

## **Short Selling, Informed Trading, and the Role of Social Media**

**Leslie Boni**

**California State University, Monterey Bay**

**Shwadhin Sharma**

**California State University, Monterey Bay**

**Christina Zhang**

**California State University, Monterey Bay**

*This paper investigates the relationship between short selling and Twitter activity prior to merger and acquisition announcements. Data are for U.S.-listed banking firms from 2009 to 2013. In the week prior to the M&A announcement, we find abnormal daily short selling, particularly for cash deals. Twitter activity, rarely present in the week prior to the M&A announcement, spikes at the time the deal is announced. Social media tips do not appear to provide a channel for information transfer to short sellers prior to M&A announcements nor do sellers use social media to apply market pressure for stocks they have shorted.*

### **INTRODUCTION**

We examine the relationship between social media and short selling prior to merger and acquisition announcements. Are abnormal short selling and social media activity observed concurrently, or does one precede the other? A growing body of research presents findings consistent with short sellers' trading on private information but the channel through which information is transferred is not well understood. Informed short selling observed after social media tips would be consistent with social media as at least one channel for the information transfer. Or possibly informed short selling occurs only concurrent with social media tips, which suggests informed short sellers and social media tipsters share a source close to the originator of the firm's news leak. Perhaps most intriguing is the possibility that informed short selling is observed prior to social media tips. This would be consistent with a conjecture that short sellers may intentionally release their private information using social media to apply downward price pressure for stocks they have already shorted.

We choose merger and acquisition announcements as the event of study for several reasons. First, the announcement that the M&A parties have reached an agreement to pursue a deal often has significant impacts on stock prices and short selling. Liu and Wu (2014) document that during 2005 to 2007, announcement-date abnormal returns and abnormal relative short selling for fixed-exchange-ratio stock mergers averaged -1.26% and 0.092, respectively. Second, multiple individuals possess material insider information prior to the announcement due to their relationship with the acquirers, the targets, or the

financial advisors. Early research by Keown and Pinkerton (1981) finds market reaction to intended mergers begins to occur days before the actual announcements suggesting that announcements are often partially anticipated because they are poorly held secrets. Bodnaruk, Massa, and Simonov (2009) investigates the possibility of information leakage around merger and acquisition events from deal advisers to their investment partners.

We create a proprietary hand-collected dataset consisting of daily short selling and Twitter activity around M&A announcements for U.S.-listed banking firms from 2009 to 2013. Because we want to examine short selling, we require that both the acquirers and targets are U.S.-listed firms. Our time period is limited by the time period for which we are able to obtain daily short selling. We are able to hand-collect data beginning in September 2009. At that time, the SEC began to require all self-regulatory organizations (SROs) to disclose daily short sale trading volume for each security. Our sample ends in February 2013 when increasingly SROs began charging for the data or created other impediments toward collection by the public. Thus, our sample is small and consists of just 47 deals. For each deal we obtain Twitter activity prior to and around the M&A announcement. We sign Twitter sentiment using the Loughran and McDonald (2011) dictionary. Deal data are from the Securities Data Corporation Mergers and Acquisitions database (SDC).

Our main findings are that in the week prior to the M&A announcement, we find abnormal daily short selling, particularly for cash deals. We argue that this is consistent with the idea that short selling might be arbitrage-driven *in anticipation of* the M&A announcement (possibly the result of private information or “tipping”). Alternatively, this finding is also consistent with the possibility that short sellers do not have any prior information that an M&A announcement is imminent but rather recognize that the acquirer’s stock is over-valued even prior to the announcement.

Next, we document that Twitter activity is rarely present in the week prior to the M&A announcement. It does spike, however, at the time the deal is announced. Using a regression framework, we find no support for the hypothesis that social media tips provide a channel for information transfer to short sellers prior to M&A announcements.

We also test whether short sellers use social media to apply market pressure for stocks they have shorted. Our findings are not consistent with this idea. Specifically, we do not find any association between abnormal short selling observed prior to announcements with Twitter sentiment observed at the time of the deal announcement.

Finally, we use a two-stage OLS analysis to test whether abnormal short selling or Twitter activity in the week prior to the announcement foreshadows abnormal returns in the 3-day announcement window. This would be consistent with short sellers or Twitter users possessing private information that an M&A announcement is imminent. We find weak evidence, if any, to support this conjecture. This finding suggests that the abnormal short selling observed for cash acquirers prior to M&A announcements is more likely the result of short sellers’ recognizing that the acquirer’s stock is over-valued prior to the announcement rather than having prior information that an M&A announcement is imminent.

