

Clancey-Shang, Danjue

**Article**

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Article

# Information Spillovers Prior to M&A Announcements

Danjue Clancey-Shang

Department of Economics & Finance, Jon M. Huntsman School of Business, Utah State University, Logan, UT 84322, USA; [danjue.shang@usu.edu](mailto:danjue.shang@usu.edu)

**Abstract:** In this paper, I study trading activities prior to M&A announcements pertaining to the rivals of the merging firms. I find that not only acquirers and targets experience increases in abnormal trading activities in stock and option markets, but also their rivals. The rise in option trading is especially strong for options that informed traders are most likely to trade. I find that the implied volatility spread (IV spread) constructed from a rival's option prices the day before the announcement can predict this rival's cumulative abnormal return (CAR) over the M&A announcement window. As the IV spread is widely adopted as a proxy for informed trading activities in the option market, my findings provide evidence for information spillovers from merging firms to their rivals prior to the announcements of the M&A deals.

**Keywords:** information spillover; option trading; M&A



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## 1. Introduction

Within-industry information spillovers across peer firms have received attention from academics for decades. While the information flows among rivals are well documented (Bernstein and Nadiri 1989; Leary and Roberts 2014; Bernard et al. 2020, among others), how such information spillovers manifest in trading activities in financial markets has been less studied. In this paper, I examine the trading of rival firms in M&A episodes in both stock and option markets.

Theoretical literature suggests that mergers and acquisitions can create positive spillovers for non-merging rivals (Deneckere and Davidson 1985; Perry and Porter 1985). The M&A's send positive signals to the market, suggesting great growth potentials of the industry, or indicating growing power for the merging firms to push up the product prices which the rivals will also benefit. Some empirical literature has documented the positive effect of takeover announcements on rival firm stock returns (Eckbo 1983, 1985; Mitchell and Mulherin 1996; Servaes and Tamayo 2013). However, Derrien et al. (2017) suggest that rivals can lose value as losing competitive power, which can well happen when the targets are private, and the acquirer rivals would negatively react to the M&A announcements. Internationally, Ranju and Mallikarjunappa (2009) document that while acquirers' rivals in general experience positive stock market reactions, the reactions are negative for horizontal mergers in India. These mixed results call for further understandings of the dynamics in the informational linkage across rival firms in M&A episodes. In this study, I take an alternative perspective, and investigate whether the trading activities pertaining to the rival firms prior to M&A announcements contain information that predicts how financial markets react to the news, and shed light on the nature of the information spillover across rivals.

Information-based tradings likely occur across stocks. Pasquariello and Vega (2015) show that heterogeneously informed traders strategically trade across assets, and find strong cross-asset informational effects. Tookes (2008) develops a model suggesting that informed traders have incentives to make information-based trades in the stocks of competitors. Akbas et al. (2015) find that firm-level monthly short interests are strongly associated

with rival firm returns. While a significant amount of research in informed trading literature studies trading activities prior to corporate events,<sup>1</sup> evidence on cross-asset trading activities in the context of these events is much less documented. The few studies I am aware of mostly focus on the stock market and look into the events of earnings announcements. For example, [Mudalige et al. \(2020\)](#) show that on the Australian Securities Exchange, institutional investors engage in information based cross-trading prior to earnings announcements, while individual investors learn from informed traders. [Duong et al. \(2015\)](#) study the cross-stock informational linkage generated by algorithm tradings prior to earnings announcements. [Tookes \(2008\)](#) finds empirical evidence that tradings of non-announcing rivals contain information for the announcing firms in the context of earnings announcements.

I examine the abnormal trading activities in both stock and option markets prior to M&A announcements, and the potential information flow between the two markets. I find that the trading activities in option markets prior to these announcements have predictive information for how the stock market interprets an M&A's impacts on the rival firms. More specifically, prior to an M&A announcement, abnormal tradings emerge not only for acquirers and targets, but also among their rival firms. The effect is especially strong for options that the prior literature has suggested the informed traders are most likely to trade. I also construct the implied volatility spread (IV spread), a measure that has been well adopted in the literature as a proxy for the signed informed trading activities in options markets. I find that the IV spread constructed from a rival's option prices the day before the announcement can predict this rival's cumulative abnormal return (CAR) over the announcement window. When the pre-announcement implied volatility spread is larger, indicating more expensive calls relative to the puts, this rival will experience higher announcement CAR. There is also some evidence that rival firms' IV spreads are negatively associated with the merging firm's announcement CAR, consistent with [Tookes \(2008\)](#)'s finding that non-announcing rivals' tradings have information content for the announcing firms. These findings align with the hypothesis that there are informed trading activities pertaining to the rival firms prior to an M&A announcement.

In a recent development in M&A literature, [Anton et al. \(2022\)](#) find that value-destroying acquisitions may get approved and completed by corporate decision makers when announcement losses from acquirer stakes can get mitigated by gains from not only target stakes, but also rival stakes with common ownership often shared between merging firms and their rivals. Their findings suggest that informed traders can have insights into how rival firms' share prices will react to an M&A announcement *ex ante*, and are able to make more informative decisions that benefit themselves accordingly. While translating nonpublic information into trading rival firms is technically still a practice that takes advantage of information most investors do not have, it has received much less attention from regulators or academics, and typically has not been considered illegal. In terms of corporate level restrictive policies, most firms are silent or vague in regulating trading of rivals ([Tookes 2008](#)). [Ayres and Bankman \(2001\)](#) suggest that there is "abundant evidence" that corporate insiders, who are explicitly prohibited by law from trading on material nonpublic fiduciary information, often leverage their informational edge and trade "substitute stocks". Rivals of the announcing firms are one of the main substitutes they discuss in-depth. My findings align with these remarks as well.

My findings contribute to the informed trading literature from a novel perspective. Both theoretical and empirical literature suggests that informed traders trade in both stock and option markets, especially options when the implicit leverage provided by options is high and the trading cost in option market is low ([Back 1993; Easley et al. 1998; Cao 1999; Cremers and Weinbaum 2010](#), among others). Several studies have documented that stock and option trading activities prior to corporate events contain information about the events, such as earnings announcements and M&A announcements, suggesting that informed traders likely have taken advantage of their informational edge and earn abnormal returns in capital markets. Unlike earnings announcements, the general public is less likely to

speculate on the timing of unscheduled events such as M&A's; these events offer especially large information advantage, hence especially profitable trading opportunities for informed traders. The informed trading activities that precede M&A announcements have been well studied, and ample evidence of such activities has been documented. However, so far the studies that examine informed tradings in option markets prior to M&A announcements only consider the merging firms. To the best of my knowledge, my study is the first to extend the consideration to the merging firms' rivals. As the merging firms and their rivals rarely announce M&A activities at the same time, the results on merging firms and their rivals are more convincingly separable, which provides a great opportunity to study the information spillovers to non-announcing rivals. I provide novel empirical evidence that aligns with the theoretical work by [Tookes \(2008\)](#), who shows that informed traders can strategically choose to trade rival firms.

My findings also shed light on the informational connection between companies and their rivals during corporate events. Such a connection has inspired investigations into rival firm market reactions across various types of corporate events, such as merger and acquisitions ([Song and Walkling 2000](#); [Shahrur and Venkateswaran 2000](#)), stock offerings ([Benveniste et al. 2002](#); [Bradley and Yuan 2013](#)), and shareholder payouts ([Erwin and Miller 1998](#)). In particular with M&A's, empirical evidence on rivals' market reactions to an announcement is mixed. In this study, I approach the rival firms' differential reactions to an M&A announcement from the pre-announcement trading perspective. I find that the rivals' differential reactions can be predicted by their IV spreads derived from option prices prior to the announcements, while prior literature widely considers the said spread as a signed proxy for informed tradings in options markets. These findings are consistent with the hypothesis that information spillovers across rivals manifest in the trading activities prior to M&A events.

