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The effects of liquidity trading on insider trade timing when an underlying option is present

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Abstract

Purpose – The purpose of this paper is to examine whether the underlying option impacts an insider's propensity to purchase and sell before corporate announcements, the proportion of insiders' trading after announcements relative to before announcements, and the insider's profitability around corporate announcements.

Design/methodology/approach – The authors test whether the timing information and option have impacted on the tendency of insider trade, the percentage of all shares traded by insiders in the post-announcement to pre-announcement periods and the average cumulative abnormal stock returns during the pre-announcement period.

Findings – Insiders' propensity to trade before announcements is higher for stocks without options listed than for stocks with traded options. This result is stronger for unscheduled announcements than for scheduled ones. The proportion of insiders' trade volume after announcements relative to before announcements in stocks that have not options listed is higher than those in stocks with traded options. The positive relationship between the insiders' signed volume and the informational content of corporate announcements is stronger in stocks without traded options than in stocks with options listed. Insider trades prior to unscheduled announcement are more profitable than those before scheduled ones.

Research limitations/implications – The paper examines whether there is a difference between the effects of optioned stock and non-optioned stock. Roll *et al.* (2010) use the relative trading volume of options to stock ratio (O/S) to proxy for informed options trading activity. Future research could explore the impact of O/S. Moreover, the authors examine how insiders with private information use such information to trade in their own firms. Mehta *et al.* (2017) argue that insiders also use private information to facilitate trading (shadow trading) in linked firms, such as supply chain partners or competitors. Therefore, future research could consider the impact of shadow trading.

Social implications – Since the insider's propensity to buy before announcements in stocks without options listed is larger than in stocks with traded options and the relationship is stronger for unscheduled announcements than for scheduled ones, the efforts of regulators should focus on monitoring insider trading in stocks without options listed prior to unscheduled announcements.

Originality/value – First, Lei and Wang (2014) find that the increasing pattern of insider's propensity to trade before unscheduled announcements is larger than that before scheduled announcements. The authors document the underlying option has impacted the insider's propensity to purchase and sell, and the relationship is stronger for unscheduled announcements than for scheduled ones. Second, related studies show insider's trading activity has shifted from periods before corporate announcements to periods after corporate announcements to decrease litigation risk. This paper find the underlying option has influenced the proportion of insiders' trading after announcements relative to before announcements when the illegal insider trade-related penalties increase.

Keywords Liquidity trading, Insider trading, Scheduled corporate announcements, Underlying option

Paper type Research paper

1. Introduction

This paper investigates the difference between insider trading in optioned and non-optioned stocks around scheduled and unscheduled corporate announcements. Extant studies have investigated insider trading around takeover and earning announcements separately. Lei and Wang (2014) exploit the time-varying liquidity trading around announcements to examine how insiders take advantage of time variation to camouflage their trades.

They find that the increasing pattern of an insider's propensity to trade is larger before unscheduled announcements than before scheduled announcements. Related studies about insider trading focus on stock markets rather than option markets. Exceptionally, Hyland *et al.* (2003) document that the level of insider trading is lower for optioned stocks than for non-optioned stocks. In addition, Ge *et al.* (2016) find that bankruptcy filing returns are significantly associated with pre-filing insider options trading, whereas filing returns are not significantly related to pre-filing insider stock trading. Therefore, this paper aims to fill a research gap by examining whether the underlying option impacts trading patterns of insider trading before corporate announcements.

In addition to information-based trading (Amel-Zadeh *et al.*, 2016), the main reasons that insiders sell their firm stocks are liquidity and diversification. Since insider sales often reflect diversification desires rather than the need to trade on information which insider purchases reflect, it is necessary to examine insider purchases and sales separately. Further, insider sales are more exposed to litigation than purchases because regulators seem to be more attentive to potentially illegal insider trading after stock price drops than after price run-ups (Gao *et al.*, 2015). Insiders might be more careful in using negative information than exploiting positive information (Lee *et al.*, 2014). Thus, it is regarded that insiders respond to positive and negative information asymmetrically. Moreover, Brochet (2010) finds that abnormal returns around filings of insider purchases are greater after the Sarbanes-Oxley Act (SOX) than before it, while in insider sales, stock returns are not more negative. Therefore, this paper explores whether the underlying option impacts an insider's propensity to purchase and sell before corporate announcements.

Some research has showed that after passing laws that don't allow insiders to trade based on material inside information, insiders' trading activity has shifted from periods before corporate announcements to periods after corporate announcements. For example, Jagolinzer and Roulstone (2007) indicate that litigation risk decreases after corporate announcements and that the increasing trading pattern of insiders has been especially apparent since the passage of the Insider Trading and Securities Fraud Enforcement Act (ITSFEA). Consistent with increased regulatory scrutiny, Lee *et al.* (2014) find that there has been a steady increase in the proportion of trades by insiders occurring directly after earnings announcements. Hyland *et al.* (2003) argue that insiders are exposed to less litigation risk when trading in the option market, and consequently, insiders have less incentive to trade in optioned stocks than in non-optioned stocks. Therefore, we explore whether the underlying option has impacted the proportion of insiders' trading after announcements relative to before announcements with increasing illegal insider trading-related penalties.

In addition to dealing with the insider's decision to trade, related research also explores the performance of insider trading around the announcement period. The analysis of profit from insider trading could provide further insights into insiders' trading patterns. Lei and Wang (2014) document that insider purchases are more profitable before unscheduled announcements than before scheduled announcements. Ali and Hirshleifer (2017) suggest that the profitability prior to quarterly earnings announcement gives a strong approach to identify future opportunistic trading. Jagolinzer and Roulstone (2007) could not find a general decreasing pattern in insider's trading profitability (abnormal return) when insider's trading increases during the periods of lower litigation risk. This implies that regulations have not restricted the ability of insiders to take advantage of private information. Since insiders are exposed to less litigation risk when trading in the option market (Hyland *et al.*, 2003), this paper explores whether the underlying option impacts the insider's profitability around corporate announcements.

Our findings are as follows. First, the insider's propensity to trade before announcements is larger for stocks without options listed than for stocks with traded options. Other things

being equal, this result is stronger for unscheduled announcements than for scheduled ones. Second, the proportion of insiders' trading volume after announcements relative to before announcements in stocks without options listed is higher than those in stocks with traded options. Ceteris paribus, the result is stronger for unscheduled announcements than for scheduled ones. Third, the positive relationship between the insiders' signed volume and the informational content of corporate announcements is stronger in stocks without traded options than in stocks that have options listed. Moreover, the difference between the effects in stocks with or without traded options is more remarkable before unscheduled announcements than before scheduled announcements. Fourth, insider trading in pre-unscheduled announcements is more profitable than those before scheduled ones. Insider trading before announcements is more profitable in stocks without options listed than those in stocks with traded options. Further, the disparity of profit between stocks without traded options and with traded options is higher before unscheduled announcements than before scheduled announcements. No matter whether insiders are purchasers or sellers, they are always momentum traders and cannot get profits. This suggests that insiders do not obtain accurate inside information. If they get correct information, they might be afraid of litigation and trade in the opposite direction.

Apart from Hyland *et al.* (2003), which find that the level of insider trading is lower for optioned stocks than for non-optioned stocks, related studies about insider trading focus on stock markets because no statute requires insiders to publicly disclose trading in the option markets. This paper compares the differences between insider trading in optioned stock and insider trading in non-optioned stock to contribute to the literature in the following aspects. First, Lei and Wang (2014) find that the increasing pattern of insider's propensity to trade before unscheduled announcements is larger than that before scheduled announcements. Lee *et al.* (2014) indicate that insiders take advantage of positive information to make profits but are more careful in exploiting negative information. We explore whether the underlying option impacts the insider's propensity to purchase and sell before corporate announcements, and whether the relationship is stronger for unscheduled announcements than for scheduled ones. Second, related studies (Brochet, 2010; Jagolinzer and Roulstone, 2007; Lee *et al.*, 2014) show that after the passing of laws that do not allow insiders to trade based on material inside information, insider's trading activity has shifted from periods prior to corporate announcements to periods after corporate announcements to decrease litigation risk. Hyland *et al.* (2003) document that insiders sustain less litigation risk when trading in the option market and thus insiders have less incentive to trade in optioned stocks than in non-optioned stocks. Therefore, this paper explores whether the underlying option influences the proportion of insiders' trading after announcements relative to before announcements when the illegal insider trading-related penalties increase.