The rest of the paper proceeds as follows. Section 2 discusses the relevant literature. Section 3 describes the sample and measures. Section 4 presents the results. Section 5 concludes.

## RELEVANT LITERATURE

### Relevant Short Selling Literature

Reed, Samadi, and Sokobin (2017) find informed short selling *prior* to corporate information events (e.g., earnings, analyst ratings, and acquisitions and mergers) for trades executed on U.S. exchanges during 2012 to 2014. Other research that provides findings consistent with short sellers’ trading on private information tips includes that of Christophe, Ferri, and Hsieh (2010) who find abnormally high short selling just prior to analyst downgrades. Blau and Tew (2014) find abnormally high levels of daily short selling activity prior to filings of class-action lawsuits. Kelley and Tetlock (2017) document “informed” retail and institutional short selling in the 2 to 5 days *prior* to two types of negative information releases (earnings and sell-side analyst releases) for firms from 2003 to 2007.

### **Relevant Social Media Literature**

Bartov, Faurel, and Mohanram (2018) document the explosion of social media (specifically Twitter activity) since 2009 and its ability to predict firm earnings *prior* to quarterly announcements. Ahern (2017) concludes private information tips that originate from firm executives circulate quickly to traders through social networks. Ahern (2017) constructs and examines social networks for a hand-collected dataset of 465 cases in which the Securities and Exchange Commission or the Department of Justice found evidence of illegal insider trading on private information (“tips”) from 1996 to 2013. Ahern concludes: “On average, inside tips originate from corporate executives and reach buy-side investors after three links in the network” (Ahern, 2017, p. 26).

Other research on the linkages between social media and financial markets includes that of Chen, De, Hu, and Hwang (2014) and Azar and Lo (2016). Chen, De, Hu, and Hwang (2014) examine articles and opinions posted on Seeking Alpha. They find both provide useful information for correctly forecasting stock prices. Azar and Lo (2016) present findings that portfolio strategies that incorporate Twitter information published at least 24 hours before Federal Open Market Committee announcements outperform their benchmark strategy.

### **Relevant Merger and Acquisition Literature**

Among the events included by Reed, Samadi, and Sokobin (2017), who find informed short selling *prior* to corporate information events during 2012 to 2014, is the announcement of a merger or acquisition. They do not examine their research question in the context of social media. Also relevant to our work is that of Jia, Redigolo, Shu, and Zhao (2018). They examine social media rumors about possible mergers and acquisitions. They conclude about 80% of these rumors are false (i.e., only about 20% come true within a year). They do not examine short selling.

Perhaps the two papers that are closest to our research is work by Liu and Wu (2014) and by Blau, Fuller, and Wade (2015). Liu and Wu (2014) examine the impact of short selling on prices of acquirers around the M&A announcement. Blau, Fuller, and Wade (2015) examine daily short selling around M&A announcements. They find short selling in acquiring firms is not abnormally high prior to M&A announcements but spikes in the period that immediately follows. Neither paper examines the possible role of social media. Both papers use data for 2005 to 2007, which is worth noting because that time period is prior to the explosion of Twitter usage.

## **DATA DESCRIPTION AND MEASURES**

We create a proprietary hand-collected dataset consisting of daily short selling and Twitter activity around M&A announcements for U.S.-listed banking firms from 2009 to 2013. Our starting point is all firms that are U.S. banks, thrifts, or their holding companies that are listed on the NYSE or Nasdaq any time during 2007 to 2015. We use CRSP delisting codes to identify firms that delist due to acquisition. We search the Securities Data Corporation Mergers and Acquisitions database (SDC) to confirm target firms and identify acquirers. We retain deals only if the acquiring firm is also listed on the NYSE or Nasdaq at the time of the deal announcement. Details of the terms of the M&A deal, deal size, type (e.g., cash or fixed-exchange-ratio), and premium are obtained from the SDC database and cross-checked using publicly available press releases and media reporting. We have daily short selling data for September 2009 through February 2013. We retain deals announced during that time period. The resulting dataset consists of 47 deals. Control variables for market capitalization, shares outstanding, prices, and returns are obtained from CRSP. We use options listing from the Chicago Board of Options Exchange (CBOE) as a control variable.

