# Three Essays on Informed Trading

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## ABSTRACT

### Three Essays on Informed Trading

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How pervasive is informed trading around takeover rumors? This dissertation tackles this research question from three different following aspects.

First, we examine insider trading surrounding takeover rumors in a sample of publicly traded U.S. firms. We find that insider net-purchases increase within the year prior to the first publication of a takeover rumor, particularly when rumor articles are either accurate (lead to a takeover announcement) or informative (provide substantial justification for the rumor's publication). Moreover, we find abnormal insider trading to be a significant predictor of takeover announcements occurring within the following year. Finally, trading patterns differ between different types of insiders in both the pre- and post-rumor periods.

Second, we examine the possibility of informed institutional trading around takeover rumors. We find that pension plan sponsors and money managers are net-buyers in firms which will become subject to takeover speculation within the following seven days. This activity is significant in predicting which rumored firms will eventually receive takeover bids. Furthermore, we find that institutions on average reverse their trades and engage in significant selling on and after the rumor date, even in those firms which will become subject to a takeover announcement.

Third, we investigate and quantify the pervasiveness of informed trading in the equity options of rumored takeover targets. We find that the volume of options traded is abnormally high over the 5-day pre-rumor period, primarily due to the number of out-of-the-money call options traded. In addition, the direction of option trades prior to takeover rumors predicts forthcoming takeover announcements and rumor date returns. Identifying suspicious trades, we find evidence of individuals trading on knowledge of takeover rumor candidacy in the options market. Our results further indicate that informed traders prefer the options market to the equity market.

# Dedication

*To my God for everything.*

*To my insightful dad for his inspiration.*

*To my lovely mom for always believing in me.*

*To my wonderful sisters for their unconditional love.*

*To my one-of-a-kind brother who supported me unconditionally.*

*To my awesome friends and colleagues for being my companions.*

*And to myself for not giving up!*

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## Table of content

## List of Tables

## List of Figures

# Chapter 1: Introduction

Different regulations prohibit trading based on non-public information and in the U.S. the Securities Exchange Commission (SEC) is mainly responsible for the enforcement. This applies to anyone who comes into possession of such information and owes a fiduciary duty.[1] However, extant literature provides mixed empirical findings about the degree of informed trading in financial markets.[2] This raises serious concerns about the effectiveness informed trading regulations.

In this thesis we use a unique hand-collected sample of takeover rumors to examine whether different market participants illegally trade on their private information. Trading prior to a published takeover rumor offers informed traders two main advantages as compared to trading shortly before a takeover announcement. First, bid negotiations might not have begun, thus reducing the likelihood that the U.S. Securities and Exchange Commission (SEC) will uncover evidence of trading based on material private information. Second, insiders can capitalize on the target firm's rumor-date cumulative abnormal returns (CARs), which are typically positive (Ahern and Sosyura, 2015; Betton, Davis, and Walker, 2018).

We investigate about the possibility of informed trading through three different channels prior to takeover rumors. In Chapter 2, we examine the open market stock trades of registered insiders within firms rumored to be the target of an impending takeover. In Chapter 3, we focus on trading behaviour of institutional investors in stocks market and examine if they engage in informed trading prior to rumors. Finally, in Chapter 4 we investigate and quantify the pervasiveness of informed trading in the equity options of firms that subsequently become the subject of a publicly announced takeover rumors.

[1] See Bainbridge (2007) and Seyhun (1992) for excellent and more detailed discussions of insider trading regulations and their enforcement.

[2] See two comprehensive surveys on insider trading: Bhattacharya (2014) and Augustin and Subrahmanyam (2020).

# Chapter 2: Insider Trading in Rumored Takeover Targets

Frederick Davis [1] , Hamed Khadivar [1], Kuntara Pukthuanthong [2] , Thomas J. Walker [1]

**Abstract**

We examine insider trading of both managing and non-managing insiders for a sample of 1,642 initial takeover rumors during the period 2002 - 2011. Using difference-in-difference regressions, we find that insider net purchases are significantly higher within the year prior to the first publication of a takeover rumor when rumor articles are either accurate (lead to a takeover announcement) or informative (provide substantial justification for the rumor's publication), particularly when better-informed individuals (managing insiders) are doing the trading. Results further indicate that insider trades can assist in predicting takeover announcements.

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## 2.1. Introduction

Substantial levels of insider trading are commonly found in the run-up to takeover announcements (Agrawal & Nasser, 2012; Augustin, Brenner, & Subrahmanyam, 2019). This is no doubt driven by a powerful financial incentive: premiums are large, averaging 46% in a sample of 10,806 control bids for public targets (Betton, Eckbo, & Thorburn, 2009), and hence stock acquisition in the run-up to a takeover can be very profitable. This finding is concerning because such trading increases price volatility (Leland, 1992), raises firms' cost of capital (Bhattacharya & Daouk, 2002), reduces liquidity (Cumming, Johan, & Lee, 2011; Agrawal & Cooper, 2015), increases legal risks (Haslem, Hutton, & Smith, 2017), and undermines investor confidence in the financial markets (Levitt, 1998; Fishe & Robe, 2004; Bris, 2005).[5]

In this paper, we examine the open market stock trades of registered insiders within firms rumored to be the target of an impending takeover. Trading prior to a published takeover rumor offers insiders a number of advantages as compared to trading shortly before a takeover announcement. First, bid negotiations might not have begun, thus reducing the likelihood that the U.S. Securities and Exchange Commission (SEC) will uncover evidence of trading based on material private information. Ke, Huddart, and Petroni (2003, p.7) note that, with respect to insider trading prosecution, "risks are smaller the further removed the trades are from the principal informational event," and insiders anticipate earnings up to two years in advance. Second, insiders can capitalize on the target firm's rumor-date cumulative abnormal returns (CARs), which are typically positive (Ahern & Sosyura, 2015; Betton, Davis, & Walker, 2018). Third, early trading circumvents the possible implementation of a blackout period prohibiting insider trades as merger negotiations ensue. This is a significant consideration given the findings of Bettis, Coles, and Lemmon (2000) who observe that over 92% of firms in their sample restrict insider trading in some fashion. Finally, such advance trading reduces the likelihood of relinquishing any profits made due to activation of the short swing rule resulting from the forced sales of target shares at the merger's completion.[6]

[5]However, insider trading could also be beneficial by inducing innovation and improving market efficiency (Leland, 1992; Piotroski & Roulstone, 2005).

[6]Section 16(b) of the Securities Exchange Act requires company insiders to return any profits made from the purchase/sale and subsequent sale/purchase of company stock if both transactions occur within a six-month period.

Our primary hypothesis is that target firm insiders, especially managing insiders, increase their net positions before material information (the takeover rumor) is made public. We test this hypothesis using a difference-in-differences (DiD) methodology to simultaneously control for both cross-sectional and time-series dependencies, as well as various determinants of insider trading based on the extant literature. We also test for abnormal insider trading after the initial takeover rumor has been published.

We find evidence that suggests that insiders increase their net position in rumored firms prior to the rumor announcement. They do so by means of a passive trading strategy: that is, rather than increasing purchases, insiders sell less than they typically do, thereby leading to a significant increase in *net* purchases. This effect is more prominent when rumors are *informative* (i.e., contain multiple credible signals), when they are *accurate* (i.e., a takeover announcement occurs within 365 calendar days after the initial publication of the rumor), and within the subcategory of managing insiders. We also find abnormal trading during the post-rumor period, with managing insiders significantly reducing their net purchases in firms that will not be subject to a bid announcement over the following 365 days. Furthermore, we find that insider net purchases have power in predicting forthcoming takeover announcements, even while extensively controlling for other potential takeover determinants. Our results are economically meaningful: over the one-year pre-rumor period, rumored target firm insiders increase the dollar value of their net purchases by 38% relative to their usual net purchase levels.

Our paper contributes to the literature in a number of ways. First, we extend prior research on insider trading within the context of mergers and acquisitions by using a large sample of rumors that incorporates a broad spectrum of media sources to precisely identify the initial ("scoop") rumor date. By relying on rumors obtained from one or a small number of publications, previous studies identify pre-rumor trading that could have occurred after the initial rumor was published. This would distort the research findings available to regulators attempting to identify and restrict the degree to which insiders act on and benefit from material private information. Second, we provide evidence that insider trading prior to takeover rumors is a determinant of takeover predictability. Third, we show how insider trading during both the pre- and post-rumor periods depends on the occupational role of the insider, as well as the accuracy of the rumor.

Our findings prompt a re-evaluation of why insiders reduce their sales rather than directly increase their purchases. We show that pre-rumor abnormal trading occurs quite far in advance of any potential forced sales resulting from a completed takeover. Indeed, only 22% of sample rumors lead to takeover announcements within one year, and only 43% of these result in successful completion within six months of the rumor. It thus seems unlikely that insiders refrain from active trading in our sample due to concerns about relinquishing profits on short swing trading transactions, as Agrawal and Nasser (2012) contend occurs prior to bid announcements. The passive insider trading we document may instead indicate a preference by insiders to avoid prosecution, as such trading is not subject to criminal or civil liability (Madison et al., 2004).

The remainder of this paper is organized as follows. Section 2.2 briefly summarizes the empirical evidence on insider trading related to takeovers. Section 2.3 outlines our hypotheses. Section 2.4 describes our data and methodology. Section 2.5 presents our results, while Section 2.6 provides a series of robustness tests. Section 2.7 concludes the paper.

## 2.2. Literature review

### 2.2.1 Informed trading prior to takeover announcements

Persistent and substantial price run-ups in target firms are common prior to takeover bids (Jarrell & Poulsen, 1989; Betton & Eckbo, 2000; Bris, 2005). Many researchers argue that investor anticipation drives these run-ups, as public signals of likely takeover bids (such as rumors or large share purchases) are typically observed shortly in advance of the run-ups (e.g., Akhigbe, Martin, & Whyte, 2007; Aspris, Foley, & Frino, 2014; Jarrell & Poulsen, 1989; Sanders & Zdanowicz, 1992). However, it is difficult to distinguish the volume and return patterns of sophisticated investors who base their trades on publicly available information from those of insiders basing trades on private information (Jensen and Ruback, 1983).

In fact, early research considers pre-bid run-ups to be prima facie evidence of insider trading (Keown & Pinkerton, 1981), and both Cornell and Sirri (1992) and Meulbroek (1992) find direct evidence of widespread illegal trading prior to takeovers in studies of prosecuted insider trading episodes. In an examination of 1,859 target firm option transactions between 1996 and 2012, Augustin et al. (2019) claim that illegal insider trading is the most likely explanation for the

bullish directional trading they uncover. Moreover, Agrawal and Nasser (2012) use DiD methodology to examine pre-bid insider trading within a sample of 3,701 takeover targets announced between 1988 and 2006. They find that although corporate insiders reduce their purchases within the year prior to the bid announcement, they reduce their sales even more, thus increasing their *net* purchases. Keown, Pinkerton, and Bolster (1992), Chakravarty and McConnell (1997), and Bris (2005) also document evidence that is consistent with profitable pre-bid insider trading.

A number of researchers incorporate takeover rumors within their analysis of informed trading. For instance, Jarrell and Poulsen (1989) analyze 172 tender offers between 1981 and 1985 and conclude that pre-bid run-ups and takeover announcement premiums are positively associated with the occurrence of takeover rumors, yet they find no evidence of illegal insider trading. Similarly, Pound and Zeckhauser (1990) analyze 42 takeover rumors within the "Heard on the Street" column of *The Wall Street Journal* (WSJ) from 1983 to 1985. They claim that pre-bid insider trading is unlikely to be prevalent, because only 43% of rumors resulted in a takeover announcement within one year of rumor publication and only two rumors occurred within 50 days of a bid. They argue that insider trading did not occur within their sample because insiders would have been more accurate and/or timely at predicting bids.

Clements and Singh (2011) study stock (options) trading activity for 393 (59) rumored target firms from January 2001 to June 2006. In the 20 days prior to rumor publication in the WSJ, the authors find evidence of positive CARs and trading volumes, consistent with informed trading. In an analysis of 33 targets between 1986 and 1996, Jayaraman, Frye, and Sabherwal (2001) find similar evidence of increased option activity within 30 days prior to rumor publication in the WSJ. However, without data on insider transactions, the authors of these studies acknowledge that they cannot distinguish between insider trading and market anticipation.

Finally, Boone and Mulherin (2009) find that the pre-announcement portion of the takeover negotiation process takes an average of six months. Thus, opportunities for insider trading related to bid activity exist far in advance of the announcement date and, consequently, the length of the run-up window examined is likely to impact any inferences made with respect to informed trading. Analyzing a 126-day pre-event window (where the event is the earlier of a bid or a takeover rumor

in the WSJ), Keown et al. (1992) discover abnormal volume patterns consistent with insider trading.

### 2.2.2 Informed trading by insider type

The literature shows that not all insiders should be treated as having equivalent access to material information. For example, Seyhun (1986) shows that the quality of information available to insiders varies during the period from 1975 to 1981: trades conducted by insiders who are perceived to be more knowledgeable tend to have better predictive power of future abnormal stock price changes over a two-month period than those made by other insiders. Ravina and Sapienza (2009) show that executives earn higher returns than independent directors or large shareholders, especially when corporate governance is weak. Similarly, Piotroski and Roulstone (2005) find that the relation between insider purchases and future earnings performance is marginally stronger for executives than for directors, suggesting that executives have more timely access to firm-related information.

Agrawal and Cooper (2015) examine insider trading in a sample of 518 firms involved in accounting scandals revealed by earnings-decreasing restatements. They find that when there are strong financial incentives to sell stock prior to such misstatements, only top managers (i.e., chairpersons, chief executive officers, chief operating officers, and presidents) do so. In addition, Davis et al. (2017) show that managing insiders (directors and officers of the company) exhibit greater opportunistic abnormal trading activity than non-managing insiders (e.g., committee members, affiliates, and beneficial owners) prior to class action litigation and settlement announcements.

### 2.2.3 Takeover predictability

While the literature on takeover predictability is vast, we note a few key papers. Cornett, Tanyeri, and Tehranian (2011) review the prior literature and develop a model to predict target firm candidacy using variables that measure management's motives to generate shareholder value, create opportunistic benefits, or both. These variables include information asymmetry, the cash ratio, size, changes in size, the concentration ratio, the dormancy period, previous mergers, price run-ups, the return on assets, the resource-growth mismatch, sales growth, sales shocks, sales

shocks squared, and share turnover (see Table A1, Part (a) of the Appendix). Ahern and Sosyura (2015) examine 501 'scoop' articles that first report a merger rumor and appeared between 2000 and 2012. They find that a journalist's age and degree, the characteristics of the published article, media sources, firm returns prior to and on the rumor date, and target newsworthiness are all predictive of forthcoming bids. Finally, Betton et al. (2018) perform an analysis of 2,074 initial takeover rumors between 2002 and 2011 and note that the nature of the evidence for a takeover contained in the rumor article also assists in the prediction of target firm bids.

### 2.3. Hypothesis development

We contend that insiders often have advance knowledge of activities that commonly lead to the creation of takeover rumors about their own firms, such as the hiring of a financial advisor specializing in mergers and acquisitions, the initiation of a public request for takeover bids, takeover negotiations, or even a block purchase of shares. In addition, we note that takeover rumors are known to provide significantly positive event date target firm returns; hence, purchasing shares in such rumored targets prior to rumor publication is likely to be profitable.[7]

However, buying shares while in the possession of material private information is illegal, and insiders could thus be dissuaded from engaging in such activity due to the possibility of financial penalties or incarceration. A related opportunity not subject to such punishment would be to simply refrain from selling shares, as insider trading legislation does not preclude an insider from remaining inactive in a pre-established share position (Bettis, Duncan, & Harmon, 1998).

Ex ante, it remains unclear whether insiders would purchase shares in firms soon to be the target of a takeover rumor, utilize a passive trading strategy as outlined above, or do both. Thus, we focus on net purchases in framing the following hypothesis:

> ***H1:*** *Insiders of rumored target firms engage in positive net purchases in their own firms prior to the initial publication of a takeover rumor.*

[7]For example, Betton et al. (2018) report returns of 8.37% (2.62%) for accurate (inaccurate) initial target firm takeover rumors over the (0, +1) rumor period.

A number of papers claim that insiders exhibit substantial variation in the success of their trades. Executive officers will have preferential access to firm information, and their insider trades are therefore likely to outperform those of other insiders. Thus, we hypothesize the following:

> ***H2:*** *Managing insiders of rumored target firms engage in more net purchases of their own firms prior to the initial takeover rumor publication than non-managing insiders.*

Finally, insiders may trade to capture not only positive returns related to potentially forthcoming takeover rumors, but also returns related to any forthcoming takeover announcements. If so, such trades may assist observers in predicting takeover announcements. Thus, we also test the following hypothesis:

> ***H3:*** *Pre-rumor insider trading is positively correlated with forthcoming takeover announcements.*

### 2.4. Data and methodology

#### 2.4.1 Sample construction

We employ the dataset first used by Betton et al. (2018) as our base sample of target firm takeover rumors. As the authors explain, this sample consists of 2,074 firms identified as potential takeover targets between January 2002 and December 2011 based on articles retrieved from Capital IQ, Factiva, ProQuest, Standard & Poor's Takeover Talk, and/or Zephyr. To correct for well-known Securities Data Company announcement date errors and omissions (Bharadwaj & Shivdasani, 2003; Faccio & Masulis, 2005; Barnes, Harp, & Oler, 2014; Mulherin & Simsir, 2015), Betton et al. verify all takeover announcement dates using information retrieved from Factiva and Google. Importantly, for each firm, the dataset includes only the initial date of a published takeover rumor defined as that rumor date for which there was no preceding instance of the same rumor for a period of at least 180 days. This 180-day minimum "clean window" is intended to capture the surprise element of the market's response.

Observations in the sample have been coded to reflect the type of rumor content. This was done by identifying one or more rationales provided within each rumor article that justify its publication (see Table A1, Part (b) of the Appendix). For example, rumors labeled as 'speculative'

are based on either takeover chatter or an increase in option activity in the target firm, with no further justification provided.[8] Rumors labeled as 'informative' are based on at least three non-speculative rumor justifications, such as insider comments, the hiring of a financial advisor, or the purchase of a large block of shares. Examples of these different types of rumors are given by Betton et al. (2018).

We apply several screens to derive our final sample from the above dataset. First, to ensure a clean study period for our DiD analysis, we consider only the first firm rumor in each year. This approach results in the elimination of 222 rumored firm observations from the sample. Second, we merge the remaining observations with insider trading data reported within Forms 3, 4, or 5 of Thomson Reuters' Insider Filing Data Feed (IFDF),[9] with 33 additional deletions arising due to a lack of coverage therein. Third, reliance on financial data from Compustat to construct several control variables necessitates the elimination of another 105 observations. Finally, our DiD methodology requires data to be available for every variable during the two-year period before rumor publication. Thus, we delete an additional 72 observations with incomplete coverage in the Center for Research in Security Prices (CRSP), Compustat, and IFDF databases. After applying these screens, we obtain a final sample of 1,642 rumored firm observations, of which 251 are categorized as speculative, 437 as informative, and 954 are associated with other rationales.

Table 1 presents summary distributions of our sample. As shown in Panel A, the number of rumors per year peaks in 2009, at 309 rumored firm observations. Panel B outlines the sample distribution according to the Fama-French 17-industry classification and demonstrates that our sample includes firms from a wide range of industries. We also note (untabulated) that 21.7% (28.9%) of rumors yield an official takeover announcement within one (two) years after the rumor date and 14.4% (9.8%) of rumors come true within 180 (90) days after the rumor date.

***Insert Table 1 about here***

[8]Many events unrelated to takeovers may be responsible for the increase in call option activity. Thus, such rumors are classified as 'speculative' unless additional information within the article suggests that a takeover is possible.
[9]We only consider open market purchases and sales of common stocks with CRSP share codes 10 to 12. We exclude filings that are amended by subsequent filings and transactions that involve indirect ownership of shares through partnerships, corporations, trusts, and other entities. In addition, we exclude transactions that are marked as inaccurate or incomplete according to cleanse indicators provided within the IFDF.

### 2.4.2 Calculation of CARs

To examine the stock market reaction to takeover rumors, we use the Carhart four-factor model (Carhart, 1997) to calculate abnormal returns:

$$R_{it} - R_{ft} = \alpha_i + \beta_{1i}(R_{mt} - R_{ft}) + \beta_{2i}SMB_t + \beta_{3i}HML_t + \beta_{4i}WML_t + \varepsilon_{it} \quad (1)$$

where $R_{it} - R_{ft}$ is the excess return of stock $i$ on day $t$; $R_{mt} - R_{ft}$ is the value-weighted market excess return on day $t$; $SMB_t$ is the return on small firms minus the returns on large firms at time $t$; $HML_t$ is the return on firms with a high book to market minus the return on firms with a low book to market at time $t$; $WML_t$ is the difference in returns between a portfolio of past winners and a portfolio of past losers at time $t$; $\beta_{1i}$, $\beta_{2i}$, $\beta_{3i}$, and $\beta_{4i}$ are the regression coefficients estimated over a 250-day period ending on day –42 relative to the event date; and $\varepsilon_{it}$ is the error term.[10] Finally, α is interpreted as the average of the individual firm-specific intercepts. The CARs are subsequently calculated by aggregating abnormal returns across firms and over time.

### 2.4.3 Insider trading measures

We construct three alternate measures of insider net purchases in precisely the same manner as Agrawal and Nasser (2012): the net number of shares bought by insiders (number of shares bought – number of shares sold), the net dollar value of shares bought ($ bought – $ sold), and the net percentage of equity bought (% bought – % sold). To calculate the dollar value, we multiply the number of shares traded by the transaction price recorded in the IFDF database, or by the closing price reported by CRSP if IFDF data are missing. To obtain the percentage of outstanding equity bought (sold), we determine the number of shares bought (sold) by insiders as a percentage of the number of shares outstanding on the day of the insiders' trade.

### 2.4.4 Cross-sectional and time-series controls: The DiD approach

We consider two sets of controls, time series and cross-sectional, to examine insider trading within rumored targets. First, we compare the levels of insider trading in both rumored and matched firms during the pre-rumor study period (the 12-month period (–12, –1) relative to the rumor's

[10]We use the value-weighted returns of the factors mimicking portfolios of size, book-to-market, value, and momentum effects.

publication) to levels during the control period (the 12-month period (–24, –13) relative to the rumor's publication).

Second, we match every rumored firm with a control firm based on its prior propensity for insider trading. We use a propensity score matching procedure based on five indices: market capitalization, insider ownership (scaled by shares outstanding), past insider trading, past stock return, and past trading volume. In each case, the control firm is chosen as the firm with the smallest Mahalanobis distance (relative to the rumored firm) at the end of fiscal year –2, where year 0 is the fiscal year in which the takeover rumor occurs. In line with Cziraki, Lyandres, and Michaely (2019), past insider trading is measured as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold) during year –2, the past stock return is measured as the market-adjusted average daily stock return (based on the equally weighted CRSP market index) during fiscal year –2, and the past trading volume is the natural logarithm of the average monthly stock trading volume during year –2.

We thus measure the abnormal insider trading in rumored firms relative to (1) contemporaneous trades by insiders in control firms (the cross-sectional control) as well as (2) trades by rumored firm insiders during the control period (the time-series control).[11] Note that this methodology requires that insider trading trends are not significantly different between rumored and control firms prior to our study period. We provide evidence of this and discuss the issue further in Section 2.6.

Table 2 reports descriptive statistics for the rumor sample and the matched control sample, along with the *p*-values for a series of univariate mean and median tests. The lack of significant differences between the sample characteristics demonstrates the closeness of the match.

***Insert Table 2 about here***

### 2.4.5 Regression specification

We regress insiders' net purchases on a vector of potential determinants of insider trading. Each regression includes four interrelated observations corresponding to each rumored firm:

[11]As a robustness test, in Section 2.6.5, we also compute abnormal insider trading using a market model approach, following Acharya and Johnson (2010).

observations for the rumored firm within both the study and control periods, as well as observations for the control firm within each of these two periods. Our regression models identify these observations using two dummy variables and their interaction term: *Pre-rumor, Rumored,* and *Pre-rumor*Rumored*. Specifically, we estimate the following equation:

$$IT_i = \beta_0 + \beta_1 Pre\text{-}rumor_i * Rumored_i + \beta_2 Pre\text{-}rumor_i + \beta_3 Rumored_i + f(Controls_i) + \varepsilon_i, \qquad i = 1, 2, \ldots \tag{2}$$

where $IT_i$ is one of the three measures of insider trading for firm $i$, as discussed in Section 2.4.3; $Pre\text{-}rumor_i$ is a dummy variable equal to one within the study period, and zero within the control period; and $Rumored_i$ is a dummy variable that equals one for rumored firms, and zero for control firms. Of particular interest is the coefficient of the interaction term $Pre\text{-}rumor_i * Rumored_i$. This term represents the DiD estimate, and the marginal effect of this variable measures abnormal insider trading relative to the dual controls. Following Agrawal and Nasser (2012) and Agrawal and Cooper (2015), we calculate the marginal effect (*ME*) at the firm level as follows:

$$\begin{aligned} ME_i = [&\{E(IT_i | Pre\text{-}rumor_i = 1, Rumored_i = 1, \bar{X}_i) \\ &- E(IT_i \mid Pre\text{-}rumor_i = 1, Rumored_i = 0, \bar{X}_i)\} \\ &- \{E(IT_i \mid Pre\text{-}rumor_i = 0, Rumored_i = 1, \bar{X}_i) \\ &- E(IT_i \mid Pre\text{-}rumor_i = 0, Rumored_i = 0, \bar{X}_i)\}], \; i = 1, 2, \\ &\ldots \end{aligned} \tag{3}$$

where $ME_i$ is the marginal effect of firm $i$; $IT_i$ is one of the three measures of insider trading for firm $i$; and $\bar{X}_i$ includes all other covariates of firm $i$ at their mean values.[12] We also calculate the percentage marginal effect as the absolute value of 100*(*ME*/Mean of the dependent variable). While the marginal effect represents the relative abnormal change in the trading position, the percentage marginal effect represents the economic magnitude of the change.

In our regression models, we include various controls based on the extant literature such as firm size (Seyhun, 1986), firm risk (Meulbroek, 2000), change in equity risk (Demsetz & Lehn,

[12]In our study, the marginal effect of *Pre-rumor*Rumored* and its regression coefficient are the same, since the interaction term is a dummy variable, and we use ordinary least squares (OLS) regressions.

1985; Jin, 2002; Aggarwal & Samwick, 2003), the firm's prior long-term return (Lakonishok & Lee, 2001), the firm's book-to-market ratio (Jenter, 2005), firm profitability (Cornett et al., 2011), information asymmetry (Aboody & Lev, 2000), insider holdings (Ofek & Yermack, 2000), the stock price run-up (Jarrell & Poulsen, 1989), and liquidity (Grossman & Stiglitz, 1980; Kyle, 1985; Holmstrom & Tirole, 1993).

The construction of these variables follows Agrawal and Nasser (2012): unless otherwise specified, all variables are calculated at the end of the fiscal year prior to the control or pre-rumor period. For prior returns, we separately measure the average daily market-adjusted return for each quarter $t$ and denote the variable representing this as $PRET_t$. For risk, $\sigma$, we use the standard deviation of the equally weighted daily stock returns over the period (–250, –126) relative to the beginning of the control or pre-rumor period. In addition, we define the change in equity risk, $\Delta\sigma$, as the difference between σ and the standard deviation of daily stock returns over trading days (–125, –1) relative to the beginning of the control or pre-rumor period. We measure profitability using the return on assets, *ROA*, defined as the ratio of net income before extraordinary (or nonrecurring) items to total assets. To control for the level of information asymmetry in the firm, we use the ratio of research and development (R&D) expenses over sales revenue, *R&D/Sales*. To account for liquidity, we use the daily average of the ratio of the share trading volume to the number of shares outstanding. Because insiders are more likely to trade on private information that proves to be valuable, we use *CAR(–40, +10)* to control for insiders' incentives to exploit their private information (Agrawal & Nasser, 2012; Ahern & Sosyura, 2015; Betton et al., 2018). Finally, because insiders with large shareholdings need to balance their portfolio after receiving new equity compensation, we control for insider ownership during the pre-rumor and control periods (Ofek & Yermack, 2000).

We also include control variables that have been shown in the literature to impact target firm takeover candidacy and rumor accuracy, and thus potentially provide an incentive for insiders to trade. These variables (defined in Table A1, Part (a) of the Appendix) include the following proxies for management's motives to generate shareholder value or to engage in opportunistic behavior: *CashRatio, ChangeSize2Yrs, Concentration, Dormancy, PrevMergers, PriorReturn2Yrs, ResMismatch, SalesGrowth2Yrs, SalesShock, SalesShockSquared,* and *ShareTurnover,* following Cornett et al. (2011) and Betton et al. (2018). We also include a variable

that serves as a proxy for firm newsworthiness, *ValuableBrand*, following Ahern and Sosyura (2015).

## 2.5. Results

### 2.5.1 Rumored target firm returns

To establish a motivation for insiders to trade in rumored targets, we present the cumulative average abnormal returns (CAARs) of such firms in Table 3. We find that takeover rumors result in significantly positive CAARs of 3.72%, on average, over the (0, +1)[13] rumor date period, while accurate and inaccurate rumors yield significantly positive CAARs of 7.01% and 2.79%, respectively. Qualitatively similar results are also found over the longer (–20, +20) rumor date window. These findings are in line with prior research (e.g., Ahern & Sosyura, 2015; Betton et al., 2018) and demonstrate that it is reasonable to presume that trading in firms that will subsequently become the subject of a publicly announced takeover rumor is profitable. Moreover, in untabulated tests, we find that the CAARs of firms associated with accurate rumors are significantly higher than those associated with inaccurate rumors over each of the above windows, implying informed trading, market anticipation, or both (Jensen & Ruback, 1983; Clements & Singh, 2011). Figure 1 plots the share price reaction around the rumor date for various categories of rumors.

***Insert Table 3 about here***

***Insert Figure 1 about here***

### 2.5.2 DiD univariate analysis of insider trading patterns prior to takeover rumors

We present the mean values of our insider net purchase measures in Columns (1) to (4) of Table 4, with the time-series control sample (one year prior to the study period) in Column (1), our study period of interest in Column (2), and the matched control firm samples in Columns (3) and (4). Column (5) presents the *p*-values of difference-in-means tests regarding the dual controls (i.e., the differences in the net purchases of rumored firms between the study and time-series control periods minus the differences in the net purchases of control firms between the study and time-series

[13]We employ a (0, +1) event window because some rumors in our sample are released after the market is closed.

control periods). In addition, the results are sub-divided according to the type of rumor associated with the target firms in Panels B to E.

We see in Column (5) of Panel A that abnormal insider net purchases are significantly positive within the year prior to all takeover rumors and across all insider trading measures, supporting H1. The statistical significance of each measure further improves when we restrict our analysis to accurate rumors (those leading to takeovers within a year), as shown in Panel B. Panel C also provides some evidence of positive insider net purchases prior to inaccurate rumors, but the level of significance is 10% at best.

We also sub-divide our sample based on the type of justification for each rumor. Panel D provides evidence of positive abnormal insider net purchases prior to the announcement of rumors containing three or more non-speculative justifications for publication (*Informative*), while no such evidence exists for rumors whose justification is based solely on gossip or on an increase in option activity (*Speculative*), as shown in Panel E. These findings are consistent with insiders increasing their net positions in firms having greater prospects of becoming future acquisition targets.

Untabulated tests further show that insiders significantly reduce their sales prior to takeover rumor announcements without any significant change in purchase levels. This finding indicates that the reported increase in net purchases is driven by a passive trading strategy whereby insiders reduce their sales below typical levels, similar to the findings by Madison, Roth, and Saporoschenko (2004) and Agrawal and Nasser (2012) prior to *bid* announcements.