The remainder of this paper is organized as follows. In Section 2, we review the literature and develop the hypotheses. Section 3 presents the methodology of constructing the sample. In Section 4, we discuss the results and Section 5 provides our conclusion.

2. Literature review and hypothesis development

Insiders might trade prior to announcements if the benefits from trading outweigh the costs of trading (Ali and Hirshleifer, 2017). The benefits mainly result from informational advantages that insiders have before the public announcements. Insiders may also exercise caution against trading before announcements owing to costs about regulatory scrutiny and litigation risks.

Moreover, insiders might prefer to trade in options instead of stocks because they may be exposed to less litigation risk. Insiders may be protected by option trading for two reasons (Hyland *et al.*, 2003). First, although insiders have responsibilities to their stockholders, they have no fiduciary obligation to option traders. Neither the rules nor case law provide a

definite definition of the option trader's right to prosecute the insider in the event of abusing private information (Sacksteder, 1988). Second, no statute requires insiders to publicly disclose trading in the options market (Cleeton and Reeder, 1987). Therefore, insiders are exposed to less litigation risk when trading in the option market and thus insiders have less incentive to trade in optioned stocks than in non-optioned stocks before announcements.

According to Chae (2005), before scheduled announcements, discretionary liquidity traders would delay trading, whereas before unscheduled announcements, they would not time their trades. Thus, cumulative trading volume of liquidity traders decreases prior to scheduled announcements. Insiders could plan their trades in anticipation of the different trading patterns of liquidity traders before scheduled vs unscheduled announcements. The varying degree of pre-announcement liquidity trading could affect insider trading[1]. Higher liquidity trading before unscheduled announcements provides better camouflage and hence implies greater benefits for insiders who trade prior to the unscheduled announcements. Thus, there should be a higher probability for insiders to trade in this context. In contrast, insiders are less able to hide their trades before scheduled announcements because of the lower volume of liquidity trading. Therefore, the propensity to trade before unscheduled announcements should be stronger than that before scheduled announcements. Therefore, we have the following hypothesis:

H1. The insider's propensity to trade before announcements in stocks without traded options is larger than in stocks with options listed. With other things the same, the relationship should be stronger for unscheduled announcements than for scheduled ones.

The following hypothesis focuses on determining the degree to which litigation risk affects insider trading patterns. Given that insider trading regulation usually increases insiders' trade-related litigation costs, prior research hypothesizes that insiders' timely trade volume prior to announcements are negatively associated with increased regulation or enforcement (Seyhun, 1992; Garfinkel, 1997). Bettis *et al.* (2000) and Jeng (1999) indicate that firms often limit their insiders' ability to trade before announcements.

When the regulations that increase illegal insider trading-related penalties are implemented, the insider's trading shifts to the post-announcement period to avoid violating securities laws. Specifically, insiders of options-listed firms might trade in the option market due to the lower litigation risk. Therefore, the proportion of insiders' trade volume after announcements relative to before announcements in stocks without traded options should be higher than those in stocks with options listed. Since insiders are more able to hide their trades before unscheduled announcements than before scheduled announcements owing to the higher amount of liquidity trading, the relationship should be stronger for unscheduled announcements than for scheduled ones. We capture this argument in the following hypothesis:

H2. The proportion of insiders' trade volume after announcements relative to before announcements in stocks without traded options should be higher than those in stocks with options listed. Ceteris paribus, the relationship should be stronger for unscheduled announcements than for scheduled ones.

Since pre-announcement insider trading is mainly driven by information, the insiders' trading direction would be associated with the direction of information shock. Specifically, insiders would buy (sell) more before announcements with positive (negative) shock. Lei and Wang (2014) find that there exists a positive relationship between insiders' signed volume and the informational content of the announcements. Given that insider's trading in the option market is exposed to less litigation risk and that insiders have greater incentives to trade in non-optioned stocks than in optioned stocks before announcements, the positive

relationship between the insiders' signed volume and the informational content of corporate announcements in stocks that have not traded options should be stronger than in stocks with options listed.

Given that pre-unscheduled-announcement liquidity trading provides better camouflage for insider trading, the difference between the effect in stocks without traded options and the effect in stocks with options listed should be more remarkable before unscheduled announcements than before scheduled announcements. Therefore, we have the following hypothesis:

H3. The positive relationship between the insiders' signed volume and the informational content of corporate announcements in stocks without traded options should be stronger than in stocks with options listed. Moreover, the difference between the effect in stocks without traded options and the effect in stocks with options listed should be more remarkable before unscheduled announcements than before scheduled announcements.

Since insider trading before unscheduled announcements is more likely to be information driven than those before scheduled announcements, pre-unscheduled-announcement insider trading should be more profitable than those before scheduled ones (Lei and Wang, 2014). Owing to less litigation risk in the option market, insiders have more incentives to trade in non-optioned stocks than in optioned stocks before announcements. Therefore, the insider trading before announcements should be less profitable in stocks with options listed than in stocks without traded options. Because pre-unscheduled-announcement liquidity trading provides better camouflage for insider trading, the profit should be higher before unscheduled announcements than before scheduled announcements. We capture this argument in the following hypothesis:

H4. Insider trading before announcements should be more profitable for stocks without traded options than for stocks with options listed. Specifically, the disparity of profit between stocks without traded options and with traded options should be higher before unscheduled announcements than before scheduled announcements.

3. Sample construction

The sample consists of companies that comprise the S&P 500 index during the 2003–2015 period. In 2002, SOX began forcing insiders to report their trading activity within two business days after trading. Before this regulation change, insiders were required to report to the SEC by the 10th day after the end of the trading month per Section 16(a) of the Securities Exchange Act of 1934. Thus, our sample is from the post-SOX period. Moreover, we exclude data during the financial crisis (2007 and 2008) since the trading behavior during this period is different from ordinary trading behavior. According to Chordia *et al.* (2001), among the scheduled announcements involving a release of relevant information, earnings announcements are the best candidates. As a result, earnings announcements are used as proxies for scheduled announcements. Among the unscheduled announcements, merger and acquisition announcements have well-documented effects on return and trading volume. Therefore, merger and acquisition announcements are used as proxies for unscheduled announcements.

A number of filters are implemented to refine the corporate announcements for research purposes. Since earnings announcements are used as proxies for scheduled announcements, according to Lei and Wang (2014), only the regular quarterly earnings announcements are included in the sample. That is, any earnings announcements that are made on irregular or unscheduled dates are not of concern. In addition, if the two types of announcements in the same firm arrive on closely adjacent dates, it would be hard to

classify insiders' trades as scheduled or unscheduled. To mitigate the confounding effects, all announcements are polled together and any two successive announcements from the same firms must be at least 30 days apart. Having satisfied the above filters and survived the matching process among different databases through CUSIP numbers, a final sample is developed.

For each announcement event in the sample, we define the announcement date as date 0, the period from trading −200 to −100 as the benchmark period, the period from trading −30 to −2 as the pre-announcement period, the period from trading −1 to +1 as the announcement period, and the period from trading +2 to +30 as the post-announcement period.

A number of data sources are utilized in this paper. Stock characteristics such as daily returns, daily trading volume, and market value are based on the Center for Research in Securities Prices (CRSP) and Compustat databases. The data on corporate announcements are mainly from two sources. The SDC database from Thomson Financial Securities Data makes available information on the targets and acquirers in announcements of mergers and acquisitions involving stocks listed on NYSE, AMEX and NASDAQ. The I/B/E/S actuals file provides earnings announcements data, including firm name, firm identifier and earnings announcement dates. Insider trading data are obtained from Mergent Financial Database – Insider Trading Data. Insiders are defined as the officers of the corporation, who are the directors, the board chair, the senior vice president or owners of more than 10 percent of the outstanding stock. Following Lei and Wang (2014), trading records must have a matching CUSIP with data available from CRSP. The transaction price for any trades must be within the daily price range as recorded in CRSP for the corresponding trading day. Moreover, duplicate transactions are removed from the sample.