The remainder of the paper is organized as follows: in Section 2, I describe the data sample and the construction of the main variables of interest. In Section 3, I describe the methodology for the empirical analysis, and discuss the empirical findings. In Section 4, I discuss the future work that can be done to provide further evidence. Section 5 concludes.

## 2. Data

### 2.1. Data Description

The data used in this study come from the following primary sources. First, I gather the data on merger and acquisitions by publicly traded US firms involving US targets between 2003 and 2013 from Securities Data Corporation (SDC) Mergers & Acquisitions database.<sup>2</sup> All acquisitions for which Compustat or CRSP data is missing are excluded. The data set includes the percentage of the target that the acquirer wants to acquire (Sought), whether the target management is opposed to the acquisition by the acquirer (Hostile), whether the acquisition is completed (Completed), the size of the acquisition in millions (Dealsize), and whether it is a cash merger (Cash Merger), defined as a merger where the primary payment is cash (i.e., the "% of cash" variable in SDC is greater than or equal to 50). I control for these deal characteristics when studying the potential predictive content in the IV spread for the magnitude of the announcement CAR.

I report the number of deals and the number of acquirers involved over years in Table 1. Panel A presents for the sample whereby merging firms have valid option listings, and Panel B presents for the sample whereby rival firms have valid option listings. Table 1 shows that both numbers steadily grow over time; though the growth is set back during the 2008 financial crisis, it has resumed since 2009.

**Table 1.** M&A Over Time.

Year	Number of Events	Number of Acquirers
	Panel A	Panel B
2003	928	561
2004	984	587
2005	1082	620
2006	1157	666
2007	1213	681
2008	1015	623
2009	747	507
2010	979	591
2011	1080	640
2012	1172	672
2013	1172	699

Table 1 presents the number of deals and acquirers in my sample by year. Panel A presents for the sample whereby merging firms have valid option listing, and Panel B presents for the sample whereby rival firms have valid option listing.

Second, I gather daily stock trading volume, stock return, closing price, and shares outstanding for the merging firms and their rivals between 2002 and 2013 from the Center for Research in Security Prices (CRSP). I then construct the cumulative abnormal return (CAR) over the two-day window from the announcement day to the first day after.

Third, I obtain accounting information for the merging firms and their rivals from Compustat. Following [Fee and Thomas \(2004\)](#), I identify rivals as any firms, besides the bidder and target, which have at least one segment for the year before the M&A in the same four-digit SIC code industry group as the merging firm. The data used to identify rivals are also from the Compustat.

Fourth, I gather end-of-day historical option data between 2002 and 2013 from the Option Price Reporting Authority (OPRA) database by option series, i.e., unique underlying symbol, option type (call or put), strike price, and expiration date. These data include daily closing price, closing NBBO bid and ask prices, contract volume, and implied volatility. I exclude daily option observations with zero or missing NBBO price or implied volatility. I also remove any daily option observation that has a bid price of zero or violates the no-arbitrage restrictions.

## 2.2. Measures of Interest

### 2.2.1. Abnormal Trading

One of the main variables of interest in this study is the abnormal trading volume on merger firms and their rivals prior to M&A announcements. Following [Campbell and Wasley \(1996\)](#), I adopt the mean-adjusted daily trading volume approach to measure the abnormal trading for both stocks and options. I take trading day  $-90$  to day  $-31$  prior to the announcement date as the benchmark period, which I denote as  $\{-90, -31\}$ . For each day over this period, I calculate the daily volume as the number of traded stocks (or traded option contracts across states of moneyness and times-to-maturity, where each contract

corresponds to 100 shares in the underlying stock). Then I calculate the average daily trading volume over this period as the benchmark daily trading volume. Over the pre-event period  $\{-20, -1\}$ , I define the abnormal mean-adjusted volume for subject firm  $i$  on day  $t$  during the pre-event period as:

$$\text{Abnormal Volume}_{it} = \text{Volume}_{it} - \text{Benchmark Volume}_i \quad (1)$$

where

$$\text{Benchmark Volume}_i = \frac{1}{60} \sum_{t=-90}^{-31} \text{Volume}_{it} \quad (2)$$

This measure demonstrates how much more trading happens to a particular firm on a daily basis as the day of the M&A announcement approaches, relative to its regular trading level. Over the 20-day window prior to an announcement, I construct this measure for all the merging firms as well as their rival firms, namely any firms having at least one segment in the same four-digit SIC code industry group as the merging firms (Fee and Thomas 2004) the year before the M&A.

### 2.2.2. Implied Volatility Spread

Implied volatility spread (IV spread) is the difference in implied volatilities between a pair of call and put options with the same time-to-maturity and strike price. Put-call parity suggests zero IV spread for European options. Cremers and Weinbaum (2010) argue that the emergence of a non-zero IV spread, even for American options, is largely driven by the price pressure induced by informed trading in option markets, and find that the magnitude of the IV spread can predict future stock returns. The intuition is that the demand for a certain type of options from informed traders drives option prices in the direction consistent with the private information, which is not yet reflected in stock prices, but will be later on. For example, a larger IV spread indicates that call options are more expensive relative to the puts. Assuming the prices for calls are driven higher by the demand of informed traders, such a demand indicates that informed traders expect the underlying stock price will increase in the near future, which later on will happen in the underlying market. They also find supportive evidence consistent with the account that the predictive power of the IV spread originates from the informed trading activities in options markets. Therefore, IV spread is widely adopted in the literature as a signed proxy for informed trading activities in option markets. For example, Bali and Hovakimian (2009), An et al. (2014), and Lin and Lu (2015) follow this path and examine the predictive content in the IV spread for future stock returns.

Following these studies, I construct the IV spread as the average difference in implied volatilities between call and put options for the same security with the same strike price and the same maturity weighted by the option open interests. In particular, the IV spread is computed for each firm  $i$  on each day  $t$  as:

$$\text{IV Spread}_{it} = \text{IV}_{it}^{\text{calls}} - \text{IV}_{it}^{\text{puts}} = \sum_{j=1}^{N_{it}} w_{jt}^i (\text{IV}_{jt}^{i,\text{calls}} - \text{IV}_{jt}^{i,\text{puts}}) \quad (3)$$

where  $j$  refers to pairs of call and put options with the same strike price and the same maturity;  $N_{it}$  is the number of put-call pairs for each stock  $i$  on day  $t$ ; and  $w_{jt}^i$  is the weight, computed as the average open interest of call and put in each pair.  $\text{IV}_{jt}^i$  represents the Black and Scholes (1973) implied volatility for each option.

### 2.3. Descriptive Statistics

In this subsection, I summarize the M&A measures as well as the stock and option characteristics in the sample used in the empirical analysis.

Panel A and Panel B of Table 2 report summary statistics for the acquirers and targets, respectively. As shown in Table 2, much fewer M&A's in the sample have targets that

are publicly traded with listed options relative to the acquirers (500+ vs. 11,000+). Most acquirers in the sample seek complete control of the targets once the deal is completed. The average deal size is 591.91 million dollars. The deals in which targets are publicly traded are much larger in size, averaging 3.50 billion dollars. In both samples deal sizes are highly positively skewed. Forty-five percent of the deals are cash mergers, in which at least half of the payments are made with cash. Ninety-one percent of the announced deals end up being completed. Note that this percentage is much lower in the mergers in which the target is a public company. Almost none of the deals are hostile.