We construct the daily short selling dataset, which provides the number of the firm’s shares that are sold short each day. Beginning in September 2009, the SEC requires all self-regulatory organizations (SROs) to disclose daily short sale trading volume for each security. We download the daily short selling data from the SRO websites and aggregate it across the SROs for each security. We follow Liu and Wu (2014) in obtaining the firm’s daily short selling as its daily short ratio, which is the number of shares

sold short on the day divided by its total trading volume. Our variable of interest is the *abnormal* daily short ratio which is the difference between this value and a benchmark for the stock's normal daily short ratio. As in Christophe, Ferri, and Hsieh (2010) and Liu and Wu (2014), we use the firm's own daily short ratio data for its benchmark. The benchmark is the median of the firm's daily short ratio taken over the 35 to 16 trading days prior to the M&A announcement.

We follow Liu and Wu (2014) to obtain abnormal daily market returns, which are the stock's daily return less the CRSP value-weighted index return that day. Cumulative abnormal returns (CARs) are for the 3-day window around the M&A announcement date, with the announcement date designated  $t = 0$ .

We hand-collect and sign Twitter activity as our proxy for social media tips. Tweets and retweets are collected for the target and acquirer firms from 10 calendar days prior to 3 calendar days after the M&A announcement date. Twitter activity is at the deal level (i.e., pooled for the target and acquirer). Any tweets that mention the deal, the possibility or rumor of a deal, stock price, or profit of the target and/or acquirer are retained. Tweets that could not be translated to English are eliminated as are tweets related to advertisements, promotions or geo-tagging locations. We retain tweets that are exact duplicates if tweeted by different users as well as re-tweets and replies to other users. We count the number of tweets and retweets for each deal each calendar day. Tweets on non-trading dates are included in the next trading date's total.

We determine a daily sentiment measure for each deal's tweets. We remove tweet handles and web addresses. Using SAS we determine Loughran and McDonald (2011) positive, negative, and negation words. We use negation words to reclassify positive words as a "negated positive" words as in Loughran and McDonald (2011). Our sentiment variable for analysis is the *standardized net sentiment (SNS)*, which equals the number of positive words minus the number of negative and negated positive words, standardized by dividing that net sentiment number of words by the number of tweets that day.

Liu and Wu (2014) show that short selling respond differently to announcements of cash deals than fixed-exchange-ratio deals. We classify deals as cash deals if acquirers use cash for the entire purchase amount of the target. If payment terms indicate that the acquirer's shares will be exchanged for shares of the target firm and indicate the specific ratio, we classify the deal as a fixed-exchange-ratio deal. We include deals in this classification even if they include some portion of cash payment in addition to shares.

Summary statistics describing the sample are provided in Table 1. Of the 47 deals in the sample, 9 are cash deals and the rest are fixed-exchange-ratio deals. In the U.S., with the exception of the small percentage that are very large "too big to fail" bank firms, bank firms tend to have market capitalizations that put them in the "small cap" (or even "microcap") category for investors. Thus, it is not surprising that the deal value for our sample, which consists entirely of bank firms acquiring or merging with other bank firms, is relatively small on average in contrast to the M&A literature on the broader universe of U.S. firms. The deal value averages \$119.7 and \$332.8 million for cash and fixed-exchange-ratio deals, respectively.

**TABLE 1**  
**SUMMARY STATISTICS**

		N	Mean	25%	Median	75%
Deal Value (\$ Million)	Cash	9	119.7	22.7	69.4	101.8
	Fixed-Exchange-Ratio	38	332.8	55.0	97.9	285.6
Deal Size Ratio	Cash	9	0.21	0.04	0.13	0.30
	Fixed-Exchange-Ratio	38	0.38	0.09	0.23	0.39
Deal Premium	Cash	9	54.4%	44.8%	58.9%	64.8%
	Fixed-Exchange-Ratio	38	49.7%	24.0%	48.2%	65.3%
Deal Number of Tweets	Cash	9	52.2	35	41	68
	Fixed-Exchange-Ratio	38	98.3	29	58	83
Market Cap (\$ Milion)	Acquirers	47	1,408.1	294.9	724.2	1,404.6
	Targets	47	236.4	28.7	57.5	193.6
Daily Short Selling Ratio	Acquirers	376	0.47	0.39	0.48	0.57
	Targets	376	0.34	0.16	0.34	0.49
Options	Acquirers	47	0.36	0	0	1
	Targets	47	0.15	0	0	0

That said, target firms still command a healthy premium on average. The premium, measured as the deal price for the target shares relative to price a week prior to the announcement, averages 54.4% for cash targets and 49.7% for fixed-exchange-ratio targets. The deal size ratio (i.e., the deal value divided by the market cap of the acquirer) averages 0.21 and 0.38 for cash and fixed-exchange-ratio deals, respectively.

