this in later sections.

In addition to the study of insiders' tendency of buying and selling under short selling pressure, we also examine the size of their transactions. We test how the shares and dollar value of insider buying or selling are changed following the variation of short selling pressure in the preceding month. The results are shown in Panel B of Table 2. Column (1) and (2) are about the transaction shares. The regression coefficient of lendable are 0.85 for *SharesBuy* and 2.34 for *SharesSell,* and both are significant. The economic significance is also considerable: for a one-standard-deviation increase of short selling pressure, the shares bought by insiders are increased by 11.1% and the shares sold by insiders are increased by 30.4%. The increase in *SharesSell* as reaction to higher shorting potential is consistent with Massa et al. (2015a) – i.e., information competition. Insiders sell more shares to quickly preempt the profitability of their private information when facing the potential trading threat from another informed trader. The increase in *SharesBuy* is consistent with the incentive based story we propose. The results suggest that when short selling pressure is high and firms are threatened by potential downward price pressure, insiders are motivated to conduct open market purchasing transaction with larger transaction size as to convey stronger positive signal to the market.

In a sum, this section shows the insiders' have more aggressive buying activity when facing higher short selling pressure. In fear of the potential value-destroying trading activity from short-sellers, insiders have the tendency to buy the firm shares in the open market. At the same time the size of their buying transaction is larger as an attempt to release stronger signals to the market comparing to the scenario with lower threat from short sellers.

3.2 Do Insiders with higher and lower incentives trade differently?

From the results above, it seems the information competition and incentivized price supporting are ongoing motivations for insider trading. More specifically, the objective of an insider is a complicated function of both trading profit and their self-interest bonded to the firm. When the short selling pressure is high therefore the potentially downward price pressure from short seller is high, insiders do not only sell the firm shares more aggressively to preempt the trading profit, but also buy the shares more actively in the open market to prevent the firm price from value destroying. The two opposite trading activities can exist at the same time for insiders, whose incentives are bonded to the firm differently; also they can exist for the same insider but at different time point with respect to the dynamic trade-off between the trading profit and bonding incentives.

To test the incentive based explanation for the insiders' higher buying activity responding to increased shorting pressure, we divide the insiders to be either *HighBonded* insiders or *LowBonded* insiders and we check look into the difference in the sensitivity of their trading activities to the short selling pressure. Basically, *HighBonded* insiders include the board of directors and the top-executives officers, whose compensation, job security and blockholding value are closely related to the firm's short-term price volatility and long-run performance. The rest of the insiders, including non-executive and non-president officers, affiliates, and beneficial, are categorized into the *LowBonded* insiders. The transaction of *HighBonded* insiders contributes to 58.4% of the overall trades.

In this section, we conduct the same set of tests as we have in Section 2.1, but do the tests for *HighBonded* and *LowBonded* insiders separately. The logistic regression results for the buy and sell tendency are shown in Panel A of Table 3, while the results for the shares and dollar value of insider transactions are shown in Panel B and C of Table 3 respectively.

[Insert Table 3 Here]

According to Column (1) and (2) of Panel A, for *HighBonded* insiders, the higher short selling pressure leads to higher tendency of both buying and selling (with coefficient 1.51 and 1.65 respectively, and are both significant at 1%). For a one-standard deviation increase in Lendable shares, the probability for a *HighBonded* insider to buy and sell the firm shares are increased by 19.6% and 21.5% respectively. However, as in Column (3) and (4), the *LowBonded* insiders only have higher to sell probability to sell the firm shares (coefficient as 1.89 and significant at 1%) but unchanged probability to buy the firm shares (coefficient as 0.47 with no significance).

Similar pattern shows for size of HighBonded/LowBonded insiders' trades. The *HighBonded* insiders have larger buying transactions when the short selling pressure is high. The coefficient is 0.77 and 0.95 for *SharesBuy* and *DollarBuy* respectively, both significant at 1%. At the same time, they have larger selling transactions as well. The coefficient is 1.68 and 2.33 for *SharesBuy* and *DollarBuy* respectively, both significant at 1%. However for the *LowBonded* insiders, they only increase the size of their selling transactions when facing the higher short selling pressure (1.54 and 2.23 for shares and dollar value sale, both significant at 1%), and have no significant change for both shares and dollar value of buy transactions.

This section provides evidence for the incentive based story for insider trading. Insiders are bonded to the firm they work for in different ways and with different strength. For instance, the compensation and job security of the executives are directly tied to the price of the firm at certain time of

a year or the long-term performance of the firm; Directors have reputation and controlling power attached to the firm value. When the shorting potential is high, although they get higher trading profit from selling more than potential short sellers, the cost from potential price depressing may be large and even outweigh their trading profit. Thus, for these *HighBonded* insiders, the value maximization strategy when shorting pressure is high can turn out to be buying instead of selling. In contrast, for other insiders whose compensation is less connected to the firm value or who are not directly responsible for the firm's malfunctioning, the bonding incentives they have would be lower, which contributes less to their overall wealth as compared to the direct profit from trading on private information. As a consequence, when shorting capacity is high, these less-boned insiders are less incentivized to sacrifice their trading profit for price supporting.

4. Cross-sectional Analysis

Although the sensitivity of insiders, especially the *HighBonded* insiders, buying to short selling pressure is consistent with the incentive story we propose, alternative explanations exists. In this section, we seek additional evidence from the cross-section of firms. Firms are different in how strongly the corporate insiders are bonded, therefore the sensitivity of insiders' buying to short selling pressure varies across firms accordingly. More specifically, if incentive based explanation holds, the more aggressive buying activities are expected to show up for firms with stronger firm level bonding for insiders.