Table I presents the summary statistics of insider trading (purchases and sales) around corporate announcements. Panels A, B and C present the number of trades, the number of shares traded and the dollar value of shares traded separately for the scheduled and unscheduled announcements. Panels D, E and F report the number of announcements, the number of firms with insiders' trades and the number of insiders who have traded in the pre- and post-announcement periods. For each variable, we report the summary statistics for the total trades as well as statistics separating insider purchases from insider sales. Table I shows that 1,830 (162) corporate insiders from 196 (12) firms jointly make 10,612 (406) trades totaling $31.84 (1.24) bn immediately before scheduled (unscheduled) announcements during the sample period. An average insider makes 2.41 (1.54) purchases during the period of 30 days before scheduled (unscheduled) announcements, whereas an average insider makes 6.30 (2.71) sales before scheduled (unscheduled) announcements. Insiders seem to refrain themselves more from making purchases than making sales before announcements, which is consistent with finding in the literature that insider purchases are more likely to be information-driven than insider sales.

While our sample contains a total of 16,258 (288) scheduled (unscheduled) announcements, insiders only trade before 2,091 (86) scheduled (unscheduled) announcements. The fact that insiders choose not to trade before the vast majority of announcements is consistent with the trend that insiders might avoid trading immediately before corporate announcements due to regulatory scrutiny and litigation concerns.

To capture the firm- and event-specific characteristics, a number of control variables are constructed as follows. The market capitalization (Size) for each firm is defined as the natural log of shares outstanding multiplied by the closing price in the end of announcement month. The pre-announcement stock price runup (Runup) is computed by the abnormal stock returns cumulated over the pre-announcement period to proxy for information leakage in the days immediately before corporate announcements. The abnormal returns are calculated by the market model over the benchmark period. The announcement return

	Scheduled		Unscheduled	
	Pre	Post	Pre	Post
Panel A: number of trades				
Purchases	564	2276	43	28
Sales	10,048	27,246	363	180
Total trades	10,612	29,522	406	208
Panel B: number of shares traded				
Shares bought (million)	28.33	97.04	0.36	1.92
Shares sold (million)	764.21	1,222.52	26.77	175.01
Total shares traded (million)	792.54	1,319.56	27.13	176.93
Panel C: dollar value of shares traded				
Shares bought ($billion)	0.79	2.20	0.01	0.08
Shares sold ($billion)	31.05	58.00	1.23	4.60
Shares traded ($billion)	31.84	60.21	1.24	4.68
Panel D: number of announcements				
Announcements with insider purchases	217	683	11	9
Announcements with insider sales	1,874	4,025	75	52
Announcements with insider trades	2,091	4,708	86	61
Panel E: number of insider trading firms				
Firms with insider purchases	27	32	2	0
Firms with insider sales	169	185	10	1
Firms with insider trades	196	217	12	1
Panel F: number of insiders				
Insiders with purchases	234	698	28	8
Insiders with sales	1,596	3,810	134	30
Insiders with trades	1,830	4,508	162	38

Notes: This table presents the summary statistics on aggregate insider trading data around scheduled and unscheduled announcements. Insider trades are classified as pre (post) trades if the transaction date falls within 30 days before (after) scheduled/unscheduled announcements. Panels A, B and C report the number of trades, number of shares traded and dollar value of shares traded, respectively, for both scheduled and unscheduled announcements. Panels D, E and F present the number of announcements in which insiders trade, number of firms in which insiders trade and number of insiders who have traded, respectively

Table I.
Insider trades around
corporate
announcements

(AnnRet) is defined as the cumulated abnormal returns over the announcement period to capture the informational content of corporate announcements. Past stock returns (PastRet) are calculated by the buy-and-hold cumulated stock return over the benchmark period. Book-to-market ratio (BM) is defined as for each firm in the end of announcement month. The raw daily abnormal trading volume ($CumAbvol_{raw}$) is computed by subtracting the average trading volume over the benchmark period from the daily trading volume over pre-announcement period. Trading volume is defined as the natural log of shares traded scaled by shares outstanding.

Table II provides the summary statistics for these control variables. Panels A and B separately report the summary statistics for the scheduled and unscheduled announcements. The mean of $Cumabvol_{raw}$ before scheduled (unscheduled) announcements is negative (positive), indicating that the raw cumulative abnormal trading volume decreases (increases) before scheduled (unscheduled) announcements. According to Chae (2005), before scheduled announcements, discretionary liquidity traders would delay trading, resulting in decreasing abnormal trading volume. Based on Cao *et al.* (2005), before unscheduled announcements, informed traders would prefer trading, resulting in increasing abnormal trading volume.

	N	Min.	Mean	P25	Median	P75	Max.	Std
Panel A: scheduled announcements								
Cumabvol$_{raw}$	16,258	−73.58	−6.14	−0.38	5.55	73.24	9.61
Runup	16,258	−4.21	−0.00	−0.05	−0.00	0.05	14.95	0.19
Size	16,258	14.81	614.96	313.46	481.16	694.41	44,726.06	1,354.37
AnnRet	16,258	−0.60	0.00	−0.03	0.00	0.03	0.78	0.06
PastRet	16,258	−0.98	0.04	−0.09	0.04	0.15	30.99	0.41
BM	16,221	0.06	0.65	0.43	0.63	0.88	2.20	0.28
Panel B: unscheduled announcements								
Cumabvol$_{raw}$	288	−42.46	4.23	−2.63	4.10	10.77	43.14	11.26
Runup	288	−0.87	−0.01	−0.07	−0.01	0.05	0.58	0.15
Size	288	23.27	608.26	341.26	554.85	728.01	3,904.44	441.75
AnnRet	288	−1.14	0.01	−0.01	0.01	0.03	0.69	0.11
PastRet	288	−0.78	0.04	−0.05	0.06	0.15	1.11	0.21
BM	288	0.08	0.67	0.44	0.66	0.89	1.49	0.26

Table II.
Summary statistics of core variables

Notes: This table presents the summary statistics of the core variables underlying corporate announcements in the sample. I define trading volume as the natural log of shares traded scaled by shares outstanding. Daily abnormal trading volume is calculated by subtracting the average trading volume over (t−60; t−31) from the daily trading volume over (t−30; t−2). Daily abnormal trading volume is then averaged across all announcements and cumulated over (t−30; t−2) to obtain the raw cumulative abnormal trading volume (Cumabvolraw). The pre-announcement stock price runup (Runup) is defined as the abnormal stock returns cumulated over (t−30; t−2). The market capitalization for each firm (Size) is defined as the natural log of shares outstanding multiplied by the closing price at the announcement month end. The announcement return (AnnRet) is the abnormal stock returns cumulated over (t−1; t+1). Past stock returns (PastRet) are defined as the buy-and-hold stock returns cumulated over (t−210; t−31). The book-to-market ratio (BM) is measured as of the announcement month end. Panel A (B) provides the summary statistics for the scheduled (unscheduled) announcements

4. Empirical results

4.1 Raw cumulative abnormal trading volume

Table III reports insider trading activities during the 30-day period prior to the scheduled and unscheduled announcement date with five-day intervals. Interestingly, the empirical pattern appears closely related to the type of announcements as one would expect. The insiders indeed trade less in the five days (number of purchases = 25) immediately preceding the scheduled announcements than in the more distant past (number of purchases = 114), even though the general decline in insider trading activities is not strictly monotonic. This time series pattern is clear when we measure insider trading by the number of trades (both purchases and sales), the share volume and the dollar volume. The drop in liquidity trading right before the scheduled announcements might contribute to the time series pattern. In contrast, the insiders do not exhibit the same time series patterns in the days before the unscheduled announcements.

The firm-level regression has the design of:

$$\text{CumAbvol}_{raw} = \alpha_0 + \alpha_1 \text{Runup} + \alpha_2 \text{AnnRet} + \varepsilon, \tag{1}$$

where CumAbvol$_{raw}$ is the raw cumulative abnormal trading volume and Runup and AnnRet are the absolute values of pre-announcement stock price runup and announcement return. The two explanatory variables are intended to capture information leakage and informational content of announcements, respectively. Absolute values of the information proxies are used because both positive and negative information shocks can affect pre-announcement trading. Once the firm-level regressions are estimated, we obtain the residuals that are essentially the information-adjusted cumulative abnormal trading volume (CumAbvol).