***Insert Table 4 about here***

### 2.5.3 Regression analysis of insider trades

Panel A of Table 5 provides the regression results for the full sample, with the exception of 117 observations which are missing due to incomplete data availability in the CRSP and Compustat databases. We report three models, each using a different measure of insider net purchases as the dependent variable.

Of particular interest is the coefficient of *Pre-rumor*Rumored*, which measures how the level of insider trading varies in relation to the time period and type of firm (rumored or control). The significant positive coefficient of the interaction term indicates that, on average, the increase

in the insiders' net purchasing in the study period relative to the control period is greater in rumored firms than in the matched control firms. This supports our central premise that insiders of rumored target firms increase their own-firm net-purchases before material information (the rumor) is released to the public. Moreover, the economic magnitude of this effect is quite substantial. A marginal effect analysis (see Equation (3)) indicates that during the year prior to the takeover rumor, insiders of rumored firms increase the net dollar value of shares purchased by about 38%.[14] Such trades represent a significant fraction of the insiders' net positions and demonstrate pervasive insider trading prior to takeover rumors.

Additionally, we note that insider net purchases are negatively correlated with firm size, consistent with the notion that smaller firms are frequently seen as more likely takeover targets (Gort, 1969) and therefore more likely to generate trading profits. This is also in line with the findings of Seyhun (1986) who observes that insiders in small firms earn substantially greater abnormal returns than insiders in large firms, thus increasing their incentives to trade on their private information.

Panel B of Table 5 provides the coefficient estimates of *Pre-rumor*Rumored* for insider trading by rumor type. We find evidence of a significant increase in insider net purchases, relative to the control sample, when rumors lead to a takeover announcement within one year (*Accurate*) or when there is detailed justification for the rumor (*Informative*). We do not find evidence of such relative increases in insiders' net purchases when rumors provide only sparse justification (*Speculative*). This further supports the notion that insiders trade based on information that is materially relevant to the firm's prospects as a takeover target.

When takeover rumors occur in close proximity to the takeover announcement, insiders could be trading on specific knowledge of takeover negotiations, rather than on information related to the rumor. To minimize this effect, we examine a subsample of 154 accurate rumors that were published four to 12 months in advance of the takeover announcement (Panel C, second row). We again find evidence, significant at the 5% level, of an increase in net insider purchases relative to the dual controls.

[14]In untabulated tests, we find that this effect is largely driven by insider trading patterns during the six-month period immediately preceding the takeover rumor.

We next investigate whether all groups of insiders behave similarly or whether our results are driven by insiders who are more likely to be informed about takeover possibilities. We use the Relationship Code Classification of insider roles in Thomson Reuter's IFDF and split insiders into a managing and a non-managing group. Following Ravina and Sapienza (2009) and Davis et al. (2017), we categorize all corporate directors and officers as managing insiders, whereas committee members, affiliates, beneficial owners, and others are considered non-managing insiders. Then, we separately compute insider net purchases for managing and non-managing insiders and examine their trading in a double DiD setting at the firm-insider level. Specifically, we re-estimate an alternative version of Equation (2) as follows:

$$\begin{aligned} IT_{i,j} = \beta_0 + \beta_1 Pre\text{-}rumor_i * Rumored_i * Managing_j + \beta_2 Pre\text{-}rumor_i \\ * Rumored_i \\ + \beta_3 Rumored_j * Managing_i + \beta_4 Pre\text{-}rumor_i * Managing_j \\ + \beta_5 Managing_i \\ + \beta_6 Pre\text{-}rumor_i + \beta_7 Rumored_j + f(Controls_i) + \varepsilon_i, \\ i = 1, 2, \dots, \text{and } j = 1, 2 \end{aligned} \tag{4}$$

where $IT_{i,j}$ is one the three measures of insider trading for firm *i*, computed separately for both managing and non-managing insiders (*j* = 1, 2), $Managing_j$ is a dummy variable that equals one for managing insiders and zero otherwise. All other variables are the same as in Equation (2). By including interaction terms between the dummy variables, we allow the coefficients to vary across firms (rumored targets and controls), time (study and control periods), and insiders (managing and non-managing).

To determine whether managing insiders engage in more net purchases of their own firms than non-managing insiders during the pre-rumor period, we are primarily interested in the coefficients of $\beta_1$ and $\beta_2$, as presented in the first and second rows of Table 5, Panel D, respectively. The coefficient of $\beta_1$ is significantly positive, in contrast to that of $\beta_2$, demonstrating that the insider trading behavior we document in our earlier tests appears to be driven more by managers than by non-managers, supporting H2. Untabulated analysis reveals that the difference between these coefficients is significant at the 5% level.

***Insert Table 5 about here***

### 2.5.4 The predictive power of insider trading

There is a clear financial incentive for insiders to increase their ownership of target firms prior to takeover announcements, given the stylized fact that their share prices increase, on average, upon the event announcements. We therefore examine whether abnormal insider trading can predict rumor accuracy (i.e., a bid announcement within one calendar year). Columns (1) to (3) of Table 6 show the results of a series of logit regressions, where the dependent variable equals one if the rumored firm becomes subject to a takeover announcement within the following 365 days, and zero otherwise. The main independent variable of interest is the abnormal level of insider trading (computed based on Equation (3)), using either the net number of shares purchased, the net dollar value of shares purchased, or the net percentage of equity purchased. A significant issue in the examination of takeover prediction is the degree of investor anticipation based on publicly available information. Thus, we include a large number of control variables from the literature (Cornett et al., 2011; Betton et al., 2018).

***Insert Table 6 about here***

Regardless of the insider trading measure examined, we find that abnormal insider net purchases are significant positive predictors of forthcoming takeover announcements, thus providing direct support for H3 and demonstrating that pre-rumor insider trading is informative. This result also supports prior research findings which suggest that pre-event insider trading provides a signal to help the market verify the credibility of any forthcoming event announcement (e.g., John & Mishra, 1990; Buffa & Nicodano, 2008; Babenko, Tserlukevich, & Vedrashko, 2012).

We further examine whether abnormal insider trading activity during the pre-rumor period can predict a firm's stock price returns following the rumor's announcement. Specifically, we compute the abnormal insider trading of each rumored firm in our sample according to Equation (3) and use that as the explanatory variable in a series of OLS regressions where the dependent variable is the CAR of the rumored firm over the rumor event period (0, +1). We estimate abnormal returns according to Carhart's (1997) four-factor model and present the regression results in Columns (4) to (6) of Table 6.

The significant positive coefficients of each abnormal insider trading measure in these columns show that the trades of insiders during the pre-rumor period can help predict rumor announcement returns; specifically, insider net buying before a takeover rumor is positively associated with significantly higher abnormal returns on the rumor date. This evidence is consistent with the research of Jenter (2005) and Cohen, Malloy, and Pomorski (2012) who find that insider trading is positively related to future returns, as well as with the work of Cziraki et al. (2019), who find significantly higher market reactions for firms that exhibit a high level of insider net buying within the six months prior to share repurchases and seasoned equity offerings.

### 2.6. Robustness

#### 2.6.1 The parallel trend assumption in DiD

We employ a number of robustness tests to verify our results. The DiD methodology requires that, in the absence of a takeover rumor, insider trading for the rumored and control firms follows parallel trends over time (Amore & Bennedsen, 2013). To address this issue, we perform two tests over the pre-study period. First, we run a series of univariate tests of insider trading during years $t = -3$ and $t = -2$, where year 0 is the year the rumor is published, with the results presented in Table A2 of the Appendix. The results provide no indication of divergent trends in insider trading between rumored and control firms over this pre-study period, as required. A visual representation of insider trading in both rumored and control firms over this period is provided in Figure 2.

***Insert Figure 2 about here***

Second, to further investigate the validity of the parallel trend assumption, we present the results of a falsification test (Abadie, 2005; Amore & Bennedsen, 2013), which estimates our models in a pre-treatment window using years $t = -3$ and $t = -2$ in place of years $t = -2$ and $t = -1$, respectively. Panel A of Table 7 presents the coefficient estimates of the main dummy variables and the interaction terms, with *Year* as an indicator variable equal to one for year $t = -2$ and zero for year $t = -3$. The lack of statistical significance for *Year*Rumored* indicates that the parallel trend assumption appears justified: both control and rumored firms display similar insider trading

trends prior to the analysis of our central thesis. Moreover, in untabulated tests, we verify that the parallel trends assumption is also valid between years $t = -3$ and $t = -4$.

***Insert Table 7 about here***

### 2.6.2 Endogeneity

A potential concern in our analysis is that, rather than insider trading occurring in anticipation of takeover rumors, takeover rumors could be a response to the registered insider trading that has already transpired. We address this issue of potential endogeneity by first noting that the insider trading we uncover does not represent active purchases, but rather reduced sales leading to increased net purchases. Unlike active trading, passive trading is not easy to notice or assess until lengthy periods of time have passed, and therefore it is unlikely to be discussed in the financial media in a timely fashion. Furthermore, the database we employ lists the rationale(s) for each rumor's publication, and these show that in most cases, rumors are based on arguments unrelated to the observation of prior registered insider trades.

However, in 213 instances, the publication mentions that the rumor is at least partially inspired by insider comments, while in 46 additional instances, the publication mentions that the rumor is at least partially in response to the purchase of a large block of shares. This results in 259 rumors that are subject to the endogeneity concern above. To be conservative, we peruse the EDGAR online database of SEC filings, identifying and removing a further 42 observations for which an investor had filed a 13D report (indicating a purchase of a large block of shares) within two months prior to the rumor publication date.

For the remaining 1,224 sample observations, we conduct a regression analysis using the same DiD approach as that employed in Section 2.5.3. We report the coefficient estimates of the main dummy variables and the interaction term in Panel B of Table 7. As indicated by the coefficients of *Pre-rumor*Rumored*, we still find significant evidence that insiders increase their net purchases before takeover rumors.

### 2.6.3 Time effects

During financial crises, it is often difficult for market participants to assess the fundamental value of share prices. Consequently, it has been argued that the informational benefits of insiders trading

are higher during such periods (Lim, Brooks, & Kim, 2008; Van Geyt, Van Cauwenberge, & Vander Bauwhede, 2013). Thus, a potential concern in our analysis is that our results may, at least in part, be driven by the financial crisis of 2007–2009 that falls within our sample period. We address this issue by removing all observations that coincided with the financial crisis period and then rerunning our central DiD analysis.

We follow Campello, Graham, and Harvey (2010), Flannery, Kwan, and Nimalendran (2013), and Del Guercio, Odders-White, and Ready (2017) and consider the financial crisis to cover the period from July 2007 to September 2009. This results in the removal of 409 observations, leaving a total of 1,116 firms in our sample. We then re-estimate the regressions we previously employed in Sections 2.5.3 and 2.6.2, reporting our results in Panel C of Table 7. The coefficients of *Pre-rumor*Rumored* remain significant for each measure of insider trading, confirming that our results are not specific to the financial crisis period of 2007–2009.

### 2.6.4 Market anticipation

While we assert that insiders trade prior to rumors due to private information they possess on rumor and/or bid probability, an alternative proposition suggests that insiders are simply sophisticated traders who base their investment decisions on public information (Jiang & Zaman, 2010). If this alternative hypothesis were true, then we should no longer expect to see abnormal insider trading in our main sample, as compared to a sample of firms matched on takeover likelihood factors.

We therefore use propensity score matching to construct a new control sample based on the main proxies of takeover likelihood, similar to the procedure performed in Section 2.4.4 in which the control sample was based on determinants of insider trading. In particular, we now match on firm size, the market-to-book ratio, the return on assets, firm leverage, the presence of a blockholder, and the presence of same-industry (at the three-digit SIC code level) bids within the prior year (Hasbrouck, 1985; Palepu, 1986; Ambrose & Megginson, 1992; Cremers, Nair, & John, 2009; Cornett et al., 2011).[15] In each case, we choose that firm as the control firm that has the closest takeover propensity score (the smallest Mahalanobis distance) relative to the rumored firm at the end of the fiscal year prior to the takeover rumor.

[15]We define a blockholder as an institutional investor holding 5% or more of firm shares outstanding.

Next, we rerun our DiD regression analysis from Section 2.5.3 using the first (second) best matches for the control group. The results are presented in Panel D (Panel E) of Table 7. The positive and statistically significant coefficients of *Pre-rumor*Rumored* show that insiders of rumored firms significantly increase their net purchases during the pre-rumor period within this subsample. This finding corroborates our assertion that insiders of rumored firms act primarily based on private, not public, knowledge of takeover likelihood.

### 2.6.5 An alternative benchmarking approach

In a final robustness check, we follow Acharya and Johnson (2010) and calculate abnormal insider trading by utilizing a market model approach to account for lagged and contemporaneous returns and trading volumes of the underlying stock, as well as for the contemporaneous returns and trade volumes of the market index.[16] As Acharya and Johnson note, this model should be adjusted if the trading pattern is likely to follow a non-normal distribution. Corporate insiders do not trade very frequently, and there are several days and even months where stocks are not traded by insiders (Ma, 2001). We therefore use a Heckman (1979) two-stage selection specification and separately model both the likelihood of insider trading and the trade amount conditional on the choice to trade. This procedure yields appropriate residuals and residual standard errors for zero and non-zero observations (Acharya & Johnson, 2010; Acharya, Gündüz, & Johnson, 2018).

The first stage of the model is specified as follows:

$$y^*_{1it} = \beta_1 X_{1it} + \varepsilon_{1it} \tag{5}$$

where $y^*_{1it}$ is a dummy variable equal to zero if there is no insider trading for firm *i* on day *t*, and one otherwise. The variable $X_{1it}$ is observed for all firms and, as explained above, includes the contemporaneous (and lagged) volume and returns of the market index (underlying stock). We use a probit model to fit Equation (5) and obtain consistent estimates of $\beta_1$, which are used to estimate the inverse Mill's ratio ($\lambda$) in the second stage, to correct for potential sample selection bias.

The second stage of the model is specified as follows:

$$y^*_{2it} = \beta_2 X_{1it} + \alpha_\lambda \lambda + \varepsilon_{2it} \tag{6}$$

[16]We use the CRSP value-weighted index in calculating market returns and the S&P 500 to calculate volume.

where $y^*_{2it}$ is firm *i*'s insider trading on day *t,* while the explanatory variables are the same as those included in Equation (5).[17] We separately fit the models for insider purchases, sales, and net purchases using daily data over an estimation window of (–48, –7) months relative to the rumor date. In our regression models, we use firm-level standard error clustering to address heteroscedasticity and serial correlation concerns, while including firm and year fixed effects to reduce any omitted variable biases (Petersen, 2009). Then, we estimate expected daily insider trading on day *t* during the monthly event window (–6, +6) as follows:[18]

$$\widehat{yexp}_{it} = \mathbb{E}[y_{it} \mid y_{it}^{observed}] * Pr(y_{it}^{observed}) \tag{7}$$

where, for firm *i* and day *t,* $\widehat{yexp}_{it}$ is the expected insider trading, $\mathbb{E}[y_{it} \mid y_{it}^{observed}]$ is the estimated insider trading from Equation (6), and $Pr(y_{it}^{observed})$ is the estimated probability of observing insider trading.

We then measure the abnormal insider trading $AIT_{it}$ of firm *i* on day *t* as the difference between the observed and expected values:

$$AIT_{it} = y_{it}^{observed} - \widehat{yexp}_{it} \tag{8}$$

Next, we define the average abnormal insider trading on day *t* as:

$$AAIT_t = \sum_{i=1}^{n} AIT_{it} / n \tag{9}$$

Finally, we define the cumulative average abnormal insider trading (*CAAIT*) over days ($t_1$, $t_2$) as:[19]

$$CAAIT_{(t_1,t_2)} = \sum_{t=t_1}^{t_2} AAIT_t \tag{10}$$

Table 8 reports the cumulative average abnormal insider trading volumes of rumored firms and their corresponding matched peers (constructed according to Section 2.4.4) for the six-month periods before and after rumors. The results are segregated by rumor subsample in Panels A to C;

[17]Our results are largely insensitive to including all the control variables from Equation (2), as well as day-of-week dummies.
[18]We choose the event window (–6, +6) because our marginal effect analysis indicates that the results in Table 5 are largely driven by insider trading patterns during the six-month period immediately preceding the takeover rumor.
[19]We drop rumored firms that were accurately identified as potential takeover targets firms one day prior to the official takeover announcements to reduce any biases arising from forced sales upon the successful completion of a takeover.

Panel A shows the results for the full sample, while Panel B (C) presents the results for accurate (inaccurate) rumors.

***Insert Table 8 about here***

Consistent with H1 and the results in Tables 4 and 5, insiders of rumored firms significantly increase their net purchases during the six-month period prior to rumors (Column (1)), whereas there is no significant abnormal trading in the control firms (Column (2)). The difference between the abnormal trading in rumored firms and that in control firms is positive and statistically significant for all measures of insider trading, as shown in Column (5). This increase in net purchase activity is mainly driven by a drop in insider sales, rather than by an increase in purchase levels, as shown in Figure 3A, corroborating our earlier finding of a passive trading strategy.

After the rumor is published, insiders of rumored firms behave differently, depending on its accuracy: insiders of accurately rumored firms marginally increase their net purchases during the six-month period after the rumor (Column (3) of Panel B, Table 8) while insiders of inaccurately rumored firms drastically reverse their trading positions and become significant net sellers post-rumor (Column (3) of Panel C of Table 8). Figures 3B and 3C graphically display these results, which are consistent with the theoretical framework of Hirshleifer, Subrahmanyam, and Titman (1994) and Brunnermeier (2005), who argue that early-informed investors are expected to sell a portion of their holdings once the signal is publicly revealed and the informational advantage is lost.

***Insert Figure 3 about here***

Reducing sales after the publication of an accurate rumor likely benefits insiders financially, given that bid announcements are well known to incur significantly positive stock price reactions, on average.[20] In contrast, the post-rumor reduction of purchases observed for accurate rumors in Figure 3B is unlikely to be of benefit to insiders. We speculate that the post-rumor reduction in observed purchases may be the result of insiders expecting enforcement of the short swing rule to nullify any gains made from round-trip trades (given that a completed takeover within

[20]In untabulated analyses, we compute Carhart's four-factor buy-and-hold abnormal returns and find that they are 7.88% and –6.38% for accurate and inaccurate rumors, respectively, over the (+2, +180) period. This result is consistent with previous findings that suggest that insider trading can predict future price movements (Jenter, 2005; Cohen et al., 2012; Cziraki et al., 2019).

six months would force the sale of any shares purchased). Furthermore, insiders may be wary of regulators scrutinizing trades in close proximity to bid announcements or they may be prohibited from trading due to firm-initiated blackout policies.

Finally, we partition insider transactions according to the managing and non-managing roles of the insiders and re-run Equations (5) to (10), with results presented in Table 9. We observe positive cumulative abnormal insider trading for both managing (Column (1)) and non-managing (Column (2)) insiders prior to the rumor, but the results are only significant for managers. On average, managing (non-managing) insiders increase their net purchases by more than $200,000 ($22,000) during the six-month period prior to the rumor. In addition, consistent with both our earlier findings (Panel D of Table 5) and with H2, we observe that, prior to the rumor, abnormal net purchases are indeed substantially driven by the trading pattern of managing insiders (Column (5)), particularly for accurate rumors (Panel B).

***Insert Table 9 about here***

Within six months following the rumor, we see that, while all insiders reduce their net purchases in rumored firms, only managing insiders do so at the 5% significance level (Columns (3) and (4) in Panel A of Table 9). Most interestingly, non-managing insiders significantly increase their net purchases in accurately rumored firms (Column (4) of Panel B of Table 9), while managing insiders appear to have already achieved their desired position, since their net purchases do not change significantly (Column (3), Panel B). This difference between the two types of insiders is significant at the 5% level (Column (6), Panel B). Managing insiders significantly reduce their net purchases in firms that are not subject to a takeover within a year ($p$ <0.05), whereas non-managing insiders do the same, but at a marginal significance level ($p$ <0.1) (Columns (3) and (4) of Panel C of Table 9). Thus, non-managing insiders trade as if they have similar access to the private information that managing insiders do, but with a delay. We depict the results graphically in Figure 3D, where we observe that non-managing insiders begin to reduce net purchases in firms subject to inaccurate takeover rumors only about two months after the first published rumor.

## 2.7. Conclusions

Our results show that insiders of rumored target firms significantly increase their net purchases during a one-year period prior to the initial rumor date. This pattern is driven by a significant reduction in sales without any significant change in purchases. The magnitude of this surge in passive trading is considerable: the net number of shares traded and the dollar value of net purchases increase by approximately 28% and 38%, respectively, relative to their usual level. Further, we find evidence that the observed insider trading patterns are more pronounced when (i) the rumor is followed by a formal takeover announcement within one calendar year after the rumor's release, (ii) more extensive justification is provided within the rumor article, and (iii) the passive trading strategy is conducted by a managing insider. Finally, we find that each of our measures for insider net purchases over the year prior to the initial rumor date predicts takeover bids, even after extensively controlling for other determinants of takeover candidacy as identified in the literature on market anticipation.

We also conclude that the high level of pre-rumor net purchasing is driven by insiders' use of privately available knowledge, rather than an astute capacity to anticipate stock price movements. This inference is based on a finding of low levels of insider net purchasing at equivalent points in time in control firms carefully matched to the study firms for their propensity to be acquired, but not themselves subject to takeover rumors.

It is essential to clarify that although we report significant evidence of insider trading during the pre-rumor period, this type of trading is not illegal. While Section 10(b) of the 1934 Securities Exchange Act prohibits insider trading on material private information (insiders are required to disclose material information or refrain from trading), it specifically does not prohibit an insider from *refraining* to trade. Reducing one's sales, even if such sales would otherwise have gone ahead as planned, is simply one way to abstain from trading (Bettis et al., 1998; Madison et al., 2004) and does not constitute a violation of the Securities Act.

Our findings could be interpreted as a sign of effective regulatory enforcement, since we find no evidence of increased purchases during a time when insiders appear to have access to material private information. However, they strike at the spirit of insider trading policy: profiting from material private information is contrary to both the stated intention of the regulatory legislation and to the implicit concept of moral fairness which is required for investor confidence (Bettis et al., 1998). Thus, while we provide evidence of effective enforcement of the letter of the

law, we also provide evidence that the intention of legislation is being subverted. The issue of sanctioning insiders' passive use of material private information therefore merits further attention.

**References**


Abadie, A. (2005). Semiparametric difference-in-differences estimators. *The Review of Economic Studies, 72*(1), 1–19.

Aboody, D., & Lev, B. (2000). Information asymmetry, R&D, and insider gains. *The Journal of Finance, 55*(6)*,* 2747–2766.

Acharya, V. V., & Johnson, T. C. (2010). More insiders, more insider trading: Evidence from private-equity buyouts. *Journal of Financial Economics*, *98*(3), 500–523.

Acharya, V. V., Gündüz, Y., & Johnson, T. C. (2018). Bank use of sovereign CDS in the Eurozone crisis: Hedging and risk incentives, Deutsche Bundesbank working paper no.26/2018.

Aggarwal, R. K., & Samwick, A. A. (2003). Why do managers diversify their firms? Agency reconsidered. *The Journal of Finance, 58*(1)*,* 71–118.

Agrawal, A., & Cooper, T. (2015). Insider trading before accounting scandals. *Journal of Corporate Finance, 34(C)*, 169–190.

Agrawal, A., & Nasser, T. (2012). Insider trading in takeover targets. *Journal of Corporate Finance, 18*(3)*,* 598–625.

Ahern, K. R., & Sosyura, D. (2015). Rumor has it: Sensationalism in financial media. *The Review of Financial Studies, 28*(7)*,* 2050–2093.

Akhigbe, A., Martin, A. D., & Whyte, A. M. (2007). Partial acquisitions, the acquisition probability hypothesis, and the abnormal returns to partial targets. *Journal of Banking and Finance, 31*(10), 3080–3101.

Ambrose, B. W., & Megginson, W. L. (1992). The role of asset structure, ownership structure, and takeover defenses in determining acquisition likelihood. *Journal of Financial and Quantitative Analysis, 27*(4), 575–589.

Amore, M. D., & Bennedsen, M. (2013). The value of local political connections in a low-corruption environment. *Journal of Financial Economics, 110*(2)*,* 387–402.

Aspris, A., Foley, S., & Frino, A. (2014). Does insider trading explain price run-up ahead of takeover announcements? *Accounting and Finance, 54*(1)*,* 25–45.

Augustin, P., Brenner, M., & Subrahmanyam, M. G. (2019). Informed options trading prior to takeover announcements: Insider trading? *Management Science*, *65*(12), 5697–5720.

Babenko, I., Tserlukevich, Y., & Vedrashko, A. (2012). The credibility of open market share repurchase signaling. *Journal of Financial and Quantitative Analysis*, *47*(5), 1059–1088.

Barnes, B. G., Harp, N., & Oler, D. (2014). Evaluating the SDC mergers and acquisitions database. *Financial Review, 49(4),* 793–822.

Bettis, J. C., Coles, J. L., & Lemmon, M. L. (2000). Corporate policies restricting trading by insiders. *Journal of Financial Economics, 57*(2)*,* 191–220.

Bettis, J. C., Duncan, W. A., & Harmon, W. K. (1998). The effectiveness of insider trading regulations. *Journal of Applied Business Research, 14(4)*, 53–70.

Betton, S., & Eckbo, B. E. (2000). Toeholds, bid jumps, and expected payoffs in takeovers. *The Review of Financial Studies*, *13*(4), 841–882.

Betton, S., Davis, F., & Walker, T. (2018). Rumor rationales: The impact of message justification on article credibility. *International Review of Financial Analysis, 58*(C)*,* 271–287.

Betton, S., Eckbo, B. E., & Thorburn, K. S. (2009). Merger negotiations and the toehold puzzle. *Journal of Financial Economics, 91*(2)*,* 158–178.

Bharadwaj, A., & Shivdasani, A. (2003). Valuation effects of bank financing in acquisitions. *Journal of Financial Economics, 67*(1)*,* 113–148.

Bhattacharya, U., & Daouk, H. (2002). The world price of insider trading. *The Journal of Finance, 57*(1)*,* 75–108.

Boone, A. L., & Mulherin, J. H. (2009). Is there one best way to sell a company? Auctions versus negotiations and controlled sales. *Journal of Applied Corporate Finance, 21*(3)*,* 28–37.

Bris, A. (2005). Do insider trading laws work? *European Financial Management, 11*(3)*,* 267–312.

Brunnermeier, M. K. (2005). Information leakage and market efficiency. *The Review of Financial Studies*, *18*(2), 417–457.

Buffa, A. M., & Nicodano, G. (2008). Should insider trading be prohibited when share repurchases are allowed? *Review of Finance*, *12*(4), 735–765.

Campello, M., Graham, J. R., & Harvey, C. R. (2010). The real effects of financial constraints: Evidence from a financial crisis. *Journal of Financial Economics, 97*(3), 470–487.

Carhart, M. M. (1997). On persistence in mutual fund performance. *The Journal of Finance*, *52*(1), 57–82.

Chakravarty, S., & McConnell, J. J. (1997). An analysis of prices, bid/ask spreads, and bid and ask depths surrounding Ivan Boesky's illegal trading in Carnation's stock. *Financial Management, 26*(2)*,* 18–34.

Clements, M., & Singh, H. (2011). An analysis of trading in target stocks before successful takeover announcements. *Journal of Multinational Financial Management*, *21*(1), 1–17.

Cohen, L., Malloy, C., & Pomorski, L. (2012). Decoding inside information. *The Journal of Finance, 67*(3)*,* 1009–1043.

Cornell, B., & Sirri, E. R. (1992). The reaction of investors and stock prices to insider trading. *The Journal of Finance*, *47*(3), 1031–1059.

Cornett, M. M., Tanyeri, B., & Tehranian, H. (2011). The effect of merger anticipation on bidder and target firm announcement period returns. *Journal of Corporate Finance, 17*(3)*,* 595–611.

Cremers, K. M., Nair, V. B., & John, K. (2009). Takeovers and the cross-section of returns. *The Review of Financial Studies, 22*(4), 1409–1445.

Cumming, D., Johan, S., & Lee, D. (2011). Exchange trading rules and stock market liquidity. *Journal of Financial Economics, 99*(3), 651–671.

Cziraki, P., Lyandres, E., & Michaely, R. (2019). What do insiders know? Evidence from insider trading around share repurchases and SEOs. *Journal of Corporate Finance,* Forthcoming.

Davis, F., Taghipour, B., & Walker, T. J. (2017). Insider trading surrounding securities class action litigation and settlement announcements. *Managerial Finance. 43*(1), 124–140.

Del Guercio, D., Odders-White, E. R., & Ready, M. J. (2017). The deterrent effect of the Securities and Exchange Commission's enforcement intensity on illegal insider trading: Evidence from run-up before news events. *The Journal of Law and Economics, 60*(2), 269–307.

Demsetz, H., & Lehn, K. (1985). The structure of corporate ownership: Causes and consequences. *Journal of Political Economy, 93*(6)*,* 1155–1177.

Faccio, M., & Masulis, R. W. (2005). The choice of payment method in European mergers and acquisitions. *The Journal of Finance, 60*(3)*,* 1345–1388.

Fishe, R. P., & Robe, M. A. (2004). The impact of illegal insider trading in dealer and specialist markets: Evidence from a natural experiment. *Journal of Financial Economics, 71*(3)*,* 461–488.

Flannery, M. J., Kwan, S. H., & Nimalendran, M. (2013). The 2007–2009 financial crisis and bank opaqueness. *Journal of Financial Intermediation, 22*(1), 55–84.

Gort, M. (1969). An economic disturbance theory of mergers. *Quarterly Journal of Economics, 83*(4)*,* 624–642.

Grossman, S. J., & Stiglitz, J. E. (1980). On the impossibility of informationally efficient markets. *American Economic Review, 70*(3)*,* 393–408.

Hasbrouck, J. (1985). The characteristics of takeover targets: Q and other measures. *Journal of Banking and Finance, 9*(3), 351–362.

Haslem, B., Hutton, I., & Smith, A. H. (2017). How much do corporate defendants really lose? A new verdict on the reputation loss induced by corporate litigation. *Financial Management, 46*(2), 323–358.

Heckman, J. J. (1979). Sample selection bias as a specification error. *Econometrica, 47* (1), 153–161.

Hirshleifer, D., Subrahmanyam, A., & Titman, S. (1994). Security analysis and trading patterns when some investors receive information before others. *The Journal of Finance*, *49*(5), 1665–1698.

Holmstrom, B., & Tirole, J. (1993). Market liquidity and performance monitoring. *Journal of Political Economy, 101*(4)*,* 678–709.

Jarrell, G. A., & Poulsen, A. B. (1989). Stock trading before the announcement of tender offers: Insider trading or market anticipation? *Journal of Law, Economics, & Organization, 5*(2), 225–248.

Jayaraman, N., Frye, M. B., & Sabherwal, S. (2001). Informed trading around merger announcements: An empirical test using transaction volume and open interest in options market. *Financial Review, 36*(2), 45–74.

Jensen, M. C., & Ruback, R. S. (1983). The market for corporate control: The scientific evidence. *Journal of Financial Economics, 11*(1–4)*,* 5–50.

Jenter, D. (2005). Market timing and managerial portfolio decisions. *The Journal of Finance, 60*(4)*,* 1903–1949.

Jiang, X., & Zaman, M. A. (2010). Aggregate insider trading: Contrarian beliefs or superior information? *Journal of Banking and Finance, 34*(6), 1225–1236.

Jin, L. (2002). CEO compensation, diversification, and incentives. *Journal of Financial Economics, 66*(1)*,* 29–63.

John, K., & Mishra, B. (1990). Information content of insider trading around corporate announcements: The case of capital expenditures. *The Journal of Finance*, *45*(3), 835–855.

Ke, B., Huddart, S., & Petroni, K. (2003). What insiders know about future earnings and how they use it: Evidence from insider trades. *Journal of Accounting and Economics*, *35*(3), 315–346.

Keown, A. J., & Pinkerton, J. M. (1981). Merger announcements and insider trading activity: An empirical investigation. *The Journal of Finance*, *36*(4), 855–869.