4.1 High E-index vs. Low E-index

E-index is a widely measure of corporate governance. It is a count for the treaties protecting the firm from potential hostile takeover. The higher the E-index, the higher level of protection is guaranteed for firm executive. If the incentive story holds for explaining the insider buying-lendable sensitivity we

observed in Section 2, then the degree of this sensitivity is expected to vary across firms where the top-executive are protected to different extent. More specifically, when the E-index of a firm is higher, the *HighBonded* insiders are more immune to potential bad consequence of price depressing, thus are less they are less motivated to buy stocks and support the market price of the firm when the potential value-destroying threat from short seller is high.

In each year, we sort the firms by their E-index. A *High E-index* variable is set to be one if the E-index of the firm is above the median of all firms in that year, and zero otherwise. We test how the corporate governance could affect the sensitivity of insider buying to short selling pressure by adding the interaction term of firm's *High E-index* dummy and the lagged short selling pressure to the sensitivity test model. The results are shown in Table 4 Panel A.

[Insert Table 4 Here]

Column (1) of Panel A shows that for all insiders, as E-index increase from low to high, the buy-lendable sensitivity decrease. As comparing Column (2) and (3), this decrease in buy-lendable sensitivity is primarily driven solely by the *HighBonded* insiders. This result is consistent with the prediction of our incentive story that the *HighBonded* insiders are the ones incentivized to buy shares as for price supporting. Thus the shifting of firm-level bonding incentives of insiders should only affect the buy activity of *HighBonded* insiders not *LowBonded* insiders. As shown in Column (4) to (6) the sell-lendable sensitivity is increased with E-index. When insiders are well protected, they feel less hesitate to engage in trading competition with short sellers, which might further depress the stock price of the firm.

4.2 Family firm vs. Non-Family firms

Insiders of family firms have stronger long-term incentive than those of non-family firms. The dramatic short selling could not only depress the firm price in short-run, but also be detrimental to the

firm value and fundamentals in the long-term. So the *HighBonded* insiders in family firms will by nature have the stronger incentive to support the firm price when short selling pressure is high.

Similar to our analysis with high and low E-index firms, we separate our sample to into family and non-family firms, and create a *Family* dummy that equals one if the firm is a family firm and zero otherwise. By introducing the interaction term of *Family* dummy and Lendable, we are able to see how the insider buy/sell-lendable sensitivity varies across family and non-family firms. The results are shown in Table 4 Panel B.

From the results of Panel B Column (1) - (3) we can see that, consistent with our expectation, the *HighBonded* insiders have higher buy-lendable sensitivity for family firms than non-family firms, where is coefficient is 1.10 significant at 1% level. However, the *LowBonded* insiders are also shown to have increased buy-lendable sensitivity for family firms. As the sell activity shown in Column (4) – (6), the sell-lendable sensitivity of all insiders are higher for family firms, and is primarily driven by the *LowBonded* insiders.

5. Informativeness of Insider trading

In our main tests, we take the existence of buy-lendable sensitivity of insiders, especially of the *HighBonded* insiders, as an evidence for the incentive based story for insider trading activity. The immediate alternative explanation is an information-based story. The lendable shares might be increased when the uncertainty is high, thus the observed increase in insiders buying as response to higher short selling pressure could be simply an outcome of insiders' private information on upcoming good news of the firm. We study the information content of the insider trading activity when short selling pressure is high. The importance of this set of analysis is threefold: first, it helps disentangle the insider buying

motivated by incentive from insider buying motivated by private information. Second, understanding of how informative the insiders' trading are is important for outsider investors. Third, the influence of insider trading on market efficiency is long lasting debate: insider trading improves the market efficiency if they accelerate the release of private information; however, insider trading could add noise to the market if the trading is motivated by their price supporting incentives.

5.1 Information-event based study

We start with information-event based study. Specifically, we use the earnings announcement as the information release events, and track the insiders' buy/sell-lendable sensitivity one month ahead of the information is announced to the market. In this context, we can test whether the buy-lendable sensitivity is purely driven by good private news about the firm. We merge our sample with the quarterly earnings announcement data and analysts earnings announcement from IBES. When the announced earnings are greater than or equal to the earnings forecast consensus of financial analysts, the earnings announcement is defined to be a good news event, otherwise the earnings announcement is defined to be a bad news event. With respect to this earnings surprise data, we define *BadNews* to be a variable equals one when there is a quarterly earnings announcement of the firm in the month and it's a bad news event, equals zero otherwise. We introduce the interaction term of *BadNews* for t+1 with *Lenable* at t-1 as the main independent variable into the buy/sell-lendable sensitivity test regression. The results are reported in Table 5.