**Table 2.** Summary Statistics of M&A Deals.

Panel A						
Variable	N	Mean	Std Dev	Lower Quartile	Median	Upper Quartile
Sought	11,472	96.01	16.22	100	100	100
Dealsize	6301	591.91	3098.94	23.80	82.09	284.00
Cash Merger	11,833	0.45	0.50	0	0	1
Completed	11,833	0.91	0.29	1	1	1
Hostile	11,833	0.00	0.04	0	0	0
A-CAR (0, 1)	11,833	−0.27	4.69	−1.33	0.20	1.66
A-Mkt Cap	11,833	16.03	41.96	0.95	2.60	9.35
A-IVS	11,736	−0.89	5.54	−2.09	−0.61	0.68
A-BAS	11,503	32.85	23.52	16.54	26.45	41.38
Panel B						
Variable	N	Mean	Std Dev	Lower Quartile	Median	Upper Quartile
Sought	526	93.37	22.34	100	100	100
Dealsize	484	3498.17	7697.47	511.96	1328.18	3069.17
Cash Merger	547	0.49	0.50	0	0	1
Completed	547	0.77	0.42	1	1	1
Hostile	547	0.02	0.13	0	0	0
T-CAR(0,1)	546	19.13	21.54	5.12	14.72	28.53
T-Mkt Cap	547	3.70	8.50	0.46	1.140	2.74
T-IVS	543	−0.71	8.56	−2.83	−0.61	1.23
T-BAS	527	35.14	21.13	20.56	30.61	42.70

Table 2 presents the summary statistics for the acquirers (Panel A) and publicly traded targets (Panel B) in acquisitions between 2003 and 2013 whereby publicly traded US firms with listed options acquire US targets. *Sought* is the percentage of target that the acquirer wants to acquire. *Hostile* is the dummy variable indicating whether the target management is opposed to acquisition by the acquirer. *Completed* is the dummy variable indicating whether the acquisition is completed. *Cash Merger* is the dummy variable indicating whether it is a merger in which the “% of cash” in SDC is greater than or equal to 50. *A-CAR(0, 1)* (*T-CAR(0, 1)*) is the acquirer (target) CAR over the 2-day period from announcement day to the day next in percentage. *A-MktCap* (*T-MktCap*) is the acquirer (target) market capitalization in billions. *A-IVS* (*T-IVS*) is the acquirer (target) implied volatility spread in percent. *A-BAS* (*T-BAS*) is the acquirer (target) bid-ask spread as a percentage of the their midpoint.

Consistent with the literature, the average target announcement CAR is highly positive (19.13%). The average acquirer announcement CAR is close to zero (−0.27%). The acquirer market capitalization averages 16.03 billion dollars, while the market capitalization for the publicly traded targets averages 3.70 billion dollars. Listed options on those merging firms are not substantially different between acquirers and targets, both with near zero IV spreads and similar bid-ask spreads.

Table 3 summarizes the rival firms. On average, each acquirer has 31.55 rivals, with a median of 13. Each target has 33.40 rivals, with a median of 15. The average acquirer rival announcement CAR is −0.04%, while the average target rival announcement CAR is 0.20%. The standard deviations for both acquirer and target rivals’ CAR are relatively big though (3.92% and 4.81%, respectively).

**Table 3.** Summary of Rivals.

Panel A					
# of Rivals	Mean	Std Dev	Lower Quartile	Median	Upper Quartile
Acquirer	31.55	38.23	4	13	48
Target	33.40	37.47	4	15	54
Panel B					
Rivals CAR(0,1)	Mean	Std Dev	Lower Quartile	Median	Upper Quartile
Acquirer	−0.04	3.92	−1.61	−0.09	1.42
Target	0.20	4.81	−1.68	0.00	1.72

Panel A presents the cross-sectional distribution of the number of rivals for both acquirers and targets. Panel B presents the distribution of the announcement CAR for both acquirer rivals and target rivals in percentage.

### 3. Empirical Methods and Results

In this section, I describe my empirical methods, present the results of the empirical analysis, and provide discussions of my findings. First, I study the abnormal trading activities for both merging firms and their rivals prior to M&A announcements. Next, I examine whether the magnitude of the IV spread, which is well accepted as a signed measure for informed option trading in the literature, can predict announcement CAR for rivals of the merging firms, indicating the potential informed trading activities of rivals prior to M&A announcements.

#### 3.1. Abnormal Trading

Abnormal trading activities on merging firms before M&A announcements have been well documented by prior literature (Keown and Pinkerton 1981; Meulbroek 1992; Jayaraman et al. 2001; Chan et al. 2015; Augustin et al. 2019, among others). Tookes (2008) suggests that informed traders of announcing firms can strategically choose to trade nonannouncing rivals, and finds empirical evidence for cross-asset informational effect in the context of earnings announcements. In this section, I examine stock and option trading activities prior to M&A announcements. I consider both merging firms and their rivals. I estimate the abnormal trading volume over the time window  $\{-20, -1\}$  based on the benchmark trading volume over  $\{-90, -31\}$  for each acquirer, target, and their rivals. I consider both the daily abnormal volume and the cumulative abnormal trading volume over the 20-day window prior to each announcement.

##### 3.1.1. Results for Merging Firms

Figure 1 presents how the average abnormal stock and option trading volume evolves over the 20-day period prior to M&A announcements for acquirers. On average, there is a sizable growth in acquirer abnormal volume over the 20-day period prior to M&A announcements, though volatile. The total daily abnormal volume on stocks grows over time and exceeds 63,646 on average, while the average abnormal trading volume on options rises to 346 contracts the day right before the announcement.



**Figure 1.** *Stock* and *Option* represent the average daily abnormal trading volume of acquirers' stocks and options over the 20-day period prior to the announcement, respectively.

Figure 2 presents how the average abnormal stock and option trading volume evolves over the 20-day period prior to M&A announcements for targets. The trading activities are much heavier for targets. The abnormal stock trading spikes and reaches 1,902,197 and the abnormal option trading reaches 6227 contracts the day right before an announcement. This is in line with the well documented effect that M&A announcements usually trigger significant positive shifts in targets' stock prices. It is also consistent with the findings by [Augustin et al. \(2019\)](#) regarding the prevalent informed trading activities of the target prior to the announcement.



**Figure 2.** *Stock* and *Option* represent the average daily abnormal trading volume of targets' stocks and options over the 20-day period prior to the announcement, respectively.

Note that both calls and puts see substantial growth in the abnormal volume, which supports [Jayaraman et al. \(2001\)](#), who find that the absolute number of calls versus puts does not necessarily provide information regarding the sign of the sentiment.

Next, I report the cumulative abnormal trading volume of stocks and options of the merging firms over the 20-day period in Table 4. Option results are reported by option type and moneyness group. Consistent with the information conveyed in the figures, target firms' abnormal volumes are substantial for both stocks and options, and across option types and moneyness groups. The average cumulative abnormal volumes over the 20-day window prior to M&A announcements are especially shocking for the targets. Acquirers' cumulative abnormal volumes are not as substantial, and more concentrated on ATM calls and OTM puts. In untabulated results, I find that the options with short times-to-maturity

see the most increase in trading volume, and the open interests also experience significant increases, consistent with the patterns the prior literature has documented in potential informed trading activities.