Keown, A. J., Pinkerton, J. M., & Bolster, P. J. (1992). Merger announcements, asymmetrical information, and trading volume: An empirical investigation. *Journal of Business Finance and Accounting, 19*(6), 901–910.

Kyle, A. S. (1985). Continuous auctions and insider trading. *Journal of the Econometric Society, 53*(6)*,* 1315–1335.

Lakonishok, J., & Lee, I. (2001). Are insider trades informative? *The Review of Financial Studies, 14*(1)*,* 79–111.

Leland, H. (1992). Insider trading: should it be prohibited? *Journal of Political Economy*, *100*(4), 859–887.

Levitt, A. (1998). The importance of high quality accounting standards. *Accounting Horizons, 12*(1)*,* 79–82.

Lim, K. P., Brooks, R. D., & Kim, J. H. (2008). Financial crisis and stock market efficiency: Empirical evidence from Asian countries. *International Review of Financial Analysis, 17*(3), 571–591.

Madison, T., Roth, G., & Saporoschenko, A. (2004). Bank mergers and insider nontrading. *Financial Review, 39*(2)*,* 203–229.

Meulbroek, L. K. (1992). An empirical analysis of illegal insider trading. *The Journal of Finance, 47*(5)*,* 1661–1699.

Meulbroek, L. K. (2000). Does risk matter? Corporate insider transactions in internet-based firms. Harvard University working paper.

Mulherin, H., & Simsir, S. A. (2015). Measuring deal premiums in takeovers. *Financial Management, 44*(1)*,* 1–14.

Ofek, E., & Yermack, D. (2000). Taking stock: Equity-based compensation and the evolution of managerial ownership. *The Journal of Finance, 55*(3), 1367–1384.

Palepu, K. G. (1986). Predicting takeover targets: A methodological and empirical analysis. *Journal of Accounting and Economics, 8*(1), 3–35.

Petersen, M. A. (2009). Estimating standard errors in finance panel data sets: Comparing approaches. *The Review of Financial Studies*, *22*(1), 435–480.

Piotroski, J. D., & Roulstone, D. T. (2005). Do insider trades reflect both contrarian beliefs and superior knowledge about future cash flow realizations? *Journal of Accounting and Economics, 39*(1)*,* 55–81.

Pound, J., & Zeckhauser, R. (1990). Clearly heard on the street: The effect of takeover rumors on stock prices. *The Journal of Business, 63*(3), 291–308.

Ravina, E., & Sapienza, P. (2009). What do independent directors know? Evidence from their trading. *The Review of Financial Studies, 23*(3)*,* 962–1003.

Sanders, R. W., & Zdanowicz, J. S. (1992). Target firm abnormal returns and trading volume around the initiation of change in control transactions. *Journal of Financial and Quantitative Analysis, 27*(1), 109–129.

Seyhun, H. N. (1986). Insiders' profits, costs of trading, and market efficiency. *Journal of Financial Economics, 16*(2)*,* 189–212.

Van Geyt, D., Van Cauwenberge, P., & Vander Bauwhede, H. (2013). The impact of the financial crisis on insider trading profitability in Belgium. *The Journal of Business Economics and Management, 14*(2)*,* 364–385.

**Table 1: Sample distribution**

Panel A shows the yearly distribution of takeover rumors for our sample of 1,642 firms from January 2002 to December 2011. Panel B shows the industry distribution of the sample based on the Fama-French 17-industry classification.

**Panel A: Distribution by year of rumor**

| Year | Rumor count | % of total count |
|---|---|---|
| 2002 | 48 | 2.92 |
| 2003 | 83 | 5.05 |
| 2004 | 94 | 5.72 |
| 2005 | 97 | 5.91 |
| 2006 | 155 | 9.44 |
| 2007 | 154 | 9.38 |
| 2008 | 180 | 10.96 |
| 2009 | 309 | 18.82 |
| 2010 | 258 | 15.71 |
| 2011 | 264 | 16.08 |
| **Total** | 1,642 | 100 |

**Panel B: Industry distribution**

| Fama-French 17-industry classification | Rumor count |
|---|---|
| Food | 55 |
| Mining and Minerals | 25 |
| Oil and Petroleum Products | 119 |
| Textiles, Apparel, & Footwear | 32 |
| Consumer Durables | 24 |
| Chemicals | 22 |
| Drugs, Soap, Perfumes, & Tobacco | 167 |
| Construction and Construction Materials | 26 |
| Steel Works, etc. | 43 |
| Fabricated Products | 2 |
| Machinery and Business Equipment | 233 |
| Automobiles | 22 |
| Transportation | 47 |
| Utilities | 3 |
| Retail Stores | 107 |
| Banks, Insurance Companies, & Other Financials | 8 |
| Other (Services, Wholesale, etc.) | 707 |
| **Total** | 1,642 |

**Table 2: Descriptive statistics of rumored target and control samples**

This table provides descriptive statistics for our sample of 1,642 rumored takeover firms and 1,642 matched control firms. *Total assets* and *sales*, as well as operating performance, financial leverage, and growth measures are obtained using data from Compustat. The market value of equity as well as measures of stock volatility and prior returns are calculated based on CRSP data. Firm size measures are calculated at the end of the fiscal year prior to the rumor date. The market value of equity is calculated as the number of common shares outstanding multiplied by the month-end price that corresponds to the end of the fiscal year prior to the rumor date. Operating performance for year *t*, *OP(t)*, is calculated as the operating income before depreciation divided by total assets in the same year. The financial leverage measure is calculated based on the last quarter of the fiscal year prior to the rumor date. Firm value is calculated as the sum of the market value of equity and total assets minus the book value of equity. The variables relating to stock volatility ($\sigma$, $\Delta\sigma$) are described in Table A1, Part (a) of the Appendix. The variable *Ret12* represents past stock returns and is measured as the market-adjusted average daily stock return during fiscal year –2. We adjust for the market return using the CRSP equally weighted market index, which includes the New York Stock Exchange, the American Stock Exchange, and the NASDAQ. The stock trading volume is the natural logarithm of the average monthly stock trading volume during year –2. Insider information data are obtained from the Thomson Financial insider trading database, based on all transactions or holdings reported by insiders during the two-year period prior to the takeover rumor date. *Past insider trading* is calculated as (number of shares purchased – number of shares sold)/(number of shares purchased + number of shares sold) during year –2. *Dormancy* is the number of months since the last merger in the same three-digit Standard Industrial Classification (SIC) industry as the target firm. The *p*-values represent the significance level of the paired differences in means and medians between rumored and control firms, respectively.

**Firm characteristics**

| Measure | *N* | Means | | | Medians | | |
|---|---|---|---|---|---|---|---|
| | | Rumored | Control | t-test (*p*-values) | Rumored | Control | Wilcoxon test (*p*-values) |
| **Firm size** | | | | | | | |
| *Market value of equity* ($ mill.) | 1,642 | 4,619 | 4,702 | 0.528 | 1,239 | 1,313 | 0.440 |
| *Total assets* ($ mill.) | 1,642 | 4,860 | 5,061 | 0.372 | 1,116 | 1,195 | 0.869 |
| *Sales* ($ mill.) | 1,614 | 2,354 | 2,118 | 0.182 | 357 | 341 | 0.221 |
| **Operating performance** | | | | | | | |
| *OP(–1)* (%) | 1,547 | 4.198 | 4.459 | 0.205 | 6.014 | 5.917 | 0.375 |
| *OP(–2)* (%) | 1,521 | 4.513 | 5.216 | 0.071 | 5.189 | 6.150 | 0.062 |
| **Financial leverage** | | | | | | | |
| *Long-term debt/total assets* | 1,608 | 0.152 | 0.156 | 0.458 | 0.089 | 0.103 | 0.193 |
| **Growth** | | | | | | | |
| *Book-to-market* | 1,516 | 0.652 | 0.638 | 0.229 | 0.394 | 0.410 | 0.794 |
| *Firm value/total assets* | 1,530 | 1.736 | 1.629 | 0.142 | 1.420 | 1.518 | 0.501 |
| *Sales growth rate* (%) | 1,574 | 22.914 | 19.296 | 0.313 | 8.026 | 7.170 | 0.095 |
| **Stock volatility and prior returns** | | | | | | | |
| $\sigma$ (%) | 1,642 | 1.150 | 1.309 | 0.295 | 0.974 | 0.844 | 0.699 |
| $\Delta\sigma$ (%) | 1,642 | 0.059 | 0.043 | 0.679 | –0.006 | –0.016 | 0.509 |
| *Ret12* | 1,642 | 0.029 | 0.031 | 0.415 | 0.009 | 0.013 | 0.612 |
| *Stock trading volume* | 1,642 | 1.412 | 1.395 | 0.810 | 0.465 | 0.488 | 0.229 |
| **Insider information** | | | | | | | |
| *Ownership* (% equity) | 1,642 | 16.031 | 16.592 | 0.174 | 5.587 | 5.102 | 0.301 |
| *Past insider trading* | 1,642 | –0.624 | –0.603 | 0.529 | –1 | –1 | 0.493 |
| *Number of insiders* | 1,508 | 14.020 | 13.699 | 0.312 | 7.000 | 7.000 | 0.869 |
| **Industry takeover activity** | | | | | | | |
| *Dormancy* | 1,642 | 1.833 | 2.009 | 0.714 | 0.100 | 0.100 | 0.652 |

**Table 3: Abnormal event returns for rumored target firms**

This table presents the CAARs for all 1,642 firms rumored to be takeover targets during the period 2002–2011, as well as for subsets of firms based on the characteristics of each takeover rumor. We use the four-factor model (Carhart, 1997) to calculate abnormal returns, as discussed in Section 2.4.2. Variable definitions are provided in Table A1, Part (b) of the Appendix. *P*-values are reported in parentheses and significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

| | *N* | CAAR(0, +1) | CAAR(–20, –1) | CAAR(+2, +20) | CAAR(–20, +20) |
|---|---|---|---|---|---|
| All | 1,642 | 3.72*** | 0.57 | –0.27 | 4.19*** |
| | | (<0.001) | (0.625) | (0.491) | (<0.001) |
| *Accurate* | 356 | 7.01*** | 3.19*** | 2.02*** | 13.92*** |
| | | (<0.001) | (<0.001) | (0.008) | (<0.001) |
| *Inaccurate* | 1,286 | 2.79*** | –0.15 | –0.86 | 1.55** |
| | | (<0.001) | (0.573) | (0.124) | (0.029) |
| *Informative* | 437 | 5.11*** | 1.98** | 1.99*** | 10.19*** |
| | | (<0.001) | (0.036) | (0.008) | (<0.001) |
| *Speculative* | 251 | 2.35*** | –1.58 | –3.27*** | –2.86* |
| | | (<0.001) | (0.135) | (<0.001) | (0.051) |

**Table 4: Univariate tests of insider net purchases**

Columns (1) to (4) show the means of three measures of insider net purchases for our sample of 1,642 rumored firms and their matched control firms from January 2002 to December 2011. We define the study period as the one-year period prior to the date on which the rumor is published, while the control period is the year prior to that. Insider trading data are obtained from the Thomson Reuters Insider Filing Data Feed. Columns (5) show the *p*-values for a series of univariate t-tests of the differences between means, with the signs of the test statistics in parentheses. Note that Panels B and C are subsets of Panel A and are exhaustive (i.e., they cover all firms in Panel A). Panels D and E are also subsets of Panel A but are non-exhaustive.

| | **Rumored target firms** | | **Control firms** | | ***p*-values** |
|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** |
| **Panel A: All rumors (*N* = 1,642)** | **Two years prior** | **One year prior** | **Two years prior** | **One year prior** | **(2 – 1) – (4 – 3)** |
| *Net number of shares bought* ('000s) | –70.671 | –61.880 | –69.245 | –73.388 | 0.036 (+) |
| *Net dollar value of shares bought* ($ mill.) | –2.102 | –1.709 | –2.071 | –2.114 | 0.052 (+) |
| *Net percentage of equity bought* | –0.729 | –0.644 | –0.718 | –0.725 | 0.088 (+) |
| **Panel B: Accurate rumors (*N* = 356)** | | | | | |
| *Net number of shares bought* ('000s) | –71.352 | –48.979 | –70.024 | –72.415 | 0.020(+) |
| *Net dollar value of shares bought* ($ mill.) | –2.003 | –1.492 | –1.986 | –2.014 | 0.014 (+) |
| *Net percentage of equity bought* | –0.695 | –0.543 | –0.729 | –0.736 | 0.008 (+) |
| **Panel C: Inaccurate rumors (*N* = 1,286)** | | | | | |
| *Net number of shares bought* ('000s) | –70.482 | –65.452 | –69.029 | –73.657 | 0.073 (+) |
| *Net dollar value of shares bought* ($ mill.) | –2.129 | –1.769 | –2.095 | –2.142 | 0.089 (+) |
| *Net percentage of equity bought* | –0.739 | –0.672 | –0.715 | –0.722 | 0.142 (+) |
| **Panel D: Informative rumors (*N* = 437)** | | | | | |
| *Net number of shares bought* ('000s) | –72.373 | –58.607 | –71.875 | –71.103 | 0.027 (+) |
| *Net dollar value of shares bought* ($ mill.) | –1.964 | –1.653 | –1.942 | –1.918 | 0.062 (+) |
| *Net percentage of equity bought* | –0.659 | –0.513 | –0.671 | –0.649 | 0.170 (+) |
| **Panel E: Speculative rumors (*N* = 251)** | | | | | |
| *Net number of shares bought* ('000s) | –76.533 | –70.143 | –75.414 | –73.025 | 0.512 (+) |
| *Net dollar value of shares bought* ($ mill.) | –2.230 | –2.196 | –2.187 | –2.170 | 0.872 (+) |
| *Net percentage of equity bought* | –0.719 | –0.634 | –0.703 | –0.698 | 0.322 (+) |

**Table 5: Regressions of insider net purchases**

Panels A to C (D) of this table present the coefficient estimates for a series of OLS regressions of three measures of insider net purchases against our explanatory variables based on Equation (2) (Equation (3)). This sample includes 1,525 takeover-rumored firms and their corresponding control firms, losing 117 observations due to incomplete data availability from CRSP and Compustat. Each regression includes four interrelated observations corresponding to each rumored firm: one observation for the rumored firm within the study period and one within the corresponding control period, plus one observation for the control firm within the study period and one within the corresponding control period. The variable *Rumored* is a dummy equal to one for a rumored firm, and zero for a control firm; *Pre-rumor* is a dummy variable equal to one for the study period, and zero for the control period. All insider trading measures are winsorized at the 1% level. The firm fixed effects employed here include the variables *CashRatio, ChangeSize2Yrs, Concentration, Dormancy, PrevMergers, PriorReturn2Yrs, ResMismatch, SalesGrowth2Yrs, SalesShock, SalesShockSquared,* and *ShareTurnover*. Table A1, Part (a) of the Appendix provides the variable definitions. Heteroscedasticity-robust standard errors are clustered at the firm level and associated *p*-values are reported in parentheses. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

**Panel A: Full sample results**

| **Dependent variable:** | **(1)** ***Net number of shares bought* ('000s)** | **(2)** ***Net dollar value of shares bought* ($ mill.)** | **(3)** ***Net percentage of equity bought*** |
|---|---|---|---|
| *Pre-rumor*Rumored* | 19.587** | 0.760** | 0.350** |
| | (0.018) | (0.036) | (0.029) |
| *Pre-rumor* | –4.653 | –0.065 | –0.024 |
| | (0.574) | (0.756) | (0.846) |
| *Rumored* | 1.761 | 0.225 | 0.002 |
| | (0.839) | (0.309) | (0.997) |
| *ln(Market Cap)* | –22.136*** | –0.925*** | –0.091*** |
| | (<0.001) | (<0.001) | (0.001) |
| *σ* | 2013.969*** | 66.550*** | 33.965*** |
| | (<0.001) | (<0.001) | (<0.001) |
| *Δσ* | –415.161 | 17.527 | 1.951 |
| | (0.593) | (0.375) | (0.865) |
| *PRET(–1)* | –7379.395*** | –126.785** | –69.414** |
| | (0.001) | (0.029) | (0.038) |
| *PRET(–2)* | –4345.638** | –73.863* | –32.312* |
| | (0.024) | (0.091) | (0.076) |
| *PRET(–3)* | –1427.726 | –38.822 | –12.375 |
| | (0.433) | (0.402) | (0.645) |
| *PRET(–4)* | –463.944 | –19.129 | –9.099 |
| | (0.770) | (0.225) | (0.698) |
| *ROA* | –35.758** | –0.893** | –1.702*** |
| | (0.015) | (0.017) | (<0.001) |
| *Book/Market* | 4.107** | 0.189* | 0.169*** |
| | (0.034) | (0.061) | (0.009) |
| *R&D/Sales* | 0.014 | 0.000 | 0.000 |
| | (0.101) | (0.390) | (0.137) |
| *Liquidity* | –1.160*** | –0.054*** | –0.023*** |
| | (<0.001) | (<0.001) | (<0.001) |
| *CAR(–40, +10)* | 6.794 | 0.024 | 0.070 |
| | (0.494) | (0.925) | (0.633) |
| *Insider Holdings* | –25.676*** | –1.772*** | –1.254*** |
| | (0.006) | (0.001) | (<0.001) |
| *Firm and Year FE* | Yes | Yes | Yes |
| *Constant* | 240.680*** | 11.136*** | –1.541*** |
| | (<0.001) | (<0.001) | (<0.001) |
| *Observations* | 6,100 | 6,100 | 6,100 |
| *Adjusted $R^2$* | 0.049 | 0.111 | 0.023 |
| *F-Test (p-value)* | <0.001 | <0.001 | <0.001 |
| *Mean of the dependent variable* | –68.750 | –1.989 | –0.704 |

| | | | |
|---|---|---|---|
| **Panel B: Insider net purchases by type of rumor** | | | |
| *Accurate* | 23.161*** | 0.964** | 0.469*** |
| | (0.001) | (0.011) | (0.004) |
| *Inaccurate* | 17.302** | 0.490* | 0.295* |
| | (0.035) | (0.062) | (0.065) |
| *Informative* | 20.842** | 0.563** | 0.313* |
| | (0.028) | (0.019) | (0.057) |
| *Speculative* | 8.132 | 0.305 | 0.152 |
| | (0.301) | (0.452) | (0.369) |
| **Panel C: Insider net purchases (accurate rumors only)** | | | |
| *Accurate* rumors within months (–3, –1) | 24.712*** | 1.213*** | 0.692*** |
| | (0.003) | (0.009) | (0.007) |
| *Accurate* rumors within months (–12, –4) | 21.468** | 0.799** | 0.372** |
| | (0.015) | (0.039) | (0.041) |
| **Panel D: Insider net purchases by insider type** | | | |
| *Pre-rumor*Rumored*Managing* | 25.794*** | 0.795*** | 0.419*** |
| | (0.001) | (0.008) | (0.002) |
| *Pre-rumor*Rumored* | 9.863 | 0.297 | 0.126 |
| | (0.271) | (0.226) | (0.378) |
| *Rumored*Managing* | 1.138 | 0.195 | 0.072 |
| | (0.672) | (0.448) | (0.501) |
| *Pre-rumor*Managing* | –4.815 | –0.263 | –0.067 |
| | (0.792) | (0.547) | (0.821) |
| *Managing* | –8.311 | –0.298 | –0.173 |
| | (0.242) | (0.329) | (0.453) |
| *Pre-rumor* | –3.740 | –0.095 | –0.082 |
| | (0.539) | (0.668) | (0.459) |
| *Rumored* | 4.976 | 0.364 | –0.094 |
| | (0.322) | (0.541) | (0.613) |

**Table 6: The predictive power of insider trades**

Columns (1) to (3) display logit regression results in which the dependent variable is a dummy variable equal to one if the rumor leads to a takeover announcement within 365 days. Columns (4) to (6) display the coefficients of OLS regressions in which the dependent variable is the CAR of rumored target firms computed over the (0, +1) rumor date period, using the Carhart (1997) four-factor model. The main independent variables of interest are measures of abnormal insider trading (*Abnormal_Shares*, *Abnormal_Dollar*, and *Abnormal_Percent*) that are calculated based on Equation (3). The firm fixed effects employed here include the variables *CashRatio, ChangeSize2Yrs, Concentration, Dormancy, ln(Market Cap), PrevMergers, PriorReturn2Yrs, ROA, ResMismatch, SalesGrowth2Yrs, SalesShock, SalesShockSquared,* and *ShareTurnover*. Heteroskedasticity-robust standard errors are clustered at the firm level and associated *p*-values are reported in parentheses. Table A1, Part (a) of the Appendix provides additional variable definitions. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| **Dependent variable:** | **Accurate** | **Accurate** | **Accurate** | **CAR(0, +1) (%)** | **CAR(0, +1) (%)** | **CAR(0, +1) (%)** |
| *Abnormal_Shares* ('0000s) | 0.471*** | | | 2.316*** | | |
| | (0.004) | | | (0.006) | | |
| *Abnormal_Dollar* ($ mill.) | | 0.809** | | | 6.470** | |
| | | (0.036) | | | (0.014) | |
| *Abnormal_Percent* (%) | | | 1.164*** | | | 12.805*** |
| | | | (0.003) | | | (0.001) |
| *Informative* | 0.903*** | 0.886*** | 0.824*** | 3.325*** | 3.648*** | 2.974*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| *Speculative* | –1.079*** | –1.091*** | –1.063*** | –2.961*** | –2.617*** | –3.391*** |
| | (<0.001) | (<0.001) | (<0.001) | (0.001) | (0.004) | (0.001) |
| $CAR_{(-5,-1)}$ | 0.442*** | 0.429*** | 0.444*** | –7.564* | –7.159* | –9.836** |
| | (0.006) | (0.007) | (0.005) | (0.066) | (0.073) | (0.014) |
| $CAR_{(-41,-1)}$ | 0.532* | 0.525* | 0.519* | 1.103 | 1.472 | 1.389 |
| | (0.057) | (0.056) | (0.061) | (0.518) | (0.419) | (0.470) |
| *ValuableBrand* | –0.669*** | –0.624*** | –0.582*** | 1.072 | 1.331 | 2.423 |
| | (0.001) | (0.001) | (0.003) | (0.501) | (0.452) | (0.271) |
| *Firm and Year FE* | Yes | Yes | Yes | Yes | Yes | Yes |
| *Constant* | –1.169*** | –1.126*** | –1.339*** | 7.130 | 5.369 | 3.946 |
| | (<0.001) | (<0.001) | (<0.001) | (0.289) | (0.466) | (0.704) |
| *Observations* | 1,525 | 1,525 | 1,525 | 1,525 | 1,525 | 1,525 |
| *Pseudo-$R^2$* | 0.189 | 0.165 | 0.176 | — | — | — |
| *Adj. $R^2$* | — | — | — | 0.051 | 0.060 | 0.067 |
| *$\chi^2$ Test (p-value)* | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

**Table 7: Coefficient estimates of the dummy variables - Robustness tests**

This table presents the coefficient estimates for the main dummy variables of interest in a series of robustness tests discussed in Sections 2.6.1 to 2.6.4. The variable *Year* is a dummy equal to one for the year $t = -2$ and zero for year $t = -3$. Our subsample in Panel A includes 1,456 takeover-rumored firms and their corresponding control firms. Our subsample in Panel B includes 1,224 takeover-rumored firms and their corresponding control firms, representing those without 13D filings within two months prior to a given rumor and without rumor rationales based on either of the dummy variables *InsiderCited* and *BlockPurchase*. Our subsample in Panel C includes 1,116 takeover-rumored firms and their corresponding control firms during the period 2002–2011, but not between July 2007 and September 2009 (the financial crisis period). Panels D and E provide coefficient estimates based on a new control sample constructed along six dimensions of takeover likelihood factors, as explained in Section 2.6.4. Our sample in Panel D (E) includes 1,525 takeover-rumored firms and their first (second) best-matched firms. The firm fixed effects employed in Panels A to E are the same as in Table 5. Variable definitions are provided in Table A1, Part (a) of the Appendix. All insider trading measures are winsorized at the 1% level. Heteroscedasticity-robust standard errors are clustered at the firm level and associated *p*-values are reported in parentheses. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

| **Dependent variable:** | **Net number of shares bought ('000s)** | **Net dollar value of shares bought ($ mill.)** | **Net percentage of equity bought** |
|---|---|---|---|
| **Panel A: Falsification** | | | |
| *Year*Rumored* | 11.584 | 0.193 | 0.144 |
| | (0.358) | (0.251) | (0.563) |
| *Year* | –5.918 | –0.083 | –0.040 |
| | (0.476) | (0.699) | (0.748) |
| *Rumored* | 3.001 | 0.172 | –0.077 |
| | (0.719) | (0.425) | (0.536) |
| **Panel B: Endogeneity** | | | |
| *Pre-rumor*Rumored* | 18.388** | 0.789** | 0.329** |
| | (0.037) | (0.031) | (0.041) |
| *Pre-rumor* | –2.029 | –0.008 | 0.002 |
| | (0.813) | (0.972) | (0.986) |
| *Rumored* | 2.356 | 0.119 | 0.033 |
| | (0.797) | (0.611) | (0.808) |
| **Panel C: Financial crisis** | | | |
| *Pre-rumor*Rumored* | 18.450** | 0.715** | 0.297** |
| | (0.032) | (0.035) | (0.045) |
| *Pre-rumor* | –3.849 | –0.039 | –0.082 |
| | (0.670) | (0.863) | (0.548) |
| *Rumored* | 5.790 | 0.209 | 0.025 |
| | (0.547) | (0.382) | (0.975) |
| **Panel D: Market anticipation - First best match** | | | |
| *Pre-rumor*Rumored* | 18.509** | 0.729** | 0.327** |
| | (0.028) | (0.039) | (0.024) |
| *Pre-rumor* | –5.301 | –0.087 | –0.008 |
| | (0.537) | (0.693) | (0.951) |
| *Rumored* | 1.284 | 0.161 | 0.024 |
| | (0.882) | (0.466) | (0.856) |
| **Panel E: Market anticipation - Second best match** | | | |
| *Pre-rumor*Rumored* | 18.792** | 0.735** | 0.348** |
| | (0.018) | (0.035) | (0.021) |
| *Pre-rumor* | –4.190 | –0.034 | –0.027 |
| | (0.617) | (0.870) | (0.835) |
| *Rumored* | 6.073 | 0.257 | 0.014 |
| | (0.473) | (0.226) | (0.913) |

**Table 8: Abnormal insider trading based on the market-model approach - Full-sample robustness tests**

This table presents the cumulative abnormal insider trading (*CAAIT*) of rumored firms and their corresponding matched peers during months $t = -6$ to $t = +6$, where month 0 is the month of rumor publication. The control sample is constructed based on propensity score matching along five dimensions, as discussed in Section 2.4.4. Detailed discussion of the methodology utilized to compute abnormal insider trading is presented in Section 2.6.5. Panel A provides the results for the whole sample, while Panel B (C) presents the results for accurate (inaccurate) rumors. The results of the difference of means t-tests (based on the abnormal trading of rumored firms vs. the abnormal trading of control firms) are presented in Columns (5) and (6). Heteroskedasticity-robust standard errors are clustered at the firm level and associated *p*-values are reported in parentheses. Section 2.4.3 provides variable definitions. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | CAAIT(–6, 0) | | CAAIT(0, +6) | | Difference | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| **Panel A: All rumors (N = 1,642)** | **Rumored firms** | **Control firms** | **Rumored firms** | **Control firms** | **(1) – (2)** | **(3) – (4)** |
| *Net number of shares bought* ('000s) | 9.743** | 0.899 | –7.205** | 1.043 | 8.844** | –8.248** |
| | (0.035) | (0.734) | (0.026) | (0.685) | (0.038) | (0.022) |
| *Net dollar value of shares bought* ($ mill.) | 0.271** | 0.025 | –0.226** | 0.029 | 0.246** | –0.255** |
| | (0.043) | (0.591) | (0.030) | (0.548) | (0.047) | (0.026) |
| *Net percentage of equity bought* | 0.109** | 0.008 | –0.089** | 0.010 | 0.102** | –0.099** |
| | (0.037) | (0.864) | (0.015) | (0.747) | (0.041) | (0.012) |
| **Panel B: Accurate rumors (N = 356)** | | | | | | |
| *Net number of shares bought* ('000s) | 12.079*** | 1.069 | 2.738* | 1.432 | 11.010*** | 1.306 |
| | (0.006) | (0.483) | (0.065) | (0.451) | (0.009) | (0.135) |
| *Net dollar value of shares bought* ($ mill.) | 0.348** | 0.029 | 0.096 | 0.040 | 0.319** | 0.056 |
| | (0.014) | (0.586) | (0.117) | (0.549) | (0.017) | (0.163) |
| *Net percentage of equity bought* | 0.137*** | 0.012 | 0.029* | 0.016 | 0.125*** | 0.013 |
| | (0.004) | (0.539) | (0.084) | (0.511) | (0.007) | (0.170) |
| **Panel C: Inaccurate rumors (N = 1,286)** | | | | | | |
| *Net number of shares bought* ('000s) | 9.328** | 0.852 | –9.913** | 0.935 | 8.476** | –10.848** |
| | (0.039) | (0.748) | (0.019) | (0.699) | (0.043) | (0.013) |
| *Net dollar value of shares bought* ($ mill.) | 0.253** | 0.024 | –0.308** | 0.027 | 0.229* | –0.335** |
| | (0.046) | (0.606) | (0.024) | (0.546) | (0.050) | (0.015) |
| *Net percentage of equity bought* | 0.092** | 0.007 | –0.115*** | 0.008 | 0.085** | –0.124*** |
| | (0.040) | (0.824) | (0.007) | (0.774) | (0.045) | (0.006) |

**Table 9: Abnormal insider trading based on the market-model approach - Insider-type robustness tests**

This table presents the cumulative abnormal insider trading (*CAAIT*) of rumored firms during months $t = -6$ to $t = +6$, where month 0 is the month of rumor publication. Detailed discussion of the methodology utilized to compute abnormal insider trading is presented in Section 2.6.5. Panel A provides the results for the whole sample, while Panel B (C) presents the results for accurate (inaccurate) rumors. The results of the difference of means t-tests (based on the abnormal trading of managing insiders vs. the abnormal trading of non-managing insiders) are presented in Columns (5) and (6). Heteroskedasticity-robust standard errors are clustered at the firm level and associated *p*-values are reported in parentheses. Section 2.4.3 provides variable definitions. Significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively.

| | **CAAIT(–6, 0)** | | **CAAIT(0, +6)** | | **Difference** | |
|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** |
| **Panel A: All rumors (N = 1,642)** | ***Managing*** | ***Non-managing*** | ***Managing*** | ***Non-managing*** | **(1) – (2)** | **(3) – (4)** |
| *Net number of shares bought* (‘000s) | 7.415*** | 0.723 | –3.482** | –1.038* | 6.692** | –2.445* |
| | (0.009) | (0.648) | (0.014) | (0.095) | (0.025) | (0.067) |
| *Net dollar value of shares bought* ($ mill.) | 0.205** | 0.022 | –0.116** | –0.031 | 0.184* | –0.085* |
| | (0.039) | (0.493) | (0.041) | (0.247) | (0.055) | (0.059) |
| *Net percentage of equity bought* | 0.081** | 0.008 | –0.040** | –0.014 | 0.073** | –0.026* |
| | (0.024) | (0.572) | (0.026) | (0.136) | (0.031) | (0.065) |
| **Panel B: Accurate rumors (N = 356)** | | | | | | |
| *Net number of shares bought* (‘000s) | 9.173*** | 1.806* | 0.875 | 2.609*** | 7.367*** | –1.734** |
| | (0.001) | (0.092) | (0.362) | (0.005) | (0.006) | (0.028) |
| *Net dollar value of shares bought* ($ mill.) | 0.296*** | 0.037 | 0.029 | 0.102** | 0.258** | –0.073** |
| | (0.006) | (0.209) | (0.414) | (0.010) | (0.013) | (0.041) |
| *Net percentage of equity bought* | 0.115*** | 0.016 | 0.012 | 0.031*** | 0.099*** | –0.019** |
| | (0.002) | (0.158) | (0.395) | (0.008) | (0.007) | (0.033) |
| **Panel C: Inaccurate rumors (N = 1,286)** | | | | | | |
| *Net number of shares bought* (‘000s) | 5.847** | 0.424 | –4.621*** | –2.049* | 5.423** | –2.572* |
| | (0.018) | (0.758) | (0.002) | (0.085) | (0.030) | (0.063) |
| *Net dollar value of shares bought* ($ mill.) | 0.168* | 0.012 | –0.142** | –0.073 | 0.156* | –0.069 |
| | (0.052) | (0.655) | (0.019) | (0.124) | (0.069) | (0.075) |
| *Net percentage of equity bought* | 0.062** | 0.008 | –0.055** | –0.026* | 0.054* | –0.029* |
| | (0.031) | (0.832) | (0.014) | (0.077) | (0.052) | (0.057) |

**Figure 1: Stock returns relative to the initial takeover rumor date**
This figure plots the market price reaction around the rumor day based on bid occurrence (*Accurate* and *Inaccurate*) and two mutually exclusive rumor categories (*Speculative* and *Informative*) for all 1,642 takeover-rumored firms from December 2002 through September 2011. Rumors are labeled as accurate (*Accurate*) if the rumored firm in question is the target of a formal takeover bid within 365 calendar days after the initial scoop article, and inaccurate (*Inaccurate*) otherwise. Rumors labeled as speculative (*Speculative*) are based on either takeover chatter or an increase in option activity in the target firm, without any further justification of the rumor. Informative (*Informative*) rumors are based on at least three rumor justifications, excluding those labeled as speculative. We use the four-factor model (Carhart, 1997) to calculate abnormal returns as discussed in Section 2.4.2.