[Insert Table 5 Here]

According to Column (1) to (3), the insiders use open market purchase as a signal to support the price when they have private information about bad news in the near future (the coefficient for *BadNews* for *BuyDummy, DollarBuy, SharesBuy* are 0.57, 0.68 and 0.57 respectively and all significant at 1%). When the short selling pressure increases, the insiders, feel the threat of downward price pressure from

potential short selling activities, therefore have even higher tendency to buy the firm shares and support the price (as in Column (1) the coefficient of interaction term is 0.721 significant at 1% level). However, conditional on coming bad news, they do not increase the strength of signal (size of buying transactions) as the increase of short selling pressure. As in the Column (4) to (6) the short selling pressure does not drive the insiders sell activity when there is no private information about bad news. When bad news is coming, insider have higher tendency to selling and large sell transaction size. Moreover, conditional on private information of bad news, insiders are selling stocks more aggressively when the shorting pressure is high, which is consistent with the prediction of information competition theory

5.2. Return Predictability of Insider trading

To show how informative the insider trading is about future returns, we study the subsequent stock returns of the firm over one to three months. We adjust the monthly individual stock returns with the corresponding market return, and calculate the cumulative stock returns as $R_{i,t+1,t+k} = \prod_{s=1}^{k}(1 + R_{i,t+1,t+s}) - 1$,where k=3. We then run the regressions of $R_{i,t+1,t+k}$ on the insider buying and selling, for k=1, 2, 3 separately. Three months (k=3) is chosen because the time span should be long enough for return patterns to be observed, but also not too long such that the noise induced by other information is low.

To show how the return predictability of insider trading is affected by the short selling pressure, we firstly divide our sample to three portfolios with respect to the ex ante short selling pressure. Then we run the regressions described above to the firms with high and low short selling pressure separately. By construction, the bottom shorting pressure firms have perfect short selling constraint, with zero or close to zero lendable shares. The results are reported in Table 6.

[Insert Table 6 Here]

From the Column (1)-(3) of the upper Panel of Table 6, the cumulative returns of firm increases dramatically following the insider buying activity for the subsequent two months, and sharply drop back to almost zero at the third month. This hump-shaped return pattern implies that when the short selling pressure is high, insiders release fake signal via open market purchase. According to Column (7)-(9) of the lower Panel of Table 6, the cumulative returns decrease steadily after the insider selling, implying that when the short selling pressure is high, insiders compete on informed trading and enhance the release of bad information. In comparison, (4)-(6) and (10)-(12) of Table 6 show that when the short selling pressure is low, the insider buying and selling do not have predictability for the market return.

Insiders conceal their trading activity when shorting selling pressure is low, thus it is less likely to be followed by outside investors and thus is not predictive about future return. When the short selling pressure is high, insider transaction is more visible to the market and is more informative about the future return. This is consistent with the theory model of Kyle (1985). When insiders are the information monopoly, they strategically trade on the market so that the information is released slowly and they can generate the optimal trading profit from their strategy.

6. Robustness

6.1 Net Buying and Net Selling

In the main tests, insider buying and selling are aggregated separately to firm-month level, and by construction, a firm can have both insider buying and selling at the same time. In this alternative setting, we check the sensitivity of net firm-level buying and selling to short selling pressure. We assign the shares and dollar value of insider buying to be positive, while assign those of insiders selling to be negative. After being aggregated to firm level at each month, the sign of shares trade value captures the net direction

of all insider transactions. Specifically, the *NetBuyDummy* equals one if the shares trade for the respective firm and month are positive, and zero otherwise. Similarly, *NetSellDummy* is set to be one when the shares trade is negative, and zero otherwise. *NetShares* and *NetDollar* is then the sum of the signed shares and dollar value for respective year and month. Specifically, *NetShares* and *NetDollar* can be negative, when the overall share or dollar value of shares bought by insiders of a firm are less than shares sold by them at the month. The results are reported in Panel A of Table 7.

[Insert Table 7 Here]

From Column (1)-(3) we can see that insiders have higher probability to buy, and this increase in probability is driven by *HighBonded* insiders not by *LowBonded* insiders. For the selling side, both *HighBonded* and *LowBonded* insiders engage in the information competition with short sellers. While for the net trading size, not any one of the two ongoing motivations for insider trading can dominate the other. We expect the coefficient estimate of *Lendable* for net sell size of *LowBonded* insiders to be significantly negative, considering that they do not have the incentive to buy and support the price.

6.2 Opportunistic and Routine Transactions

The other set of alternative variables for insider trading is routine and opportunistic trades, following Cohen, Malloy and Pomorski (2012). It distinguishes the insider trades that are purely routinized from that are information driven. In the sample insiders have open market transaction on the firm stock for at least three consecutive years in the past are included. At the beginning of each year, we track the insiders' stock trading activity during the previous three years. An insider is defined to be a routine trader afterwards if she has transactions at the same month for the three consecutive years. The non-routine insider is defined to be optimistic trader. The selling or buying transactions from a routine trader is defined to be routine sell or routine buy respectively. Similarly, selling or buying transaction from an opportunistic

trader is defined to be opportunistic selling or optimistic buying. Optimistic selling or buying is found to be information driven. The results are reported in Panel B of Table 7.

The results are also consistent with our main results. As shown in Column (1) – (4), *HighBonded* insiders have higher tendency to buy when the short selling pressure is high, and is mainly driven by their opportunistic transaction. They also have higher tendency to sell, and it is true for both of their opportunistic and routine selling. As shown in Column (5) – (6), *LowBonded* insiders have no change in their tendency to buy when the short selling pressure is high, and it's true for either opportunistic or routine buys. But they do have higher tendency to sell, and it holds for both of their opportunistic and routine transactions.