Tweets and retweets are collected for the target and acquirer firms from 10 calendar days prior to 3 calendar days after the M&A announcement date. Once we map these to trading dates for our analyses, for the cross section of all deals in the sample, we can retain and analyze a trade-date event window of just  $t = -6$  to  $t = +1$  where the announcement date is  $t = 0$ . Consider for example a tweet observed 3 calendar days after a Friday deal announcement. The tweet's trade date is  $t = +1$ . Similarly, for a deal announced on a Monday, tweets observed 10 calendar days prior occur on a Friday, which is  $t = -6$ . Table 1 reports the total number of tweets at the deal level (i.e., pooled for the target and acquirer) that occur in the  $t = -6$  to  $t = +1$  trade date event window. The average number of tweets is 52.2 and 98.3 for cash and fixed-exchange-ratio deals, respectively.

As in prior research, we will use options listing as an instrumental variable for regressions that examine the relationship between short selling and other variables. Table 1 reports that just 36% of acquirers and 15% of targets have exchange-listed options on their stocks. This is probably not surprisingly given the relatively small market cap of bank firms on average.

Daily short selling (averaged for the firm over the  $t = -6$  to  $t = +1$  trade date event window) is 47% of daily trading volume for acquirers and 34% for targets. We focus on *abnormal* short selling, which is the difference between this value and the median in the 35 to 16 trading days prior to the M&A announcement.

## RESULTS

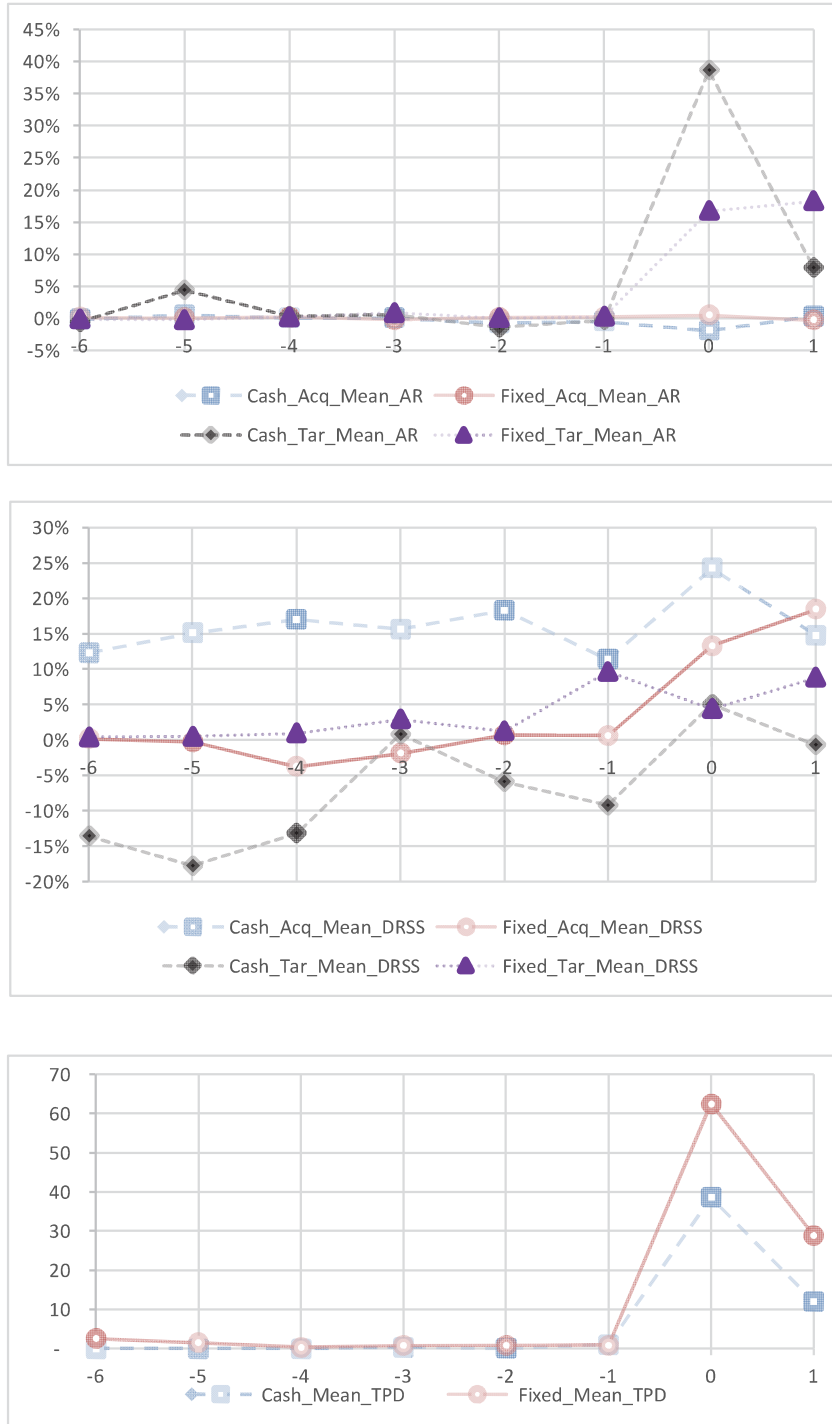
Our objective is to analyze the relationship between daily short selling and social media activity in the week prior to and around M&A announcements. Foreshadowing our main results, Figure 1 reports cross-sectional means of abnormal returns (“AR”), abnormal short selling (“DRSS”), and tweets per day (“TPD”) for the 8-day event window. Means are reported separately each day for cash-deal acquirers (“Cash\_Acq”), cash-deal targets (“Cash\_Tar”), fixed-exchange-ratio acquirers (“Fixed\_Acq”), and fixed-exchange-ratio targets (Fixed\_Tar”). The upper panel shows means of abnormal returns are very close to