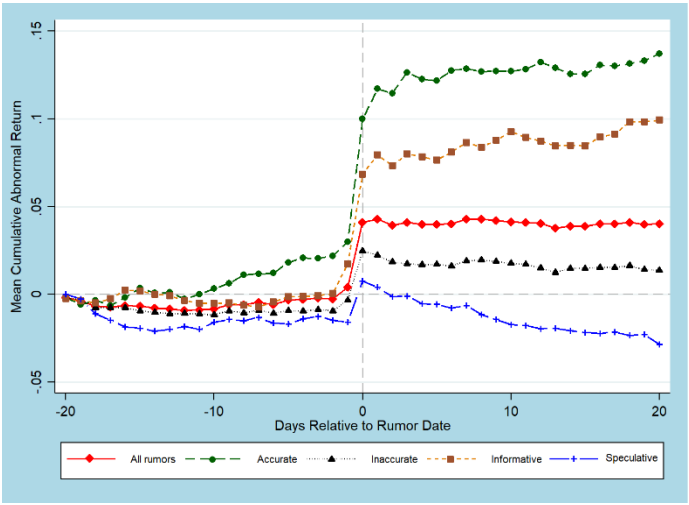


**Figure 2: Parallel trends in insider trading prior to takeover rumors**
This figure plots insider abnormal net purchases in terms of net shares bought during months $t = -36$ to $t = -1$, where month 0 is the month of rumor publication. The sample contains 1,547 takeover-rumored firms and their corresponding control firms with non-missing data during years $t = -3$ to $t = -1$.

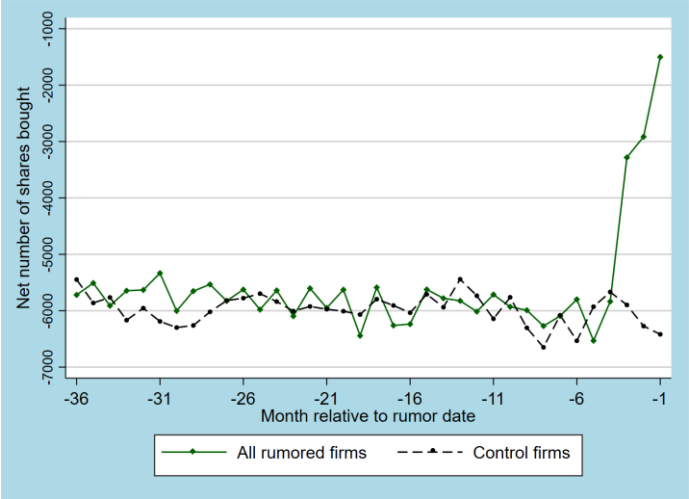
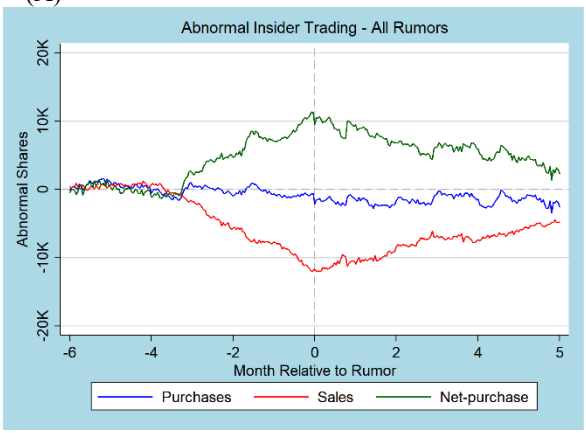
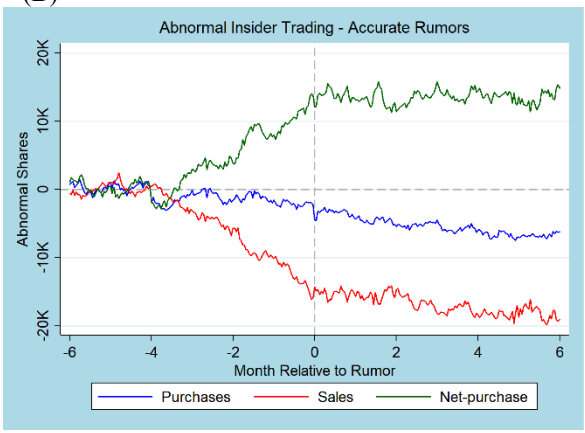


**Figure 3: Cumulative average abnormal insider trading around takeover rumors**
This figure plots cumulative average abnormal insider trading during months $t = -6$ to $t = +6$, where month 0 is the month of rumor publication. Section 2.6.5 contains a detailed discussion of the methodology used. Panels A to C present the results for abnormal insider purchases, sales, and net-purchases, respectively. Panel D shows the abnormal insider net purchases of managing and non-managing insiders for both accurate and inaccurate rumors.

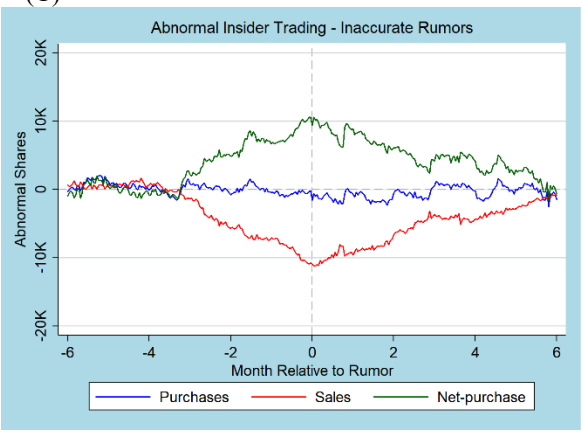
(A)



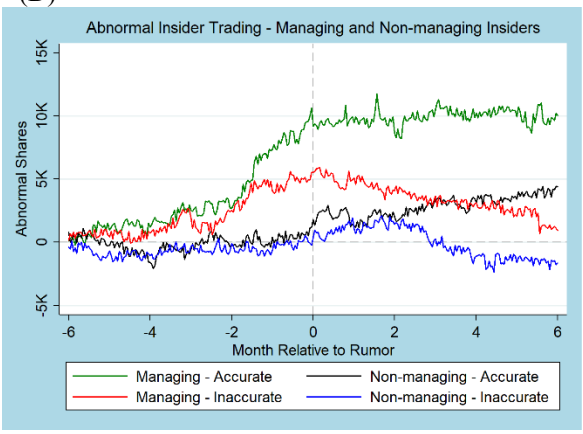

(B)




(C)




(D)



## Appendix

## Table A1: Variable definitions

| (a) Potential determinants of insider trading | |
|---|---|
| $\sigma$ | Standard deviation of daily stock returns over trading days (–250, –126) relative to the beginning of the control or pre-rumor period (Agrawal and Nasser, 2012). |
| $\Delta\sigma$ | Difference between σ (risk, defined above) and the standard deviation of the daily stock returns over trading days (–125, –1) relative to the beginning of the control or pre-rumor period (Agrawal and Nasser, 2012). |
| *Abnormal_Shares* ('0000s) | Abnormal number of shares bought by insiders of rumored targets during the year prior to the rumor. This variable is computed using Equation (3) and is expressed in tens of thousands of shares. |
| *Abnormal_Dollar* ($ mill.) | Abnormal dollar value of shares bought by insiders of rumored targets during the year prior to the rumor. This variable is computed using Equation (3) and is expressed in millions of dollars. |
| *Abnormal_Percent* (%) | Abnormal percentage of equity bought by insiders of rumored targets during the year prior to the rumor. This variable is computed using Equation (3) and is expressed as a percentage. |
| *Accurate* | Dummy variable that equals one if the rumored target firm became subject to a formal takeover announcement within one calendar year after the initial rumor date; otherwise the variable equals zero (Ahern and Sosyura, 2015; Betton et al., 2018). |
| *Book/Market* | The ratio of a firm's book value to its market value at the end of the fiscal year prior to the control or pre-rumor period (Agrawal and Nasser, 2012). |
| *CAR* | Cumulative abnormal return on the rumor date, with expected returns based on Carhart's (1997) four-factor model. |
| *CashRatio* | The ratio of cash and marketable securities to marketable assets (Cornett et al., 2011). |
| *ChangeSize2Yrs* | The percentage change in the firm's total assets over the previous two years (Cornett et al., 2011). |
| *Concentration* | The ratio of the sales of the largest four firms to the total three-digit SIC industry sales of the target firm (Cornett et al., 2011). |
| *Dormancy* | The number of months since the last merger in the same three-digit SIC industry as the target firm (Cornett et al., 2011). |
| *Liquidity* | Daily average of the ratio of share trading volume to the number of shares outstanding, computed over the year prior to the control or pre-rumor period (Agrawal and Nasser, 2012). |
| *ln(Market Cap)* | Natural logarithm of the firm's market capitalization, defined as the number of common shares outstanding multiplied by the closing price on the last trading day during the fiscal year ending before the control or pre-rumor period (Agrawal and Nasser, 2012). |
| *Pre-rumor* | Dummy variable that equals one for the study period, and zero for the control period (Agrawal and Nasser, 2012). |
| $PRET_t$ | Average daily market-adjusted returns for quarter *t* before the beginning of the control or pre-rumor period. We adjust for market returns using the CRSP equally weighted market index, which includes the New York Stock Exchange, the American Stock Exchange, and NASDAQ (Agrawal and Nasser, 2012). |
| *PrevMergers* | Count variable of the number of times a firm proposes or receives a merger bid in the prior two years (Cornett et al., 2011). |
| *PriorReturn2Yrs* | The change in a firm's stock price in the two years prior to a given quarter (Cornett et al., 2011). |
| *R&D/Sales* | The ratio of R&D expenses to sales revenue, calculated for the fiscal year prior to the control or pre-rumor period (Agrawal and Nasser, 2012). |
| *ResMismatch* | Dummy variable that equals one if either i) a firm's sales growth in the last two years is less than the industry median and the long-term debt ratio is greater than the industry median, or ii) the firm's sales growth in the last two years is greater than the industry median and the long-term debt ratio is less than the industry median; otherwise the variable equals zero (Cornett et al., 2011). |
| *ROA* | Ratio of net income before extraordinary (or nonrecurring) items to total assets at the end of the fiscal year prior to the control or pre-rumor period (Cornett et al., 2011). |

| | |
|---|---|
| *Insider Holdings* | The logarithm of 1 plus the number of total shares held (when the dependent variable is the net number of shares bought), logarithm of 1 plus the dollar value of shares held (when the dependent variable is the net dollar value of shares bought), and the total number of shares held normalized by shares outstanding (when the dependent variable is the net percentage of equity bought) (Agrawal and Nasser, 2012). |
| *Rumored* | Dummy variable that equals one for rumored firms and zero for control firms (Agrawal and Nasser, 2012). |
| *SalesGrowth2Yrs* | The percentage change in the firm's sales over the previous two years (Cornett et al., 2011). |
| *SalesShock* | The absolute value of the difference between the two-year median industry sales growth rate and the two-year median sales growth rate of all sample target firms (Cornett et al., 2011). |
| *SalesShockSquared* | The square of sales shock (Cornett et al., 2011). |
| *ShareTurnover* | The ratio of the number of the firm's shares of stock traded to total shares outstanding (Cornett et al., 2011). |
| *ValuableBrand* | An indicator variable representing target firm inclusion in a list of the top 100 brands from the marketing consultancy firms Interbrand and BrandZ at any time between 2002 and 2011 (Ahern and Sosyura, 2015). |
| *Year* | Dummy variable that equals one for year t = –2 and zero for year t = –3. |

**(b) Rumor content characteristics (rationales)**

| | |
|---|---|
| *AdvisorHired* | Rumor indicates that the target firm has retained the services of an investment bank or financial advisor. |
| *AnalystReport* | Rumor is the result of one or more analysts reasoning that a takeover seems logical. |
| *BidderDenied* | Rumor indicates that a potential bidding firm denies that parties are in negotiations. |
| *BidderMentioned* | Rumor indicates the name of one or more potential bidders. |
| *BlockPurchase* | Rumor indicates that 5% or more of shares outstanding have recently been purchased by a single entity. |
| *FinancingSource* | Rumor provides substantial details as to how financing for the deal would occur. |
| *IndustryActivity* | Rumor indicates that either a competitor is being taken over or that the target industry appears ripe for takeovers. |
| *Informative* | Rumor based on at least three rumor justifications, excluding those labeled as speculative. |
| *InsiderCited* | Rumor predicated on an anonymous source. |
| *MgmtConcerns* | Rumor indicates concerns with the current management. |
| *OptionsIncreased* | Rumor specifically mentions that an increase in call options is indicative of an impending takeover. |
| *PEFundInvolved* | Rumor indicates that a private equity or hedge fund has expressed interest in a potential takeover deal. |
| *Speculative* | Rumor based solely on either takeover chatter or an increase in option activity in the target firm, with no further justification provided. |
| *SynergyCited* | Rumor indicates that the target firm has specific attributes that would provide unique synergies to an acquirer. |
| *TakeoverChatter* | Rumor provides very few details yet mentions that the target firm is subject to ongoing takeover chatter. |
| *TargetDenied* | Rumor indicates that the target firm denies that parties are in negotiations. |
| *TargetDistress* | Rumor indicates that the target firm has been experiencing substantial financial and/or operating distress. |
| *TargetInitiated* | Rumor is initiated by the target firm itself. |
| *Undervalued* | Rumor indicates that the target firm can be seen as undervalued, prompting takeover interest. |
| *UnusualActivity* | Rumor indicates that something unusual has occurred that has led to takeover speculation (e.g., two chief executive officers simultaneously absent from a conference or other changes in executive team schedules or habits). |

**Table A2: Univariate tests of insider net purchases - Parallel trend assumption**

This table provides the means of three measures of insider net purchases for 1,547 firms that are rumored to be takeover targets, as well as for a corresponding sample of 1,547 matched firms, during the years $t = -2$ and $t = -3$, where $t = 0$ is the year the rumor is published. Columns (5) to (8) show the *p*-values for a series of univariate t-tests of the difference between the means, with the signs of the test statistics in parentheses. The reduced sample size in this table is due to missing data in year $t = -3$.

| | **Rumored target firms** | | **Control firms** | | ***p*-values** | | | |
|---|---|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)** |
| **Panel A: All rumors (N = 1,547)** | **Three years prior** | **Two years prior** | **Three years prior** | **Two years prior** | **2 – 1** | **1 – 3** | **4 – 3** | **(2 – 1) – (4 – 3)** |
| *Net number of shares bought* ('000s) | –68.367 | –70.091 | –71.956 | –70.187 | 0.764 (–) | 0.372 (+) | 0.934 (+) | 0.455 (–) |
| *Net dollar value of shares bought* ($ mill.) | –1.863 | –1.889 | –2.151 | –2.098 | 0.812 (–) | 0.696 (+) | 0.831 (+) | 0.362 (–) |
| *Net percentage of equity bought* | –0.751 | –0.770 | –0.778 | –0.747 | 0.905 (–) | 0.809 (+) | 0.395 (+) | 0.479 (–) |
| **Panel B: Accurate rumors (N = 329)** | | | | | | | | |
| *Net number of shares bought* ('000s) | –69.561 | –71.155 | –71.058 | –72.603 | 0.884 (–) | 0.651 (+) | 0.217 (–) | 0.209 (–) |
| *Net dollar value of shares bought* ($ mill.) | –2.164 | –1.901 | –1.839 | –2.028 | 0.904 (+) | 0.257 (–) | 0.445 (–) | 0.351 (+) |
| *Net percentage of equity bought* | –0.713 | –0.687 | –0.792 | –0.764 | 0.433 (+) | 0.468 (+) | 0.215 (+) | 0.442 (–) |
| **Panel C: Inaccurate rumors (N = 1,218)** | | | | | | | | |
| *Net number of shares bought* ('000s) | –68.045 | –69.803 | –72.199 | –69.534 | 0.435 (–) | 0.250 (+) | 0.337 (+) | 0.768 (–) |
| *Net dollar value of shares bought* ($ mill.) | –1.782 | –1.886 | –2.235 | –2.117 | 0.810 (–) | 0.539 (+) | 0.723 (+) | 0.761 (–) |
| *Net percentage of equity bought* | –0.761 | –0.793 | –0.774 | –0.743 | 0.243 (–) | 0.429 (+) | 0.574 (+) | 0.783 (–) |
| **Panel D: Informative rumors (N = 406)** | | | | | | | | |
| *Net number of shares bought* ('000s) | –66.171 | –70.228 | –70.130 | –71.649 | 0.489 (–) | 0.710 (+) | 0.587 (–) | 0.890 (–) |
| *Net dollar value of shares bought* ($ mill.) | –2.169 | –2.031 | –2.082 | –2.065 | 0.609 (+) | 0.215 (–) | 0.621 (+) | 0.424 (+) |
| *Net percentage of equity bought* | –0.705 | –0.685 | –0.729 | –0.690 | 0.281 (+) | 0.579 (+) | 0.343 (+) | 0.458 (–) |
| **Panel E: Speculative rumors (N = 225)** | | | | | | | | |
| *Net number of shares bought* ('000s) | –81.402 | –76.940 | –73.815 | –75.225 | 0.905 (+) | 0.638 (–) | 0.464 (–) | 0.365 (+) |
| *Net dollar value of shares bought* ($ mill.) | –2.597 | –2.363 | –2.166 | –2.124 | 0.705 (+) | 0.325 (–) | 0.509 (+) | 0.558 (+) |
| *Net percentage of equity bought* | –0.680 | –0.651 | –0.703 | –0.714 | 0.212 (+) | 0.391 (+) | 0.792 (–) | 0.416 (+) |

# Chapter 3: Institutional Trading in Firms Rumored to be Takeover Targets

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## Abstract

In this paper we examine institutional trading in proximity to takeover rumors by combining the ANcerno dataset of transaction-level institutional trades with a unique sample of takeover rumor 'scoops'. We find that institutions are net buyers in firms which subsequently become subject to takeover speculation and that institutional trading predicts which rumored firms will eventually receive takeover bids. Segregating funds according to their propensity to trade, we show that those less likely to purchase rumored targets by chance over the pre-rumor period are more likely to identify firms which will receive bid proposals and that they trade more profitably over both the pre- and post-rumor periods. We test for the presence of informed trading in a variety of ways and conclude that institutional investors appear to trade on material private information which identifies the firms soon to be the target of takeover speculation.

## 3.1. Introduction

The literature is divided regarding the ability of institutional investors to earn abnormal returns. While many authors[21] report evidence of such competence, some contend otherwise (e.g., Jensen, 1968; Carhart, 1997; Fama and French, 2010) or note that such profitability is short lived (Edelen et al., 2016). Furthermore, it remains unclear whether any observed capabilities result from superior analysis of public information, as claimed by Dechow et al. (2001), Engelberg et al. (2012), and Akbas et al. (2015), or from the ability to gather and interpret private information as argued by Christophe et al. (2004, 2010) and Irvine et al. (2007). Given this debate and the growing interest in the roles of institutions surrounding corporate events (Chemmanur et al., 2018), we seek to determine whether and how institutional investors take advantage of the well-documented abnormal returns around the takeover rumor date of potential target firms (Ahern and Sosyura, 2015; Betton et al., 2018).

Using a proprietary database of transaction-level institutional trading activity from ANcerno together with a hand-collected dataset of initial takeover rumors provided by Betton et al. (2018), we address the following specific research questions. First, do institutional investors profit by trading in firms before and/or after the initial publication of a takeover rumor? Second, do institutional investors behave as if they possess private information about those firms which will soon be rumored targets? Third, are results representative of all institutions or instead driven by a select group of funds? Finally, does the informational content of the rumor relate to the institutional ability to discover or discern its impact?

To answer these questions, we analyze daily institutional trading patterns over the (-30, +30) rumor date period, considering both the type of institutional investor as well as the content of the rumor article. We also examine the predictive power of institutional trading as well as the profitability of round-trip trades (a purchase followed by a sale, or vice-versa). Furthermore, we distinguish between "*smart*" funds and "*lucky*" funds according to their propensity to trade (as derived from a bootstrap procedure conditioned on the number of trades executed within the year). For robustness, we construct momentum quintiles to show that our main results are not driven by momentum trading

[21] See, for example, Coval and Moskowitz (2001), Irvine et al. (2007), Boehmer et al. (2008), Kacperczyk et al. (2005, 2006), Diether et al. (2009), and Puckett and Yan (2011).

as documented in Griffin et al. (2003). Finally, we perform a number of tests to provide evidence as to whether institutions are acting on public or private information.

Previewing our results, we find the following. First, institutional investors in aggregate trade in a profitable manner in the pre-rumor period, yet not in the post-rumor period. Second, publicly available information related to takeover propensity does not enable institutions to replicate this performance. Moreover, an analysis of intraday trading patterns, bid-ask spreads, and short utilization ratios confirms the presence of informed trading, and we thus infer that institutions trade on private information. Third, we find that smart funds are responsible for 71% of the abnormal net-buying observed over the (-10, -1) period, and 83.8% of post-commission profits over the (-30, +30) period, as compared to lucky funds. Finally, institutional trading over the pre-rumor period is related to information subsequently provided within the published rumor article; specifically, abnormal net-buying is higher when rumors present specific and multiple avenues by which private information may have been leaked.

Our study contributes to the literature on institutional trading around corporate events. Institutions have been shown to utilize private information to their advantage prior to seasoned equity offerings (Chemmanur et al., 2009), initial public offerings (Chemmanur et al., 2010), takeover announcements (Jegadeesh and Tang, 2010; Fich et al., 2020), earnings announcements (Berkman and McKenzie, 2012), stock split announcements (Chemmanur et al., 2015), open market share repurchases (Chemmanur et al., 2016), CEO turnovers (Chemmanur et al., 2018), and dividend reduction announcements (Henry et al., 2017). However, the literature is silent on institutional trading prior to takeover rumors, despite enticing returns: two-day rumor date CAARs have been shown to average 3.81%, with select categories of rumors demonstrating CAARs averaging up to 10% (Betton et al., 2018).

Our paper also contributes to the current debate on whether and how institutional investors profit prior to takeover announcements. Griffin et al. (2012), Jedadeesh and Tang (2010), and Fich et al. (2020) are among those contending that, at best, only subsets of institutions outperform prior to merger announcements. However, these papers do not examine the performance stemming from news announcements over the pre-bid period. We demonstrate that institutions benefit from impending takeover rumors, and we provide evidence supporting the presence of informed trading. Furthermore, we link our results to specific rumor article content to provide insight into the source of pre-rumor

information that funds seem to obtain. Taken together, this information attests to the sophisticated nature of institutional trading within the context of mergers and acquisitions, most particularly for smart funds.

The remainder of this paper is organized as follows. Section 3.2 briefly summarizes the existing empirical evidence on institutional trading. Section 3.3 describes our data, while Section 3.4 presents our results Finally, Section 3.5 provides a summary and conclusion of our work.

## 3.2. Literature Review

A number of studies investigate the pre- and post-event trading patterns of institutional investors to infer whether they are in possession of material private information. Ali et al. (2004) and Battalio and Mendenhall (2005) determine that institutions trade based on private information about future earnings announcements. Irvine et al. (2007) find that some institutions significantly increase their purchases in firms soon to receive an analyst's initial buy recommendation. Campbell et al. (2009) find that institutional trading significantly predicts firms' earnings surprises. Hendershott et al. (2015) show that lagged institutional order flow computed prior to Reuters' news announcements predicts the sentiment of the news, the stock market reaction on the news announcement day, the stock market reaction on crisis news days, and earning announcement surprises.

Using ANcerno data on institutional trade transactions from 1999 to 2005, Chemmanur et al. (2009) report that institutions possess private information about seasoned equity offerings (SEOs). Other studies offering evidence that institutions trade based on their private information include investigations of corporate spin-offs (Chemmanur and Hu, 2016), credit rating changes (Jain and Wang, 2013), dividend cuts (Henry et al., 2017), ex-dividend returns (Henry and Koski, 2017), IPOs (Chemmanur et al., 2010), and option backdating scandals (Bernile et al., 2015).

Within the context of mergers and acquisitions, Ashraf and Jayaraman (2014) examine changes in quarterly institutional ownership in response to takeover announcements. They find that 'active' institutions (investment companies and independent investment advisors) have superior skill in identifying mergers with higher wealth implications. They conclude that such institutions are better informed as to the likelihood of merger success. Using quarterly 13F filings, Bodnaruk et al. (2009) argue that funds affiliated with the advisors of bidders take positions in target firms before a takeover announcement.

Griffin et al. (2012) conclude that institutional investors do not possess private information related to takeover and earning announcements, as pre-announcement trades are not profitable and are not predictive of takeover outcomes. Jegadeesh and Tang (2010) use monthly data to study the pattern and profitability of institutional trades around takeover announcements between 1998 and 2005. Concurring with Griffin et al. (2012), they report that institutions, as a group, do not buy target stocks prior to bid announcements, and their pre-bid trades do not generate abnormal returns.

However, they identify two subsets of funds that demonstrate superior pre-trading skills: funds whose main broker is also the main broker for the investment bank advising the target firm, and funds previously displaying a greater than average chance of buying target stocks prior to announcements ("smart" funds).

Fich et al. (2020) study the trading strategies of hedge funds and mutual funds in a sample of 7,184 M&A announcements between 1990 and 2015. They find that hedge funds (mutual funds) increase (reduce) their holdings in takeover candidates starting in the most recent quarter prior to the bid announcement. These changes in ownership are both statistically significant and economically important and can predict future bid announcements. Moreover, these trading patterns accelerate during the announcement quarter, consistent with hedge funds executing merger arbitrage strategies and subsequently prompting an equilibrium response from mutual funds. This evidence leads the authors to conclude that hedge funds enjoy superior access to private information or have superior skill in processing public information.

In this research paper we also find that certain funds outperform others; however, in contrast to many of the above authors, we find evidence that institutions, as a group, are net buyers of target firms in the pre-event period, and that this aggregate activity is profitable and predictive of forthcoming bids. One likely explanation for this discrepancy is that our event of interest is the rumor date rather than the bid announcement used in prior studies. Only 21% of our sample rumors lead to a bid announcement, and these occur on average 116 days prior to the public bid announcement. In addition, we analyze trading on a daily basis as opposed to using monthly or quarterly data.

Employing data from ANcerno and using a sample of 501 takeover rumors from 2000 to 2011, Ahern and Sosyura (2015) present evidence of institutional trading in proximity to the rumor date. As institutional trading is not the primary focus of their paper, they refrain from analyzing the statistical significance of their results. However, they show that the institutional buy-sell imbalance is somewhat positive over the (-20, +1) rumor date period (Figure 4, p. 2083). They also note that institutional investors are net sellers of rumored targets in the 30 days following the rumor's publication, regardless of whether the rumor eventuates. Moreover, they demonstrate that as a fraction of total CRSP volume, institutional investors buy substantially fewer shares in rumored firms during the post-rumor period. They thus contend that stock returns of rumored target firms are driven by the overreaction of unsophisticated retail traders.

Our paper corroborates many of their findings while adding rigor by providing the associated statistical tests for significance. In addition, we expand on their analysis by providing daily institutional trading measures (broken down by rumor type and fund type), controlling for institutional momentum buying, examining the predictive power of institutional trades, calculating the profitability of such trades, and determining whether the trades are likely to occur by chance. While we concur that retail investors may be responsible for driving post-rumor target stock returns, we find evidence that short-sellers and market makers also play a role. Additionally, we show that target returns are driven by a subset of funds investing as if they possess private information.

## 3.3. Data

We employ the dataset first used by Betton et al. (2018) as our base sample of target firm takeover rumors, consisting of 2,074 observations between January 2002 and December 2011. These rumors are based on articles retrieved from Capital IQ, Factiva, ProQuest, Standard & Poor's Takeover Talk, and Zephyr, retaining only those for which there was no preceding instance of the same rumor for a period of at least 180 days. The content of each rumor article has been coded according to the justification provided for the speculated takeover bid. In order to preserve a clear distinction between rumors and takeover announcements, the authors exclude rumors in which either the rumored bidder or the target confirms that negotiations are underway. In addition, official announcement dates are verified using Factiva and Google to correct for Securities Data Corporation (SDC) announcement date errors and omissions, as SDC accuracy has been criticized in several studies (Bharadwaj and Shivdasani, 2003; Faccio and Masulis, 2005; Barnes et al., 2014; Mulherin and Simsir, 2015).

Institutional trading data are obtained from ANcerno (also known as the Abel/Noser Corporation), a New York based brokerage firm. ANcerno collects trade information directly from institutional clients, providing exclusive analysis regarding execution costs. Puckett and Yan (2011) investigate this dataset for survivorship and selection biases. They conclude that the former is not a concern and that the latter is likely minor. Specifically, they note that clients are required to submit all of their trades to ANcerno to receive an optimal consultation on execution costs, and as full confidentiality is provided, it is unclear why they would instead submit a non-random portion thereof. Moreover, Hu et al. (2018) note that any sample selection biases within ANcerno are not obvious, while Puckett and Yan (2011), Anand et al. (2012), and Jame (2018) show that ANcerno institutions

on average do not differ from 13F institutions in return characteristics, stock holdings, or stock trades.[22] While these authors do find that ANcerno institutions are larger than the typical 13F institution, they note that many studies find evidence of a negative relation between fund size and performance (e.g., Yan, 2008; Lewellen, 2011), with ANcerno institutions therefore *less* likely to yield evidence of positive returns.

Institutional coverage within the ANcerno database is quite broad, and utilizing this dataset allows us to observe daily trades made by investment managers and plan sponsors. According to Hu et al. (2018), the data account for $37 trillion worth of trades and cover about 15% (12%) of the Center for Research in Security Prices (CRSP) volume over the period 1999 – 2005 (1999 – 2011). Previous academic studies that use ANcerno data include Bethel et al. (2009), Chemmanur et al. (2009), Goldstein et al. (2009), Henry and Koski (2017), and Hu et al. (2014, 2018), among more than 50 others.[23]

The ANcerno data contains different variables for identifying the client, manager, broker, and stock related to each transaction. The *clientcode* is a unique identifier for each of ANcerno's institutional clients while *clienttypecode* classifies the type of institution: plan sponsors (*clienttypecode*=1), investment managers (*clienttypecode*=2), and brokers (*clienttypecode*=3). In our study, we only include transactions of plan sponsors and money managers (consistent with Pucket and Yan, 2011, and Chemmanur et al., 2018) as ANcerno data do not contain many broker clients. The *clientmgrcode* refers to the fund within each institution that is responsible for the trade. Further, the data identify whether the recorded transaction was initiated as a purchase or sale and also include the *Ticker* and *CUSIP* of the traded stock, the number of shares traded (*volume*), the execution price (*price*), and the commission paid for the transaction (*commission*).