7. Conclusions and Remarks

In this paper, we postulate that trading profit and bonding are the two factors of concern when insiders are trading in the open market. Using the presence of short selling pressure as the vehicle, we find that the inform-trading and incentivized trading both exist. The increase of short selling pressure drives up the insiders' probability to sell and share/dollar value to sell in the near future. This is consistent with the empirical findings of Massa et al. (2015a) and is an outcome of insiders trading competition on private information. More interestingly, we find that despite the changes of sell activities, insiders also buy the firm shares more aggressively under higher short selling pressure. This evidence indicates that with the potential price depressing threat from short sellers, insiders also release good signal to support the price via open market purchase. Consistent with the incentive story, we find the buy-lendable sensitivity for insider to be primarily driven by the directors or top-executive officers who are closely bonded to the firm.

Moreover, the buy-lendable sensitivity for insiders varies cross-sectional with the characteristics of a firm. We find that insiders have more aggressive buying activities as response to short selling pressure when the firm has a high E-index, where top-executives are better protected by the anti-takeover entries; or when the firm is a family firm, where the insiders have stronger long-term bonding with the firm.

We also study the informativenes of insider trading. Conditional on a forthcoming bad private news about earnings announcement, insiders increase their probability to buy as to deter the entering of short sellers and support the price from being depressed; meanwhile they also have higher tendency to compete in trading on this bad private news and sell more aggressively. We further analyze the return pattern three months subsequent to the insider trading activities, finding that when the short selling pressure is close to zero, the insiders trading is not predictable for future returns. This could be explained by the fact that they trade more strategically to conceal the information they have when they are information monopoly in the market. Interestingly, when the short selling pressure is high, the insider selling is followed by steady decrease in stock price, but insiders' buying is followed by a hump-shaped stock price movement. This implies that when the short selling pressure is high, insider selling is bad-information driven and accelerates information release, but insider buying is more like a fake signaling that only support the price in a short-run.

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Appendix A. Variable Definitions

Variables	Definitions
Insider Trading Variables	
$BuyDummy_{i,t}$	Equals one if there is at least one insider buying transaction of firm i at month t; zero if there is no insider transaction of firm i at month t.
$SellDummy_{i,t}$	Equals one if there is at least one insider selling transaction of firm i at month t; zero if there is no insider transaction of firm i at month t.
$SharesBuy_{i,t}$	The natural logarithm of one plus the number of shares that insiders in firm i purchased at month t.
$SharesSell_{i,t}$	The natural logarithm of one plus the number of shares that insiders in firm i sale at month t.
$DollarBuy_{i,t}$	The natural logarithm of one plus the market value of shares that insiders in firm i purchased at month t.
$DollarSell_{i,t}$	The natural logarithm of one plus the market value of shares that insiders in firm i sale at month t.
$HighBonded$	Insiders that are board directors and top executive officers following the definition of Thomson Reuters Form4
$LowBonded$	Insiders that are available in Thomson Reuters Form4 but are not categorized to be HighBonded insiders
Firm Characteristics	
$Ln(Sales)$	Natural logarithm of total sales (in $millions)
$Inst.Ownership$	Percentage of shares held by institutional investors, averaged over the four quarters in a year
Ln(Market Size)	Natural logarithm of total assets (in $millions)
M/B	Market capitalization divided by book value of the firm
$Idiosyncratic\ Volatility$	The standard deviation of the stock's past 12 month return
$Leverage$	Long-term debt plus current liability, divided by total assets
$Turnover$	The sum of monthly trading volumes divided by shares outstanding
$PastRet$	The cumulative stock return for the past 12 month

Table 1. Summary Statistics

This Table presents summary statistics of the key variables from July 2006 to Nov, 2011. Variable definitions are in Appendix A. All variables are winsorized at 1% and 99% level.

	Obs.	Mean	Std.Dev	5%	25%	50%	75%	95%
Full Sample								
Lendable	288,931	0.15	0.13	0.00	0.01	0.14	0.26	0.38
market size	282,072	0.00	0.01	0.00	0.00	0.00	0.00	0.01
B/M	266,079	0.44	0.56	-0.19	0.03	0.29	0.72	1.54
Turnover	283,915	0.00	0.00	0.00	0.00	0.00	0.00	0.01
PastReturn	283,801	0.00	0.18	-0.25	-0.07	-0.00	0.07	0.25
Leverage	255,499	0.20	0.26	0.00	0.02	0.14	0.30	0.61
Sale (million)	267,514	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Idiosyncratic volatility	281,277	0.48	0.32	0.14	0.27	0.40	0.60	1.10
IO	239,699	0.57	3.83	0.03	0.27	0.60	0.83	1.02
SellDummy	263,055	0.24	0.42	0.00	0.00	0.00	0.00	1.00
BuyDummy	234,468	0.14	0.35	0.00	0.00	0.00	0.00	1.00
HighBonded BuyDummy	244,272	0.18	0.38	0.00	0.00	0.00	0.00	1.00
HighBonded SellDummy	227,939	0.12	0.32	0.00	0.00	0.00	0.00	1.00
LowBonded BuyDummy	238,335	0.16	0.36	0.00	0.00	0.00	0.00	1.00
LowBonded SellDummy	212,408	0.05	0.23	0.00	0.00	0.00	0.00	1.00
Conditional on non-zero insider buy or sell dummies								
SharesSell	88,017	0.22	3.00	0.00	0.00	0.01	0.05	0.40
SharesBuy	88,017	0.13	7.20	0.00	0.00	0.00	0.00	0.10
HighBonded SharesSell	88,017	0.10	1.71	0.00	0.00	0.00	0.02	0.20
HighBonded SharesBuy	88,017	0.05	4.99	0.00	0.00	0.00	0.00	0.04
LowBonded SharesSell	88,017	0.12	1.91	0.00	0.00	0.00	0.01	0.14
LowBonded SharesBuy	88,017	0.08	3.15	0.00	0.00	0.00	0.00	0.02
DollarSell	88,017	4.92	66.89	0.00	0.00	0.14	1.11	10.82
DollarDuy	88,017	1.16	92.21	0.00	0.00	0.00	0.02	0.64
HighBonded DollarSell	88,017	2.42	32.19	0.00	0.00	0.00	0.43	6.18
HighBonded DollarDuy	88,017	0.23	6.48	0.00	0.00	0.00	0.01	0.26
LowBonded DollarSell	88,017	2.50	46.67	0.00	0.00	0.00	0.22	3.75
LowBonded DollarDuy	88,017	0.94	91.78	0.00	0.00	0.00	0.00	0.11