zero most days prior to the announcement, which occurs on  $t = 0$ . Even on the announcement date, means of abnormal returns are different from zero, and positive, only for the target firms, with cash-deal targets quite a bit higher than fixed-exchange-ratio targets. The abnormal return is a one-day event in our sample consistent with earlier research that finds the market quickly incorporates some or all of the premium.

The middle panel reports abnormal short selling activity for the 8-day event window. The following observations are worth noting. Abnormal short selling is positive on the announcement date for both cash acquirers and fixed-exchange-ratio acquirers. This is consistent with the idea that short selling is arbitrage-driven and/or the result of information in the M&A announcement that reveals the acquirer's stock is over-valued prior to the announcement. Intriguingly, in our sample, for cash acquirers (but not for fixed-exchange-ratio acquirers), abnormal short selling is also positive on average each day in the week *prior* to the M&A announcement. This is consistent with the idea that short selling might be arbitrage-driven *in anticipation of* the M&A announcement (possibly the result of private information or "tipping"). It is also consistent with the possibility that short sellers do not have any prior information that an M&A announcement is imminent but rather recognize that the acquirer's stock is over-valued even prior to the announcement. Also interesting in our sample is that abnormal short selling is *negative* prior to the announcement for cash targets. This is consistent with the idea that short sellers avoid targets *in anticipation of* the M&A announcement that the target will be acquired at a premium (possibly the result of private information or "tipping"). It is also consistent with the possibility that short sellers do not have any prior information that an M&A announcement is imminent but rather recognize that the target's stock is under-valued even prior to the announcement. Finally, abnormal short selling is *positive* the day before the announcement for fixed-exchange-ratio targets on average. This suggests that short sellers do not anticipate the M&A announcements on average for these deals announced the following trading day.

We turn our attention now to the lower panel of Figure 1 which shows the number of tweets per day for the cash and fixed-exchange-ratio deals. On average, there are almost no tweets per day leading up to the M&A announcement. That said, for both cash and fixed-exchange-ratio deals, Twitter activity spikes at the time the deal is announced. Twitter activity continues – albeit at diminished volume on average – the following trading day.

**FIGURE 1**  
**MEANS OF ABNORMAL RETURNS, SHORT SELLING, AND TWEETS PER DAY**



Overall, Figure 1 suggests, for cash deals, abnormal short selling activity possibly in anticipation of announcements in the week prior to the M&A announcement. Although these results indicate the

possibility that short sellers possess private information of imminent M&A announcements, we find no evidence in our sample of Twitter activity that social media tipping exists.