ANcerno removed *clientcodes* in the data after September 2011 which was a key variable that separately identified trades from different institutions. This makes us unable to include 107 firms with takeover rumors after September 2011 as we examine daily institutional trading over the (-30, +30) day period relative to each rumor. We require daily CRSP files to get information on share prices, the number of shares outstanding, share volume, and returns; therefore, we delete firms with incomplete CRSP coverage (96 firms). We merge institutional trading data from ANcerno with the

[22] However, it remains unknown whether selection biases exist related to geographic location or investor aptitude.
[23] Hu et al. (2018) provides further commentary as well as an extensive list of publications which use ANcerno data.

rumor sample and exclude 182 firms without any trades during a period of (-90, -1) days relative to the rumor, with our final sample including 1,689 takeover-rumored firms.[24]

As shown in Panel A of Table 1, the number of rumors per year increases during the sample period and reaches a peak of 382 in 2011 despite excluding rumors after September 2011. Panel B reports the sample distribution according to the Fama-French 17 industry classification and shows that our sample includes firms from a wide range of industries. Panel C presents attributes of the rumor sample which have previously been used as determinants of takeover predictability, with definitions provided in Appendix A.

***Insert Table 1 about here***

Panel D reports summary statistics of institutional trading attributes within rumored targets. Results are given for executed transactions that occurred over the (-60, +20) day period relative to the rumor date. Overall, the number of transactions, the number of shares traded, and the dollar value of shares traded trend upward over time, as the final years of the study period have more rumors and greater ANcerno coverage of institutions.

Finally, Panel E presents the cumulative average abnormal returns (CAARs) of rumored firms around the rumor date. Rumors are labelled as "*accurate*" if the rumored firm in question is indeed the target of a formal takeover bid within 365 calendar days after the initial scoop article, and otherwise "*inaccurate*".[25] In addition, two mutually exclusive rumor categories are created based on the degree to which the rumor article content justifies a connection to future takeover prospects. "*Speculative*" rumors are based on either takeover chatter or an increase in option activity in the target firm, without any further explanation provided in the article. "*Informative*" rumors are based on at least three rumor justifications, excluding those comprising speculative rumors. Appendix A reports the individual rationales (e.g., M&A advisor hired, synergies cited, analyst reported) considered as justification for the rumor article's publication.

We find that takeover rumors yield significantly positive CAARs of 4.11% over the rumor date period, while accurate and inaccurate rumors result in significantly positive CAARs of 8.63% and 2.90%, respectively. Qualitatively similar results are also found over the longer (-20, +20) rumor

[24] Using *lognumber*, a unique code assigned to each batch of trading data sent to ANcerno by a client, we also remove data repetitions related to corrections as per Anad et al. (2011) and Hu et al. (2018).
[25] We explore alternative definitions of rumor accuracy, with results presented in the Internet Appendix (Section A.III).

date window. These findings are in line with prior research (e.g., Ahern & Sosyura, 2015; Betton et al., 2018) and demonstrate that net-buying shares in firms that will subsequently become the subject of a publicly announced takeover rumor can be reasonably presumed to be profitable. In addition, post-rumor we observe a strong market reversal for speculative rumors, with CAARs of -1.26% over the (+2, +20) period. Figure 1 plots these share price reactions around the rumor date.

***Insert Figure 1 about here***

## 3.4. Results

### 3.4.1. Institutional trading patterns before takeover rumors

We begin by examining the trading activity of ANcerno institutions in rumored targets.[26] For each day *t*, we separately aggregate the dollar value of all institutional buy and sell transactions for every rumored firm *i*. To prevent institutional trading in large firms from dominating our results, we normalize institutional trades by each firm's market capitalization (MC), lagged by one year:

$$IBuys_{i,t} = \frac{\sum_{n=1}^{Number\ of\ Buys_{i,t}} (Dollar\ value\ of\ buys_{i,t}^{n})}{MC_{i,t-250}} \quad (1)$$

$$ISales_{i,t} = \frac{\sum_{n=1}^{Number\ of\ Sales_{i,t}} (Dollar\ value\ of\ sales_{i,t}^{n})}{MC_{i,t-250}} \quad (2)$$

We define institutional order flow (IOF) and institutional order volume (IOV) as follows:

$$\text{IOF}_{i,t} = IBuys_{i,t} - ISales_{i,t} \quad (3)$$

$$\text{IOV}_{i,t} = IBuys_{i,t} + ISales_{i,t} \quad (4)$$

Our institutional trading measures are similar to those of Campbell et al. (2009) and Hendershott et al. (2015), and we winsorize trades at the top and bottom 1% to diminish the effect of outliers. As a basis for statistical tests, we use the (-90, -31) day window prior to the rumor announcement date (day 0) as our benchmark. Similar to Corwin et al. (2004) and Irvine et al. (2007), we employ a series of *t*-tests to evaluate the significance of any single day's average trading level as compared to benchmark levels.

[26] Hereafter, we use "institutions" to refer to ANcerno institutions unless indicated otherwise.

Table 2 provides tabulated means of these institutional trading variables over the (-20, +20) time period relative to the initial rumor publication date, while Figure 2 plots institutional trading activity for each type of institution. As we see from Panels B and C of the graph, although there are fewer investment managers than pension plan sponsors in ANcerno, they account for most of the institutional trading activity we uncover. This is consistent with the findings of Hu et al. (2018) who find that the quantity and the size of investment managers' trades tend to be larger than those of pension plan sponsors.

***Insert Table 2 about here***

***Insert Figure 2 about here***

Institutional trading activity prior to takeover rumors is quite different from that which occurs in the post-rumor period. As shown in Column 3, IOF is significantly positive in the week prior to the rumor's release (driven by increased purchases), but significantly negative on the rumor date and thereafter.

As indicated in Column 5, the number of institutions engaging in trades significantly increases over the days shortly before the rumor. The small magnitude of this increase suggests that aggregate trading activity is mainly a consequence of increased trading intensity rather than additional entrants.

In Column 6 (7), we report the ratio of the dollar trading volume of ANcerno buy (sell) transactions to the daily trading volume reported by CRSP for each day over the (-30, +30) rumor date period, where CRSP volume is calculated as the product of the CRSP daily closing price and the number of shares traded.[27] The ratio of ANcerno buy transactions to CRSP dollar volume significantly increases shortly prior to the rumor, albeit only at the 10% significance level on day (-1).[28] This implies that over the pre-rumor period, institutions purchase rumored firm shares more actively than does the broader cross-section of investors which includes retail investors. Given the significantly positive abnormal returns we find for rumored target firms on the rumor date (Table 1, Panel E), our

[27] In order to identify trades solely between ANcerno clients, we follow Hu et al. (2018) and round transaction prices to the penny, and then impose the condition that the rounded transaction price should be equal for the same stock on the same day between buy and sell trades. If these conditions apply, we recognize the trades as double-sided and only include the maximum of the buy and sell volumes in our calculations for Column 6. We estimate an ANcerno to CRSP dollar volume of 9.3% during the benchmark period, which is between the 8% reported in Puckett and Yan (2011) and the 12% found in Hu et al. (2018). We adjust NASDAQ volumes according to Gao and Ritter (2010).

[28] This may be an indication that private information is leaking to other traders at this time.

findings are thus consistent with institutions acting on their private information concerning forthcoming rumor announcements and takeover possibilities.

Switching our focus to the post-rumor period, we see that institutions are net sellers of rumored targets, with ISales (IOF) significantly positive (negative) almost every day over the (0, +14) period as shown in Column 2 (3) of Table 2. Furthermore, the ratio of ANcerno sales to CRSP dollar volume over this timeframe is significantly above the benchmark level, highlighting the increased selling activity of institutions relative to a broader composition of investors. Such institutional selling may be expected, even in the absence of private information, as it is well-known that most rumors do not lead to a bid and thus rumored firm share prices tend to decline over time.

The pre-rumor/post-rumor change in IOF we uncover is compatible with the theoretical frameworks of Hirshleifer et al. (1994) and Brunnermeier (2005), who argue that "early-informed" investors are expected to at least partially sell their related holdings once information leakage occurs and an informational advantage (i.e., that related to rumor prospects) is lost. However, it is not yet clear if institutional investors retain an informational advantage about future bid prospects once the rumor is published. In addition, it is unclear whether the content of the rumor article has any bearing on institutional trading activity.

We investigate these issues further, with Table 3 and Figure 3 presenting IOF and IOV trading measures according to the nature and accuracy of the rumor article.

***Insert Table 3 about here***

***Insert Figure 3 about here***

We find pre-rumor institutional order flow to be significant on multiple days for both accurate and inaccurate rumors, with the magnitude significantly larger for the former. On the rumor day, IOV peaks[29] while IOF drops significantly for rumored firms regardless of accuracy. IOF remains significantly negative for almost every day of the (+1, +20) rumor date period for accurately rumored firms. This is an interesting result, as these are the firms that will experience the well-documented share price increase on the impending takeover announcement date. This evidence supports the contention that institutions no longer possess private information regarding takeover prospects and

[29] It should be noted that some rumors in our sample are released after the market is closed. Consistent with this, we observe that a significant fraction of trades is recorded as occurring at the opening of trading on the day after the rumor.

lack the skill to utilize public knowledge to their advantage at this time. This evidence also supports the findings of Griffin et al. (2012) and Jegadeesh and Tang (2010) who contend that institutional investors do not trade as if they are informed prior to bid announcements.

Institutional trading activity also differs according to the nature of the rumor article's content (Table 3, Columns 5 – 8). Beginning on day (-7), we find IOF to be significantly higher for informative rumors than for speculative rumors in the pre-rumor period. This corroborates the notion that existing sources of reliable information not yet made public drive the trading activity of institutions during the pre-rumor period.[30] Post-rumor, we do not find much evidence of abnormal trading in firms with speculative rumors after day (+1), while we find significantly negative IOF (increased selling) in firms with informative rumors for most of the post-rumor period analyzed.

Our evidence thus suggests that in aggregate, institutional investors possess private information during the pre-rumor period related to takeover prospects, yet we find no such evidence during the post-rumor period. We infer that these investors are informed based upon the abnormally high levels of IOF in firms soon to be subject to takeover speculation. However, our findings raise an obvious question: who stands on the other side of pre-rumor and post-rumor trades? We discuss this issue in the following section.

### 3.4.2. Counterparties to institutional trades

While our findings suggest that institutions engage in abnormal trading of potential target firms, buying pre-rumor and selling post-rumor, it is important to consider who might be the counterparty to their trades. We offer a number of alternative explanations which are not mutually exclusive.

First, we recall from Table 2 that the ratio of ANcerno buy/sell trading volume to CRSP trading volume is significantly positive over the pre-rumor/post-rumor period. As ANcerno funds are representative of institutions (Puckett and Yan, 2011), the typical counterparty to ANcerno trades as captured by the CRSP dataset is not likely to be institutions. Rather, retail investors would appear to be the likely liquidity provider, as Ahern and Sosyura (2015) similarly deduce.

[30] In Table A4, we also examine institutional trading according to a variety of non-mutually exclusive takeover rationales as listed in Appendix A. Arguably, the rationales found to have significant IOF over the (-10, -1) period are those providing many opportunities for information leakage: *AdvisorHired*, *BlockPurchase*, *InsiderCited*, *PEFundInvolved*, and *SynergyCited*.

In support of this view, we show in Panel E of Table 1 that there is an incentive for retail investors to sell during the pre-rumor period. Specifically, over the (-20, -1) period we find a positive price runup of 1.7% for all rumors (significant at the 10% level), and 2.39% for accurate rumors (significant at the 1% level). Even without a price runup, the existence of heterogeneous beliefs may lead to heavy trading (Kandel and Pearson 1995; Kim and Verrecchia, 1994, 1997). Moreover, purchasing a rumored firm's stock post-rumor may be considered enticing for those believing rumors to be true, despite most rumors being false, and therefore a sign of non-sophisticated trading typically associated with retail investors. Furthermore, Barber and Odean (2008) show that retail investors face a costly search problem and solve this by purchasing those stocks that have recently caught their attention.

Retail investors are not necessarily the only counterparty, and further investigation reveals the trading activities of market makers as well. Market makers have an obligation to keep a fair and orderly market with reasonable liquidity for buyers and sellers (Lee et al., 1993) and may handle trades for clients or buy for their own accounts. In addition, according to the information asymmetry model (e.g., Copeland and Galai, 1983; Glosten and Milgrom, 1985; Kyle, 1985), market makers are able to identify changes in adverse selection and adjust bid-ask spreads accordingly. Examining changes in the bid-ask spread within our sample, we find significant increases shortly before the rumor, consistent with market makers acting as liquidity providers and receiving compensation through larger bid-ask spreads (see Figure A1 of the Internet Appendix). However, within our dataset we are unable to determine who the market makers are buying for, nor which side of the trade they are taking.

Finally, we also find evidence of short-selling activity over both the pre-rumor and post-rumor periods, as shown in Figure A2 of the Internet Appendix. Such trades may offset informed trades, as "falsely informed traders" (Cornell and Sirri, 1992) may fail to accurately recognize the extent of the inside information reflected in the stock prices and incorrectly believe they have superior information.

In line with our contentions, Hendershott et al. (2015) use Consolidated Equity Audit Trail Data (CAUD) files that contain detailed information on all orders executed on the NYSE and find that around news announcements, institutional trading volume is roughly half that of CRSP trading volume while retailers and market makers represents the other half. Similarly, Griffin et al. (2003)

find that institutional trading represents about 45% of total trading volume on the NASDAQ while market makers and retail investors account for the rest. Ultimately, however, we are not able to provide definitive evidence as to the identity of those acting as liquidity providers for ANcerno funds.

### 3.4.3. Robustness tests

To test whether our results are driven by institutional momentum buying (also known as *trend-chasing* or *positive feedback trading*) as found in earlier studies (Lakonishok et al., 1992; Grinblatt et al., 1995; Badrinath and Wahal, 2002; Griffin et al., 2003), in Table 4 we partition our sample of rumored takeover firms into quintiles based on CAARs over the (-30, -10) window prior to the rumor. We then examine each quintile separately, with AARs and IOF displayed for each day. Rumored targets with the lowest CAR (-30, -10) are assigned to Quintile 1, while those with the highest CAR over the same period are assigned to Quintile 5. Our results show a similar pattern across quintiles: significant buying activity within one week prior to the rumor date contrasting with significant selling during the post-rumor period. Regardless of prior returns, institutions appear to identify potential takeover targets prior to the rumor date.

An alternative explanation could be that changes in institutional trading volume might increase return volatility, prompting news agencies to generate the rumor articles comprising our sample (Hendershott et al., 2015). To test this alternative hypothesis, for each day surrounding the rumor period we plot the return volatility and absolute value of stock returns (|AAR|) in Panels A and B of Figure 4. We find that both return volatility and the absolute value of stock returns increase significantly one day before the rumor while institutional order measures begin to rise eight days before the rumor (Table 2). This suggests that this alternative explanation is unlikely.[31] Furthermore, we note that the justifications which ostensibly provide the basis for the rumor's creation (e.g., *BlockPurchase*, *IndustryActivity*, *OptionsIncreased*, *TargetInitiated*, and *UnusualActivity*) limit the ability of news agencies to delay reporting until after high volatility in trading is observed.

***Insert Table 4 about here***

***Insert Figure 4 about here***

[31] Unlike the end-date return volatility, intraday volatility is not easily observable by investors without access to the order book.

While we assert that institutions trade prior to rumors based on private information they possess on rumor and/or bid probability, it is plausible that institutions instead invest based on public information. If true, then within a sample of firms matched on takeover likelihood factors we should detect abnormal institutional trading. We provide results of the analysis of this alternative hypothesis in Table A1 of the Internet Appendix. We do not find any significant abnormal trading in the control sample, while the difference in IOF (rumored firms minus control firms) remains significantly positive in the pre-rumor period and significantly negative in the post-rumor period. This supports our prior findings and provides additional support for the notion that institutions trade as a result of being informed about rumor prospects.

### 3.4.4. The predictive power of institutional trading

#### 3.4.4.1. Predicting rumor accuracy

We further examine whether abnormal institutional trading prior to rumors can predict rumor accuracy (i.e., rumors resulting in a takeover announcement). We fit a logit regression where the dependent variable equals one if the rumored firm becomes subject to a takeover announcement within the following 365 days.[32] The main independent variable of interest is the buy-and-hold cumulative abnormal institutional order flow defined as follows:

$$BHAIOF_i(t_0, t_1) = \sum_{t_0}^{t_1}(IOF_i - IOF_{i,Benchmark})_t \quad (5)$$

where $IOF_i$ is the institutional order flow of firm *i* and $IOF_{i,Benchmark}$ is the average daily institutional order flow calculated over the (-90, -31) window prior to the rumor date for firm *i*. We extensively control for other determinants of takeover candidacy by including multiple proxies for managerial motivation to pursue a deal, target newsworthiness, abnormal returns surrounding the rumor date, as well as year and industry fixed effects (Cornett et al., 2011; Ahern and Sosyura, 2015; Betton et al., 2018). Table 5 shows the results for a series of logistic regressions focusing on different time periods in proximity to the rumor date, while Appendix A provides variable definitions.

***Insert Table 5 about here***

The estimated logit regressions exhibit significant and positive coefficients for abnormal buy-and-hold IOF prior to accurate rumors. This finding provides multivariate support for our central

[32] For robustness, we provide results according to various definitions of accuracy in the Internet Appendix.

premise that institutions privately gather and process information before material information (the rumor's release) is available for public consumption. This informational advantage is substantial, as takeover rumors in general and accurate rumors in particular are found to result in significant positive short-term abnormal returns for target firms on the rumor day. Establishing a stock position in such firms in advance of the rumor not only allows institutions to capture these abnormal returns, but also makes such trades more innocuous than if target firm shares were purchased shortly before a forthcoming takeover announcement. In support of this view, Ke et al. (2003) note that with respect to illegal insider-trading prosecution, "risks are smaller the further removed the trades are from the principal informational event".

In Columns 3 and 4 of Table 5 we examine whether institutional trading is informative in predicting rumor accuracy after takeover rumors are made public. Contrary to our results in the first two columns, we find significant and negative coefficients for abnormal buy-and-hold institutional order flow (BHAIOF) over the post-rumor periods. In addition, the results in Columns 5 and 6 show significant and negative coefficients for BHAIOF(-5, +5) and BHAIOF(-10, +10). This indicates that institutions are significant sellers of rumored firms which eventually receive takeover bids, and thereby forego significantly positive returns upon the official takeover announcement.

We offer a number of non-mutually exclusive potential explanations for this behavior. First, such actions are consistent with the information acquisition model of Hirshleifer et al. (1994) in which institutions are expected to reverse their positions based on short-lived private information after realizing returns. Said differently, rumor publication reduces information asymmetry and this reduces the value of private information for informed institutions (Tetlock, 2010), encouraging institutions to reverse their positions and lock in their gains. Second, takeover negotiations are highly uncertain and time consuming (Gao and Oler, 2012), involving many different decision makers (e.g., target managers, bidder managers, target advisors, and bidder advisors) and subject to changing business conditions. Under such circumstances, institutional investors may lack confidence in their ability to predict the takeover announcement, preferring instead to ensure they avoid a potential price reversal for falsely rumored firms (Ahern and Sosyura, 2015; Betton et al., 2018). Third, expected future benefits are uncertain: takeover announcement date returns are significantly smaller for firms that have been rumored to be potential targets in the past (Ahern and Sosyura, 2015; Betton et al., 2018) while rumors reduce the likelihood of deal completion by about 40% (Alperovych et al., 2016). This

may encourage institutional investors to pursue alternative uses of their funds (Wermers, 2003). Finally, the significant selling activity in accurately rumored firms shortly after the rumor date may reflect portfolio rebalancing requirements, as accurate rumors have the largest market reaction on the rumor day (Figure 1), yet institutional investors do not typically over-weight individual stocks in their portfolio for long (Alexander et al., 2007).

#### 3.4.4.2. Predicting the stock market reaction to takeover rumors

We proceed to investigate the informativeness of institutional trading in a multivariate setting. In particular, we examine whether lagged abnormal institutional trading predicts abnormal returns around the rumor date while providing controls as motivated by the literature (e.g., Cornett et al. (2011), Ahern and Sosyura (2015), and Betton et al. (2018)). If institutions possess material private information regarding takeover rumors, they are likely to increase their net purchases in advance of those rumors which yield high rumor date returns. In this case, we expect positive coefficients for institutional buying measures in the regression models. Table 6 shows the results of the regressions.

***Insert Table 6 about here***

We first note that in line with the findings of Betton et al. (2018) and Ahern and Sosyura (2015), the independent variables *CAR(-5, -1)*, *informative* rumors, and *speculative* rumors each have significant coefficients. Of particular interest in this paper are the coefficients of our buy-and-hold cumulative abnormal institutional order flow (BHAIOF) measures as explanatory variables. The positively significant coefficients of *BHAIOF(-10, -1)* and *BHAIOF(-5, -1)* in the first two columns show that trades of institutions during the pre-rumor period have power in predicting rumor announcement returns. In Columns 3 to 7, we calculate individual institutional trading measures for every rumored firm on day (-1) relative to the rumor. Our results in Columns 3 to 5 suggest significantly positive predictive power for IOF, IOV, and IBuys. Offering further support, we see in Column 6 that institutional sales are negatively related to rumor date abnormal returns. However, this statistical significance is lost when we include institutional purchases in the same model (Column 7). Overall, our results in Table 6 show that institutional buying positively predicts rumor date returns, supporting the hypothesis that institutions possess private information related to takeover rumors over the pre-rumor period.

### 3.4.5. Private information or luck?

We now investigate whether the abnormal institutional trading we observe is driven by a subset of funds investing wisely. We first note that there are two ways that trades are reported by ANcerno. First, the investment manager may invest on behalf of a pension plan sponsor who subscribes to ANcerno; in this case we observe the investment manager trading for the specific plan sponsor. Second, the investment manager may directly report trades to ANcerno; in this case all trades are reported on behalf of the investment manager. Therefore, we follow Jame (2018) and refer to a client-manager pair as a fund, where the client could be either an investment manager or a plan sponsor. This identification also accounts for the possible hierarchical structure of funds and their management companies as documented in the literature (e.g., Sensoy et al., 2014; Korteweg and Sorensen, 2017).

We classify funds as "*smart"* and "*lucky"* funds based on their net positions in rumored firms and on the total number of securities they trade every year. Specifically, we aggregate all ANcerno transactions into a fund-firm level and calculate the buy-and-hold cumulative abnormal institutional order flow (BHAIOF) over the 30-day window prior to the rumor. As some funds might purchase rumored firms only by chance, we use a bootstrap procedure similar to that used by Jegadeesh and Tang (2010) to determine the probability that a fund buys rumored targets conditioned on the number of trades it executes within that year.[33] For each year-fund observation, we identify the pool of unique stocks traded by the fund during that year. In addition, for every fund, we replace each stock it trades with a random stock from the pool of traded stocks (without replacement) and compute the number of times each fund is a net-buyer of a rumored target within the month prior to the rumor. Using a bootstrap simulation (N=10,000), we estimate the probability distribution of the number of rumored targets that each fund purchases by chance.

Given the discrete nature of the outcome variable and the fact that rumors are independently scattered during any particular year, the number of times a fund purchases a rumored target by chance during the year, conditional on the total number of trades it executes, follows a Poisson distribution ($p_i \sim Po(\lambda)$). Using the probability function of the Poisson distribution (for each fund-year observation) we compute the probability of hitting '$r$' targets by chance as:

[33] We refer the reader to Jegadeesh and Tang (2010, p.19) for an extended discussion.

$$P(X = r_{it}) = \frac{e^{-\lambda_{it}} * \lambda_{it}^{r_{it}}}{r_{it}!} \quad (6)$$

where $r_{it}$ is the observed number of positive net-purchases within rumored targets by fund *i* within the month prior to the rumor during year *t*, and $\lambda_{it}$ is the Poisson distribution parameter for fund *i* during year *t* which is estimated using the bootstrap simulation. For each calendar year, we label a fund as smart if both of the following two conditions are satisfied. First, the probability of hitting the rumored firms by chance is less than 5% (computed using Equation 6). Second, the observed number of hits on rumored firms is larger than the average number of hits ($r_{it} > \lambda_{it}$). If either condition is violated, we label the fund as lucky. To illustrate, Figure 5 presents the probability distribution of hitting rumored targets by chance for two anonymous funds during the year 2009.

***Insert Figure 5 about here***

We note that institutional trading desks usually divide trade orders into several trades or among several brokers, while in ANcerno the allocation to each broker is defined as a "ticket" and each ticket may lead to several different trade executions. Therefore, similar to Anand et al. (2012) and Busse et al. (2019) we perform the bootstrap methodology at the ticket level so that the trade execution by brokers does not affect our results.

We report results in Table 7, presenting the sample size and the number of funds that are classified as smart and lucky each year in Panel A. Overall, we classify 9% of net-buying funds as smart. In Panel B, we report whether the probability distribution representing the number of times a fund purchases rumored targets in one year is statistically different from the distribution in the following year. We observe that in all years the chi-squared statistic is significant at the 1% level which implies that smart funds persistently outperform lucky funds within a short horizon prior to takeover rumors.

***Insert Table 7 about here***

We next examine the trading patterns of smart and lucky funds around takeover rumors. Table 8 (9) presents the results for smart (lucky) funds, in aggregate and by rumor accuracy, with the results plotted in Panels A – C of Figure 6. In Columns 1, 3, and 5 of Table 8 we see that smart funds are significant net buyers of rumored target firms during the pre-rumor period, regardless of rumor accuracy, with IOF significantly positive throughout the entire (-8, -1) window relative to the rumor

date. In contrast, we do not observe any abnormal IOF by lucky funds prior to rumors, as displayed in Table 9.

***Insert Figure 6 about here***

***Insert Table 8 about here***

***Insert Table 9 about here***

Upon rumor publication and afterwards, both smart and lucky funds engage in significant selling of rumored firm shares.[34] For smart funds, we observe significantly negative IOF in inaccurately rumored firms on eleven days over the (0, +20) period, whereas we observe such IOF on only 2 days in accurately rumored firms over this period. In contrast, we observe significantly negative IOF for lucky funds on every day of the (0, +20) period for accurately rumored firms, and on six days over this period for inaccurately rumored firms. Given that accurately rumored target firms will receive, on average, a premium upon bid announcement, the evidence presented in Tables 8 and 9 supports the proposition that smart funds are better informed than lucky funds over both the pre- and post-rumor periods.[35]

To further investigate whether trades of smart and/or lucky funds are informative and can predict rumor accuracy, we fit a logit regression where the dependent variable equals one if the rumored firm becomes subject to a takeover announcement within the following 365 days. We include measures of fund trading as explanatory variables along with other control measures, and present results in Table 10. Panel A presents the results using the buy-and-hold abnormal institutional order flow of smart funds as an independent variable. The positive and significant coefficients of $BHAIOF(-10, -1)_{smart}$ and $BHAIOF(-5, -1)_{smart}$ in the first two columns of Panel A show that trades of smart funds during the pre-rumor period have power in predicting rumor accuracy. The positive and statistically significant coefficients for $BHAIOF(+1, +5)_{smart}$ and $BHAIOF(+1, +10)_{smart}$ in Columns 3 and 4 indicate that smart fund trades during the post-rumor periods are informative in predicting rumor accuracy as well.

***Insert Table 10 about here***

[34] Since ANcerno does not provide reliable intraday time stamps and marks a significant fraction of trades as occurring at the opening of trading, we cannot examine whether transactions execute before or after the rumor is released to the market on day (0).

[35] Further evidence is provided in the Internet Appendix (Tables A3 and A4).

Finally, combining the pre- and post-rumor periods, the coefficients of $BHAIOF(-5, +5)_{smart}$ and $BHAIOF(-10, +10)_{smart}$ in Columns 5 and 6 remain positive and significant. Taken together, these results indicate that smart funds appear confident in not only identifying takeover targets prior to the rumor, but in predicting the existence and ultimate success of takeover negotiations. Such evidence is consistent with the accumulation of private information.

In Panel B of Table 10, we examine the predictive power of trades by lucky funds in a similar fashion to the above. Contrary to our prior results for smart funds, the pre-rumor trades of lucky funds do not predict rumor accuracy (Columns 1 and 2). When examining the post-rumor period as well as combined pre- and post-rumor windows, the BHAIOF of lucky funds is significant but *negatively* relates to rumor accuracy. This indicates that lucky funds are not able to predict rumor accuracy before or after the rumor's publication, and thus lucky funds do not appear to be informed.

### 3.4.6 Profitability of institutional trading around takeover rumors

In this section, we examine the profitability of institutional trading using actual execution prices and executed volume. We closely follow Pucket and Yan (2011) to calculate the holding-period profits of round-trip trades (trades in which funds purchase and sell or sell and repurchase the same stock) as the difference between the dollar values of consecutive sale and purchase transactions. We aggregate observations at the firm-fund levels and acknowledge any unrealized return as of the end of the trading period by marking the net positions to market at the end of each trading horizon (Irvine, 2007; Puckett and Yan, 2011; Chemmanur and He, 2016). We use volume-weighted average execution prices of purchases (sales) when funds execute multiple purchases (sales) as part of their round-trip transactions, and apply the DGTW benchmark (as per Daniel, Grinblatt, Titman, and Wermers, 1997) return over the holding periods to calculate abnormal profits.[36] Our measures of trading performance account for implicit trading costs (e.g., price impact) as we use actual prices of executed transactions in order to calculate the returns.

Results are presented in Table 11. Panel A shows the abnormal trading profits of smart and lucky funds for the whole sample while Panel B (C) presents their trading performance in accurately (inaccurately) rumored firms. The results demonstrate that smart funds outperform lucky funds, although both fund types earn significant abnormal returns through their trades over different

[36] We refer the reader to Puckett and Yan (2011, pg. 609) for further details.

horizons. This is consistent with previous studies that document the profitability of institutional trading around various events (e.g., Chemmanur et al., 2009; Busse et al., 2012; Bernile et al., 2015; Chemmanur and He, 2016; Chemmanur et al., 2018) and with studies demonstrating the superior performance of a subset of institutions (Ashraf and Jayarman, 2007; Bodnaruk et al., 2007; Jegadeesh and Tang, 2010; Griffin et al., 2012).[37]

***Insert Table 11 about here***

Our results in Table 11 indicate that traders informed about impending takeover rumors receive substantial profits. For example, we find that smart funds earn an average abnormal profit of about $365,900 per rumor over the (-5, +5) rumor date period. The economic magnitude of this trading activity is quite substantial and translates into gains of almost $28 million for smart funds within our sample. Additionally, establishing a stock position in such firms in advance of the rumor allows institutions to not only capture abnormal returns upon rumor publication but also to benefit further when the rumor is followed by a formal bid. This informed institutional trading pattern is thus consistent with illegal trading by insiders, calling into question the integrity of financial markets and meriting further regulatory attention.

## 3.5. Conclusion

There is an ongoing debate about the nature of institutional trading surrounding corporate events and in particular whether institutional investors are informed (Bernile et al., 2015). In this paper, we combine two proprietary datasets, one consisting of transaction-level institutional trades and the other consisting of first-instance published takeover rumors, to answer the following questions: First, do institutions have private information about those firms which are subject to forthcoming takeover rumors? Second, do institutional investors appear to profit by trading in firms prior to the first publication of a takeover rumor? Third, are results representative of all institutions or instead driven by a select group of funds? Finally, does the type of takeover rumor matter? That is, does the informational content of the rumor relate to the institutional ability to discover or discern its impact?