	$(t{-}30; t{-}26)$	$(t{-}25; t{-}21)$	$(t{-}20; t{-}16)$	$(t{-}15; t{-}11)$	$(t{-}10; t{-}6)$	$(t{-}5; t{-}1)$
Panel A: scheduled announcements						
Number of purchases	114	130	78	102	109	25
Number of sales	1,926	1,987	2,034	1,703	1,300	1,152
Total number of trades	2,040	2,117	2,112	1,805	1,409	1,177
Shares bought (million)	6.31	3.86	2.39	5.04	10.13	0.03
Shares sold (million)	116.47	119.07	260.37	93.36	136.00	34.67
Total shares traded (million)	122.78	122.93	262.76	98.40	146.13	34.70
Shares bought ($million)	128.43	137.74	65.52	161.97	280.98	0.72
Shares sold ($billion)	5.69	5.75	8.64	4.56	4.45	1.99
Shares traded ($billion)	5.81	5.89	8.70	4.72	4.74	1.99
Panel B: unscheduled announcements						
Number of purchases	9	15	11	2	1	5
Number of sales	41	63	80	65	63	52
Total number of trades	50	78	91	67	64	57
Shares bought (million)	0.11	0.16	0.06	0.00	0.00	0.00
Shares sold (million)	2.02	3.13	3.16	5.04	10.59	3.32
Total shares traded (million)	2.13	3.29	3.21	5.04	10.59	3.33
Shares bought ($million)	3.64	4.70	2.26	0.05	0.05	0.25
Shares sold ($billion)	0.07	0.12	0.11	0.23	0.55	0.17
Shares traded ($billion)	0.07	0.13	0.12	0.23	0.55	0.17

Notes: This table examines the time series pattern of insider trading before scheduled and unscheduled announcements. The pre-announcement 30 day window $(t{-}30; t{-}1)$ is sliced into six five-day intervals, where t is the announcement date. Summary statistics on the number of trades, dollar volume and share volume are provided for both insider purchases and sales. Panel A provides the summary statistics for the scheduled announcements and Panel B for the unscheduled announcements

Table III.
Time series patterns
of pre-announcement
insider trading

Table IV presents the summary statistics for the full sample. Based on the mean statistics, the raw cumulative abnormal trading volume is negative (positive) before the scheduled (unscheduled) announcements and the information-adjusted cumulative abnormal trading volume maintains the same signs as the raw volume, suggesting the decrease (increase) in

	N	Min.	Mean	P25	Median	P75	Max.	Std
Panel A: raw cumulative abnormal trading volume								
Scheduled	16,258	−73.58	−0.07	−6.14	−0.38	5.55	73.24	9.61
Unscheduled	288	−42.46	4.23	−2.63	4.10	10.77	43.14	11.26
Panel B. Adjusted cumulative abnormal trading volume								
Scheduled	16,258	−74.38	−0.07	−6.08	−0.31	5.57	69.81	9.55
Unscheduled	288	−42.68	4.14	−2.47	4.13	10.67	42.64	11.00

Notes: This table presents the summary statistics of pre-announcement cumulative abnormal trading volume before and after the orthogonalization procedure using all announcements. To carry out the orthogonalization procedure, I first pool together all the announcements for each firm, and then regress the raw cumulative abnormal trading volume on stock price runup and announcement return associated with each announcement. The regression equation is:

$$\text{Cumabvol}_{\text{raw}} = \alpha_0 + \alpha_1 \text{Runup} + \alpha_2 \text{AnnRet} + \varepsilon,$$

where Cumabvol raw is the raw cumulative abnormal trading volume constructed as in Table II. Runup and AnnRet are the absolute values of pre-announcement stock price runup proxying for informational leakage and announcement returns, respectively. The above regression is estimated for each firm in the sample, and the information-adjusted cumulative abnormal trading volume is then obtained as the regression residuals. Panels A and B provide the summary statistics before and after the orthogonalization procedure, respectively

Table IV.
Orthogonalization of
trading volume: full
sample

the abnormal trading volume prior to scheduled (unscheduled) announcements. Thus, Table IV supports that the pre-announcement-period liquidity trading is higher for unscheduled announcements than for the scheduled ones.

4.2 Insider's decision to trade

To test *H1*, a logit regression is used to model insiders' decision to trade before corporate announcements. Since corporate insiders have private information about the forthcoming announcements, they likely buy (sell) prior to positive (negative) news. It is appropriate to separate the analysis of the insider's propensity to buy stocks from that to sell stocks. Running the regressions separately for insider purchases and sales is supported by the insider trading-related studies, which document that insider purchases are more likely to be information driven than insider sales (Lakonishok and Lee, 2001; Jeng *et al.*, 2003; Lei *et al.*, 2014; Chang and Watson, 2015). The regression specification is as follows:

$$\log it\left(\frac{\text{prob(buy} = 1)}{1-\text{prob(buy} = 1)}\right) = \alpha_0 + \alpha_1 \text{Size} + \alpha_2 \text{Runup} + \alpha_3 \text{AnnRet}$$
$$+ \alpha_4 \text{PastRet} + \alpha_5 \text{BM} + \alpha_6 \text{CumAbvol}$$
$$+ \alpha_7 \text{CumAbvolInd} + \alpha_8 \text{Opt} + \alpha_9 \text{OptInd} + \varepsilon, \tag{2}$$

$$\log it\left(\frac{\text{prob(sell} = 1)}{1-\text{prob(sell} = 1)}\right) = \alpha_0 + \alpha_1 \text{Size} + \alpha_2 \text{Runup} + \alpha_3 \text{AnnRet}$$
$$+ \alpha_4 \text{PastRet} + \alpha_5 \text{BM} + \alpha_6 \text{CumAbvol}$$
$$+ \alpha_7 \text{CumAbvolInd} + \alpha_8 \text{Opt} + \alpha_9 \text{OptInd} + \varepsilon. \tag{3}$$

The dependent variables are the logit of an indicator variable that takes the value of one if there are insider purchases or sales within the pre-announcement period and zero otherwise. The set of explanatory variables include a number of controls, Size, Runup, AnnRet, PastRet, BM, and CumAbvol. Ind is an indicator variable that takes the value of one for unscheduled announcements and zero for scheduled announcements. Opt is a dummy variable equal to one if the stock had traded options and zero otherwise.

Firm size (Size) is included as a control variable because insiders in larger firms generally have more stock option grants and higher stock ownership than insiders in smaller firms, hence, they are more likely to trade. Moreover, there are more insiders in a large firm. It becomes more likely that at least one insider in a larger company would choose to trade prior to the corporate announcements. Therefore, a positive sign for Size is expected for the insider's propensity to trade. Besides firm size, book-to-market ratio (BM) also captures strong common variation in stock returns (Fama and French, 1993). Firms that have high BM (a low stock price relative to book value) tend to have low earnings on assets. Since low stock price (or low earning) is less appealing for insiders to trade, the sign of BM should be negative.

The information proxies include the price run-up (Runup) in the pre-announcement period and the announcement return (AnnRet) to capture the potential information leakage and the informational content of the announcement, respectively. Since insider purchases are mainly driven by information, insiders are more likely to buy in smaller pre-announcement information leakage and larger announcement return. Thus, a negative (positive) sign of Runup (AnnRet) is expected for the probability of insider purchases. For the probability of insider sales, the estimated effects of information proxies could be weaker because insider sales are mainly driven by diversification and are less likely to be information-driven than insider purchases.

Recent stock return (PastRet) is also controlled because extant literature indicates that insiders are contrarian investors in general. Given the insiders' tendency to buy (sell) stocks following the recent decline (rise) in stock price, PastRet is expected to have a negative (positive) sign for the insider probability to buy (sell).