**Table 4.** Abnormal Trading of Merging Firms.

Panel A							
Stock	ITM		ATM		OTM		
	Call	Put	Call	Put	Call	Put	
Abnormal Volume	830.57	131.38	315.74	1367.24	776.29	1190.72	1252.84
<i>t</i> -value	2.11	0.22	0.58	1.72	1.45	1.52	2.30

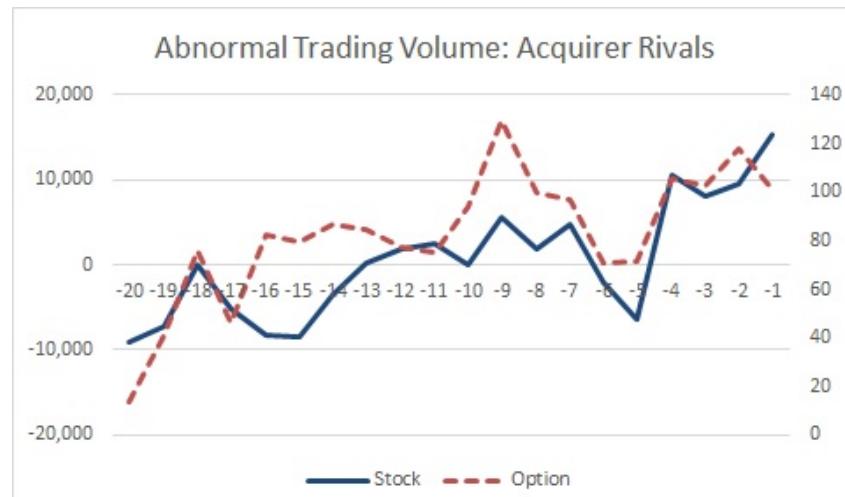
  

Panel B							
Stock	ITM		ATM		OTM		
	Call	Put	Call	Put	Call	Put	
Abnormal Volume	140,693.72	3197.69	5853.19	4455.94	3446.37	16,254.37	11,080.24
<i>t</i> -value	5.12	2.99	1.97	2.10	2.32	2.04	1.80

Table 4 reports the cumulative abnormal trading volume of the merging firms in hundred shares (for stock) or in number of contracts (for options) over the 20-day period prior to the announcements. Panel A presents the results for the acquirers. Panel B presents the results for the targets.

### 3.1.2. Results for Rival Firms

In this subsection, I present how the average abnormal trading volumes evolve over the 20-day period prior to M&A announcements for acquirer rivals and target rivals, respectively. As shown in Figures 3 and 4, the trend of increasing abnormal volume for both acquirer and target rivals is, although slow and somewhat volatile, notable. For acquirer rivals, the average daily abnormal trading volume rises to 15,000 for stocks, and grows to exceed 100 contracts for options the day right before announcement. We see a similar pattern and magnitude of increase in stock and option markets of target rivals as well. Note this is a measure averaged across all the rivals of a merging firm. When taking into account the fact that each merging firm on average has more than 30 rivals, the actual total abnormal trading volume across all the rivals is very substantial.



**Figure 3.** *Stock* and *Option* represent the average daily abnormal trading volume of the stocks and options over the 20-day period prior to the announcement for acquirer rivals, respectively.



**Figure 4.** *Stock* and *Option* represent the average daily abnormal trading volume of the stocks and options over the 20-day period prior to the announcement for target rivals, respectively.

Then I report the cumulative abnormal trading volumes of the stocks and options over the 20-day pre-announcement period averaged across all the merging firm rivals in Table 5. Option results are reported by option type and moneyness group. We can see that both acquirer rivals and target rivals experience significant abnormal trading volumes in the stock market. Acquirer rivals experience significant abnormal trading activities in both ATM and OTM option groups, while target rivals see a higher abnormal volume in the ATM group. Again, when the average number of rivals each merging firm has is taken into account, these abnormal option trading activities pertaining to the rival firms are considerable.

**Table 5.** Abnormal Trading of Rival Firms.

Panel A							
Stock	ITM		ATM		OTM		
	Call	Put	Call	Put	Call	Put	
Abnormal Volume	105.59	−29.66	68.16	505.59	306.43	343.50	232.91
<i>t</i> -value	2.17	−0.52	1.61	6.85	7.63	4.47	5.41

Panel B							
Stock	ITM		ATM		OTM		
	Call	Put	Call	Put	Call	Put	
Abnormal Volume	4354.17	−123.82	−67.17	619.36	404.24	136.64	284.65
<i>t</i> -value	2.21	−0.69	−0.50	2.70	3.44	0.55	1.94

Table 5 reports the cumulative abnormal trading volume of the merging firm rivals in hundred shares (for stock) or in number of contracts (for options) over the 20-day period prior to the announcements. Panel A presents the results for the acquirer rivals. Panel B presents the results for the target rivals.

In untabulated results, similar with the merging firms, I find that the rival options with short times-to-maturity also see the most increase in trading volume, and the open interests also experience significant increases, which are patterns consistent with potential informed trading activities.

In summary, abnormal trading volumes increase in both stock and option markets as the M&A announcement day approaches, not only for merging firms, but also for their rivals. Overall, the trading volume of call options experiences bigger increases, especially for ATM and OTM groups. Since the informed traders are more likely to trade ATM (for the sake of lower transaction costs and higher liquidity) and OTM (for the sake of greater leverages) options, as well as short-term options, my findings are consistent with the

evidence of informed trading in option markets prior to M&A announcements, for both merging firms and their rivals.<sup>3</sup>

### 3.2. IV Spread and Announcement CAR

#### 3.2.1. Empirical Methods

Chan et al. (2015) find that the magnitude of the IV spread constructed from option prices observed prior to M&A announcements can predict the acquirer's announcement CAR. As IV spread is well adopted in the literature to proxy for the signed informed trading activities in option markets, they suggest that informed traders capitalize on their informational advantage in option markets in the M&A context. Built upon their work, and the evidence documented by Ayres and Bankman (2001) that insiders consider trading rival firms "substitutes for insider trading", my study not only considers the merging firms, but also examines whether the magnitude of the IV spread constructed from rival firms can predict the rival firm CAR over an announcement window as well. Consistent with Chan et al. (2015), the main regression model is specified as:

$$\begin{aligned} CAR_{it,t+1} = & \beta_{0i} + \beta_{1i} IV\ Spread_{it-1} + \gamma_{1i} Completed_{it} \\ & + \gamma_{2i} Sought_{it} + \gamma_{3i} Hostile_{it} + \gamma_{4i} Cash\ Merger_{it} \\ & + \gamma_{5i} Mkt\ Cap_{it} + \gamma_{6i} Ret\ Last\ Month_{it} + \gamma_{7i} Ret\ Last\ Year_{it} \\ & + \gamma_{8i} BM_{it} + \gamma_{9i} Year\ Fixed\ Effect_{it} \\ & + \gamma_{10i} Ind\ Fixed\ Effect_{it} + \epsilon_{it} \end{aligned} \quad (4)$$

where  $CAR_{it,t+1}$  is the two-day cumulative abnormal return from the M&A announcement date  $t$  to the day next for each firm  $i$ ,  $IV\ Spread$  is the IV spread on day  $t - 1$  for each firm  $i$ , constructed as Cremers and Weinbaum (2010) do.  $Sought$  is the percentage of the target that the acquirer wants to acquire.  $Hostile$  is the dummy variable indicating whether the target management is opposed to the acquisition by the acquirer.  $Completed$  is the dummy variable indicating whether the acquisition is completed.  $Dealsize$  is the size of the acquisition in millions, and  $Cash\ Merger$  is the dummy variable indicating whether it is a merger in which the "% of cash" in SDC is greater than or equal to 50.  $Mkt\ Cap$  is the natural logarithm of the market capitalization the day before the event day.  $BM$  is the natural logarithm of the book-to-market ratio.  $Ret\ Last\ Year$  is the buy-and hold return over day  $-250$  to  $-21$ .  $Ret\ Last\ Month$  is the buy-and hold return over day  $-20$  to  $-1$ .