[37] We perform a series of robustness tests in which we remove 79 observations for which the announcement is forthcoming within the next 30 days. All the results in Tables 1 to 11 remain qualitatively unchanged. The respective tables are unreported for brevity but are available from the authors upon request.

We find institutional order flow to be significantly positive over the pre-rumor period, while significantly negative shortly thereafter, and this activity does not appear to be driven by institutional momentum buying. Our results hold after controlling for publicly available information, and when compared to a sample of firms matched according to takeover candidacy. The evidence is thus consistent with institutions utilizing private information when trading in rumored targets, as opposed to being skilled at gathering public information.

We examine profitability using actual execution prices and executed volume to establish that institutions on average do indeed trade profitably over the rumor date period on round-trip trades. To investigate further, we categorize institutions according to their propensity to trade. Specifically, we utilize a bootstrap procedure as per Jegadeesh and Tang (2010) to determine the probability that a fund buys rumored targets by chance conditional on the number of trades it executes within a given year. We define those funds less likely to purchase rumored targets by chance as 'smart' funds and those more likely to purchase rumored targets by chance as 'lucky' funds.

We find that smart funds represent 9% of our sample, and uncover a stark contrast in trading activity: smart funds drive pre-rumor purchases and display wisdom over the post-rumor period, relative to lucky funds, by refraining from significant sales of rumored firms which lead to actual bid proposals. The profitability of trading in rumored target firms is thus found to be significantly higher for smart funds than for lucky funds over both the pre- and post-rumor date periods, averaging 4.07% over the (-30, +30) rumor date period. Reduced selling of accurately rumored firms in the post-rumor period also allows smart funds to take advantage of a further price appreciation as the takeover announcement date approaches.[38] Money managers appear to engage more in such trading strategies than pension plan sponsors, but both are significant buyers of rumored firms throughout the seven-day pre-rumor period.

Regarding the informational content of the rumor, we find significantly increased IOF during the pre-rumor period when rumors are informative and/or justified by certain rationales such as *AdvisorHired*, *BlockPurchase*, *InsiderCited*, *PEFundInvolved*, and *SynergyCited*. These rumor types appear to offer institutions more opportunities to acquire private information. In contrast, other rumor types, such as those generated by takeover chatter or based solely on an increase in option activity in

[38] We do not report trade execution up until the announcement date of accurate rumors; however, in untabulated analysis we confirm that announcement date returns for rumored targets are significantly positive, as expected.

the target firm (speculative rumors) do not appear to generate any significant institutional trading activity. In general, corporate insiders, investment bankers, journalists, and lawyers (among others) may be informed of impending rumors and would have an incentive to leak this information (Van Bommel, 2003; Brunnermeier, 2005).

The evidence presented in this paper is thus consistent with institutions, and in particular smart funds, benefitting from short-lived private information by buying rumored firms in the pre-rumor period and selling upon rumor publication or shortly thereafter (while selling less in accurately rumored firms).

Regulators have become more 'evidence based' in their approach to policy making concerning insider trading (Aspris et al., 2014). We propose that they incorporate our findings into their algorithms to help identify and limit the leakage of material private information related to takeover rumors and any subsequent bid announcements. This may serve to mitigate threats to the financial integrity of markets which have been associated with insider trading, such as increased price volatility (Leland, 1992), reduced liquidity (Agrawal and Cooper, 2015), increased legal risks (Haslem et al., 2017) and decreased investor confidence (Fishe and Robe, 2004) and a sense of moral injustice (Bris, 2005).

## References


Adelson, R. M. (1966). Compound Poisson distributions. *Journal of the Operational Research Society*, *17*(1), 73-75.

Agrawal, A., & Cooper, T. (2015). Insider trading before accounting scandals. *Journal of Corporate Finance, 34*(C), 169-190.

Ahern, K. R., & Sosyura, D. (2015). Rumor has it: Sensationalism in financial media. *The Review of Financial Studies*, *28*(7), 2050-2093.

Anand, A., Irvine, P., Puckett, A., & Venkataraman, K. (2012). Performance of institutional trading desks: An analysis of persistence in trading costs. *The Review of Financial Studies*, *25*(2), 557-598.

Akbas, F., Armstrong, W. J., Sorescu, S., & Subrahmanyam, A. (2015). Smart money, dumb money, and capital market anomalies. *Journal of Financial Economics*, *118*(2), 355-382.

Alexander, G. J., Cici, G., & Gibson, S. (2007). Does motivation matter when assessing trade performance? An analysis of mutual funds. *The Review of Financial Studies*, *20*(1), 125-150.

Ali, A., Durtschi, C., Lev, B., & Trombley, M. (2004). Changes in institutional ownership and subsequent earnings announcement abnormal returns. *Journal of Accounting, Auditing & Finance*, *19*(3), 221-248.

Alperovych, Y., Cumming, D. J., & Groh, A. P. (2016). M&A rumors: Why sellers hate them. *Available at SSRN 2848303*.

Ashraf, R., & Jayaraman, N. (2014). Institutional investors' trading behavior in mergers and acquisitions. *Advances in Financial Economics*, *17*, 229-281.

Aspris, A., Foley, S., & Frino, A. (2014). Does insider trading explain price run-up ahead of takeover announcements? *Accounting and Finance, 54*(1)*,* 25-45.

Badrinath, S. G., & Wahal, S. (2002). Momentum trading by institutions. *The Journal of Finance*, *57*(6), 2449-2478.

Barber, B. M., & Odean, T. (2008). All that glitters: The effect of attention and news on the buying behavior of individual and institutional investors. *The Review of Financial Studies*, *21*(2), 785-818.

Barnes, B. G., Harp, N. L., & Oler, D. (2014). Evaluating the SDC mergers and acquisitions database. *Financial Review*, *49*(4), 793-822.

Battalio, R. H., & Mendenhall, R. R. (2005). Earnings expectations, investor trade size, and anomalous returns around earnings announcements. *Journal of Financial Economics*, *77*(2), 289-319.

Berkman, H., & McKenzie, M. D. (2012). Earnings announcements: Good news for institutional investors and short sellers. *Financial Review*, *47*(1), 91-113.

Bernile, G., Sulaeman, J., & Wang, Q. (2015). Institutional trading during a wave of corporate scandals: "Perfect payday"? *Journal of Corporate Finance*, *34*, 191-209.

Bethel, J. E., Hu, G., & Wang, Q. (2009). The market for shareholder voting rights around mergers and acquisitions: Evidence from institutional daily trading and voting. *Journal of Corporate Finance*, *15*(1), 129-145.

Betton, S., Davis, F., & Walker, T. (2018). Rumor rationales: The impact of message justification on article credibility. *International Review of Financial Analysis*, *58*, 271-287.

Bharadwaj, A., & Shivdasani, A. (2003). Valuation effects of bank financing in acquisitions. *Journal of Financial Economics*, *67*(1), 113-148.

Black, F. (1986). Noise. *The Journal of Finance*, *41*(3), 528-543.

Bodnaruk, A., Massa, M., & Simonov, A. (2009). Investment banks as insiders and the market for corporate control. *The Review of Financial Studies*, *22*(12), 4989-5026.

Boehmer, E., Jones, C. M., & Zhang, X. (2008). Which shorts are informed? *The Journal of Finance*, *63*(2), 491-527.

Boulatov, A., Hendershott, T., & Livdan, D. (2012). Informed trading and portfolio returns. *Review of Economic Studies*, *80*(1), 35-72.

Bris, A. (2005). Do insider trading laws work? *European Financial Management, 11*(3)*,* 267-312.

Brunnermeier, M. K. (2005). Information leakage and market efficiency. *The Review of Financial Studies*, *18*(2), 417-457.

Busse, J. A., Green, T. C., & Jegadeesh, N. (2012). Buy-side trades and sell-side recommendations: Interactions and information content. *Journal of Financial Markets*, *15*(2), 207-232.

Busse, J. A., Tong, L., Tong, Q., & Zhang, Z. (2019). Trading regularity and fund performance. *The Review of Financial Studies*, *32*(1), 374-422.

Campbell, J. Y., Ramadorai, T., & Schwartz, A. (2009). Caught on tape: Institutional trading, stock returns, and earnings announcements. *Journal of Financial Economics*, *92*(1), 66-91.

Campbell, J. Y., Champbell, J. J., Campbell, J. W., Lo, A. W., & MacKinlay, A. C. (1997). The econometrics of financial markets. Princeton University Press: Princeton, NJ.

Carhart, M. M. (1997). On persistence in mutual fund performance. *The Journal of Finance*, *52*(1), 57-82.

Chemmanur, T. J., & He, S. (2016). Institutional trading, information production, and corporate spin-offs. *Journal of Corporate Finance*, *38*, 54-76.

Chemmanur, T. J., He, S., & Hu, G. (2009). The role of institutional investors in seasoned equity offerings. *Journal of Financial Economics*, *94*(3), 384-411.

Chemmanur, T. J., Hu, G., & Huang, J. (2010). The role of institutional investors in initial public offerings. *The Review of Financial Studies*, *23*(12), 4496-4540.

Chemmanur, T. J., Hu, G., & Huang, J. (2015). Institutional investors and the information production theory of stock splits. *Journal of Financial and Quantitative Analysis*, *50*(3), 413-445.

Chemmanur, T. J., Hu, G., Li, Y., & Xie, J. (2018). Do institutions have the information to play a significant role in corporate governance? Direct evidence from institutional trading around CEO turnovers. Working Paper. Boston College.

Christophe, S. E., Ferri, M. G., & Angel, J. J. (2004). Short-selling prior to earnings announcements. *The Journal of Finance*, *59*(4), 1845-1876.

Christophe, S. E., Ferri, M. G., & Hsieh, J. (2010). Informed trading before analyst downgrades: Evidence from short sellers. *Journal of Financial Economics*, *95*(1), 85-106.

Copeland, T. E., & Galai, D. (1983). Information effects on the bid-ask spread. *The Journal of Finance*, *38*(5), 1457-1469.

Cornell, B., & Sirri, E. R. (1992). The reaction of investors and stock prices to insider trading. *The Journal of Finance*, *47*(3), 1031-1059.

Cornett, M. M., Tanyeri, B., & Tehranian, H. (2011). The effect of merger anticipation on bidder and target firm announcement period returns. *Journal of Corporate Finance, 17*(3), 595-611.

Corwin, S. A., Harris, J. H., & Lipson, M. L. (2004). The development of secondary market liquidity for NYSE-listed IPOs. *The Journal of Finance*, *59*(5), 2339-2374.

Coval, J. D., & Moskowitz, T. J. (2001). The geography of investment: Informed trading and asset prices. *Journal of Political Economy*, *109*(4), 811-841.

Daniel, K., Grinblatt, M., Titman, S., & Wermers, R. (1997). Measuring mutual fund performance with characteristic-based benchmarks. *The Journal of Finance*, *52*(3), 1035-1058.

Dechow, P. M., Hutton, A. P., Meulbroek, L., & Sloan, R. G. (2001). Short-sellers, fundamental analysis, and stock returns. *Journal of Financial Economics*, *61*(1), 77-106.

Diether, K. B., Lee, K. H., & Werner, I. M. (2009). It's SHO time! Short-sale price tests and market quality. *The Journal of Finance*, *64*(1), 37-73.

Easley, D., Engle, R. F., O'Hara, M., & Wu, L. (2008). Time-varying arrival rates of informed and uninformed trades. *Journal of Financial Econometrics*, *6*(2), 171-207.

Edelen, R. M., Ince, O. S., & Kadlec, G. B. (2016). Institutional investors and stock return anomalies. *Journal of Financial Economics*, *119*(3), 472-488.

Engelberg, J. E., Reed, A. V., & Ringgenberg, M. C. (2012). How are shorts informed? Short sellers, news, and information processing. *Journal of Financial Economics*, *105*(2), 260-278.

Faccio, M., & Masulis, R. W. (2005). The choice of payment method in European mergers and acquisitions. *The Journal of Finance*, *60*(3), 1345-1388.

Fama, E. F., & French, K. R. (2010). Luck versus skill in the cross-section of mutual fund returns. *The Journal of Finance*, *65*(5), 1915-1947.

Fich, E., Lantushenko, V., & Sialm, C. (2020). Institutional trading around M&A announcements. Working Paper No. w25814, National Bureau of Economic Research.

Fishe, R. P., & Robe, M. A. (2004). The impact of illegal insider trading in dealer and specialist markets: Evidence from a natural experiment. *Journal of Financial Economics, 71*(3)*,* 461-488.

Gao, Y., & Oler, D. (2012). Rumors and pre-announcement trading: Why sell target stocks before acquisition announcements? *Review of Quantitative Finance and Accounting, 39(4),* 485-508.

Gao, X., & Ritter, J. R. (2010). The marketing of seasoned equity offerings. *Journal of Financial Economics*, *97*(1), 33-52.

Glosten, L. R., & Milgrom, P. R. (1985). Bid, ask and transaction prices in a specialist market with heterogeneously informed traders. *Journal of Financial Economics*, *14*(1), 71-100.

Goldstein, M. A., Irvine, P., Kandel, E., & Wiener, Z. (2009). Brokerage commissions and institutional trading patterns. *The Review of Financial Studies*, *22*(12), 5175-5212.

Griffin, J. M., Harris, J. H., & Topaloglu, S. (2003). The dynamics of institutional and individual trading. *The Journal of Finance*, *58*(6), 2285-2320.

Griffin, J. M., Shu, T., & Topaloglu, S. (2012). Examining the dark side of financial markets: Do institutions trade on information from investment bank connections? *The Review of Financial Studies*, *25*(7), 2155-2188.

Grinblatt, M., Titman, S., & Wermers, R. (1995). Momentum investment strategies, portfolio performance, and herding: A study of mutual fund behavior. *The American Economic Review*, 1088-1105.

Haslem, B., Hutton, I., & Smith, A. H. (2017). How much do corporate defendants really lose? A new verdict on the reputation loss induced by corporate litigation. *Financial Management, 46*(2), 323-358.

Hendershott, T., Livdan, D., & Schürhoff, N. (2015). Are institutions informed about news? *Journal of Financial Economics*, *117*(2), 249-287.

Henry, D., Nguyen, L., & Pham, V. H. (2017). Institutional trading before dividend reduction announcements. *Journal of Financial Markets*, *36*, 40-55.

Henry, T. R., & Koski, J. L. (2017). Ex-dividend profitability and institutional trading skill. *The Journal of Finance*, *72*(1), 461-494.

Hirshleifer, D., Subrahmanyam, A., & Titman, S. (1994). Security analysis and trading patterns when some investors receive information before others. *The Journal of Finance*, *49*(5), 1665-1698.

Hu, G., Jo, K. M., Wang, Y. A., & Xie, J. (2018). Institutional trading and Abel Noser data. *Journal of Corporate Finance*, *52*, 143-167.

Hu, G., McLean, R. D., Pontiff, J., & Wang, Q. (2014). The year-end trading activities of institutional investors: Evidence from daily trades. *The Review of Financial Studies*, *27*(5), 1593-1614.

Irvine, P., Lipson, M., & Puckett, A. (2007). Tipping. *The Review of Financial Studies*, *20*(3), 741-768.

Jain, P. K., & Wang, Q. (2013). Credit-rating changes and institutional trading. *The Journal of Trading*, *8*(1), 38-47.

Jame, R. (2018). Liquidity provision and the cross section of hedge fund returns. *Management Science*, *64*(7), 3288-3312.

Jegadeesh, N., & Tang, Y. (2010). Institutional trades around takeover announcements: Skill vs. inside information. Working Paper, Emory University.

Jensen, M. C. (1968). The performance of mutual funds in the period 1945-1964. *The Journal of Finance*, *23*(2), 389-416.

Johnson, N. L., Kemp, A. W., & Kotz, S. (2005). *Univariate discrete distributions* (Vol. 444). John Wiley & Sons, New York, NY.

Kacperczyk, M., Sialm, C., & Zheng, L. (2005). On the industry concentration of actively managed equity mutual funds. *The Journal of Finance*, *60*(4), 1983-2011.

Kacperczyk, M., Sialm, C., & Zheng, L. (2006). Unobserved actions of mutual funds. *The Review of Financial Studies*, *21*(6), 2379-2416.

Kandel, E., & Pearson, N. D. (1995). Differential interpretation of public signals and trade in speculative markets. *Journal of Political Economy*, *103*(4), 831-872.

Ke, B., Huddart, S., & Petroni, K. (2003). What insiders know about future earnings and how they use it: Evidence from insider trades. *Journal of Accounting and Economics*, *35*(3), 315-346.

Kim, O., & Verrecchia, R. E. (1994). Market liquidity and volume around earnings announcements. *Journal of Accounting and Economics*, *17*(1-2), 41-67.

Kim, O., & Verrecchia, R. E. (1997). Pre-announcement and event-period private information. *Journal of Accounting and Economics*, *24*(3), 395-419.

Korteweg, A., & Sorensen, M. (2017). Skill and luck in private equity performance. *Journal of Financial Economics*, *124*(3), 535-562.

Kyle, A. S. (1985). Continuous auctions and insider trading. *Econometrica: Journal of the Econometric Society*, *53*(6), 1315-1335.

Lakonishok, J., Shleifer, A., & Vishny, R. W. (1992). The impact of institutional trading on stock prices. *Journal of Financial Economics*, *32*(1), 23-43.

Lee, C. M., Mucklow, B., & Ready, M. J. (1993). Spreads, depths, and the impact of earnings information: An intraday analysis. *The Review of Financial Studies*, *6*(2), 345-374.

Leland, H. (1992). Insider trading: Should it be prohibited? *Journal of Political Economy*, *100*(4), 859-887.

Lewellen, J. (2011). Institutional investors and the limits of arbitrage. *Journal of Financial Economics*, *102*(1), 62-80.

Mulherin, H., & Aziz Simsir, S. (2015). Measuring deal premiums in takeovers. *Financial Management*, *44*(1), 1-14.

Puckett, A., & Yan, X. (2011). The interim trading skills of institutional investors. *The Journal of Finance*, *66*(2), 601-633.

Ross, S. M. (2014). Introduction to probability models. Academic Press, Cambridge, MA.

Sensoy, B. A., Wang, Y., & Weisbach, M. S. (2014). Limited partner performance and the maturing of the private equity industry. *Journal of Financial Economics*, *112*(3), 320-343.

Song, M. H., & Walkling, R. A. (2000). Abnormal returns to rivals of acquisition targets: A test of the acquisition probability hypothesis. *Journal of Financial Economics*, *55*(2), 143-171.

Tetlock, P. C. (2010). Does public financial news resolve asymmetric information? *The Review of Financial Studies*, *23*(9), 3520-3557.

Van Bommel, J. (2003). Rumors. *The Journal of Finance*, *58*(4), 1499-1520.

Wermers, R. (2003). Is money really 'smart'? New evidence on the relation between mutual fund flows, manager behavior, and performance persistence. Working Paper, University of Maryland.

Yan, X. (2008). Liquidity, investment style, and the relation between fund size and fund performance. *Journal of Financial and Quantitative Analysis*, *43*(3), 741-767.

**Figure 1. Stock returns around takeover rumors**

This figure plots the market price reaction around the rumor day based on bid occurrence (*Accurate* vs. *Inaccurate*) and two mutually exclusive rumor categories (*Speculative* vs. *Informative*). Our sample includes 1,689 takeover-rumored firms with available institutional trading data in ANcerno during the period January 2002 – September 2011. Rumors are labeled as accurate (*Accurate*) if the rumored firm in question is the target of a formal takeover bid within 365 calendar days after the initial scoop article, and inaccurate (*Inaccurate*) otherwise. Rumors labeled as speculative (*Speculative*) are based on either takeover chatter or an increase in option activity in the target firm, without any further justification of the rumor. Informative (*Informative*) rumors are based on at least three rumor justifications, excluding those labeled as speculative. CAARs are calculated using a standard market model (based on the CRSP value-weighted market index).

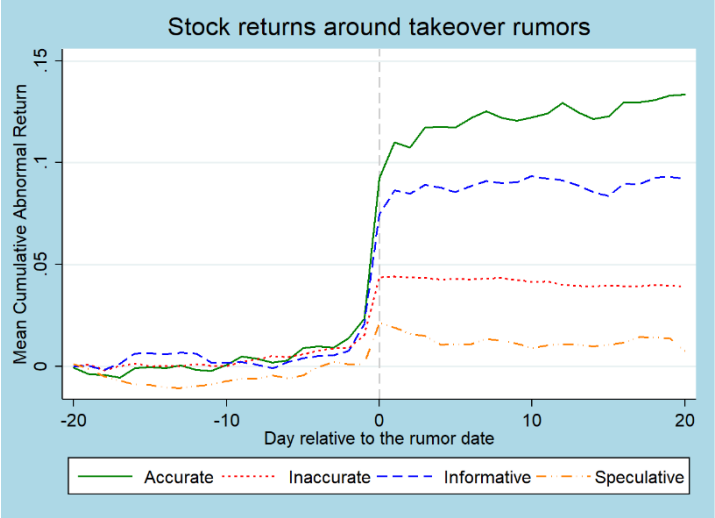
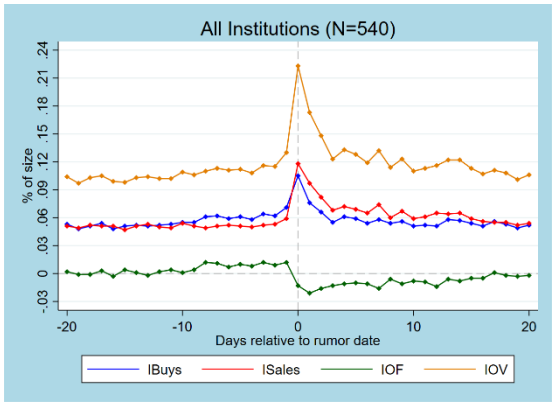
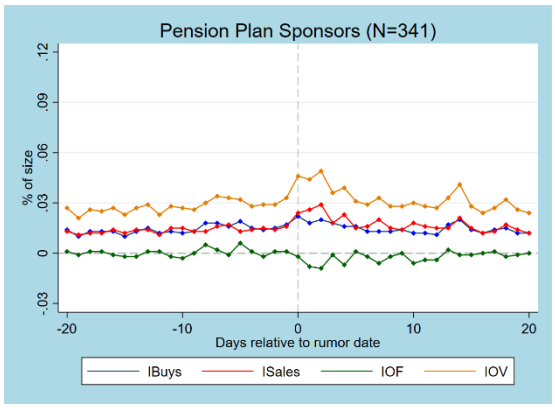


**Figure 2. Institutional trading measures by type of institution**
This figure depicts the daily means of four institutional trading measures by type of institution for each day over the period (-20, +20), where day 0 represents the initial rumor announcement date. The full sample includes 1,689 takeover-rumored firms from January 2002 to September 2011, with institutional trading data obtained from ANcerno. Panel A presents the results for all institutions while Panels B and C plot the results for pension plan sponsors and investment managers, respectively.

Panel A: All institutions




Panel B: Pension plan sponsors




Panel C: Investment managers

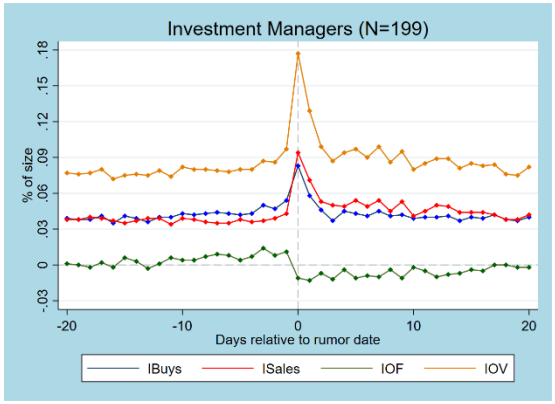


**Figure 3. Institutional order flow by type of rumor**
This figure plots the institutional order flow (IOF) for each day over the period (-10, +10), where day 0 represents the initial rumor announcement date. Panel A plots the IOF based on rumor accuracy (accurate vs. inaccurate). Rumors are labelled as accurate if the rumored firms in question indeed become the target of a formal takeover bid within 365 calendar days after the initial scoop article; otherwise, they are labelled as inaccurate. Panel B plots the IOF based on the rationales justifying the rumor article's publication. Speculative rumors are based on either takeover chatter or an increase in option activity in the target firm, without any further explanation provided in the article. Informative rumors are based on at least three rumor justifications, excluding those comprising speculative rumors.

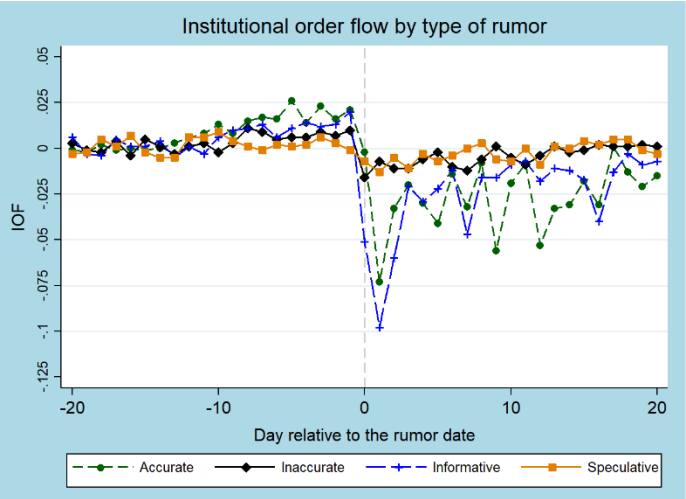
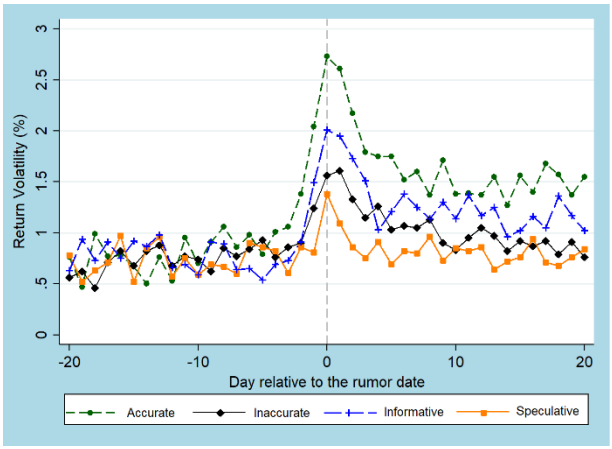


**Figure 4. Price volatility around takeover rumors**
Panel A plots the return volatility (i.e., the standard deviation of daily returns) of rumored firms around the takeover rumor date. The sample contains all 1,689 takeover-rumored firms from January 2002 to September 2011. Panel B plots market price reaction around the rumor day based on rumor accuracy (accurate vs. inaccurate) and two mutually exclusive rumor categories (speculative vs. informative). Appendix A provides variable definitions.

Panel A: Return volatility around the rumor date




Panel B: Stock price return around the rumor date

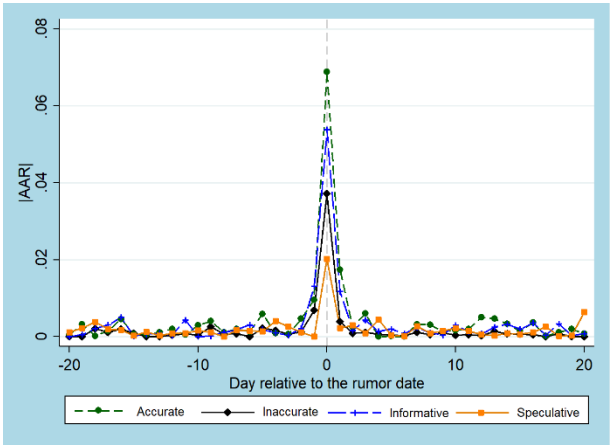
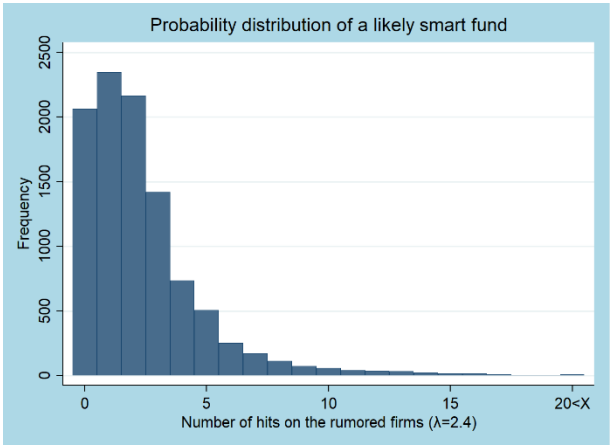


**Figure 5. Probability distribution of buying rumored targets by chance**
This figure presents the probability distribution of buying rumored targets by chance for two anonymous funds during the year 2009. The distribution is constructed using the bootstrap methodology discussed in Section 4.5. Both funds are net-buyers of six different rumored targets within the month prior to the rumor date ($r_{it} = 6$). Based on the probability distributions, the fund in Panel A is likely to be smart since there is only a 2.4% chance that it buys rumored firms by chance (see Equation 6; $r_{it} = 6$, $\lambda_{it} = 2.4$). The fund in Panel B is likely to be lucky since there is a 13.6% chance that it buys rumored firms by chance (see Equation 6; $r_{it} = 6$, $\lambda_{it} = 4.7$).

Panel A: Probability distribution of a likely smart fund




Panel B: Probability distribution of a likely lucky fund

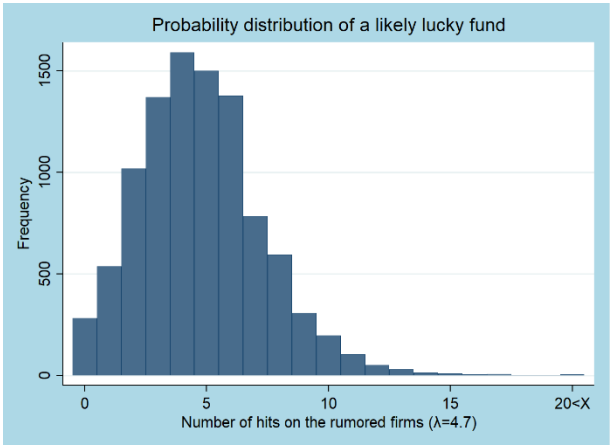


**Figure 6. Institutional order flow by type of fund**
This figure plots the institutional order flow (IOF) for each day over the period (-20, +20), where day 0 represents the initial rumor announcement date. Rumors are labelled as accurate if the rumored firms in question indeed become the target of a formal takeover bid within 365 calendar days after the initial scoop article; otherwise, they are labelled as inaccurate. The classification of funds as smart and lucky funds is described in detail in Section 4.5.

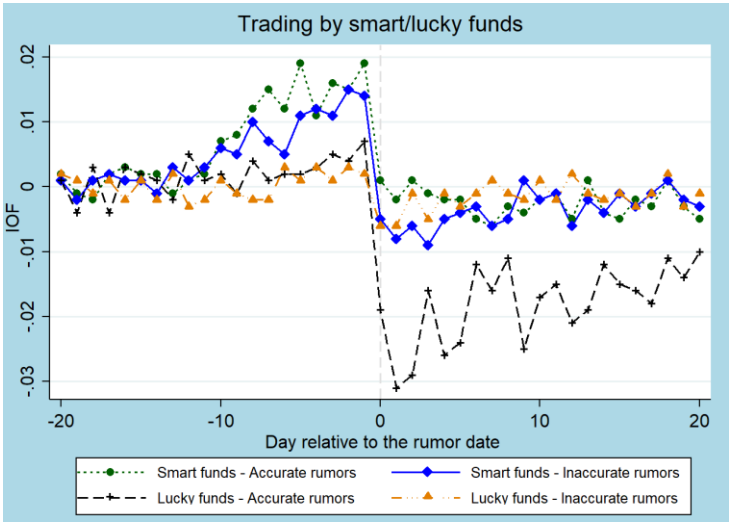


**Table 1. Summary statistics of rumored target firms.**

Panel A shows the time distribution of 1,689 takeover-rumored firms during the period from January 2002 to September 2011. Panel B reports the industry distribution of the sample based on the Fama-French 17 industry classification. For comparison purposes, the industry distribution of active CRSP firms as of December 31, 2011 is also reported. Panel C presents attributes of the rumor sample which have previously been used as determinants of takeover predictability, with definitions provided in Appendix A. Panel D presents summary statistics of the institutional trading attributes for rumored target firms. Panel E shows the CAARs of the rumored firms computed using a standard market model (based on the CRSP value-weighted market index). *P*-values are reported in parentheses and significance at the 10%, 5%, and 1% levels is indicated by *, **, and ***, respectively. The institutional trading data are obtained from ANcerno Ltd. and cover all trades executed by ANcerno clients during the period (-60, +20) relative to the takeover rumor (day 0).