Recognizing our sample is relatively small, we check whether extreme observations skew the cross-sectional means. For the most part, the observations for the medians are consistent with those observed for the means shown in Figure 1. The exception is that abnormal short selling, while still *positive* the day before the announcement for fixed-exchange-ratio targets on average, the magnitude is close to zero.

We next test whether means of abnormal short selling are significantly different from zero over the week prior to the announcement ( $t = -6$  to  $t = -2$ ) and the announcement window ( $t = -1$  to  $t = +1$ ). We calculate the daily average of abnormal short selling (“mean\_DRSS”) for each firm for these 5-day and 3-day event windows. Results are provided in Table 2. Confirming the observations from Figure 1, for the 3-day announcement window, abnormal short selling is positive for both cash acquirers and fixed-exchange-ratio acquirers (significant at the 5% level for cash acquirers and at the 1% level for fixed-exchange-ratio acquirers). For cash acquirers (but not for fixed-exchange-ratio acquirers), abnormal short selling is positive (significantly different from zero at the 5% level) for the week prior to the announcement. Table 2 shows that the abnormal short selling, observed to be *negative* prior to the announcement for cash targets, is negative on average but not significantly different from zero. Finally, abnormal short selling is *positive* (significant at the 5% level) for the 3-day announcement window for fixed-exchange-ratio *targets*.

**TABLE 2**  
**MEANS OF ABNORMAL SHORT SELLING, RETURNS, AND TWITTER ACTIVITY**

(a) Abnormal Short Selling and Returns				
	<u>N</u>	mean_DRSS <u>[-6, -2]</u>	mean_DRSS <u>[-1, +1]</u>	CAR <u>[-1, +1]</u>
Cash Deals				
Acquirers	9	0.16 ** (0.02)	0.17 ** (0.03)	-2.0% (0.25)
Targets	9	-0.10 (0.22)	-0.02 (0.85)	46.2% *** (0.00)
Fixed-Exchange-Ratio Deals				
Acquirers	38	-0.01 (0.55)	0.11 *** (0.00)	0.5% (0.82)
Targets	38	0.01 (0.75)	0.08 ** (0.04)	35.3% *** (0.00)
P-values of two-sided t-tests of the means are provided in parentheses. *** p<0.01, ** p<0.05, * p<0.1				
(b) Twitter Activity				
	<u>N</u>	<u>[-6, -2]</u>	<u>[-1, +1]</u>	
Tweets per Day				
Cash	9	0.1	17.3	
Fixed-Exchange-Ratio	38	1.2	30.7	
Average Daily SNS				
Cash	9	0.00	-0.11	
Fixed-Exchange-Ratio	38	-0.04	-0.10	



Table 2 also shows means for cumulative abnormal returns (CARs) for the 3-day announcement window. CARs are different from zero (significant at the 1% level) and positive only for the target firms.

Panel B of Table 2 reports cross-sectional averages of the number of tweets per day per deal over the prior week and 3-day announcement window. Tweets for fixed-exchange-ratio deals average about 1 tweet per day while the average for cash deals is close to zero. Panel B also reports the cross-sectional mean of the daily average standardized net sentiment variable (SNS) for the twitter activity. Average sentiment is zero (cash deals) or slightly negative (fixed-exchange-ratio deals) the week prior to the announcement and slightly negative for the 3-day announcement window.

Our focus is the relationship between abnormal short selling and social media activity prior to the announcement. While the results observed so far suggest Twitter activity prior to the announcement is rare on average, some deals may generate Twitter activity and that activity might be associated with abnormal short selling. We analyze this possibility using an OLS regression analysis of whether cross-sectional variance in abnormal short selling in the week prior to the announcement is associated with variance in twitter activity. The dependent variable is the firm's average for abnormal daily short selling over the prior week (i.e.,  $t = -6$  to  $t = -2$ ). The right-hand side variables of interest are the prior week (i.e.,  $t = -6$  to  $t = -2$ ) number of tweets per day and twitter sentiment. We include right-hand side control variables for log of market cap, a dummy variable which equals 1 if the deal is a cash deal and 0 if a fixed-exchange-ratio deal, the deal premium, and the deal size ratio. We estimate the regressions separately for acquirers and targets.