Table 2. Regression of insider trading activities on short selling pressure

This Table presents the tests results of how the short selling pressure affects insider buys and sells using sample from June 2006 to December 2011. In Panel A, we estimate a logistic regression where the dependent variables $BuyDummy_{i,t}$ ($SellDummy_{i,t}$) is a dummy variable equals one if insiders of firm i has conduct any open market purchase (sale) transactions at month t, and equals zero when there is no insider transactions. By construction, *BuyDummy* and *SellDummy* have the common benchmark as firm-month with no insider transaction. The results for *BuyDummy* and *SellDummy* are reported in Columns (1) and (2) respectively. In Panel B, the dependent variables are $SharesBuy_{i,t}$ and $SharesSell_{i,t}$, which is the nature logarithm of one plus total shares insider bought or sale for firm i, at month t, the results are reported in Columns (1) and (2) respectively. Dependent variable are $DollarBuy_{i,t}$ and $DollarSell_{i,t}$ the nature logarithm of one plus total dollar value insider bought or sale for firm i, at month t, and results are reported in Columns (3) and (4) respectively. All control variables are defined in Appendix A. We include firm, year, and month fixed effects. P-values based on robust standard errors are reported in parentheses under the corresponding estimated coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A. logit regression for insider buy and sell dummies

	(1) $BuyDummy_{i,t}$	(2) $SellDummy_{i,t}$
$Lendable_{i,t-1}$	1.24***	1.685***
	(0.000)	(0.000)
$log(market\ size)$	-0.82***	1.682***
	(0.000)	(0.000)
M/B	0.0221	-0.35***
	(0.766)	(0.000)
$PastRet$	-0.132**	0.0928
	(0.028)	(0.112)
$Idiosyncratic\ Volatility$	-0.30***	0.438***
	(0.000)	(0.000)
$Turnover$	331.8***	137.3***
	(0.000)	(0.000)
$Leverage$	-0.544**	0.258
	(0.021)	(0.220)
IO	-0.63***	-0.72***
	(0.002)	(0.000)
$Log(sales)$	0.113**	-0.081**
	(0.011)	(0.047)
$Fixed\ effect$	YES	YES
$Obs.$	93,901	130,691

Panel B. Regression for insider buy and sell transaction size

	(1) $SharesBuy_{i,t}$	(2) $SharesSell_{i,t}$	(4) $DollarBuy_{i,t}$	(4) $SharesSell_{i,t}$
$Lendable_{i,t-1}$	0.852***	2.345***	1.022***	3.261***
	(0.000)	(0.000)	(0.000)	(0.000)
$log(market\ size)$	-1.089***	1.743***	-1.155***	2.345***
	(0.000)	(0.000)	(0.000)	(0.000)
M/B	0.133**	-0.224***	0.147**	-0.290***
	(0.014)	(0.002)	(0.029)	(0.002)
$PastRet$	-0.0718	0.353***	-0.228***	0.443***
	(0.133)	(0.000)	(0.000)	(0.000)
$Idiosyncratic\ Volatility$	-0.214***	0.440***	-0.316***	0.484***
	(0.000)	(0.000)	(0.000)	(0.000)
$Turnover$	259.0***	167.8***	324.7***	187.9***
	(0.000)	(0.000)	(0.000)	(0.000)
$Leverage$	-0.278	0.322	-0.295	0.432
	(0.116)	(0.183)	(0.181)	(0.165)
IO	-0.383***	-0.433**	-0.457***	-0.566**
	(0.007)	(0.026)	(0.010)	(0.024)
$Log(sales)$	0.124***	-0.128***	0.149***	-0.164***
	(0.000)	(0.005)	(0.000)	(0.006)
$Fixed\ effect$	YES	YES	YES	YES
$Obs.$	211,525	211,525	211,525	211,525

Table 3. Regression of HighBonded and LowBonded insider trading on short selling pressure

This Table presents the tests results of how the short selling pressure affects the buys and sells for *HighBonded* and *LowBonded* insiders using sample from June 2006 to December 2011. In Panel A, a conditional logistic model is used. The dependent variables $BuyDummy_{i,t}$ ($SellDummy_{i,t}$) are firm level indicator of buy (sell) activities for the two groups of insiders separately. The results of *BuyDummy* and *SellDummy* for *HighBonded* insiders are reported in Columns (1) and (2), for LowBonded insiders are reported in Column (3) and (4). In Panel B, the dependent variables are $SharesBuy_{i,t}$ and $SharesSell_{i,t}$ for the two groups of insiders, the results for *HighBonded* insiders are reported in Columns (1) and (2) respectively, for *LowBonded* insiders are reported in Column (3) and (4). In Panel B, the dependent variables are $DollarBuy_{i,t}$ and $DollarSell_{i,t}$, and results are similarly reported for *HighBonded* and *LowBonded* insiders in Columns (1) - (4). We include firm, year, and month fixed. P-values based on robust standard errors are reported in parentheses under the corresponding estimated coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively

Panel A. Conditional Logistic regression for HighBonded and LowBonded insider trading dummy

	(1) ***HighBonded*** $BuyDummy_{i,t}$	(2) ***HighBonded*** $SellDummy_{i,t}$	(3) ***LowBonded*** $BuyDummy_{i,t}$	(4) ***LowBonded*** $SellDummy_{i,t}$
$Lendable_{i,t-1}$	1.511***	1.653***	0.472	1.889***
	(0.000)	(0.000)	(0.338)	(0.000)
$log(market\ size)$	-0.920***	2.095***	-0.945***	1.970***
	(0.000)	(0.000)	(0.000)	(0.000)
M/B	0.156*	-0.395***	-0.00495	-0.524***
	(0.058)	(0.000)	(0.967)	(0.000)
$PastRet$	-0.128*	0.0298	-0.000646	0.337***
	(0.052)	(0.673)	(0.995)	(0.000)
$Idiosyncratic\ Volatility$	-0.300***	0.491***	-0.296**	0.450***
	(0.000)	(0.000)	(0.013)	(0.000)
$Turnover$	347.6***	135.5***	395.3***	142.3***
	(0.000)	(0.000)	(0.000)	(0.000)
$Leverage$	-0.464*	0.675***	-0.246	0.187
	(0.072)	(0.008)	(0.512)	(0.473)
IO	-0.565**	-0.516***	-0.458	-0.729***
	(0.011)	(0.007)	(0.138)	(0.000)
$Log(sales)$	0.0881*	-0.0527	0.130*	-0.135***
	(0.077)	(0.298)	(0.061)	(0.006)
$Fixed\ effect$	YES	YES	YES	YES
$Obs.$	81,765	99,188	35,446	88,567

Panel B. Regression for HighBonded and LowBonded insider trading shares

	(1)	(2)	(3)	(4)
	HighBonded $SharesBuy_{i,t}$	***HighBonded*** $SharesSell_{i,t}$	***LowBonded*** $SharesBuy_{i,t}$	***LowBonded*** $SharesSell_{i,t}$
$Lendable_{i,t-1}$	0.776***	1.675***	0.194*	1.541***
	(0.000)	(0.000)	(0.097)	(0.000)
$log(market\ size)$	-0.967***	1.338***	-0.429***	1.127***
	(0.000)	(0.000)	(0.000)	(0.000)
M/B	0.211***	-0.0620	0.0453	-0.235***
	(0.000)	(0.339)	(0.173)	(0.000)
$PastRet$	-0.0646	0.223***	0.0430	0.473***
	(0.131)	(0.000)	(0.144)	(0.000)
$Idiosyncratic\ Volatility$	-0.182***	0.266***	-0.0364	0.271***
	(0.000)	(0.000)	(0.306)	(0.000)
$Turnover$	216.0***	112.2***	106.2***	111.7***
	(0.000)	(0.000)	(0.000)	(0.000)
$Leverage$	-0.176	0.705***	0.0246	0.108
	(0.265)	(0.001)	(0.821)	(0.587)
IO	-0.265**	-0.0514	-0.0878	-0.254
	(0.037)	(0.763)	(0.315)	(0.112)
$Log(sales)$	0.0712**	0.00701	0.0632***	-0.124***
	(0.018)	(0.862)	(0.002)	(0.001)
$Fixed\ effect$	YES	YES	YES	YES
$Obs.$	211,525	211,525	211,525	211,525

Panel C. Regression for HighBonded and LowBonded insider trading dollar value

	(1)	(2)	(3)	(4)
	HighBonded $DollarBuy_{i,t}$	***HighBonded*** $DollarSell_{i,t}$	***LowBonded*** $DollarBuy_{i,t}$	***LowBonded*** $DollarSell_{i,t}$
$Lendable_{i,t-1}$	0.946***	2.332***	0.214	2.232***
	(0.000)	(0.000)	(0.135)	(0.000)
$log(market\ size)$	-1.043***	1.787***	-0.455***	1.552***
	(0.000)	(0.000)	(0.000)	(0.000)
M/B	0.244***	-0.0691	0.0418	-0.315***
	(0.000)	(0.413)	(0.305)	(0.000)
$PastRet$	-0.202***	0.290***	-0.00272	0.619***
	(0.000)	(0.000)	(0.940)	(0.000)
$Idiosyncratic\ Volatility$	-0.267***	0.280***	-0.0720*	0.311***
	(0.000)	(0.002)	(0.099)	(0.000)
$Turnover$	272.9***	129.1***	132.1***	124.5***
	(0.000)	(0.000)	(0.000)	(0.000)
$Leverage$	-0.172	0.921***	0.0366	0.190
	(0.386)	(0.001)	(0.784)	(0.466)
IO	-0.328**	-0.0896	-0.0859	-0.351*
	(0.040)	(0.686)	(0.423)	(0.093)
$Log(sales)$	0.0946**	0.00469	0.0667***	-0.156***
	(0.012)	(0.929)	(0.009)	(0.002)
$Fixed\ effect$	YES	YES	YES	YES
$Obs.$	211,525	211,525	211,525	211,525