**Panel A: Distribution by year of rumor**

| Year | Rumor count | % of total count |
|---|---|---|
| 2002 | 31 | 1.84 |
| 2003 | 58 | 3.43 |
| 2004 | 84 | 4.97 |
| 2005 | 81 | 4.80 |
| 2006 | 151 | 8.94 |
| 2007 | 150 | 8.88 |
| 2008 | 140 | 8.29 |
| 2009 | 305 | 18.06 |
| 2010 | 307 | 18.18 |
| 2011 | 382 | 12.62 |
| **Total** | 1,689 | 100 |

**Panel B: Industry distribution**

| Fama-French 17 Industry Classification | Rumor count | % of CRSP population | CRSP population |
|---|---|---|---|
| Food | 59 | 46% | 128 |
| Mining and Minerals | 25 | 17% | 146 |
| Oil and Petroleum Products | 129 | 50% | 258 |
| Textiles, Apparel, and Footwear | 34 | 61% | 56 |
| Consumer Durables | 29 | 31% | 93 |
| Chemicals | 22 | 29% | 76 |
| Drugs, Soap, Perfumes, Tobacco | 171 | 72% | 237 |
| Construction and Construction Materials | 34 | 31% | 107 |
| Steel Works | 49 | 94% | 52 |
| Fabricated Products | 2 | 7% | 29 |
| Machinery and Business Equipment | 233 | 42% | 557 |
| Automobiles | 23 | 30% | 76 |
| Transportation | 49 | 28% | 178 |
| Utilities | 6 | 4% | 147 |
| Retail Stores | 109 | 51% | 212 |
| Banks, Insurance Companies, and Other Financials | 8 | 0% | 2,866 |
| Other (Services, Wholesale, etc.) | 707 | 44% | 1,625 |
| **Total** | 1,689 | 25% | 6,843 |

**Panel C: Rumored target firm attributes**

| Variable | N | Mean | Median | SD | Min | Max |
|---|---|---|---|---|---|---|
| Cashratio | 1,614 | 0.222 | 0.138 | 0.225 | 0.001 | 0.931 |
| Changesize2y | 1,567 | 0.307 | 0.131 | 0.675 | -0.651 | 3.966 |
| Concentration | 1,620 | 0.562 | 0.535 | 0.203 | 0.252 | 0.986 |
| Dormancy | 1,687 | 2.135 | 0.1 | 9.321 | 0.033 | 65.533 |
| Infoasymm | 1,585 | 0.056 | 0 | 0.230 | 0 | 1 |
| Prevmergers | 1,689 | 1.036 | 1 | 1.653 | 0 | 13 |
| Priorreturn2y | 1,637 | 0.412 | 0.050 | 1.382 | -0.940 | 8.010 |
| Resmismatch | 1,548 | 0.520 | 1 | 0.499 | 0 | 1 |
| ROA | 1,612 | -0.001 | 0.009 | 0.064 | -0.443 | 0.116 |
| Salesgrowth2y | 1,569 | 0.359 | 0.134 | 1.058 | -0.932 | 8.231 |
| Salesshock | 1,618 | 0.112 | 0.078 | 0.120 | 0 | 0.660 |
| SalesshockSq | 1,618 | 0.027 | 0.006 | 0.063 | 0 | 0.436 |
| Shareturnover | 1,607 | 13.439 | 13.568 | 0.952 | 9.706 | 15.255 |
| Size | 1,614 | 7.531 | 7.633 | 1.696 | 2.540 | 10.853 |

*Continued on the next page*

*Table 1 continued*

**Panel D: Institutional trading attributes for rumored target firms**

| Year | # of trades | # of shares traded (mill.) | $ value of shares traded (bill.) | Average share volume | Median share volume | Average dollar volume | Median dollar volume | # of investment managers | # of plan sponsors |
|---|---|---|---|---|---|---|---|---|---|
| 2002 | 31,105 | 453 | 11.5 | 14,581 | 1,580 | 369,432 | 39,063 | 16 | 147 |
| 2003 | 27,050 | 308 | 6.9 | 11,406 | 1,600 | 249,457 | 31,040 | 14 | 110 |
| 2004 | 73,156 | 800 | 13.1 | 10,941 | 1,000 | 179,020 | 18,275 | 13 | 103 |
| 2005 | 57,723 | 857 | 21.2 | 14,846 | 990 | 368,320 | 29,025 | 13 | 73 |
| 2006 | 156,562 | 1,894 | 53.9 | 12,096 | 770 | 344,384 | 23,612 | 19 | 36 |
| 2007 | 170,790 | 1,521 | 53.7 | 8,908 | 600 | 314,972 | 22,879 | 14 | 32 |
| 2008 | 117,844 | 1,650 | 46.4 | 14,002 | 880 | 393,703 | 26,745 | 68 | 68 |
| 2009 | 1,226,490 | 8,034 | 159.2 | 6,550 | 300 | 129,804 | 7,227 | 148 | 174 |
| 2010 | 1,313,300 | 6,126 | 160.4 | 4,664 | 200 | 122,106 | 5,794 | 145 | 170 |
| 2011 | 1,541,392 | 6,377 | 163.3 | 4,136 | 181 | 105,942 | 5,511 | 127 | 171 |

**Panel E: Abnormal event returns for rumored target firms**

| | N | CAAR(0, +1) | CAAR(-20, -1) | CAAR(+2, +20) | CAAR(-20, +20) |
|---|---|---|---|---|---|
| All rumors | 1,689 | 4.11*** | 1.70* | 0.03 | 5.93*** |
| | | (0.001) | (0.085) | (0.607) | (0.001) |
| Accurate | 359 | 8.63*** | 2.39*** | 1.85** | 13.36*** |
| | | (0.001) | (0.001) | (0.012) | (0.001) |
| Inaccurate | 1,330 | 2.90*** | 1.53* | -0.50 | 3.94** |
| | | (0.001) | (0.097) | (0.173) | (0.018) |
| Informative | 435 | 6.56*** | 2.08** | 0.32 | 9.23*** |
| | | (0.001) | (0.029) | (0.285) | (0.001) |
| Speculative | 304 | 1.79*** | 0.12 | -1.26*** | 0.76 |
| | | (0.001) | (0.471) | (0.008) | (0.152) |

**Table 2. Institutional trading activity**

This table presents daily averages of the ANcerno-based institutional trading measures for all 1,689 takeover-rumored firms during the period (-30, +30), where day 0 represents the initial rumor announcement date. Tests of significance are based on t-tests of individual day observations relative to the (-90, -31) benchmark period distribution prior to the rumor. The significance of multiple day periods, i.e., (-30, -21) and (+21, +30), is evaluated by comparing the daily means across all days in the multiple day period to the daily means of all days in the benchmark period. IBuys (ISales) denote institutional purchases (sales) and are computed based on Equation 1 (2). IOF (IOV) is defined as the difference between (the sum of) the dollar value of institutional purchases and institutional sales. *#Institutions trading* denotes the daily average number of institutions trading per rumored firm. *ANcerno purchases (sales) to CRSP $ volume* is computed as the ratio of the dollar value of institutional purchases, divided by the dollar value of all trades (as reported by CRSP) over a given period. Our methodology matches that of Corwin et al. (2004) and Irvine et al. (2007). Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively. The bracketed signs in Columns 6 and 7 indicate whether the ANcerno purchases/sales to CRSP $ volume are larger (+) or smaller (-) than the respective benchmark values for the period (-90, -31) reported in the last row.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| Relative day | IBuys (% of size) | ISales (% of size) | IOF (% of size) | IOV (% of size) | #Institutions trading | ANcerno purchases to CRSP $ volume | ANcerno sales to CRSP $ volume |
| -30 to -21 | 0.049 | 0.050 | -0.001 | 0.099 | 5.104 | 0.045 (-) | 0.046 (-) |
| -20 | 0.053 | 0.051 | 0.002 | 0.104 | 4.938 | 0.043 (-) | 0.044 (-) |
| -19 | 0.048 | 0.049 | -0.001 | 0.097 | 5.064 | 0.046 (-) | 0.047 (+) |
| -18 | 0.051 | 0.052 | -0.001 | 0.103 | 5.150 | 0.046 (+) | 0.045 (-) |
| -17 | 0.054 | 0.051 | 0.003 | 0.105 | 5.129 | 0.044 (-) | 0.044 (-) |
| -16 | 0.048 | 0.051 | -0.003 | 0.099 | 5.040 | 0.046 (+) | 0.046 (-) |
| -15 | 0.051 | 0.047 | 0.004 | 0.098 | 5.066 | 0.048 (+) | 0.047 (+) |
| -14 | 0.052 | 0.051 | 0.001 | 0.103 | 5.151 | 0.043 (-) | 0.044 (-) |
| -13 | 0.051 | 0.053 | -0.002 | 0.104 | 5.112 | 0.046 (+) | 0.047 (+) |
| -12 | 0.052 | 0.050 | 0.002 | 0.102 | 4.998 | 0.045 (-) | 0.045 (-) |
| -11 | 0.053 | 0.049 | 0.004 | 0.102 | 5.023 | 0.043 (-) | 0.044 (-) |
| -10 | 0.055 | 0.054 | 0.001 | 0.109 | 5.156 | 0.046 (+) | 0.045 (-) |
| -9 | 0.055 | 0.051 | 0.004 | 0.106 | 5.160 | 0.045 (-) | 0.046 (+) |
| -8 | 0.061** | 0.049 | 0.012* | 0.110 | 5.147 | 0.043 (-) | 0.044 (-) |
| -7 | 0.062*** | 0.051 | 0.011* | 0.113 | 5.250** | 0.046 (-) | 0.046 (-) |
| -6 | 0.059** | 0.052 | 0.007 | 0.111 | 5.204 | 0.044 (-) | 0.044 (-) |
| -5 | 0.061*** | 0.051 | 0.010*** | 0.112 | 5.282*** | 0.055** (+) | 0.045 (-) |
| -4 | 0.058 | 0.05 | 0.008** | 0.108 | 5.257*** | 0.058*** (+) | 0.044 (-) |
| -3 | 0.064*** | 0.052 | 0.012*** | 0.116** | 5.192*** | 0.056*** (+) | 0.043 (-) |
| -2 | 0.062*** | 0.053 | 0.009*** | 0.115** | 5.308*** | 0.065*** (+) | 0.043 (-) |
| -1 | 0.071*** | 0.059 | 0.012*** | 0.130*** | 5.424*** | 0.048* (+) | 0.040 (-) |
| 0 | 0.105*** | 0.118*** | -0.013*** | 0.223*** | 6.016*** | 0.037* (-) | 0.048 (+) |
| +1 | 0.076*** | 0.097*** | -0.021*** | 0.173*** | 5.523*** | 0.035** (-) | 0.054** (+) |
| +2 | 0.066*** | 0.082*** | -0.016*** | 0.148*** | 5.438*** | 0.036 (-) | 0.053** (+) |
| +3 | 0.055 | 0.068*** | -0.013*** | 0.123*** | 5.290** | 0.031*** (-) | 0.055*** (+) |
| +4 | 0.061*** | 0.072*** | -0.011*** | 0.133*** | 5.461*** | 0.034** (-) | 0.057*** (+) |
| +5 | 0.059** | 0.069*** | -0.010*** | 0.128*** | 5.278** | 0.034** (-) | 0.055*** (+) |
| +6 | 0.054 | 0.065*** | -0.011*** | 0.119 | 5.295** | 0.036 (-) | 0.048 (+) |
| +7 | 0.058 | 0.074*** | -0.016*** | 0.132*** | 5.092 | 0.033** (-) | 0.051** (+) |
| +8 | 0.054 | 0.060** | -0.006*** | 0.114 | 5.115 | 0.031*** (-) | 0.055*** (+) |
| +9 | 0.056 | 0.067*** | -0.011*** | 0.123** | 5.133 | 0.034** (-) | 0.057*** (+) |
| +10 | 0.051 | 0.059** | -0.008*** | 0.110 | 5.198 | 0.038 (-) | 0.050* (+) |
| +11 | 0.052 | 0.061*** | -0.009*** | 0.113 | 5.156 | 0.041 (-) | 0.053** (+) |
| +12 | 0.051 | 0.065*** | -0.014*** | 0.116 | 5.047 | 0.035 (-) | 0.049* (+) |
| +13 | 0.058 | 0.064*** | -0.006 | 0.122 | 5.088 | 0.038 (-) | 0.048 (+) |
| +14 | 0.057 | 0.065*** | -0.008** | 0.122 | 5.094 | 0.037 (-) | 0.049 (+) |
| +15 | 0.054 | 0.059*** | -0.005 | 0.113 | 5.118 | 0.040 (-) | 0.046 (+) |
| +16 | 0.051 | 0.056 | -0.005 | 0.107 | 5.062 | 0.048 (+) | 0.046 (-) |
| +17 | 0.056 | 0.055 | 0.001 | 0.111 | 5.017 | 0.045 (-) | 0.045 (-) |
| +18 | 0.053 | 0.055 | -0.002 | 0.108 | 5.017 | 0.042 (-) | 0.049* (+) |
| +19 | 0.049 | 0.052 | -0.003 | 0.101 | 5.038 | 0.040 (-) | 0.056*** (+) |
| +20 | 0.052 | 0.054 | -0.002 | 0.106 | 4.995 | 0.040 (-) | 0.048 (+) |
| +21 to +30 | 0.053 | 0.054 | -0.001 | 0.107 | 5.116 | 0.041 (-) | 0.049 (+) |
| Benchmark (-90 to -31) | 0.051 | 0.052 | -0.001 | 0.103 | 5.097 | 0.046 | 0.046 |

**Table 3. Institutional trading activity by rumor type**

This table presents daily averages of the ANcerno-based institutional trading measures for all 1,689 takeover-rumored firms during the period (-30, +30), according to the type of rumor. Rumors are labelled as accurate if the rumored firm in question indeed becomes the target of a formal takeover bid within 365 calendar days after the initial scoop article; otherwise, it is labelled as inaccurate. Speculative rumors are based on either takeover chatter or an increase in option activity in the target firm, without any further explanation provided in the article. Informative rumors are based on at least three rumor justifications, excluding those comprising speculative rumors. Tests of significance are based on t-tests of individual day observations relative to the (-90, -31) benchmark period distribution prior to the rumor. The significance of multiple day periods, i.e., (-30, -21) and (+21, +30), is evaluated by comparing the daily means across all days in the multiple day period to the daily means of all days in the benchmark period. IOF (IOV) is defined as the difference between (the sum of) the dollar value of institutional purchases and institutional sales. Our methodology is identical to Corwin et al. (2004) and Irvine et al. (2007). Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| Relative day | Type of rumor | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Accurate rumors | | Inaccurate rumors | | Informative rumors | | Speculative rumors | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| | IOF | IOV | IOF | IOV | IOF | IOV | IOF | IOV |
| -30 to -21 | 0.001 | 0.103 | -0.001 | 0.098 | 0.001 | 0.090 | -0.001 | 0.130 |
| -20 | -0.001 | 0.103 | 0.003 | 0.104 | 0.006 | 0.089 | -0.003 | 0.129 |
| -19 | -0.002 | 0.108 | -0.001 | 0.094 | -0.003 | 0.096 | -0.002 | 0.128 |
| -18 | 0.002 | 0.106 | -0.002 | 0.102 | -0.004 | 0.095 | 0.005 | 0.134 |
| -17 | -0.001 | 0.107 | 0.004 | 0.104 | 0.005 | 0.099 | 0.001 | 0.124 |
| -16 | 0.000 | 0.102 | -0.004 | 0.098 | 0.001 | 0.098 | 0.007 | 0.125 |
| -15 | -0.001 | 0.099 | 0.005 | 0.098 | 0.001 | 0.087 | -0.002 | 0.129 |
| -14 | 0.000 | 0.104 | 0.001 | 0.103 | 0.004 | 0.084 | -0.005 | 0.120 |
| -13 | 0.003 | 0.105 | -0.003 | 0.104 | -0.005 | 0.097 | -0.005 | 0.125 |
| -12 | 0.006 | 0.102 | 0.001 | 0.102 | 0.001 | 0.085 | 0.006 | 0.119 |
| -11 | 0.008 | 0.106 | 0.003 | 0.101 | -0.003 | 0.089 | 0.006 | 0.126 |
| -10 | 0.013 | 0.117** | -0.002 | 0.107 | 0.006 | 0.090 | 0.009 | 0.133 |
| -9 | 0.008 | 0.112** | 0.003 | 0.104 | 0.010 | 0.092 | 0.004 | 0.121 |
| -8 | 0.015* | 0.113*** | 0.011 | 0.109 | 0.011 | 0.094 | 0.001 | 0.118 |
| -7 | 0.017** | 0.121*** | 0.009 | 0.111 | 0.013** | 0.106 | -0.001 | 0.124 |
| -6 | 0.016** | 0.126*** | 0.005 | 0.107 | 0.006 | 0.089 | 0.002 | 0.134 |
| -5 | 0.026*** | 0.128*** | 0.006** | 0.108 | 0.011* | 0.114* | 0.001 | 0.132 |
| -4 | 0.014** | 0.116** | 0.006* | 0.106 | 0.014*** | 0.090 | 0.002 | 0.128 |
| -3 | 0.023*** | 0.121*** | 0.009** | 0.115 | 0.012** | 0.104 | 0.006 | 0.142* |
| -2 | 0.016*** | 0.120*** | 0.007** | 0.114 | 0.013** | 0.093 | 0.003 | 0.143** |
| -1 | 0.021*** | 0.131*** | 0.010*** | 0.130*** | 0.020*** | 0.119*** | -0.001 | 0.152*** |
| 0 | -0.002 | 0.311*** | -0.016*** | 0.199*** | -0.051*** | 0.306*** | -0.007* | 0.163*** |
| +1 | -0.073*** | 0.290*** | -0.007 | 0.142*** | -0.098*** | 0.258*** | -0.013** | 0.165*** |
| +2 | -0.033*** | 0.144*** | -0.011** | 0.149*** | -0.060*** | 0.163*** | -0.005 | 0.160*** |
| +3 | -0.020*** | 0.128*** | -0.011* | 0.122* | -0.021*** | 0.131*** | -0.011* | 0.135 |
| +4 | -0.030*** | 0.151*** | -0.006 | 0.128** | -0.029*** | 0.130*** | -0.003 | 0.139 |
| +5 | -0.041*** | 0.143*** | -0.002 | 0.124** | -0.022*** | 0.127*** | -0.007 | 0.134 |
| +6 | -0.014*** | 0.129*** | -0.010* | 0.116 | -0.012** | 0.103 | -0.004 | 0.130 |
| +7 | -0.032*** | 0.158*** | -0.012** | 0.125** | -0.047*** | 0.116** | 0.000 | 0.124 |
| +8 | -0.008* | 0.121*** | -0.006 | 0.112 | -0.016*** | 0.110** | 0.003 | 0.118 |
| +9 | -0.056*** | 0.156*** | 0.001 | 0.114 | -0.016*** | 0.126*** | -0.006 | 0.138* |
| +10 | -0.019*** | 0.130*** | -0.005 | 0.105 | -0.009** | 0.106 | -0.007 | 0.162*** |
| +11 | -0.008** | 0.123*** | -0.009* | 0.110 | -0.007** | 0.131*** | 0.000 | 0.128 |
| +12 | -0.053*** | 0.154*** | -0.004 | 0.106 | -0.018*** | 0.132*** | -0.009 | 0.157*** |
| +13 | -0.033*** | 0.149*** | 0.001 | 0.115 | -0.011*** | 0.115** | 0.001 | 0.141** |
| +14 | -0.031*** | 0.152*** | -0.002 | 0.114 | -0.012*** | 0.124*** | 0.000 | 0.132 |
| +15 | -0.018*** | 0.130*** | -0.001 | 0.108 | -0.017*** | 0.105 | 0.004 | 0.139* |
| +16 | -0.031*** | 0.128*** | 0.002 | 0.101 | -0.040*** | 0.133*** | 0.002 | 0.133 |
| +17 | 0.001 | 0.154*** | 0.001 | 0.099 | -0.013*** | 0.099 | 0.005 | 0.121 |
| +18 | -0.013*** | 0.116 | 0.001 | 0.106 | -0.003 | 0.094 | 0.005 | 0.122 |
| +19 | -0.021*** | 0.123** | 0.002 | 0.095 | -0.009** | 0.093 | -0.001 | 0.129 |
| +20 | -0.015*** | 0.121 | 0.001 | 0.102 | -0.007* | 0.098 | -0.003 | 0.126 |
| +21 to +30 | -0.011* | 0.115 | 0.002 | 0.104 | -0.003 | 0.101 | -0.001 | 0.119 |
| Benchmark (-90 to -31) | 0.001 | 0.105 | -0.001 | 0.102 | 0.001 | 0.096 | 0.001 | 0.126 |

**Table 4. Institutional trading activity by momentum quintiles**

This table presents abnormal returns and institutional order flow for our sample of 1,689 takeover-rumored firms by momentum quintiles. Firms are portioned into quintiles based on the cumulative abnormal return over the (-30, -10) window relative to the rumor announcement date (day 0). Tests of significance are based on t-tests of individual day observations relative to the (-90, -31) benchmark period distribution prior to the rumor. IOF is defined as the difference between the dollar value of institutional purchases and institutional sales. AAR denotes daily average abnormal returns computed using a standard market model (based on the CRSP value-weighted market index). Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| Relative | Quintile 1 (low returns) | | Quintile 2 | | Quintile 3 | | Quintile 4 | | Quintile 5 (high returns) | |
|---|---|---|---|---|---|---|---|---|---|---|
| day | AARs | IOF | AARs | IOF | AARs | IOF | AARs | IOF | AARs | IOF |
| -15 | -1.14** | -0.009* | -0.27 | -0.001 | 0.12 | 0.004 | 0.21 | 0.008 | 0.62 | 0.016*** |
| -14 | -0.84* | -0.008* | -0.09 | 0.001 | 0.04 | -0.002 | 0.25 | 0.003 | 0.65 | 0.012** |
| -13 | -0.75 | -0.012** | -0.35 | -0.006 | -0.01 | -0.002 | 0.38 | 0.001 | 0.81** | 0.008 |
| -12 | -0.81 | -0.013** | 0.04 | 0.005 | 0.10 | 0.001 | 0.19 | 0.005 | 0.68* | 0.011** |
| -11 | -0.82* | -0.005 | -0.43 | -0.003 | -0.22 | 0.008 | 0.36 | 0.005 | 0.64 | 0.015*** |
| -10 | -1.62*** | -0.014*** | -0.16 | 0.009 | 0.11 | -0.001 | 0.44 | 0.008 | 1.43*** | 0.003 |
| -9 | 0.96** | -0.007 | 0.16 | 0.009 | -0.13 | 0.005 | 0.10 | 0.004 | 0.22 | 0.009 |
| -8 | -0.13 | 0.005 | 0.06 | 0.011 | -0.02 | 0.006 | 0.19 | 0.009* | 0.20 | 0.031*** |
| -7 | 0.16 | 0.017*** | 0.12 | 0.014** | -0.12 | 0.004 | -0.21 | -0.001 | 0.41 | 0.019*** |
| -6 | 0.35 | 0.011** | -0.35 | -0.002 | 0.18 | 0.015** | -0.04 | 0.008 | -0.12 | 0.005 |
| -5 | 0.12 | 0.012** | 0.23 | 0.004 | 0.29 | 0.003 | 0.09 | 0.017*** | 0.47 | 0.012** |
| -4 | 0.40 | 0.010** | -0.06 | 0.005 | 0.07 | -0.004 | 0.45 | 0.012* | -0.03 | 0.016*** |
| -3 | -0.04 | 0.017*** | -0.09 | 0.021*** | 0.02 | 0.005 | 0.05 | 0.012* | 0.40 | 0.007 |
| -2 | -0.32 | 0.008 | 0.08 | 0.002 | 0.41 | 0.009 | -0.03 | 0.011 | 0.48 | 0.015*** |
| -1 | 0.74** | 0.003 | 0.33 | 0.008* | 0.70** | 0.014*** | 0.88** | 0.016*** | 0.78** | 0.018*** |
| 0 | 3.89*** | -0.015*** | 4.23*** | -0.017*** | 2.84*** | -0.008** | 2.99*** | -0.013*** | 4.64*** | -0.011*** |
| +1 | 0.14 | -0.016*** | 0.07 | -0.012*** | 0.65* | -0.025*** | 1.00*** | -0.021*** | 0.12 | -0.032*** |
| +2 | -0.52 | -0.016*** | 0.06 | -0.021*** | -0.13 | -0.003 | 0.14 | -0.030*** | 0.01 | -0.008 |
| +3 | -0.13 | -0.008* | 0.60 | -0.019*** | -0.16 | -0.008** | -0.02 | -0.004 | 0.24 | -0.024*** |
| +4 | -0.83* | -0.013** | 0.30 | -0.011** | 0.02 | -0.019*** | 0.07 | 0.002 | 0.11 | -0.015*** |
| +5 | -0.32 | -0.010** | 0.15 | 0.003 | -0.04 | -0.025*** | 0.00 | -0.007 | -0.01 | -0.012*** |
| +6 | 0.02 | -0.014*** | -0.02 | 0.001 | -0.28 | -0.023*** | -0.01 | -0.016*** | 0.16 | -0.005 |
| +7 | 0.38 | -0.017*** | 0.24 | -0.009* | 0.07 | -0.031*** | -0.11 | -0.029*** | -0.02 | 0.008 |
| +8 | 0.09 | -0.005 | 0.07 | -0.001 | -0.13 | -0.006 | -0.04 | -0.007 | -0.28 | -0.009* |
| +9 | -0.11 | -0.019*** | -0.17 | -0.013** | -0.12 | 0.003 | -0.09 | -0.014*** | -0.07 | -0.011* |
| +10 | 0.16 | -0.015** | -0.26 | -0.001 | -0.21 | -0.009 | -0.17 | -0.011* | 0.30 | -0.005 |
| +11 | 0.30 | 0.005 | 0.33 | -0.009 | -0.24 | -0.020*** | 0.17 | -0.004 | -0.31 | -0.016*** |
| +12 | -0.22 | -0.012* | 0.10 | -0.013* | -0.11 | -0.018*** | -0.04 | -0.016*** | 0.44 | -0.010 |
| +13 | -0.26 | -0.002 | -0.01 | -0.008 | -0.15 | -0.012** | 0.06 | -0.016*** | -0.37 | 0.008 |
| +14 | 0.36 | -0.014** | 0.04 | -0.007 | -0.09 | -0.015*** | -0.03 | -0.011** | -0.68 | 0.005 |
| +15 | -0.03 | -0.012* | -0.04 | 0.005 | -0.10 | -0.019*** | 0.25 | 0.003 | 0.25 | -0.002 |

**Table 5. The predictive power of institutional trading**

This table reports logit regression results in which the dependent variable is a dummy variable equal to one if the rumor leads to a takeover announcement wihin 365 days, and zero otherwise. The main independent variable of interest is the buy-and-hold cumulative abnormal institutional order flow defined as $BHAIOF_i(t_0, t_1) = \sum_{t_0}^{t_1}(IOF_i - IOF_{i,Benchmark})_t$, where $IOF_i$ is the institutional order flow of firm $i$ and $IOF_{i,Benchmark}$ is the average daily institutional order flow calculated over the (-90, -31) window prior to the rumor date for firm $i$. In Columns 1 and 2 (3 and 4), BHAIOF is computed using institutional trading data over the pre-rumor (post-rumor) periods. In Columns 5 and 6, BHAIOF is computed based on institutional trading pattern over the combined pre- and post-rumor period. The respective time periods are provided next to each variable name. Appendix A provides further variable definitions. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent: *Accurate* | Before rumor | | After rumor | | Around rumor | |
| BHAIOF(-10, -1) | 0.139** | | | | | |
| | (0.025) | | | | | |
| BHAIOF(-5, -1) | | 0.220** | | | | |
| | | (0.032) | | | | |
| BHAIOF(+1, +5) | | | -0.135*** | | | |
| | | | (0.008) | | | |
| BHAIOF(+1, +10) | | | | -0.068*** | | |
| | | | | (0.002) | | |
| BHAIOF(-5, +5) | | | | | -0.175*** | |
| | | | | | (0.001) | |
| BHAIOF(-10, +10) | | | | | | -0.296** |
| | | | | | | (0.001) |
| Informative | 0.975*** | 0.956*** | 0.965*** | 0.970*** | 0.973*** | 0.966*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Speculative | -0.571** | -0.550** | -0.555** | -0.554** | -0.544** | -0.540** |
| | (0.036) | (0.044) | (0.042) | (0.043) | (0.047) | (0.049) |
| Size | -0.252*** | -0.251*** | -0.255*** | -0.254*** | -0.258*** | -0.256*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| CAR(0, +1) | 4.355*** | 4.438*** | 3.896** | 4.004*** | 3.835*** | 3.918** |
| | (0.003) | (0.003) | (0.010) | (0.008) | (0.009) | (0.017) |
| CAR(-5, -1) | 1.192 | 1.189 | 1.250 | 1.274 | 1.341 | 1.314 |
| | (0.173) | (0.172) | (0.155) | (0.147) | (0.128) | (0.133) |
| CAR(-41, -1) | -0.062 | -0.043 | -0.043 | -0.054 | -0.082 | -0.029 |
| | (0.844) | (0.890) | (0.891) | (0.862) | (0.795) | (0.926) |
| ValuableBrand | -0.459** | -0.432* | -0.482** | -0.468** | -0.469** | -0.466** |
| | (0.040) | (0.054) | (0.031) | (0.036) | (0.036) | (0.037) |
| EstDealLikelihood | 0.072 | 0.060 | 0.116 | 0.107 | 0.139 | 0.126 |
| | (0.719) | (0.765) | (0.575) | (0.602) | (0.500) | (0.540) |
| Cashratio | -0.809* | -0.827** | -0.785* | -0.783* | -0.801* | -0.799* |
| | (0.053) | (0.048) | (0.060) | (0.060) | (0.055) | (0.056) |
| Changesize2y | 0.105 | 0.109 | 0.101 | 0.105 | 0.095 | 0.101 |
| | (0.422) | (0.403) | (0.440) | (0.420) | (0.471) | (0.440) |
| Concentration | -0.034 | -0.027 | -0.050 | -0.061 | -0.070 | -0.071 |
| | (0.931) | (0.944) | (0.898) | (0.875) | (0.857) | (0.854) |
| Dormancy | 0.003 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 |
| | (0.773) | (0.756) | (0.794) | (0.802) | (0.810) | (0.788) |
| Infoasymm | 0.155 | 0.162 | 0.151 | 0.157 | 0.156 | 0.150 |
| | (0.617) | (0.599) | (0.626) | (0.614) | (0.617) | (0.629) |
| Prevmergers | 0.061 | 0.061 | 0.061 | 0.061 | 0.059 | 0.058 |
| | (0.193) | (0.189) | (0.190) | (0.195) | (0.206) | (0.213) |
| Priorreturn2y | 0.007 | 0.014 | 0.011 | 0.009 | 0.010 | 0.013 |
| | (0.894) | (0.803) | (0.840) | (0.868) | (0.859) | (0.811) |
| Resmismatch | 0.214 | 0.212 | 0.226 | 0.216 | 0.211 | 0.209 |
| | (0.146) | (0.151) | (0.126) | (0.143) | (0.154) | (0.157) |
| ROA | -0.093 | -0.209 | -0.035 | -0.014 | -0.072 | -0.041 |
| | (0.943) | (0.872) | (0.978) | (0.991) | (0.956) | (0.975) |