The variable (CumAbvolInd) is defined as an interaction term between CumAbvol and an indicator variable (Ind). Lei and Wang (2014) document that insiders are more likely to trade in the pre-announcement period when the volume of liquidity trading is higher. Thus, the estimated coefficient for CumAbvol is expected to be positive for the insider's propensity to buy. They also indicate a stronger effect of liquidity trading on the insider's propensity to buy for unscheduled announcements than for scheduled announcements. The estimated coefficient for CumAbvolInd is expected to be positive owing to the insider's propensity to buy. Moreover, insider sales are less likely to be information-driven, implying potentially weaker effects for the insider's propensity to sell.

The primary focus of the regressions is the Opt, which is a dummy variable equal to one if the stock had traded options and zero otherwise. The variable (OptInd) is defined as an interaction term between Opt and an indicator variable (Ind). H1 predicts that the insider's propensity to trade before announcements in stocks that have no options listed is larger than in stocks with traded options. Therefore, the estimated coefficient for Opt is expected to be negative for the insider's propensity to buy. H1 further predicts a stronger effect of liquidity trading on the insider's propensity to buy for unscheduled announcements than for scheduled ones. In other words, the estimated coefficient for the interaction term OptInd is expected to be negative for the insider's propensity to buy. Again, there exists a weaker effect for the insider's propensity to sell.

Table V reports the results for the insider's probability to buy in the pre-announcement period. Our proxy for the level of liquidity trading CumAbvol presents a positive and significant estimate at the 1 percent level in both the full sample and scheduled subsample (in the unscheduled subsample, this variable is significantly positive at 10 percent level). In other words, the higher the pre-announcement liquidity trading, the more likely insiders will buy before announcements. Specifically, the coefficient for the interaction term Cumabvolind is positive and statistically significant at the 1 percent level, indicating that the coefficient of CumAbvol for the unscheduled announcements is higher than the scheduled announcements regardless of the specification. The effect of liquidity trading on the insider's propensity to buy prior to unscheduled announcement is stronger than prior to pre-scheduled announcement.

The estimated coefficient for Opt is negative and significant at 5 percent level for the insider's propensity to buy. This supports the predictions in H1, which state that the insider's propensity to trade before announcements in stocks that have no options listed is larger than in stocks with traded options. The coefficient for the interaction term OptInd is negative and significant at the 1 percent level for the insider's propensity to buy. This further supports H1, which documents a stronger effect of liquidity trading on the insider's propensity to buy for unscheduled announcements than for scheduled ones. Overall, the results in Table V lend a strong empirical support to H1.

Among the set of control variables, the effect of SIZE, PastRet and BM ratio are significant at the 10 percent level, whereas Runup and AnnRet are insignificant. The size effect is positive, reflecting the higher likelihood of insider purchases before corporate announcements owing to the larger number of insiders present in a large company. The coefficient of past returns (PastRet) is consistently negative, suggesting insiders are contrarian investors in general. The BM ratio effect is negative, proving that firms with higher BM are less appealing for insiders to trade.

Turning to the regressions for the insider's probability to sell in the pre-announcement period, the results for sale trade show similar results to those for buy trade. The size effect

	Buy			Sell		
	Scheduled	Unscheduled	All	Scheduled	Unscheduled	All
Intercept	-4.1327*** (0.0001)	-2.7679*** (0.0032)	-4.0656*** (0.0001)	1.2823*** (0.0001)	0.0196 (0.7383)	0.0912*** (0.0001)
Size	0.0003* (0.0697)	0.0007* (0.0854)	0.0004* (0.0637)	0.0001*** (0.0001)	0.0002* (0.0583)	0.0001*** (0.0001)
Runup	-0.6367 (0.2347)	-0.6179 (0.6561)	-0.6295 (0.1941)	0.1747* (0.0991)	1.2854 (0.2712)	0.2053* (0.0822)
AnnRet	0.4193 (0.6568)	-1.8696 (0.2482)	-0.1101 (0.8934)	-0.4716 (0.2174)	0.2425 (0.8738)	0.0673 (0.2970)
PastRet	-0.0686* (0.0716)	-1.1611* (0.0754)	-0.1128* (0.0584)	0.0476*** (0.0091)	0.4308 (0.5690)	0.0561*** (0.0079)
BM ratio	-0.1456 (0.2631)	-0.6525 (0.4076)	-0.1911 (0.3665)	-1.337*** (0.0001)	-1.7898*** (0.0014)	-0.0913*** (0.0001)
Cumabvol	0.0231*** (0.0001)	0.0257* (0.0749)	0.02319*** (0.0001)	0.0091*** (0.0006)	0.0193* (0.0565)	0.0126*** (0.0007)
CumabvolInd			0.0149* (0.0796)			0.0131* (0.0911)
Opt	-0.1631** (0.0471)	-0.9127** (0.0228)	-0.1535** (0.0358)	-0.0419* (0.0576)	-0.2161* (0.0586)	-0.0727* (0.0848)
OptInd			-2.0191*** (0.0001)			-0.1521*** (0.0001)
Adj. R^2	0.2124	0.2028	0.1196	0.1324	0.1228	0.0196

Notes: This table examines the insider's decision to buy before corporate announcements using the full sample. The dependent variable is the logit of an indicator variable that takes the value of one if there are insider purchases within 30 days before the announcement and zero otherwise. Runup, Size, AnnRet, PastRet and BM are defined in Table II. Cumabvol is information-adjusted cumulative abnormal trading volume; Cumabvolind is the interaction term between Cumabvol and an indicator variable that takes the value of one for unscheduled announcements and zero for scheduled announcements. The logistic regression equation is specified as follows:

$$\log it\left(\frac{\text{prob(buy} = 1\text{ orsell} = 1)}{1 - \text{prob(buy} = 1\text{ orsell} = 1)}\right) = \alpha_0 + \alpha_1 Size + \alpha_2 Runup + \alpha_3 AnnRet + \alpha_4 PastRet + \alpha_5 BM + \alpha_6 CumAbvol + \alpha_7 CumAbvolInd + \alpha_8 OPT + \alpha_9 OPTInd + \varepsilon.$$

The first three columns estimate the regression equation for buy trade. The last three columns estimate the regression equation for sale trade. P-values are reported in parentheses. *, **, ***Denote statistical significance at 10, 5 and 1 percent levels, respectively

Table V.
Insider's decision to buy or sell

and the effect of past returns and BM ratio continue to show the expected signs and statistical significance at the 10 percent level.

Interestingly, the coefficients for CumAbvol are positive and highly statistically significant at the 1 percent level for scheduled announcements, whereas the coefficients for CumAbvol are positive and only significant at the 10 percent level for unscheduled announcements. This implies that the drop in the liquidity trading before scheduled announcements dampens the insider's propensity to sell. Nonetheless, the weak evidence prior to unscheduled announcements suggests that insiders sales before corporate announcements are less likely to be information-driven than insider purchases.

4.3 Proportion of insiders' trading post-announcements to pre-announcements
To test *H2*, the relation between the timing of insider-trading, trends in insider-trading restrictions, event announcement and option trading is evaluated by the following multivariate estimation (firm and time subscripts have been omitted):

$$PostRatio = \alpha_0 + \gamma_1 Size + \gamma_2 Runup + \gamma_3 AnnRet + \gamma_4 PastRet$$
$$+ \gamma_5 BM + \gamma_6 Cumabvol + \gamma_7 CumabvolInd + \gamma_8 Opt$$
$$+ \gamma_9 OptInd + \gamma_{10} Trend + \varepsilon. \tag{4}$$

The dependent variable is PostRatio, which is defined as the percentage of all shares traded by insiders in the post-announcement period. Since an insider's actions depend on the sign of the news release, Equation (4) is also estimated with purchases and sales evaluated separately (i.e. utilizing $PostRatio_{Buys}$ and $PostRatio_{Sells}$ as the dependent variables). Trend is an iterative count variable that increases by one for each year during the specified time period. The set of explanatory variables includes a number of controls, Size, Runup, AnnRet, PastRet, BM, CumAbvol, Ind and Opt.

The signs of Trend variables should be positive because insider trading would move to post-announcement period with the passage of regulations that increase illegal insider trading-related penalties.