Results of the estimations, reported in Table 3, indicate no association between abnormal short selling and social media activity prior to the announcement. For acquirers, the only variable associated with short selling prior to the announcement is whether the deal is a cash or fixed-exchange-ratio deal. Abnormal short selling is higher prior to cash deals, consistent with our results reported earlier in Figure 1 and Table 2. For targets, abnormal short selling prior to the announcement is higher for deals when the deal size is smaller relative to the acquirer market cap. Overall, the results so far indicate no support for the hypothesis that social media tips provide a channel for information transfer to short sellers prior to M&A announcements.

**TABLE 3**  
**SHORT SELLING AND TWITTER ACTIVITY PRIOR TO M&A ANNOUNCEMENTS**

	Dependent variable is acquirer's mean_DRSS [-6,-2]	Dependent variable is target's mean_DRSS [-6,-2]
log (market cap)	-0.0156 (0.486)	0.0145 (0.608)
cash dummy	0.1624*** (0.009)	-0.1159 (0.246)
deal premium	-0.0175 (0.779)	0.0514 (0.670)
deal size ratio	-0.0450 (0.155)	-0.0770*** (0.004)
tweets per day [-6,-2]	0.0012 (0.641)	0.0033 (0.597)
average daily SNS [-6,-2]	-0.0765 (0.538)	0.0891 (0.701)
Constant	0.3273 (0.501)	-0.2477 (0.670)
Observations	47	47
Adjusted R-squared	0.190	-0.027

Robust p-values are provided in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

The results so far indicate Twitter activity is rarely present in the week prior to the announcement but it spikes at the time the deal is announced. We now test the conjecture that short sellers use social media to apply market pressure for stocks they have shorted. Is short selling observed prior to announcements correlated with Twitter activity (sentiment in particular) observed at the time of the deal announcement?

To test this conjecture, we estimate a two-stage regression model. The two-stage model allows us to address possible endogeneity concerns. In the first stage, we create an instrumental variable for abnormal daily short selling by regressing it on an options listing dummy variable and control variables. We use the logic as in Karpoff and Lou (2010) and Henry, Kisgen and Wu (2015) that short selling is likely related to whether or not options are listed on the firm's stock but that options listing is unlikely to be related to Twitter sentiment at the time the deal is announced. The abnormal daily short selling variable is the firm's average over [-6,-2]. The second-stage dependent variable is the 3-day announcement window daily average standardized net sentiment variable (SNS) for the twitter activity. The model is estimated separately for acquirers and targets. The right-hand side variable of interest is the instrumental variable for abnormal daily short selling. If short sellers use social media to apply market pressure for stocks they have shorted, we expect a negative relationship between abnormal short selling pre-announcement and twitter sentiment at announcement: higher abnormal of short selling should be associated with less positive (or more negative) sentiment. Right-hand side control variables in the second-stage regression are log of market cap, a dummy variable which equals 1 if the deal is a cash deal and 0 if a fixed-exchange-ratio deal, the deal premium, and the deal size ratio.

We report the results for the second stage regression in Table 4. The estimate for the coefficient for the instrumental variable for abnormal daily short selling in the week prior to the announcement is not significantly different from zero for either acquirers or for targets. These findings indicate no support for the conjecture that short sellers on average use social media at the time of the announcement to apply market pressure for stocks they short prior to the announcement.

**TABLE 4**  
**DO SHORT SELLERS USE TWITTER TO APPLY PRICE PRESSURE?**

	Dependent variable is acquirer's average daily SNS [-1,+1]	Dependent variable is target's average daily SNS [-1,+1]
Instrumental Variable for mean_DRSS [-6,-2]	0.1766 (0.905)	0.0868 (0.959)
log (market cap)	0.0062 (0.816)	0.0012 (0.967)
cash dummy	-0.0440 (0.847)	-0.0051 (0.979)
deal premium	0.0959 (0.152)	0.0880 (0.406)
deal size ratio	0.0391 (0.584)	0.0334 (0.800)
Constant	-0.2829 (0.620)	-0.1750 (0.732)
Observations	47	47
Adj. R-squared	0.010	0.026

Robust p-values are provided in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

Lastly, we test whether abnormal short selling or Twitter activity in the week prior to the announcement foreshadows abnormal returns in the 3-day announcement window. Such a finding would be consistent with short sellers or Twitter users possessing private information that an M&A announcement is imminent. We again employ a two-stage regression model approach. As before, we create the instrumental variable for abnormal daily short selling (the firm's average over the event window  $t = -6$  to  $t = -2$ ), regressing it on an options listing dummy variable and control variables. The second-stage dependent variable is the 3-day announcement window cumulative abnormal return (CAR). The right-hand side variables of interest are instrumental variable for abnormal daily short selling as well as the  $t = -6$  to  $t = -2$  number of tweets per day and twitter sentiment. As before, we include right-hand side control variables in the second-stage regression for log of market cap, a dummy variable which equals 1 if the deal is a cash deal and 0 if a fixed-exchange-ratio deal, the deal premium, and the deal size ratio.