In order to test whether the predictive power of IV spread for future stock returns varies in option market liquidity, I also consider the following specification:

$$\begin{aligned} CAR_{it,t+1} = & \beta_{0i} + \beta_{1i} IV\ Spread_{it-1} + \beta_{1i} IV\ Spread_{it-1} * Bid-Ask\ Spread_{it-1} \\ & + \gamma_{1i} Completed_{it} + \gamma_{2i} Sought_{it} + \gamma_{3i} Hostile_{it} + \gamma_{4i} Cash\ Merger_{it} \\ & + \gamma_{5i} Mkt\ Cap_{it} + \gamma_{6i} Ret\ Last\ Month_{it} + \gamma_{7i} Ret\ Last\ Year_{it} \\ & + \gamma_{8i} BM_{it} + \gamma_{9i} Year\ Fixed\ Effect_{it} \\ & + \gamma_{10i} Ind\ Fixed\ Effect_{it} + \epsilon_{it} \end{aligned} \quad (5)$$

where  $Bid-Ask\ Spread_{it-1}$  is the open interest weighted option bid-ask spread as a percentage of their midpoint. According to Easley et al. (1998) and Cao (1999), informed traders are more likely to trade in option market when options are more liquid.

#### 3.2.2. Results for Merging Firms

Table 6 presents the results from the regression of the announcement CAR of the merging firms on their IV spread and the control variables, as seen in Chan et al. (2015). Consistent with the findings in Chan et al. (2015), the IV spread has a strong predictive power for merging firms' CAR over the announcement window. Hostile deals usually cause the acquirer to have more negative CAR, and the target to have more positive CAR.

Cash deals generate more positive market reactions for both acquirers and targets. Market capitalization has a negative effect on announcement CAR for both acquirers and targets.

**Table 6.** Implied Volatility Spread and Merging Firm Announcement CAR.

	Acquirer			Target		
IV Spread	0.0264 *** (3.16)	0.0275 *** (3.87)	0.0159 (0.98)	0.1192 (1.10)	0.1282 (0.93)	0.0913 (0.97)
IV Spread × Bid-Ask Spread			0.0343 1.47			-0.1830 -0.29
Completed		0.0029 (1.6)	0.0030 * (1.86)		0.0830 *** (3.62)	0.0775 *** (3.79)
Sought		-0 (-0.93)	-0 (-1.01)		0.0016 *** (4.30)	0.0014 *** (3.8)
Hostile		-0.0280 ** (-2.32)	-0.0279 ** (-2.31)		0.1329 ** (2.24)	0.1300 ** (2.35)
Cash Merger		0.0046 *** (5.51)	0.0049 *** (5.38)		0.1312 *** (7.28)	0.1224 *** (6.38)
Mkt Cap		-0.0013 *** (-4.89)	-0.0013 *** (-4.85)		-0.0268 *** (-4.32)	-0.0272 *** (-4.23)
Ret Last Month		0.0026 (-0.73)	0.0036 (0.82)		-0.1300 ** (-2.41)	-0.1317 ** (-2.42)
Ret Last Year		-0.0028 *** (-4.02)	-0.0029 *** (-4.09)		-0.0253 * (-1.64)	-0.0255 * (-1.64)
BM		0.0009 (1.48)	0.0009 (1.37)		0.0134 (1.19)	0.0133 (1.18)
FE	No	Year&Ind	Year&Ind	No	Year&Ind	Year&Ind
N	11,563	11,079	10,857	542	524	510
AdjR <sup>2</sup>	0.0008	0.0115	0.012	0.0004	0.2535	0.2543

Table 6 reports the regression of the merging firms' announcement CAR on the IV spread and controls. For each stock, *IV Spread* is the spread in volatilities between a pair of call and put with the same strike and maturity weighted with each pair's average open interest. *Bid-Ask Spread* is the open interest weighted option bid-ask spread as a percentage of their midpoint. *Sought* is the percentage of the target that the acquirer wants to acquire. *Hostile* is the dummy variable indicating whether the target management is opposed to the acquisition. *Completed* is the dummy variable indicating whether the acquisition is completed. *Cash Merger* is the dummy variable indicating whether it is a merger in which the "% of cash" in SDC is greater than or equal to 50. *Mkt Cap* is the natural logarithm of the market capitalization the day before the event day. *BM* is the natural logarithm of the ratio of the book value to the market capitalization. *Ret Last Year* is the buy-and hold return over day -250 to -21. *Ret Last Month* is the buy-and hold return over day -20 to -1. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

However, note that, just as in [Chan et al. \(2015\)](#), the coefficient on the interaction term *IV Spread × Bid-Ask Spread* is insignificant for both acquirers and targets. If anything, it has a positive sign for acquirers. This is inconsistent with the prior literature that suggests informed traders are more likely to trade in option markets when options are more liquid.

### 3.2.3. Results for Rival Firms

Next, I study the information content in the IV spread constructed from a rival firm's options. I examine the predictive power of a rival firm's IV spread for its CAR over the M&A announcement window. I regress each rival's announcement CAR on its IV spread and other controls. I also include the interaction between the IV spread and the bid-ask spread as one of the controls in order to investigate the impact of the option liquidity on potential informed trading activities pertaining to these rivals.

Table 7 reports the results of this regression for all acquirer rivals. The coefficient on the IV spread is positive and statistically significant at 0.01 level, ranging from 0.0117 to 0.0240. The results are robust across all specifications. 1-standard-deviation increase in the acquirer rivals' IV spread leads to an increase in their announcement CAR by 0.1% to 0.2%. Given the average announcement CAR of 0.04% for acquirer rivals, this is economically significant as well. Furthermore, the coefficient on the interaction term *IV Spread × Bid-Ask Spread* is negative and statistically significant at 0.01 level, consistent with the prior literature in that informed trader choose to trade in option markets when the options are more liquid, indicating lower option transaction costs. In other words, the predictive power of the rival's

IV spread for its CAR over the M&A announcement window is weaker when its options are more expensive to trade, indicated by a larger bid-ask spread.

Interestingly, the coefficient on *Hostile* is positive and statistically significant in two specifications and insignificant in the other two. This result provides marginal evidence that a rival is more likely to gain higher announcement CARs when the deal is hostile. Such an effect is erased by the industry fixed effect. Cash mergers are more likely to generate positive announcement CAR for acquirer rivals, which may relate to less uncertainty associated with cash mergers. In those deals that would eventually end up being completed, acquirer rivals are more likely to generate negative returns over the announcement window, consistent with the remark that a to-be-completed M&A increases the acquirer's market power.<sup>4</sup>

**Table 7.** Implied Volatility Spread and Acquirer Rival Announcement CAR.

	(1)	(2)	(3)	(4)	(5)
IV Spread	0.0140 *** (20.78)	0.0118 *** (19.94)	0.0117 *** (16.68)	0.0132 *** (16.62)	0.0240 *** (20.23)
IV Spread × Bid-Ask Spread					-0.0174 *** (-9.73)
Completed		-0.0005 ** (-2.43)	-0.0004 ** (-2.51)	-0.0003 (-0.40)	-0.0004 (-0.42)
Sought		0 ** (2.55)	0 *** (2.58)	-0 (-0.38)	-0 (-0.033)
Hostile		0.0064 *** (4.6)	0.0070 *** (4.59)	-0.0018 (-0.30)	-0.0016 (-0.26)
Cash Merger		0.0003 *** (3.73)	0.0003 *** (3.72)	0.0003 (0.57)	-0.0003 (0.57)
Mkt Cap		-0.0001 *** (-3.74)	-0.0001 *** (-2.86)	0 (0.91)	0 (0.85)
Ret Last Month		-0.0014 *** (3.37)	-0.0015 *** (-3.41)	-0.0040 *** (-8.48)	-0.0039 *** (-9.43)
Ret Last Year		-0.0033 (-45.37)	-0.0033 ** (-45.41)	-0.0035 *** (-45.74)	-0.0034 *** (-43.21)
BM		0.0006 *** (10.61)	0.0006 *** (10.72)	0.0005 *** (9.19)	0.0004 *** (8.24)
FE	No	No	Year	Year&Ind	Year&Ind
N	460,102	454,447	454,447	454,446	440,126
AdjR <sup>2</sup>	0.0007	0.0064	0.0065	0.0079	0.0081