Firm size (Size) is included as a control variable because firm size is associated with the amount of information available regarding announcements and with the market's reaction to these announcements. Larger firms face greater political costs and greater litigation risk (Rogers and Stocken, 2005) and thus, are more likely to regulate their insiders' trading than are small firms. Insiders in larger firms should be more likely to move their trading from the pre-announcement period to post-announcement to reduce litigation risk and political cost. Therefore, a positive sign is expected for Size.

Firms with low BM tend to have high earnings on assets. Since high stock price (or high earning) is more appealing for insiders to trade, lower BM firms would face greater litigation risk. Insiders in lower BM firms should be more likely to move their trading to post-announcement to reduce litigation risk. Thus, the sign of BM should be negative.

Recent stock return (PastRet) is also controlled since there is evidence that insiders sell after prices have risen and buy after prices have fallen (Rozeff and Zaman, 1998). The sign of PastRet is uncertain because the impacts of recent stock returns on the trading in pre- (post-) announcement periods are similar.

When the volume of liquidity trading in the pre-announcement period is higher, insiders are more likely to trade in the pre-announcement period instead of post-announcement period. Thus, the estimated coefficient for CumAbvol is expected to be negative for the PostRatio. Chae (2005) finds that the volume of liquidity trading decreases before scheduled announcements, whereas the opposite relation holds for volume after the announcement. It indicates a stronger effect of liquidity trading on PostRatio for scheduled announcements

than for unscheduled announcements. The estimated coefficient for CumAbvolInd is expected to be positive.

H2 predicts that the proportion of insiders' trade volume after announcements relative to before announcements in stocks without options listed should be higher than those in stocks that have traded options. Therefore, the estimated coefficient for Opt is expected to be negative for PostRatio. *H2* further predicts the relationship should be stronger for unscheduled announcements than for scheduled ones. In other words, the estimated coefficient for the interaction term OptInd is expected to be negative for PostRatio. Again, there exists a weaker effect for the insider's propensity to sell.

Table VI reports the distribution of insiders' buy trade around corporate announcements. The signs of Trend variables present a positive and significant estimate at the 10 percent level in both the full sample and subsamples, indicating that insider trading moves to post-announcement period with the passage of regulations that increase illegal insider trading-related penalties. Among the set of control variables, the effect of Size, PastRet, BM Ratio, Runup and AnnRet are all insignificant at the 10 percent level, although the signs are almost similar as predicted.

The coefficient of CumAbvol for the unscheduled announcements is negative and significant at the 5 percent level, showing that insiders are more likely to trade in the pre-announcement period instead of post-announcement when the volume of liquidity trading in the pre-unscheduled announcement period is higher. The coefficient for CumAbvolInd is positive and significant at the 5 percent level, indicating a stronger effect of liquidity trading on PostRatio for scheduled announcements than for unscheduled announcements.

The coefficient for Opt is negative and significant at the 5 percent level in both the full sample and subsamples. It supports *H2*, which implies that the proportion of insiders' trade volume after announcements relative to before announcements in stocks without options listed is higher than those in stocks that have traded options. The coefficient for the interaction term OptInd is negative and significant at the 5 percent level, supporting *H2*, which implies that the relationship is stronger for unscheduled announcements than for scheduled ones.

Turning to the distribution of insiders' sale trade around corporate announcements, the results for sale trade show similar results to the results for buy trade. The control variables, which include the effect of size, PastRet, BM Ratio, Runup and AnnRet are all insignificant at the 10 percent level.

The coefficients of Cumabvol for the insiders' sale trade are negative and significant at the 10 percent level, while those for the insiders' buy trade are significant at the 5 percent level. It indicates that the effect of liquidity insiders' sale trades on PostRatio is weaker than that of buy trades. The coefficient for Opt for the insiders' sale trade is negative and significant at the 10 percent level only in the full sample, while those for the insiders' buy trade are significant at the 5 percent level in all samples. It implies that the effect of options listed on the proportion of insiders' sale trade volume is weaker than that of buy trade.

4.4 The relationship between the insiders' signed volume and the informational content of announcements

The implications on insiders' direction of trade before the corporate announcements are examined. The regression equation for test *H3* is as follow:

$$
\begin{aligned}
\text{InsTrd} = {} & \alpha_0 + \alpha_1 \text{Size} + \alpha_2 \text{Runup} + \alpha_3 \text{AnnRet} + \alpha_4 \text{PastRet} + \alpha_5 \text{BM} \\
& + \alpha_6 \text{AnnRetInd} + \alpha_7 \text{AnnRetOpt} + \alpha_8 \text{AnnRetIndOpt} + \varepsilon.
\end{aligned}
\tag{5}
$$

The dependent variable InsTrd is a measure of insider trading intensity defined as the difference between the dollar value of insider purchases and sales scaled by the total dollar value of insider purchases and sales before each announcement. The set of explanatory

The effects of liquidity trading

	Buy			Sell		
	Scheduled	Unscheduled	All	Scheduled	Unscheduled	All
Intercept	0.9722 (39.7609)	0.8599 (0.8051)	0.9681 (39.5071)	0.8896 (42.5869)	0.0084** (0.0239)	0.8799 (41.8834)
Size	0.0001 (0.3634)	0.0002 (0.3010)	0.0001 (0.2502)	0.0003 (0.4936)	0.0002 (0.1265)	0.0003 (0.4840)
Runup	0.0178 (0.4558)	−0.9142 (−0.4001)	0.011 (0.2809)	0.0165 (0.3972)	−0.6088 (−0.9992)	0.0029 (0.0712)
AnnRet	−0.0285 (−0.4643)	−3.3133 (−0.9111)	−0.0446 (−0.7226)	0.2453 (3.5071)	0.3543 (0.7594)	0.2011 (2.9807)
PastRet	−0.0072 (−0.4855)	−0.6073 (−0.6048)	−0.0077 (−0.5173)	−0.0396 (−2.1463)	−0.0847 (−0.2357)	−0.0450 (−2.4273)
BM ratio	−0.024 (−1.8474)	−0.1992 (−0.2847)	−0.0294 (−1.5944)	0.0311 (1.8787)	0.5689 (2.4552)	0.0361 (2.2456)
Cumabvol	−0.0011 (−0.2370)	−0.0021** (−0.0243)	−0.0014 (−0.2356)	−0.0003* (−0.0702)	−0.0051** (−0.0941)	−0.0003* (−0.0813)
Cumabvolind			0.0003*** (0.0113)			0.0047 (0.1193)
Opt	−0.0002*** (0.0010)	−0.0754** (−0.0130)	−0.0003*** (0.0022)	−0.0074 (−0.1321)	−0.3548 (−0.1842)	−0.0095* (−0.0719)
OptInd			−0.1035** (−0.0195)			−0.2429 (−0.5982)
Trend	0.0011* (0.0703)	0.0127*** (0.0095)	0.0015* −0.0703	0.0058 (0.3331)	0.0087** (0.0323)	0.0061 (0.3466)
Adj. R^2	0.0025	0.0308	0.0033	0.0124	0.1228	0.0196

Notes: This table examines the relation between the timing of insider buy's trades, event announcement and option trading. The dependent variable is PostRatio, which is defined as the percentage of all shares traded by insiders that are traded in the post-announcement period. Size, Runup, AnnRet, PastRet and BM are defined in Table II. Cumabvol is information-adjusted cumulative abnormal trading volume; Trend is an iterative count variable that increases by one for each year during the specified time period; Ind is an indicator variable that takes the value of one for unscheduled announcements and zero for scheduled announcements. Cumabvolind is the interaction term between Cumabvol and Ind. OPT is a dummy variable equal to one if the stock had traded options and zero otherwise. The regression is as follows:

$$\text{PostRatio} = \gamma_0 + \gamma_1 \text{Size} + \gamma_2 \text{Runup} + \gamma_3 \text{AnnRet} + \gamma_4 \text{PastRet} + \gamma_5 \text{BM} + \gamma_6 \text{Cumabvol} + \gamma_7 \text{Cumabvolind} + \gamma_8 \text{OPT} + \gamma_9 \text{OPTInd} + \gamma_{10} \text{Trend} + \varepsilon$$

The first (last) three columns estimate the regression equation for buy (sale) trade. P-values are reported in parentheses. *, **, ***Denote statistical significance at 10, 5 and 1 percent levels, respectively

Table VI.
The distribution of insiders' trade around corporate announcements

variables include the five control variables in the logit regressions discussed earlier, Runup, Size, AnnRet, PastRet and BM. AnnRetInd is an interaction term between the announcement return AnnRet and an indicator variable Ind. AnnRetOpt is an interaction term between AnnRet and Opt, which is a dummy variable equal to one if the stock had traded options and zero otherwise. AnnRetIndOpt is an interaction term between the AnnRet, Ind and Opt.