Table 4. Cross firm variation of buy/sell-lendable sensitivity

This Table presents the tests results of how the firm specific features affect the buy/sell-lendable sensitivity for *All*, *HighBonded* and *LowBonded* insiders using sample from June 2006 to December 2011. In Panel A, sample firms are ranked with respect to the value of E-index, where *High E-index* is a dummy equals one if the firm has above median, and zero otherwise. The dependent variables $BuyDummy_{i,t}$ and $SellDummy_{i,t}$ are firm level indicator of buy and sell activities for *All*, *HighBonded* and *LowBonded* insiders separately. The results of *BuyDummy* for *All, HighBonded, LowBonded* insiders are reported in Columns (1) - (3) respectively. The results of *SellDummy* for the three insiders groups are reported in Column (4) - (6) respectively. In Panel B, sample firms are merged with family firm data, where *Family* is a dummy equals one if the firm is a family firm, and zero otherwise. The independent variable of interest is the interaction of *Family* dummy and Lendable of previous month. The dependent variables $BuyDummy_{i,t}$ and $SellDummy_{i,t}$ *All*, *HighBonded* and *LowBonded* insiders separately. The results of *BuyDummy* for *All, HighBonded, LowBonded* insiders are reported in Columns (1) - (3) respectively. The results of *SellDummy* for the three insiders groups are reported in Column (4) - (6) respectively. The same set of control variables are included as Table 4, and their definitions are in Appendix A. We include year, and month fixed effects. P-values based on robust standard errors are reported in parentheses under the corresponding estimated coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A. Insider Buy/Sell-Lendable Sensitivity for high and low E-index firms

	(1)	(2)	(3)	(4)	(5)	(6)
	All Insiders	***HighBonded***	***LowBonded***	***All Insiders***	***HighBonded***	***LowBonded***
	$BuyDummy_{i,t}$	$BuyDummy_{i,t}$	$BuyDummy_{i,t}$	$SellDummy_{i,t}$	$SellDummy_{i,t}$	$SellDummy_{i,t}$
High E-index ×	-0.0892**	-0.109***	-0.0843	0.0765***	0.105***	0.109***
$Lendable_{i,t-1}$	(0.020)	(0.009)	(0.202)	(0.001)	(0.000)	(0.000)
Fixed effect	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Obs.	48,298	47,305	43,785	66,270	59,204	57,441

Panel B. Insider Buy/Sell-Lendable Sensitivity for family and non-family firms

	(1)	(2)	(3)	(4)	(5)	(6)
	All Insiders	***HighBonded***	***LowBonded***	***All Insiders***	***HighBonded***	***LowBonded***
	$BuyDummy_{i,t}$	$BuyDummy_{i,t}$	$BuyDummy_{i,t}$	$SellDummy_{i,t}$	$SellDummy_{i,t}$	$SellDummy_{i,t}$
$Family$ ×	1.174***	1.101***	1.141**	0.477**	-0.372	0.910***
$Lendable_{i,t-1}$	(0.000)	(0.001)	(0.014)	(0.031)	(0.148)	(0.001)
Fixed effect	YES	YES	YES	YES	YES	YES
Controls	YES	YES	YES	YES	YES	YES
Obs.	43,982	42,697	40,588	56,739	50,942	50,289

Table 5. Earnings announcement based study

This Table presents the tests results of buy/sell-lendable sensitivity for all insiders conditional on there is an upcoming bad earnings announcement news, using sample from June 2006 to December 2011. *BadNews* is a dummy variable, which equals one if there is a quarterly earnings announcement of the firm in the subsequent month and the earnings announcement comes out to be negative surprise to the market, and equals zero otherwise. The interaction of the *BadNews* for t+1 is interacted with *Lenable* at t-1 as the key independent variable of interest. The dependent variables are the Dummies and magnitudes for insider buys and sells. We use the same set of control variables as tests before which is not tabulated here. we only show the coefficient of the explanatory variable of interest. We include firm, year, and month fixed effects. P-values based on robust standard errors are reported in parentheses under the corresponding estimated coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	(1) $BuyDummy_{i,t}$	(2) $DollarBuy_{i,t}$	(3) $SharesBuy_{i,t}$	(4) $SellDummy_{i,t}$	(5) $DollarSell_{i,t}$	(6) $SharesSell_{i,t}$
$BadNews_{i,t+1} \times Lendable_{i,t-1}$	0.721***	0.0499	-0.168	0.100	1.018***	0.698***
	(0.001)	(0.822)	(0.345)	(0.626)	(0.001)	(0.004)
$BadNews_{i,t+1}$	0.517***	0.676***	0.570***	0.458***	0.382***	0.312***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
$Lendable_{i,t-1}$	1.102***	1.472***	1.262***	0.211	-0.223	-0.457
	(0.003)	(0.000)	(0.000)	(0.456)	(0.631)	(0.205)
$Fixed\ effect$	YES	YES	YES	YES	YES	YES
$Obs.$	93,901	211,525	211,525	130,691	211,525	211,525

Table 6. Return predictability of insider trading

This Table presents the tests results return patterns in the subsequent three months following insider buys or sells, using sample from June 2006 to December 2011. The dependent variables are the market adjusted cumulative returns for t+1 to t+k, where k=1, 2, 3. The independent variable is insider *BuyDummy* at month t, and the results are reported in Column (1) – (3) and (4) – (6) for highest and lowest short selling pressure portfolios respectively. The independent variable is insider *SellDummy* at month t, and the results are reported in Column (7) – (9) and (10) – (12) for highest and lowest short selling pressure portfolios respectively. We use the same set of control variables as tests before which is not tabulated here. Show the coefficient of the explanatory variable of interest. We include firm, year, and month fixed effects. P-values based on robust standard errors are reported in parentheses under the corresponding estimated coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