Table 7 reports the regression of the acquirer rival announcement CAR on the IV spread and controls. For each acquirer rival, *IV Spread* is the spread in volatilities between a pair of call and put with the same strike and maturity weighted with each pair's average open interest. *Bid-Ask Spread* is the open interest weighted option bid-ask spread as a percentage of their midpoint. *Sought* is the percentage of the target that the acquirer wants to acquire. *Hostile* is the dummy variable indicating whether the target management is opposed to acquisition by the acquirer. *Completed* is the dummy variable indicating whether the acquisition is completed. *Cash Merger* is the dummy variable indicating whether it is a merger in which the "% of cash" in SDC is greater than or equal to 50. *Mkt Cap* is the natural logarithm of market capitalization of the acquirer rival the day before the event day. *BM* is the natural logarithm of the ratio of the book value to the market capitalization for the acquirer rival. *Ret Last Year* is the buy-and hold return over day -250 to -21. *Ret Last Month* is the buy-and hold return over day -20 to -1. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

Table 8 reports the results for target rivals. The coefficient on the IV spread is positive and statistically significant, ranging from 0.0125 to 0.0217, indicating that a target rival's pre-announcement IV spread can also predict the rival's announcement CAR positively. The results are robust across specifications. 1-standard-deviation increase in the target rivals' IV spread leads to an increase in their announcement CAR by 0.1% to 0.2%. Given the average announcement CAR of 0.2% for target rivals, this is economically significant as well. The coefficient on the interaction term *IV Spread × Bid-Ask Spread* is negative but statistically insignificant.

The coefficient on *Hostile* is still positive and statistically significant in two specifications, suggesting that a target's rival is also more likely to gain higher announcement CAR when the deal is hostile. Such an effect is erased by the industry fixed effect. Cash mergers are more likely to generate positive announcement CARs for target rivals as well. In those deals that would end up being completed, target's rivals are more likely to generate positive

returns over the announcement window, consistent with the view that a to-be-completed M&A deal may indicate a higher probability for the target's rivals to become targets as well.

**Table 8.** Implied Volatility Spread and Target Rival Announcement CAR.

	(1)	(2)	(3)	(4)	(5)
IV Spread	0.0125 *** (4.42)	0.0151 *** (3.99)	0.0154 *** (5.06)	0.0166 *** (5.78)	0.0217 *** (4.14)
IV Spread × Bid-Ask Spread					-0.0100 (-1.38)
Completed		0.0016 ** (2.36)	0.0018 *** (2.58)	0.0031 (0.79)	0.0029 (0.80)
Sought		-0 *** (-3.97)	-0 *** (-3.77)	-0.0001 (-0.75)	-0 (-0.88)
Hostile		0.0082 *** (3.85)	0.0084 *** (3.95)		
Cash Merger		0.0017 *** (3.89)	0.0018 *** (3.77)	-0 (-0.01)	0.0002 (0.05)
Mkt Cap		-0.0005 *** (-3.43)	-0.0005 *** (-3.28)	-0.0005 *** (-3.29)	-0.0005 *** (-3.16)
Ret Last Month		-0.0044 *** (-13.10)	-0.0044 (-12.11)	-0.0049 *** (-13.19)	-0.0048 *** (-13.17)
Ret Last Year		-0.0061 *** (-4.10)	-0.0064 (-4.11)	-0.0075 *** (-5.19)	-0.0072 *** (-5.17)
BM		0.0005 ** (1.98)	0.0004 * (1.82)	0.0001 (0.59)	-0.0024 *** (-0.51)
FE	No	No	Year	Year&Ind	Year&Ind
N	37,818	37,819	37,818	38,946	37,900
AdjR <sup>2</sup>	0.0052	0.0063	0.0063	0.1169	0.1204

Table 8 reports the regression of the target rival announcement CAR on the IV spread and controls. For each target rival, *IV Spread* is the spread in volatilities between a pair of call and put with the same strike and maturity weighted with each pair's average open interest. *Bid-Ask Spread* is the open interest weighted option bid-ask spread as a percentage of their midpoint. *Sought* is the percentage of the target that the acquirer wants to acquire. *Hostile* is the dummy variable indicating whether the target management is opposed to acquisition by the acquirer. *Completed* is the dummy variable indicating whether the acquisition is completed. *Cash Merger* is the dummy variable indicating whether it is a merger in which the "% of cash" in SDC is greater than or equal to 50. *Mkt Cap* is the natural logarithm of market capitalization of the target rival the day before the event day. *BM* is the natural logarithm of the ratio of the book value to the market capitalization for the target rival. *Ret Last Year* is the buy-and hold return over day -250 to -21. *Ret Last Month* is the buy-and hold return over day -20 to -1. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

The untabulated results suggest that these findings are not driven by the regular predictive power of the IV spread for future stock returns documented by [Cremers and Weinbaum \(2010\)](#), as the results are mostly either insignificant or less significant when a date other than the actual announcement day is selected. <sup>5</sup>

### 3.3. Robustness and Further Discussion

In this subsection, I discuss the robustness of my findings, and document further empirical evidence regarding informed trading activities of rival firms prior an M&A announcement.

#### 3.3.1. Robustness

First, note that the results are not driven by the target firms being the rivals of the acquirers or the other way around, as I exclude merging firms when constructing the rival sample. Second, I make sure that the results are not driven by within-industry mergers. Prior literature has well documented that, with potential prospects of being acquired, target rivals tend to experience significant positive stock market responses over the announcement window. I conduct the analysis outlined in Equation (4) on the samples of the within- and cross-industry mergers separately, to make sure that the results are not solely driven by target rivals' strong market responses to the announcements of the within-industry mergers. In various analyses, I consider a deal a within-industry merger when the acquirer and the target share the same 2- or 4-digit SIC code. Across over 10,000 M&A deals in my

sample, only 480 deals have the acquirers and targets share the same 4-digit SIC codes; in 705 deals, they share the same 2-digit SIC codes. In unreported results, I find that the information spillovers in option markets prior to M&A announcements documented in the main analyses are not driven by within-industry deals; the predictive power of a rival firm's IV spread for its announcement CAR is significant on both sub-samples.

Next, I further my investigation by looking into each industry, characterized by the 2-digit SIC codes. I present the top 10 acquirer industries in Table A1. As evident in Table A1, the sample has a significant number of deals in manufacturing industries. Therefore, I first investigate the information spillovers in manufacturing and non-manufacturing industries separately. In unreported results, I find that although my sample is heavily concentrated in manufacturing industries, the predictive power of a rival's IV spread for its announcement CAR is equally strong in non-manufacturing industries, if not stronger. Then, I conduct the same analysis for each of the top industries, as well as on the samples excluding each of the top industries. I also examine industries with especially oligopolistic sector structures, such as Communication and Airlines. In unreported results, I find heterogeneous predictive power of the IV spread for a rival's announcement CAR across industries, but the results hold similarly strong when excluding any significant industry. For instance, the results are significant for Business Service, the industry with the largest presentation in the deal sample. For Airline industry, the statistical significance of this predictive power is marginal (with a robust  $t$ -statistic of 1.35), likely due to a small sample size, but its magnitude is more than ten times larger than the sample average (0.1571 vs. 0.0117). Although Communication industry has a significant presentation in my sample, the predictive power of a rival's IV spread for its announcement CAR is neither statistically nor economically significant. This is consistent with the lack of strong market reactions across rival firms when an M&A deal is announced in Communication: informed traders lack incentives to leverage their informational advantage when the industry-wide market response is lackluster.<sup>6</sup>

Last but not the least, I obtain new M&A announcement data over the more recent time period, 2014–2020. I investigate whether the findings in the main analyses still hold over this time period, as equity and option market efficiency has improved, and the regulatory attention over insider trading activities has intensified over the recent years. I present the results in Table A2.