Lei and Wang (2014) document that the relationship between the insiders' signed volume and the informational content of announcements is positive, implying that the sign of AnnRet is positive. Further, the positive relationship is stronger before unscheduled announcements than before scheduled ones, indicating that the coefficient of AnnRetInd should be positive.

H3 predicts that the positive relationship between the insiders' signed volume and the informational content of announcements in stocks without traded options should be stronger than in stocks that have options listed. Therefore, the estimated coefficient for AnnRetOpt is expected to be negative. *H3* further predicts the difference between the effect in stocks without traded options and the effect in stocks that have options listed should be more remarkable before unscheduled announcements than before scheduled announcements. In other words, the estimated coefficient for the interaction term AnnRetIndOpt is expected to be negative.

Table VII presents the relationship between the insiders' signed volume and the informational content of announcements. The coefficient of AnnRet for the unscheduled announcements is positive and significant at the 5 percent level, showing the positive relationship between the insiders' signed volume and the informational content of unscheduled announcements. The coefficient of AnnRetInd is positive and significant at the 5 percent level, indicating the positive relationship is stronger before unscheduled announcements than before scheduled ones.

The coefficient for AnnRetOpt is negative and significant at the 5 percent level for all samples, supporting *H3*, which implies that the positive relationship between the insiders'

	Scheduled	Unscheduled	All
Intercept	−0.9478 (−2.7802)	−1.0061 (−4.9155)	−0.9481 (−2.8179)
Size	−0.0001 (−2.6519)	−0.0002 (−1.0278)	−0.0001 (−2.5047)
Runup	−0.5501 (−4.6953)	−1.7853 (−2.2657)	−0.587 (−5.0654)
AnnRet	0.2756 (0.4604)	0.2256** (0.0261)	0.2798 (0.466)
PastRet	−0.1921 (−3.5947)	−0.5529 (−1.3036)	−0.1988 (−3.7437)
BM ratio	0.3948 (8.3729)	0.4227 (1.4694)	0.3986 (8.5638)
AnnRetInd			1.1392** (0.0144)
AnnRetOpt	−0.1413** (−0.0224)	−0.0458*** (−0.0052)	−0.1440** (−0.02282)
AnnRetIndOpt			−1.4981** (−0.0189)
Adj. R^2	0.4217	0.4906	0.4414

Notes: This table examines the insiders' direction of trade before the corporate announcements. The dependent variable InsTrd is a measure of insider trading intensity defined as the difference between the dollar value of insider purchases and sales scaled by the total dollar value of insider purchases and sales before each announcement. Size, Runup, AnnRet, PastRet and BM are defined in Table I. Ind is an indicator variable that takes the value of one for unscheduled announcements and zero for scheduled announcements. OPT is a dummy variable equal to one if the stock had traded options and zero otherwise. AnnRetInd, AnnRetOpt and AnnRetIndOpt are the interaction term between AnnRet, Ind and Opt. The regression is as follows:

$$\text{InsTrd} = \alpha_0 + \alpha_1 \text{Size} + \alpha_2 \text{Runup} + \alpha_3 \text{AnnRet} + \alpha_4 \text{PastRet} + \alpha_5 \text{BM} + \alpha_6 \text{AnnRetInd} + \alpha_7 \text{AnnRetOPT}$$

$$+ \alpha_8 \text{AnnRetIndOPT} + \varepsilon.$$

Table VII.
The insider trading intensity before corporate announcements

The first four columns estimate the regression equation for scheduled and unscheduled announcements separately. The last two columns pool together the scheduled and unscheduled announcements and re-estimate the regression equation augmented with the interaction terms AnnRetInd and AnnRetIndOpt. *P*-values are reported in parentheses. **, ***Denote statistical significance at 10, 5 and 1 percent levels, respectively

signed volume and the informational content of announcements in stocks without traded options should be stronger than in stocks that have options listed. The coefficient for the interaction term AnnRetIndOpt is negative and significant at the 5 percent level, supporting *H3*, which implies that the difference between the effect in stocks without traded options and the effect in stocks that have options listed should be more remarkable before unscheduled announcements than before scheduled announcements.

4.5 Profitability of insider's trade

The profitability analysis of insider trading provides further insights into insiders' trading patterns. Since insider purchases are more likely to be information-driven than insider sales, we focus on insider purchases when examining the profitability of insider trading. A multivariate regression analysis is conducted to control for variables that could affect the analysis of relative profitability. The following regression is to test *H4*:

$$AbRet = \alpha_0 + \alpha_1 Size + \alpha_2 Runup + \alpha_3 AnnRet + \alpha_4 PastRet$$

$$+ \alpha_5 BM + \alpha_6 Ind + \alpha_7 Opt + \alpha_8 IndOpt + \varepsilon. \quad (6)$$

The dependent variable AbRet is the equal-weighted average cumulative abnormal stock returns during the period from the insider trading day to one day prior to event announcement day. In addition to the five control variables, the set of explanatory variables also includes an indicator variable Ind, Opt and IndOpt, which is an interaction term between the Ind and Opt.

Table VIII presents that the coefficient of Ind is positive and significant at the 5 percent level, showing that insider trading in pre-unscheduled announcement is more profitable than those before scheduled ones. The coefficient of Opt is negative and significant at the 5 percent level, indicating that the insider trading in stocks that have no options listed is more profitable than that in stocks with traded options before announcements, which supports *H4*. Further, the coefficient of IndOpt is negative and significant at the 5 percent

	Scheduled	Unscheduled	All
Intercept	0.0011* (0.0528)	−0.0029* (0.0587)	0.0011** (0.0439)
Size	0.0001 (0.5229)	0.0001 (0.2486)	0.0001 (0.6852)
Runup	0.0283*** (0.0010)	0.0239*** (0.0010)	0.0295*** (0.0010)
AnnRet	0.0088*** (0.0001)	0.0240 *** (0.0001)	0.0138*** (0.0001)
PastRet	0.0001 (0.8669)	−0.0078** (0.0154)	0.0003 (0.4753)
BM	−0.0006 (0.2870)	0.0014 (0.3538)	−0.0007 (0.1743)
Ind			0.0107** (0.0328)
Opt	−0.0003** (0.0384)	−0.0017** (0.0154)	−0.0003** (0.0433)
Indopt			−0.0017** (0.0328)
Adj. R^2	0.4953	0.9514	0.5649

Notes: This table examines the profitability of insider's trade around the corporate announcements. The dependent variable AbRet is the equal-weighted average cumulative abnormal stock returns. Size, Runup, AnnRet, PastRet and BM are defined in Table I. Ind is an indicator variable that takes the value of one for unscheduled announcements and zero for scheduled announcements. OPT is a dummy variable equal to one if the stock had traded options and zero otherwise. IndOpt are the interaction term between Ind and Opt. The regression is as follows:

$$AbRet = \alpha_0 + \alpha_1 Size + \alpha_2 Runup + \alpha_3 AnnRet + \alpha_4 PastRet + \alpha_5 BM + \alpha_6 Ind + \alpha_7 OPT + \alpha_8 IndOPT + \varepsilon.$$

The first four columns estimate the regression equation for scheduled and unscheduled announcements separately. The last two columns pool together the scheduled and unscheduled announcements and re-estimate the regression equation augmented with the interaction term IndOpt. *P*-values are reported in parentheses. *,**, ***Denote statistical significance at 10, 5 and 1 percent levels, respectively

level, implying the disparity of profit between stocks without traded options and with traded options is higher before unscheduled announcements than before scheduled announcements which also supports *H4*.