	Insider buy activities					
	High $Lendable_{t-1}$			Low $Lendable_{t-1}$		
	(1)	(2)	(3)	(4)	(5)	(6)
	$\boldsymbol{R_{i,t+1}}$	$\boldsymbol{R_{i.t+1,t+2}}$	$\boldsymbol{R_{i,t+1,t+3}}$	$\boldsymbol{R_{i,t+1}}$	$\boldsymbol{R_{i.t+1,t+2}}$	$\boldsymbol{R_{i,t+1,t+3}}$
$BuyDummy_{i,t}$	0.00901**	0.0158***	0.00494	0.00613	0.00415	-0.00229
	(0.021)	(0.002)	(0.373)	(0.225)	(0.523)	(0.761)
Obs.	24,281	24,273	24,256	18,215	18,187	18,147
	Insider sell activities					
	High $Lendable_{t-1}$			Low $Lendable_{t-1}$		
	(7)	(8)	(9)	(10)	(11)	(12)
	$\boldsymbol{R_{i,t+1}}$	$\boldsymbol{R_{i,t+1,t+2}}$	$\boldsymbol{R_{i,t+1,t+3}}$	$\boldsymbol{R_{i,t+1}}$	$\boldsymbol{R_{i,t+1,t+2}}$	$\boldsymbol{R_{i,t+1,t+3}}$
$SellDummy_{i,t}$	-0.000837	-0.00429*	-0.0156***	-0.000790	-0.00544	-0.00320
	(0.648)	(0.094)	(0.000)	(0.910)	(0.538)	(0.746)
Obs.	32,748	32,739	32,720	17,573	17,544	17,502

Table 7. Robustness tests: Alternative definitions of insider buys and sells

This Table presents the tests results of the sensitivity of the main results to different definition of insider trading. Panel A reports the results for Insider net buy and sell activities. The dependent variables are the net buy and sell dummies and net trading size for *All*, *HighBonded* and *LowBonded* Insiders. Panel B reports the results for insider trades that are information driven and non-information driven. The dependent variables are the net buy and sell dummies for *All*, *HighBonded* and *LowBonded* Insiders. We use the same set of control variables as tests before which is not tabulated here. We only show the coefficient of the explanatory variable of interest. We include firm, year, and month fixed effects for net trading tests, and only firm fixed effect of tests of trading size. P-values based on robust standard errors are reported in parentheses under the corresponding estimated coefficients. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

Panel A. Net Buy and Net Sells

	Conditional Logistic Regression: tendency to trade					
	(1)	(2)	(3)	(4)	(5)	(6)
	All Insiders	***HighBonded***	***LowBonded***	***All Insiders***	***HighBonded***	***LowBonded***
	$BuyDummy_{i,t}$	$BuyDummy_{i,t}$	$BuyDummy_{i,t}$	$SellDummy_{i,t}$	$SellDummy_{i,t}$	$SellDummy_{i,t}$
$Lendable_{i,t-1}$	1.025***	1.420***	0.250	1.451***	1.435***	1.774***
	(0.002)	(0.000)	(0.660)	(0.000)	(0.000)	(0.000)
Controls	YES	YES	YES	YES	YES	YES
Fixed effect	YES	YES	YES	YES	YES	YES
Obs.	95,765	86,544	38,279	138,787	105,281	95,957
	Regression: size of trade					
	(7)	(8)	(9)	(10)	(11)	(12)
	All Insiders	***HighBonded***	***LowBonded***	***All Insiders***	***HighBonded***	***LowBonded***
	$NetShares_{i,t}$	$NetShares_{i,t}$	$NetShares_{i,t}$	$NetDollar_{i,t}$	$NetDollar_{i,t}$	$NetDollar_{i,t}$
$Lendable_{i,t-1}$	-0.732	-0.753	0.535	-0.218	-0.319	0.330
	(0.394)	(0.402)	(0.745)	(0.791)	(0.702)	(0.839)
Controls	YES	YES	YES	YES	YES	YES
Fixed effect	YES	YES	YES	YES	YES	YES
Obs.	25,697	22,142	9,158	25,613	22,076	9,112

Panel B. Opportunistic and Routine buys and sells

	HighBonded			
	(1) Opportunistic $BuyDummy_{i,t}$	(2) Routine $BuyDummy_{i,t}$	(3) Opportunistic $BuyDummy_{i,t}$	(4) Routine $SellDummy_{i,t}$
$Lendable_{i,t-1}$	1.055**	0.447	0.880***	1.530***
	(0.019)	(0.482)	(0.001)	(0.000)
$Controls$	YES	YES	YES	YES
Obs.	42,838	20,770	63,747	33,636
	LowBonded			
	(5) Opportunistic $BuyDummy_{i,t}$	(6) Routine $BuyDummy_{i,t}$	(7) Opportunistic $BuyDummy_{i,t}$	(8) Routine $SellDummy_{i,t}$
$Lendable_{i,t-1}$	0.781	0.0577	0.839***	2.182***
	(0.385)	(0.971)	(0.005)	(0.000)
$Controls$	YES	YES	YES	YES
Obs.	12,035	4,667	47,766	23,235