We can see that the information spillover across rival firms in option markets prior to M&A announcements is still statistically significant over this more recent time period, as evident in the statistically positive coefficients on IV spread across specifications for both acquirer rivals and target rivals in Table A2. Note that although the coefficients on IV Spread in Table A2 are statistically significant, the magnitude of these coefficients is smaller compared to the main analyses over the period 2003–2013 (Tables 7 and 8). This is consistent with [Clancey-Shang \(2016\)](#), who finds that the predictive power of the IV spread for future stock returns has declined overtime.<sup>7</sup>

### 3.3.2. Further Discussion

In this subsection, I provide further discussions on the information spillover prior to M&A announcements. First, I investigate whether this effect differentiates across deal characteristics. I examine Equation (4) on sub-samples split based on whether a deal is a cash merger, or whether a deal is LBO. In unreported results, I find that, for acquirer rivals, the predictive power of the IV spread for their M&A announcement CAR does not differentiate between the cash and non-cash deals. Interestingly, for target rivals, the magnitude of this predictive power is relatively larger for non-cash deals, but the statistical significance is marginal, suggesting potentially higher level of heterogeneity in the implication of non-cash deals for target rivals. For both target and acquirer rivals, the predictive power of the IV spread for their M&A announcement CAR is larger for LBO mergers; this effect is especially strong for target rivals, in line with the literature documenting the implications of LBO mergers for target rivals.

Next, I explore whether the informed trading activities in rival firms' option markets have any indication for the merging firm's announcement CAR. According to [Tookes \(2008\)](#), informed traders may trade rivals over corporate announcements, and non-announcing rivals' tradings contain information content for the announcing firms. As target firms' announcement CAR's in general tend to be positive and lack variation, I study the information content in acquirer rivals' IV spreads and examine their connection with the acquirer's CAR over the two-day announcement window.

If an insider is confident that the acquisition will be perceived as an activity that will considerably increase the acquirer's market power, then they will likely expect the acquirer rivals' share prices react to the announcement negatively. Then they may enter short positions of the rivals. If they believe the opposite will happen, i.e., the acquisition is value destroying and makes the rivals more competitive, and expect the market is going to resonate with such a belief, they will likely enter long positions of the rivals. Therefore, the signed informed trading activities pertaining to the acquirer's rivals, proxied by their IV spreads, will be negatively associated with the acquirer's announcement CAR. On the other hand, however, value adding M&A's can have the positive effects spillover to the rivals ([Deneckere and Davidson 1985](#)). In that case, rival firms' IV spreads may be positively associated with the acquirer's CAR over the announcement window.

In order to answer the empirical question of how the IV spreads of the rival firms can predict the announcement CAR of a merging firm, I regress the acquirer's announcement CAR on its own IV spread, as well as the IV spread averaged across all its rivals. Table 9 presents the results of this analysis. While the coefficient on the IV spread still holds positive, the coefficient on the average rival IV spread is negative, but insignificant.

**Table 9.** Rival Implied Volatility Spread and Acquirer Announcement CAR.

	(1)	(2)	(3)
IV Spread	0.0264 *** (3.16)	0.0293 *** (3.26)	0.0329 *** (3.54)
Rivals' IV Spread		-0.0239 (-1.55)	-0.0246 (-1.57)
Completed			0.0027 * (1.65)
Sought			-0 (-0.87)
Hostile			-0.0322 *** (-2.79)
Cash Merger		0.0043 *** (4.64)	0.0043 *** (4.64)
Mkt Cap			-0.0014 *** (-5.17)
Ret Last Month			0.0032 (0.68)
Ret Last Year			-0.0027 *** (-3.68)
BM			0.0012 ** (1.97)
FE	No	No	No
N	11,563	11,304	10,831
AdjR <sup>2</sup>	0.0008	0.0008	0.0069

Table 9 reports the regression of the acquirers' announcement CAR on the average rival IV spread and controls. For each acquirer, *IV Spread* is the spread in volatilities between a pair of call and put with the same strike and maturity weighted with each pair's average open interest, and *Rivals' IVspread* is the IV spread averaged across all rivals. *Bid-Ask Spread* is the open interest weighted option bid-ask spread as a percentage of their midpoint for the acquirer. *Sought* is the percentage of the target that the acquirer wants to acquire. *Hostile* is the dummy variable indicating whether the target management is opposed to the acquisition by the acquirer. *Completed* is the dummy variable indicating whether the acquisition is completed. *Cash Merger* is the dummy variable indicating whether it is a merger in which the "% of cash" in SDC is greater than or equal to 50. *Mkt Cap* is the natural logarithm of the acquirer's market capitalization the day before the event day. *BM* is the natural logarithm of the ratio of the book value to the market capitalization for the acquirer. *Ret Last Year* is the buy-and hold return over day -250 to -21. *Ret Last Month* is the buy-and hold return over day -20 to -1. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

As prior literature has documented different implications of cash and non-cash mergers, I further split the sample by the primary payment method (whether *Cash Merger* equals 1), and present the results in Table 10.

Table 10 shows that the coefficient on *Rivals' IV Spread* is significantly negative for cash mergers. It implies that the option trading of the acquirer rivals consists of negative predictive content for the acquirer's announcement CAR. In untabulated results, such a negative relation appears to be driven by the value adding acquisitions. For non-cash mergers, this coefficient is insignificant.

**Table 10.** Cash vs. Non-Cash.

	Cash			Non-Cash		
IV Spread	0.0201 (1.46)	0.0285 ** (1.99)	0.0296 *** (2.07)	0.0369 *** (3.09)	0.0363 *** (2.95)	0.0350 *** (3.40)
Rivals' IV Spread	−0.0443 * (−1.76)	−0.0487 * (−1.83)	−0.0447 * (−1.74)	−0.0021 (−0.12)	0.0014 (0.07)	0.0016 (0.08)
Completed		0.0026 (−0.87)	−0.0095 (−1.05)		0.0063 *** (2.98)	0.0069 *** (3.53)
Sought		−0 (−0.15)	−0 (−0.15)		−0 (−0.94)	−0 (−0.03)
Hostile		−0.0117 (−0.72)	−0.0090 (−0.53)		−0.0529 *** (−3.05)	−0.0539 *** (−3.29)
Mkt Cap		−0.0012 *** (−2.70)	−0.0016 *** (−2.58)		−0.0015 *** (−4.30)	−0.0013 *** (−3.02)
Ret Last Month		0.0083 (−0.81)	0.0083 (1.22)		0.0002 (0.08)	−0.0016 (−0.29)
Ret Last Year		−0.0039 *** (−3.81)	−0.0035 *** (−3.53)		−0.0023 ** (−2.28)	−0.0026 *** (−2.99)
BM		0.0014 (1.41)	0.0012 (1.13)		0.0011 (1.41)	0.0028 (0.41)
FE	No	No	Year	No	No	Year
N	5106	4924	4923	6199	5908	5907
AdjR <sup>2</sup>	0.0013	0.0047	0.0056	0.0013	0.0088	0.0130