Moreover, we recalculate an excess return by subtracting the risk free rate from the firm-month return for each firm-month observation to examine which type of traders insiders are. These excess returns are regressed on the Fama-French (1993) factors, the Carhart (1997) momentum factor, indicator variables, announcement and option dummies for whether the firm-month is in proximity to an insider-trading event. The regression model is as follows:

$$R-R_f = \alpha_0 + \alpha_1(R_m-R_f) + \alpha_2\text{SMB} + \alpha_3\text{HML} + \alpha_4\text{UMD}$$

$$+ \alpha_5\text{Month} + \alpha_6\alpha_6\text{Ind} + \alpha_7\text{Opt} + \alpha_8\text{IndOpt} + \varepsilon. \tag{7}$$

The dependent variable is excess return $R-R_f$. R is the raw monthly return; R_f is the monthly risk-free rate; R_m is the value-weighted, monthly market return; SMB is the difference in monthly return between a portfolio of small firm stocks (low Size) and a portfolio of large firm stocks (high Size); HML is the difference in monthly returns between a portfolio of value (high BM) stocks and a portfolio of glamour (low BM) stocks; UMD is difference in monthly returns between a portfolio of winner (high PastRet) stocks and a portfolio of loser (low PastRet) stocks; Month is a set of five indicator variables specifying whether the firm-month occurs in months -6 to -4, -3 to -1, month 0, month $+1$ to $+3$, or month $+4$ to $+6$, relative to the insider purchase or sale.

In Table IX, we presents the profitability of insider's all trade in all the sample. We find that in three months before the insider purchases, firms experience a positive return of 0.77 percent (the coefficient of month -3 to -1 plus the intercept). This indicates that insiders are momentum purchasers who buy shares after price increases. Examining returns in the three months after insider purchases exhibits that insiders earn a negative return of -0.78 percent

	Buy	Sell
Intercept	0.0027 (0.7441)	−0.0012 (0.8829)
Month −6 to −4	0.0021 (0.182)	−0.0058*** (0.0001)
Month −3 to −1	0.0050** (0.0011)	−0.0094*** (0.0001)
Month 0	−0.0092*** (0.0001)	0.0135*** (0.0001)
Month +1 to +3	−0.0105*** (0.0001)	0.0004*** (0.0001)
Month +4 to +6	0.0010 (0.5141)	0.0032 (0.0186)
Ind	0.0052 (0.1407)	0.0057 (0.1071)
Opt	−0.0064*** (0.0001)	−0.0059*** (0.0001)
IndOpt	−0.0096 (0.1553)	−0.0095 (0.1577)
Adj. R^2	0.2863	0.2383

Notes: This table examines the insider-trading profitability around the corporate announcements. The dependent variable is excess return $R-R_f$. R is the raw monthly return; R_f is the monthly risk-free rate; R_m is the value-weighted, monthly, market return; SMB is the difference in monthly return between a portfolio of small firm stocks (low Size) and a portfolio of large firm stocks (high Size); HML is the difference in monthly returns between a portfolio of value (high BM) stocks and a portfolio of glamour (low BM) stocks; UMD is difference in monthly returns between a portfolio of winner (high PastRet) stocks and a portfolio of loser (low PastRet) stocks; MonthDum$_i$ is a set of five indicator variables specifying whether the firm-month occurs in months -6 to -4, -3 to -1, month 0, month $+1$ to $+3$, or month $+4$ to $+6$, relative to the insider purchase or sale. An indicator variable Ind that takes the value of one for unscheduled announcements and zero for scheduled announcements. OPT is a dummy variable equal to one if the stock had traded options and zero otherwise. *P*-values are reported in parentheses. **, ***Denote statistical significance at 10, 5 and 1 percent levels, respectively. The regression is as follows:

$$R-R_f = \alpha_0 + \alpha_1(R_m-R_f) + \alpha_2\text{SMB} + \alpha_3\text{HML} + \alpha_4\text{UMD} + \alpha_5\text{Month} + \alpha_6\alpha_6\text{Ind} + \alpha_7\text{Opt} + \alpha_8\text{IndOpt} + \varepsilon.$$

Table IX.
Insider-trading
profitability

(the coefficient of month +1 to +3 plus the intercept). In three months before the insider sales, firms experience a negative return of −1.06 percent. This indicates that insiders are momentum sellers who sell shares after price decreases. Examining returns in the three months after insider sales exhibits that insiders earn a negative return of −0.08 percent.

Therefore, whenever insiders are purchasers or sellers, they are always momentum traders and cannot get profits after three months they trade. It suggests that insiders do not obtain accurate inside information. If they obtain accurate information, they might be afraid of litigation and trade the opposite direction.

5. Conclusion

In this study, we utilize the insider trading data of companies that comprise the S&P 500 index to explore the difference between the insider trading in optioned and non-optioned stocks around scheduled and unscheduled corporate announcements. We study four issues in sequence. First, the insider's propensity to buy before announcements is larger for stocks without options listed than for stocks with traded options. This result is stronger for unscheduled announcements than for scheduled ones. The results for the insider's probability to sell are similar (but weaker) with the results for the insider's probability to buy.

Second, for the insiders' buy trades, insiders are more likely to trade in the pre-announcement period rather than in the post-announcement period when the volume of liquidity trading in the pre-unscheduled announcement period is higher. Moreover, there is a stronger effect of liquidity trading on the post-announcement period for scheduled announcements than for unscheduled announcements. The proportion of insiders' trade volume after announcements relative to before announcements in stocks without options listed is higher than those in stocks with traded options. The result is stronger for unscheduled announcements than for scheduled ones. For the insiders' sale trade, the above coefficients are not as significant as those for the insiders' buy trade, indicating the effects for insiders' sales are weaker than those for buy trades.

Third, there is a positive relationship between the insiders' signed volume and the informational content of unscheduled announcements. The positive relationship is stronger before unscheduled announcements than before scheduled ones. Moreover, the positive relationship between the insiders' signed volume and the informational content of announcements is stronger in stocks without traded options than in stocks with options listed. The difference between the effect in stocks without traded options and the effect in stocks with options listed is more outstanding before unscheduled announcements than before scheduled announcements.

Fourth, insider trading is more profitable prior to unscheduled announcements than before scheduled ones. Moreover, insider trading is more profitable for stocks without options listed than for stocks with traded options before announcements. Additionally, the disparity of profit between stocks without traded options and with traded options is higher before unscheduled announcements than before scheduled announcements. We recalculate an excess return by subtracting the risk-free rate from the firm-month return for each firm-month observation to examine which type of traders insiders are. We find no matter if insiders are purchasers or sellers, they are always momentum traders and cannot achieve profits, suggesting that insiders do not obtain accurate inside information. If they obtain accurate information, they might be afraid of litigation and trade in the opposite direction.

The above findings have important implications for market regulators. Since the insider's propensity to buy before announcements in stocks without options listed is larger than in stocks with traded options and the relationship is stronger for unscheduled announcements than for scheduled ones, the efforts of regulators should focus on monitoring insider trading in stocks without options listed prior to unscheduled announcements. Since acquisition decisions may be the most important corporate resource allocation decisions that CEO take (Harford and Li, 2007), CEO's trading should be carefully scrutinized by market regulators.

Several possible directions for future research are suggested. Our paper examines whether there is a difference between the effects of optioned stock and non-optioned stock. Roll *et al.* (2010) use the relative trading volume of options to stock ratio (O/S) to proxy for informed options trading activity. Future research could explore the impact of O/S on the aforementioned effects. Moreover, we examine how insiders with private information use such information to trade in their own firms. Mehta *et al.* (2017) argue that insiders also use private information to facilitate trading (shadow trading) in linked firms, such as supply chain partners or competitors. Therefore, future research could consider the impact of shadow trading to explore whether our hypotheses are still supported. In this paper, we focus on legal insider trading. Since earnings and takeover news are also the most common types of information in the sample of prosecuted insider trading cases (Del Guercio *et al.*, 2017), future research could use the sample of illegal insider trading to examine whether our hypotheses are still supported.

Note

1. Collin-Dufresne and Fos (2015) indicate that insiders choose to trade on days when liquidity is abnormally high.

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Further reading

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