Results for the second stage regression are reported in Table 5. For the acquirer firms, the results in Table 5 suggest short sellers may possess private information that an M&A announcement is imminent. The estimate for the prior week abnormal short selling variable is negative for acquirers (i.e., higher abnormal short selling is associated with more negative returns) but not significant at conventional levels (p-values in the 0.2 to 0.3 range).

Tweets per day (pooled observations for the deal, i.e., for both the acquirer and the target) are positive but not significant at conventional levels (p-values in the 0.1 to 0.2 range). The tweet sentiment variable (pooled observations for the deal) is negative: more positive twitter sentiment prior to the announcement is associated with a more negative return for the acquirer but not significant at conventional levels (p-values in the 0.1 to 0.2 range).

In contrast, for the target firms, the results in Table 5 suggest evidence of little association between the 3-day announcement CAR and anything except the deal premium. In sum, the results in Table 5 provide at most weak evidence that abnormal short selling or Twitter activity in the week prior to the announcement foreshadows abnormal returns in the 3-day announcement window. In other words, we find modest results, if any, to support the conjecture that short sellers or Twitter users possess private information that an M&A announcement is imminent.

**TABLE 5**  
**DO SHORT SELLING OR TWITTER ACTIVITY FORECAST ANNOUNCEMENT RETURNS?**

	Dependent variable is acquirer's CAR [-1,+1]	Dependent variable is target's CAR [-1,+1]
Instrumental Variable for mean_DRSS [-6,-2]	-0.7235 (0.213)	0.1695 (0.872)
log (market cap)	-0.0191 (0.274)	-0.0303 (0.171)
cash dummy	0.1149 (0.267)	0.0782 (0.565)
deal premium	-0.0213 (0.619)	0.6525*** (0.000)
deal size ratio	0.1025** (0.017)	0.0415 (0.598)
tweets per day [-6,-2]	0.0003 (0.174)	-0.0002 (0.517)
average daily SNS [-6,-2]	-0.0990 (0.199)	0.0044 (0.976)
Constant	0.3371 (0.363)	0.5683 (0.157)
Observations	47	47
Adj. R-squared	0.364	0.849

Robust p-values are provided in parentheses. \*\*\* p<0.01, \*\* p<0.05, \* p<0.1

## CONCLUSIONS

Academic research continues to investigate the trading of short sellers to try to determine their motivations. In particular, a growing body of research provides evidence consistent with trading on private information prior to important corporate announcements. *How* short sellers obtain private information is not well understood, however. In this paper, we have examined one possible explanation for transmission of private information: Twitter activity prior to M&A announcements. We perform the analyses using a proprietary hand-collected dataset of daily short selling and Twitter activity around M&A announcements for U.S.-listed banking firms.

Although we document abnormal daily short selling prior to M&A announcements (particularly for cash deals), we find no support for the hypothesis that social media tips provide a channel for information transfer to short sellers prior to M&A announcements. In fact, we find little Twitter activity occurs in the week prior to M&A announcements. Furthermore, we find weak evidence, if any, to support the conjecture that abnormal short selling or Twitter activity in the week prior to the announcement foreshadows abnormal returns in the 3-day announcement window. Our results suggest abnormal short selling observed for cash acquirers prior to M&A announcements is more likely the result of short sellers' recognizing that the acquirer's stock is over-valued prior to the announcement rather than having prior information that an M&A announcement is imminent.

It is well worth noting several important limitations of our research. First, our sample of deals is small (just 47 deals over the 2009 to 2013). Second, the firms in our sample are all U.S.-listed bank firms that acquire other U.S.-listed bank firms. The average market capitalization and deal size for our sample thus are both small relative to the broader universe of firms studied in the M&A literature. Therefore, we

believe this paper provides the basis for future research to analyze whether the findings for the sample analyzed here hold for a broader universe of firms.

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