Table 10 reports the regressions of the acquirer announcement CAR on the IV spread, the average rival IV spread, and the controls, for cash and non-cash mergers, respectively. For each acquirer, *IV Spread* is the spread in volatilities between a pair of call and put with the same strike and maturity weighted with each pair's average open interest, and *Rivals' IV Spread* is the IV spread averaged across all rivals. *Bid-Ask Spread* is the open interest weighted option bid-ask spread as a percentage of their midpoint for the acquirer. *Sought* is the percentage of the target that the acquirer wants to acquire. *Hostile* is the dummy variable indicating whether the target management is opposed to the acquisition by the acquirer. *Completed* is the dummy variable indicating whether the acquisition is completed. *Dealsize* is the size of acquisition in millions, and *Cash Merger* is the dummy variable indicating whether it is a merger in which the "% of cash" in SDC is greater than or equal to 50. *Mkt Cap* is the natural logarithm of the acquirer's market capitalization the day before the event day. *BM* is the natural logarithm of the ratio of the acquirer's book value to the market capitalization. *Ret Last Year* is the acquirer's buy-and hold return over day −250 to −21. *Ret Last Month* is the acquirer's buy-and hold return over day −20 to −1. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

#### 4. Future Work

In this study, I provide an overview of the potential information spillovers from merging firms to their rivals prior to M&A announcements from the stock and option trading perspective. I document the rival firms' rising abnormal trading volumes in stock and option markets prior to the announcements, and show that the option trading activities of the non-announcing rival firms have predictive content for these rivals' announcement CARs. The empirical design of this overview provides broad implications and insights, which can be refined in many ways. In this section, I discuss potential future directions related studies can develop in.

Whether an acquirer gains market power by an act of acquisition would strongly affect the directions informed traders may trade on rival firms prior to the M&A announcement. A more direct way to investigate whether an acquirer gains market power by this M&A

is to examine the Herfindahl-Hirschman Index (HHI) around M&A deals. Evidence that insiders can correctly predict which mergers increase acquirers' market power, which subsequently leads to stronger negative market reactions for the rival firms, would support the view discussed in this study.

Second, corporate insiders' choice to capitalize on their information advantage regarding a particular corporate event may ultimately depend on how well they can predict the reaction of a rival's share price to that event. One way to assess such a predictability is to examine the past stock price correlation or co-movement between a merging firm and its rivals, especially during similar corporate events. The IV spread of a rival should have a stronger predictive power for its own announcement CAR when historically the rival follows a certain pattern in its co-movement with the merging firm.

Third, insiders are much more likely to choose rival firms as an alternative way to capitalize on their private information when the risk of being caught is very high to trade their own firms. We can study which insiders at which firms are at a higher risk of being caught for insider trading, and whether their rival firms are more heavily traded prior to corporate events.

Furthermore, the definition of "rivals" I have adopted in this study is very broad. A deeper dive into the association and rivalness between merging firms and their rivals can potentially yield a more refined rival sample. As discussed previously, the effects estimated in this study may be downward biased. A more refined rival sample is worth further investigation.

## 5. Concluding Remarks

In this paper, I study the information spillover across rival firms in the context of M&A events. I investigate the trading activities pertaining to the non-merging rivals prior to M&A announcements and their implications for market responses of rival firms when the deal is announced. I find that abnormal stock and option trading activities grow as the announcement day approaches, not only for acquirers and targets, but also for their rivals. The abnormal trading activity growth is especially strong for options that the previous literature suggests informed traders mostly likely trade. Further analysis suggests that the IV spread, which is well adopted in the literature to capture informed trading in option markets, can predict the announcement CAR, not only for merging firms, but also for their rivals. This effect is heterogeneous across industries, but overall robust and not driven by any specific industries or sectors. Interestingly, LBO may have special implications for the documented information spillovers, especially for the target rivals. There is also some evidence that for certain M&A deals (for example, cash mergers), the rival firms' average IV spread is negatively associated with the acquirer CAR over the announcement window (0, 1).

I contribute to the literature on the information spillovers in M&A episodes from option market perspectives. My findings speak to the informed trading literature by taking rivals of the merging firms into consideration. The evidence is consistent with the theoretical frameworks by [Tookes \(2008\)](#), which suggests that information based tradings may occur across rivals. It is also consistent with remarks discussed in the legal literature regarding corporate insiders' alternative approaches to insider trading.

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## Appendix A

**Table A1.** Top 10 Acquirer Industries.

Year	Number of Events	Number of Acquirers
1	Business Service	1922
2	Instruments & Related Products Manufacturing	762
3	Industrial Machinery & Equipment Manufacturing	719
3	Holding & Other Investment Offices	719
5	Electronic & Other Electric Equipment Manufacturing	654
6	Chemical & Allied Products Manufacturing	596
7	Oil & Gas Extraction	496
8	Communications	488
9	Health Services	487
10	Depository Institutions	456

**Table A2.** Implied Volatility Spread and Rival Announcement CAR: 2014–2020.

Panel A: Acquirer Rivals				
IV Spread	0.0062 ** (2.46)	0.0063 ** (2.50)	0.0067 *** (2.63)	0.0123 *** (4.62)
Deal Characteristics	No	Yes	Yes	Yes
FE	No	No	Year	Year&Acquirer
AdjR <sup>2</sup>	0.0001	0.0008	0.0029	0.1347
Panel B: Target Rivals				
IV Spread	0.0068 ** (1.97)	0.0072 ** (2.10)	0.0069 ** (1.99)	0.0094 *** (2.72)
Deal Characteristics	No	Yes	Yes	Yes
FE	No	No	Year	Year&Target
AdjR <sup>2</sup>	0.0001	0.0020	0.0033	0.0915

Table A2 reports the regression of the rival announcement CAR on the IV spread and controls for acquirers (Panel A) and targets (Panel B). For each rival, *IV Spread* is the spread in volatilities between a pair of call and put with the same strike and maturity weighted with each pair's average open interest. *Cash* is an indicator variable reported in Bloomberg equal to one for cash deals, and zero otherwise; *DealValue* is the announced deal value reported in Bloomberg. *Cash* and *Deal Value* are controlled as deal characteristics. \*\*\*  $p < 0.01$ , \*\*  $p < 0.05$ , \*  $p < 0.1$ .

## Notes

- 1 See Keown and Pinkerton (1981), Meulbroek (1992), Jayaraman and Shastri (1993), Amin and Lee (1997), Chakravarty and McConnell (1999), and Chan et al. (2015), among others.
- 2 I also obtain additional M&A data over 2014 to 2020 from Bloomberg for additional robustness analysis.
- 3 Note that I examine abnormal trading activities for merging firms and their rivals, benchmarked against their previous “normal” levels of trading, to alleviate the concerns over randomly rising trading activities not related to M&A activities, supposing that randomly rising activities likely even out cross-sectionally; this methodology does not completely eliminate the potential scenario that trading volume happens to rise unrelated to merger activities.
- 4 Note that the low adjusted  $R^2$  suggests that the predictive content in the IV spread is far from fully explaining the announcement CAR, consistent with the literature.
- 5 Note that the definition of the “rivals” I adopt in this study is quite broad. There is heterogeneity in the impact and implication an M&A has for the merging firms’ rivals across the rival sample. The information spillover effects are very much diluted, which poses a downward bias to the estimation of the real effect on rivals especially closely associated with the merging firms. The true effects can be even stronger than what I have documented here.
- 6 I highly appreciate the anonymous reviewers’ suggestions and insights on this subject.
- 7 I obtain the data on M&A announcements over 2014–2020 from Bloomberg, due to data access limitations. I only include the deals involving US publicly traded firms. Bloomberg provides less comprehensive information regarding M&A deals than SDC. As the equation is estimated with different data sources over two time periods, the inference drawn regarding the declining predictive power of the IV spread overtime should be interpreted with caution.

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