*Continued on the next page*

*Table 5 continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| Salesgrowth2y | 0.001 | 0.001 | 0.005 | 0.004 | 0.005 | 0.005 |
| | (0.986) | (0.991) | (0.954) | (0.961) | (0.952) | (0.953) |
| Salesshock | -4.596*** | -4.569*** | -4.653*** | -4.696*** | -4.668*** | -4.799*** |
| | (0.007) | (0.007) | (0.006) | (0.006) | (0.006) | (0.005) |
| SalesshockSq | 5.208 | 5.090 | 5.294* | 5.368* | 5.321* | 5.583* |
| | (0.103) | (0.111) | (0.097) | (0.092) | (0.097) | (0.081) |
| Shareturnover | -0.180** | -0.181** | -0.189** | -0.185** | -0.186** | -0.188** |
| | (0.050) | (0.048) | (0.039) | (0.043) | (0.043) | (0.041) |
| Constant | 2.507** | 2.492** | 2.646** | 2.609** | 2.648** | 2.673** |
| | (0.042) | (0.043) | (0.032) | (0.034) | (0.031) | (0.030) |
| Industry / Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 |
| Pseudo $R^2$ | 0.163 | 0.165 | 0.166 | 0.165 | 0.169 | 0.168 |

**Table 6. Multivariate analysis of rumored target firm cumulative abnormal returns on the rumor date**

This table reports coefficient estimates for a series of OLS regressions of target firm cumulative abnormal returns (CARs) on a number of explanatory variables. CARs are calculated as the sum of the value-weighted market-model abnormal returns for target firms over days (0, +1) relative to the initial rumor date (day 0). Of particular interest are the coefficients of the buy-and-hold cumulative abnormal institutional order flow defined as $BHAIOF_i(t_0, t_1) = \sum_{t_0}^{t_1}(IOF_i - IOF_{i,Benchmark})_t$, where $IOF_i$ is the institutional order flow of firm *i* and $IOF_{i,Benchmark}$ is the average daily institutional order flow calculated over the (-90, -31) window prior to the rumor date for firm *i*. Other variable definitions are provided in Appendix A. Industry fixed effects are based on the Fama-French 17 industry classification. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| Dependent: CAR(0, +1) | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| BHAIOF(-10, -1) | 0.003** | | | | | | |
| | (0.019) | | | | | | |
| BHAIOF(-5, -1) | | 0.022*** | | | | | |
| | | (0.000) | | | | | |
| $IOF_{t-1}$ | | | 0.090*** | | | | |
| | | | (0.000) | | | | |
| $IOV_{t-1}$ | | | | 0.082*** | | | |
| | | | | (0.000) | | | |
| $IBuys_{t-1}$ | | | | | 0.132*** | | 0.131*** |
| | | | | | (0.000) | | (0.000) |
| $ISales_{t-1}$ | | | | | | -0.051** | -0.003 |
| | | | | | | (0.028) | (0.908) |
| Informative | 0.035*** | 0.034*** | 0.035*** | 0.032*** | 0.033*** | 0.034*** | 0.033*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Speculative | -0.029*** | -0.028*** | -0.030*** | -0.031*** | -0.031*** | -0.030*** | -0.031*** |
| | (0.001) | (0.002) | (0.001) | (0.001) | (0.000) | (0.001) | (0.000) |
| Size | -0.003 | -0.003 | -0.001 | -0.001 | 0.000 | -0.002 | 0.000 |
| | (0.552) | (0.524) | (0.868) | (0.830) | (0.996) | (0.579) | (0.998) |
| CAR(-5, -1) | -0.072* | -0.070* | -0.095** | -0.088** | -0.104*** | -0.068* | -0.103*** |
| | (0.069) | (0.078) | (0.017) | (0.024) | (0.008) | (0.087) | (0.009) |
| CAR(-41, -1) | 0.008 | 0.009 | 0.006 | 0.013 | 0.011 | 0.009 | 0.011 |
| | (0.545) | (0.486) | (0.673) | (0.323) | (0.401) | (0.501) | (0.398) |
| ValuableBrand | 0.006 | 0.008 | 0.004 | 0.006 | 0.005 | 0.005 | 0.005 |
| | (0.526) | (0.411) | (0.674) | (0.533) | (0.571) | (0.606) | (0.569) |
| EstAnnReturn | 0.108 | 0.105 | 0.157 | 0.159 | 0.179 | 0.121 | 0.179 |
| | (0.398) | (0.411) | (0.218) | (0.210) | (0.156) | (0.346) | (0.157) |
| Cashratio | -0.014 | -0.015 | -0.009 | -0.012 | -0.009 | -0.015 | -0.009 |
| | (0.455) | (0.423) | (0.604) | (0.502) | (0.610) | (0.422) | (0.608) |
| Changesize2y | -0.009 | -0.008 | -0.009 | -0.009 | -0.009 | -0.009* | -0.009 |
| | (0.108) | (0.134) | (0.110) | (0.113) | (0.119) | (0.100) | (0.119) |
| Concentration | 0.003 | 0.004 | 0.008 | -0.000 | 0.005 | -0.001 | 0.005 |
| | (0.851) | (0.824) | (0.614) | (0.984) | (0.758) | (0.949) | (0.766) |
| Dormancy | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |
| | (0.254) | (0.255) | (0.298) | (0.335) | (0.352) | (0.271) | (0.353) |
| Infoasymm | -0.005 | -0.004 | -0.004 | -0.003 | -0.003 | -0.003 | -0.003 |
| | (0.769) | (0.806) | (0.816) | (0.833) | (0.823) | (0.833) | (0.823) |
| Prevmergers | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 | -0.001 |
| | (0.735) | (0.735) | (0.622) | (0.744) | (0.666) | (0.754) | (0.669) |
| Priorreturn2y | 0.002 | 0.003 | 0.002 | 0.002 | 0.002 | 0.002 | 0.002 |
| | (0.347) | (0.249) | (0.447) | (0.444) | (0.500) | (0.357) | (0.500) |
| Resmismatch | -0.002 | -0.003 | -0.002 | -0.003 | -0.003 | -0.003 | -0.003 |
| | (0.716) | (0.678) | (0.707) | (0.638) | (0.647) | (0.693) | (0.646) |
| ROA | 0.100* | 0.095* | 0.103* | 0.090 | 0.090 | 0.104* | 0.090 |
| | (0.081) | (0.097) | (0.068) | (0.110) | (0.109) | (0.068) | (0.110) |
| Salesgrowth2y | 0.006* | 0.006 | 0.006 | 0.006 | 0.006 | 0.006* | 0.006 |
| | (0.087) | (0.100) | (0.100) | (0.120) | (0.120) | (0.100) | (0.120) |
| Salesshock | 0.038 | 0.041 | 0.055 | 0.050 | 0.060 | 0.037 | 0.060 |
| | (0.596) | (0.565) | (0.445) | (0.485) | (0.401) | (0.609) | (0.402) |

*Continued on the next page*

*Table 6 continued*

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| SalesshockSq | -0.061 | -0.070 | -0.094 | -0.072 | -0.096 | -0.051 | -0.096 |
| | (0.653) | (0.605) | (0.487) | (0.589) | (0.471) | (0.706) | (0.473) |
| Shareturnover | 0.002 | 0.002 | 0.001 | -0.002 | -0.002 | 0.001 | -0.002 |
| | (0.686) | (0.641) | (0.719) | (0.628) | (0.667) | (0.782) | (0.661) |
| Constant | 0.060 | 0.058 | 0.035 | 0.083 | 0.064 | 0.068 | 0.065 |
| | (0.397) | (0.412) | (0.617) | (0.238) | (0.358) | (0.343) | (0.355) |
| Industry / Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 |
| Adjusted $R^2$ | 0.052 | 0.059 | 0.068 | 0.077 | 0.086 | 0.051 | 0.086 |

**Table 7. Classification of smart and lucky funds**

Panel A provides information on the number of funds with positive buy-and-hold cumulative abnormal institutional order flow (BHAIOF) over the 30-day window prior to the takeover rumor. These funds are classified into two groups, smart and lucky, based on the bootstrap methodology discussed in Section 4.5. In Panel B, we compute the aggregate chi-squared statistic as the sum of the chi-squared ($\chi^2$) statistic for each year-fund observation with degrees of freedom equal to the sum of the degrees of freedoms (Adelson, 1966; Johnson, 2005; Ross, 2014). Individual chi-squared statistics are computed under the hypothesis that the probability distribution of the number of times a fund purchases rumored targets in one year is statistically different from the distribution in the following year.

**Panel A: Fund classification**

| Year | N | Smart | Lucky |
|---|---|---|---|
| 2002 | 236 | 29 | 207 |
| 2003 | 305 | 37 | 268 |
| 2004 | 460 | 52 | 408 |
| 2005 | 594 | 76 | 518 |
| 2006 | 728 | 83 | 645 |
| 2007 | 861 | 105 | 756 |
| 2008 | 1,172 | 99 | 1,073 |
| 2009 | 1,258 | 107 | 1,151 |
| 2010 | 1,322 | 112 | 1,110 |
| 2011 | 896 | 85 | 811 |

**Panel B: Transition between the smart and lucky categories (contingency table)**

| | Smart | | | | Lucky | | | |
|---|---|---|---|---|---|---|---|---|
| Period | Persistent | Non-persistent | $\sum \chi^2$ | P-value | Persistent | Non-persistent | $\sum \chi^2$ | P-value |
| 2002 – 2003 | 23 | 6 | 44.543 | 0.054 | 72 | 135 | 21.697 | 0.892 |
| 2003 – 2004 | 28 | 9 | 67.098 | 0.023 | 107 | 161 | 24.215 | 0.914 |
| 2004 – 2005 | 41 | 11 | 91.761 | 0.002 | 149 | 259 | 28.630 | 0.979 |
| 2005 – 2006 | 60 | 16 | 129.124 | 0.005 | 151 | 367 | 47.578 | 0.781 |
| 2006 – 2007 | 71 | 12 | 153.836 | 0.001 | 203 | 442 | 56.492 | 0.895 |
| 2007 – 2008 | 86 | 19 | 177.925 | 0.004 | 215 | 541 | 59.736 | 0.885 |
| 2008 – 2009 | 77 | 22 | 207.442 | 0.001 | 354 | 719 | 82.128 | 0.735 |
| 2009 – 2010 | 96 | 11 | 145.174 | 0.006 | 317 | 834 | 78.439 | 0.842 |
| 2010 – 2011 | 104 | 8 | 123.678 | 0.021 | 246 | 864 | 60.561 | 0.902 |

**Table 8. Daily trading activity of smart funds**

This table presents daily averages of smart fund trading measures for all 1,689 takeover-rumored firms during the period (-30, +30), where day 0 represents the initial rumor announcement date. IOF (IOV) is defined as the difference between (the sum of) the dollar value of institutional purchases and institutional sales. Tests of significance are based on t-tests of individual day observations relative to the (-90, -31) benchmark period distribution prior to the rumor. The significance of multiple day periods, i.e., (-30, -21) and (+21, +30), is evaluated by comparing the daily means across all days in the multiple day period to the daily means of all days in the benchmark period. Our methodology matches that of Corwin et al. (2004) and Irvine et al. (2007). Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | All rumors | | *Accurate* rumors | | *Inaccurate* rumors | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Relative day | IOF | IOV | IOF | IOV | IOF | IOV |
| -30 to -21 | 0.002 | 0.014 | 0.002 | 0.016 | 0.001 | 0.014 |
| -20 | 0.001 | 0.017 | 0.002 | 0.015 | 0.001 | 0.018 |
| -19 | -0.003 | 0.015 | -0.001 | 0.016 | -0.002 | 0.015 |
| -18 | 0.001 | 0.016 | -0.002 | 0.017 | 0.001 | 0.016 |
| -17 | 0.002 | 0.018 | 0.002 | 0.014 | 0.002 | 0.019 |
| -16 | 0.001 | 0.015 | 0.003 | 0.015 | 0.001 | 0.015 |
| -15 | 0.002 | 0.019 | 0.002 | 0.015 | 0.001 | 0.020* |
| -14 | 0.001 | 0.016 | 0.002 | 0.016 | -0.001 | 0.016 |
| -13 | 0.002 | 0.013 | -0.001 | 0.014 | 0.003 | 0.013 |
| -12 | 0.001 | 0.012 | 0.001 | 0.017 | 0.001 | 0.011 |
| -11 | 0.003 | 0.020* | 0.002 | 0.018 | 0.003 | 0.020* |
| -10 | 0.006 | 0.021** | 0.007* | 0.024** | 0.006 | 0.021** |
| -9 | 0.006 | 0.016 | 0.008** | 0.019* | 0.005 | 0.015 |
| -8 | 0.010** | 0.016 | 0.012** | 0.022** | 0.010** | 0.015 |
| -7 | 0.009** | 0.020** | 0.015*** | 0.029*** | 0.007** | 0.017 |
| -6 | 0.006** | 0.021** | 0.012*** | 0.034*** | 0.005* | 0.018 |
| -5 | 0.013*** | 0.027*** | 0.019*** | 0.032*** | 0.011** | 0.026*** |
| -4 | 0.012*** | 0.022*** | 0.011*** | 0.029*** | 0.012*** | 0.020*** |
| -3 | 0.012*** | 0.027*** | 0.016*** | 0.024*** | 0.011*** | 0.028*** |
| -2 | 0.015*** | 0.027*** | 0.015*** | 0.028*** | 0.015*** | 0.027*** |
| -1 | 0.015*** | 0.033*** | 0.019*** | 0.031*** | 0.014*** | 0.033*** |
| 0 | -0.004*** | 0.054*** | 0.001 | 0.052*** | -0.005*** | 0.054*** |
| +1 | -0.007*** | 0.038*** | -0.002 | 0.064*** | -0.008*** | 0.031*** |
| +2 | -0.005*** | 0.022*** | 0.001 | 0.029*** | -0.006*** | 0.020** |
| +3 | -0.007*** | 0.022** | -0.001 | 0.017* | -0.009*** | 0.023*** |
| +4 | -0.004*** | 0.025*** | -0.002 | 0.027*** | -0.005*** | 0.024*** |
| +5 | -0.004*** | 0.022*** | -0.002 | 0.024*** | -0.004*** | 0.022*** |
| +6 | -0.003 | 0.020** | -0.005** | 0.026*** | -0.003** | 0.018* |
| +7 | -0.006*** | 0.027*** | -0.006** | 0.021** | -0.006*** | 0.028*** |
| +8 | -0.005** | 0.021** | -0.003 | 0.016 | -0.005*** | 0.022*** |
| +9 | 0.001 | 0.021** | -0.004 | 0.018 | 0.001 | 0.022** |
| +10 | -0.002 | 0.022** | -0.002 | 0.017 | -0.002* | 0.023*** |
| +11 | -0.001 | 0.020** | -0.001 | 0.019** | -0.001 | 0.020** |
| +12 | -0.006** | 0.017 | -0.005* | 0.014 | -0.006*** | 0.018 |
| +13 | -0.001 | 0.019** | 0.001 | 0.024*** | -0.002 | 0.018* |
| +14 | -0.004** | 0.023** | -0.004* | 0.025*** | -0.004** | 0.023** |
| +15 | -0.002 | 0.019** | -0.005 | 0.019** | -0.001 | 0.019* |
| +16 | -0.003 | 0.020** | -0.002 | 0.021** | -0.003* | 0.020** |
| +17 | -0.001 | 0.020** | -0.003 | 0.017 | -0.001 | 0.021** |
| +18 | 0.001 | 0.021** | 0.001 | 0.023** | 0.001 | 0.021** |
| +19 | -0.002 | 0.016 | -0.003 | 0.019 | -0.002 | 0.015 |
| +20 | -0.003 | 0.015 | -0.005 | 0.015 | -0.003 | 0.015 |
| +21 to +30 | -0.001 | 0.017 | -0.002 | 0.019 | -0.001 | 0.016 |
| Benchmark (-90 to -31) | 0.001 | 0.015 | -0.001 | 0.017 | 0.001 | 0.015 |

**Table 9. Daily trading activity of lucky funds**

This table presents daily average trading measures of lucky funds for all 1,689 takeover-rumored firms during the period (-30, +30), where day 0 represents the initial rumor announcement date. IOF (IOV) is defined as the difference between (the sum of) the dollar value of institutional purchases and institutional sales. Tests of significance are based on t-tests of individual day observations relative to the (-90, -31) benchmark period distribution prior to the rumor. The significance of multiple day periods, i.e., (-30, -21) and (+21, +30), is evaluated by comparing the daily means across all days in the multiple day period to the daily means of all days in the benchmark period. Our methodology matches that of Corwin et al. (2004) and Irvine et al. (2007). Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | All rumors | | *Accurate* rumors | | *Inaccurate* rumors | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Relative day | IOF | IOV | IOF | IOV | IOF | IOV |
| -30 to -21 | 0.001 | 0.047 | 0.002 | 0.048 | 0.001 | 0.047 |
| -20 | 0.002 | 0.043 | 0.001 | 0.039 | 0.002 | 0.044 |
| -19 | 0.001 | 0.042 | -0.004 | 0.046 | 0.001 | 0.041 |
| -18 | 0.001 | 0.048 | 0.003 | 0.041 | -0.001 | 0.050* |
| -17 | 0.001 | 0.053** | -0.004 | 0.049* | 0.001 | 0.054** |
| -16 | -0.001 | 0.049 | 0.003 | 0.035 | -0.002 | 0.054** |
| -15 | 0.001 | 0.039 | 0.002 | 0.037 | 0.001 | 0.040 |
| -14 | -0.001 | 0.044 | 0.001 | 0.039 | -0.002 | 0.045 |
| -13 | 0.001 | 0.053** | -0.002 | 0.045 | 0.002 | 0.055** |
| -12 | -0.001 | 0.049* | 0.005 | 0.038 | -0.003 | 0.053* |
| -11 | -0.001 | 0.046 | 0.001 | 0.044 | -0.002 | 0.047 |
| -10 | 0.001 | 0.050 | 0.002 | 0.045 | 0.001 | 0.051 |
| -9 | -0.001 | 0.046 | -0.001 | 0.048 | -0.001 | 0.045 |
| -8 | -0.001 | 0.039 | 0.004 | 0.047* | -0.002 | 0.037 |
| -7 | -0.001 | 0.048 | 0.001 | 0.043 | -0.002 | 0.049 |
| -6 | 0.003 | 0.045 | 0.002 | 0.039 | 0.003 | 0.047 |
| -5 | 0.001 | 0.040 | 0.002 | 0.042 | 0.001 | 0.040 |
| -4 | 0.003 | 0.048 | 0.003 | 0.036 | 0.003 | 0.051 |
| -3 | 0.002 | 0.052* | 0.005 | 0.039 | 0.001 | 0.056* |
| -2 | 0.003 | 0.047 | 0.004 | 0.035 | 0.003 | 0.050 |
| -1 | 0.004* | 0.057** | 0.007* | 0.048* | 0.002 | 0.060** |
| 0 | -0.009*** | 0.113*** | -0.019*** | 0.213*** | -0.006*** | 0.086*** |
| +1 | -0.011*** | 0.078*** | -0.031*** | 0.123*** | -0.006*** | 0.066*** |
| +2 | -0.007*** | 0.075*** | -0.029*** | 0.076*** | -0.001 | 0.075*** |
| +3 | -0.007*** | 0.049** | -0.016*** | 0.055*** | -0.005** | 0.047* |
| +4 | -0.006*** | 0.066*** | -0.026*** | 0.072*** | -0.001 | 0.065*** |
| +5 | -0.007*** | 0.057*** | -0.024*** | 0.077*** | -0.003** | 0.052*** |
| +6 | -0.003** | 0.050*** | -0.012*** | 0.068*** | -0.001 | 0.045 |
| +7 | -0.004** | 0.055** | -0.016*** | 0.077*** | 0.001 | 0.049* |
| +8 | -0.003* | 0.049** | -0.011*** | 0.068*** | -0.001 | 0.044 |
| +9 | -0.007*** | 0.053** | -0.025*** | 0.067*** | -0.002** | 0.049** |
| +10 | -0.003* | 0.046* | -0.017*** | 0.059*** | 0.001 | 0.043 |
| +11 | -0.005*** | 0.053** | -0.015*** | 0.065*** | -0.002** | 0.050** |
| +12 | -0.003 | 0.049** | -0.021*** | 0.063*** | 0.002 | 0.045 |
| +13 | -0.005** | 0.050** | -0.019*** | 0.067*** | -0.001 | 0.046 |
| +14 | -0.004** | 0.048** | -0.012*** | 0.059*** | -0.002* | 0.045 |
| +15 | -0.004** | 0.052*** | -0.015*** | 0.055*** | -0.001* | 0.051** |
| +16 | -0.006*** | 0.045 | -0.016*** | 0.062*** | -0.003* | 0.041 |
| +17 | -0.005 | 0.046 | -0.018*** | 0.044** | -0.001 | 0.046 |
| +18 | -0.001 | 0.043 | -0.011*** | 0.051** | 0.002 | 0.041 |
| +19 | -0.005** | 0.048* | -0.014*** | 0.055*** | -0.003* | 0.046 |
| +20 | -0.003* | 0.047 | -0.010*** | 0.055** | -0.001 | 0.045 |
| +21 to +30 | -0.003** | 0.046 | -0.009** | 0.051** | -0.001 | 0.045 |
| Benchmark (-90 to -31) | -0.001 | 0.044 | 0.001 | 0.042 | -0.001 | 0.045 |

**Table 10. The predictive power of trades by smart and lucky funds**

This table reports logit regression results in which the dependent variable is a dummy variable equal to one if the rumor leads to a takeover announcement wihin 365 days. The main independent variable of interest is the buy-and-hold cumulative abnormal institutional order flow defined as $BHAIOF_i(t_0, t_1) = \sum_{t_0}^{t_1}(IOF_i - IOF_{i,Benchmark})_t$, where $IOF_i$ is the institutional order flow of firm *i* and $IOF_{i,Benchmark}$ is the average daily institutional order flow calculated over the (-90, -31) window prior to the rumor date for firm *i*. Appendix A provides other variable definitions. Panel A shows regression estimates for smart funds while Panel B presents the results for lucky funds. Some controls are insignificant and untabulated for brevity. They include the following variables: *ValuableBrand, EstDealLikelihood, Cashratio, Changesize2y, Concentration, Dormancy, Infoasymm, Prevmergers, Priorreturn2y, Resmismatch, ROA, Salesgrowth2y, Salesshock, SalesshockSq,* and *Shareturnover*. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| **Panel A: The predictive power of *smart* fund trades** | | | | | | |
|---|---|---|---|---|---|---|
| Dependent: *Accurate* | (1) | (2) | (3) | (4) | (5) | (6) |
| BHAIOF(-10, -1) $_{smart}$ | 0.722** | | | | | |
| | (0.017) | | | | | |
| BHAIOF(-5, -1) $_{smart}$ | | 1.041** | | | | |
| | | (0.035) | | | | |
| BHAIOF(+1, +5) $_{smart}$ | | | 5.408** | | | |
| | | | (0.019) | | | |
| BHAIOF(+1, +10) $_{smart}$ | | | | 3.296** | | |
| | | | | (0.013) | | |
| BHAIOF(-5, +5) $_{smart}$ | | | | | 6.253*** | |
| | | | | | (0.004) | |
| BHAIOF(-10, +10) $_{smart}$ | | | | | | 3.812** |
| | | | | | | (0.011) |
| Informative | 0.935*** | 0.906*** | 0.973*** | 0.986*** | 0.924*** | 0.897*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Speculative | -0.586** | -0.612** | -0.575** | -0.569** | -0.598** | -0.598** |
| | (0.033) | (0.029) | (0.038) | (0.039) | (0.033) | (0.034) |
| Size | -0.252*** | -0.243*** | -0.267*** | -0.252*** | -0.241*** | -0.239*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| CAR(0, +1) | 4.351*** | 4.377*** | 4.082*** | 4.149*** | 4.461*** | 4.454*** |
| | (0.004) | (0.003) | (0.006) | (0.004) | (0.003) | (0.004) |
| CAR(-5, -1) | 0.874 | 0.916 | 1.354 | 1.415 | 0.326 | 0.278 |
| | (0.365) | (0.309) | (0.113) | (0.106) | (0.748) | (0.763) |
| CAR(-41, -1) | -0.027 | -0.031 | -0.094 | -0.099 | 0.029 | 0.046 |
| | (0.943) | (0.929) | (0.772) | (0.771) | (0.854) | (0.875) |
| Constant | 2.742** | 2.709** | 1.991 | 2.027* | 3.163** | 3.215** |
| | (0.026) | (0.031) | (0.105) | (0.098) | (0.014) | (0.010) |
| Observations | 1459 | 1459 | 1459 | 1459 | 1459 | 1459 |
| Industry / Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Pseudo $R^2$ | 0.174 | 0.168 | 0.170 | 0.171 | 0.189 | 0.193 |
| **Panel B: The predictive power of *lucky* fund trades** | | | | | | |
| Dependent: *Accurate* | (1) | (2) | (3) | (4) | (5) | (6) |
| BHAIOF(-5, -1) $_{lucky}$ | 0.127 | | | | | |
| | (0.483) | | | | | |
| BHAIOF(-10, -1) $_{lucky}$ | | 0.072 | | | | |
| | | (0.695) | | | | |
| BHAIOF(+1, +5) $_{lucky}$ | | | -0.163*** | | | |
| | | | (0.002) | | | |
| BHAIOF(+1, +10) $_{lucky}$ | | | | -0.132*** | | |
| | | | | (0.009) | | |
| BHAIOF(-5, +5) $_{lucky}$ | | | | | -0.472** | |
| | | | | | (0.018) | |
| BHAIOF(-10, +10) $_{lucky}$ | | | | | | -0.188** |
| | | | | | | (0.041) |

*Continued on the next page*

*Table 10 continued*

| | | | | | | |
|---|---|---|---|---|---|---|
| Informative | 0.987*** | 0.986*** | 0.965*** | 0.961*** | 0.959*** | 0.964*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Speculative | -0.564** | -0.578** | -0.562** | -0.556** | -0.541** | -0.551** |
| | (0.039) | (0.035) | (0.040) | (0.043) | (0.048) | (0.045) |
| Size | -0.251*** | -0.253*** | -0.246*** | -0.248*** | -0.252*** | -0.251*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| CAR(0, +1) | 4.229*** | 4.402*** | 3.934*** | 3.852** | 3.452** | 3.745** |
| | (0.004) | (0.003) | (0.009) | (0.011) | (0.022) | (0.013) |
| CAR(-5, -1) | 1.229 | 1.202 | 1.292 | 1.290 | 1.356 | 1.324 |
| | (0.162) | (0.171) | (0.147) | (0.142) | (0.123) | (0.131) |
| CAR(-41, -1) | -0.054 | -0.065 | -0.029 | -0.038 | -0.035 | -0.029 |
| | (0.879) | (0.842) | (0.918) | (0.905) | (0.917) | (0.922) |
| Constant | 2.472** | 2.213* | 2.335* | 2.508** | 2.392** | 2.256* |
| | (0.046) | (0.057) | (0.051) | (0.043) | (0.049) | (0.055) |
| Observations | 1459 | 1459 | 1459 | 1459 | 1459 | 1459 |
| Industry / Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Pseudo $R^2$ | 0.165 | 0.166 | 0.169 | 0.171 | 0.175 | 0.169 |

**Table 11. The profitability of institutional trading**

This table reports the abnormal profit (in thousands of dollars) of smart and lucky funds in rumored target firms over different trading horizons. Panel A shows the abnormal holding-period profit of smart and lucky funds for the whole sample while Panel B (C) presents the results for accurately (inaccurately) rumored firms. We use actual execution prices and executed volumes to calculate the raw profits and apply the DGTW benchmark (as per Daniel, Grinblatt, Titman, and Wermers, 1997) over the holding periods to calculate the abnormal profits. We use the volume-weighted average execution price of buys (sells) when funds execute multiple buy (sell) transactions and acknowledge any unrealized profit as of the end of the trading period by marking the net positions to market at the end of each trading horizon. P-values are in parentheses. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| **Panel A: All rumors** | | | | | | |
|---|---|---|---|---|---|---|
| | Before trading commissions | | | After trading commissions | | |
| | (1) | (2) | (3) | (4) | (5) | (6) |
| Trade window | Smart | Lucky | Difference | Smart | Lucky | Difference |
| [-30, +30] | 417.0*** | 91.9* | 325.2*** | 365.9*** | 70.7 | 295.1** |
| | (0.003) | (0.054) | (0.009) | (0.008) | (0.113) | (0.014) |
| [-20, +20] | 342.9*** | 107.6** | 237.5** | 309.5*** | 70.1* | 239.5** |
| | (0.001) | (0.031) | (0.015) | (0.006) | (0.096) | (0.011) |
| [-5, +5] | 303.2*** | 120.8** | 182.4** | 267.5** | 99.1** | 168.4** |
| | (0.007) | (0.024) | (0.016) | (0.015) | (0.047) | (0.021) |
| **Panel B: Accurate rumors** | | | | | | |
| [-30, +30] | 707.0*** | 193.9** | 513.0*** | 644.8*** | 156.6** | 488.2** |
| | (0.001) | (0.016) | (0.003) | (0.005) | (0.035) | (0.010) |
| [-20, +20] | 534.7*** | 157.1*** | 377.6*** | 478.0*** | 119.5** | 359.6*** |
| | (0.001) | (0.008) | (0.002) | (0.004) | (0.017) | (0.007) |
| [-5, +5] | 443.9*** | 135.5*** | 308.3*** | 417.5*** | 107.0** | 310.4*** |
| | (0.002) | (0.003) | (0.007) | (0.007) | (0.021) | (0.007) |
| **Panel C: Inaccurate rumors** | | | | | | |
| [-30, +30] | 338.7*** | 64.4 | 274.3** | 290.6** | 47.4 | 243.2** |
| | (0.008) | (0.127) | (0.019) | (0.012) | (0.269) | (0.023) |
| [-20, +20] | 291.1*** | 91.4* | 199.7** | 263.8*** | 56.8* | 207.0** |
| | (0.004) | (0.064) | (0.037) | (0.009) | (0.089) | (0.032) |
| [-5, +5] | 265.2** | 116.8** | 148.4** | 227.0** | 96.9* | 130.1* |
| | (0.012) | (0.039) | (0.040) | (0.026) | (0.061) | (0.053) |

# Appendix A. Variable definitions

| *Variable* | **Definition** |
|---|---|
| *Accurate* | Dummy variable that equals one if the rumored target firm becomes subject to a formal takeover announcement within one calendar year after the initial rumor date; otherwise the variable equals zero (Ahern and Sosyura, 2015; Betton et al., 2018). |
| *ANcerno purchases to CRSP $ volume* | The ratio of the dollar value of institutional purchases, divided by the dollar value of all trades (as reported by CRSP) over a given period. Institutional purchases are computed based on the sample of institutions covered in the ANcerno database (Ahern and Sosyura, 2015). |
| *ANcerno sales to CRSP $ volume* | The ratio of the dollar value of institutional sales, divided by the dollar value of all trades (as reported by CRSP) over a given period. Institutional sales are computed based on the sample of institutions covered in the ANcerno database (Ahern and Sosyura, 2015). |
| *BHAIOF($t_0$,$t_1$)* | Buy-and-hold cumulative abnormal institutional order flow, computed as the difference between the daily institutional order flow (IOF) and the benchmark level of IOF (measured as the daily average IOF over the period (-90, -31)), aggregated over the period ($t_0$,$t_1$): $BHAIOF_i(t_0, t_1) = \sum_{t_0}^{t_1}(IOF_i - IOF_{i,Benchmark})_t$ (Hendershott et al., 2015). |
| *CAR* | Cumulative abnormal return on the rumor date, computed using a standard market model based on the CRSP value-weighted market index (Campbell et al., 1997). |
| *CashRatio* | The ratio of cash and marketable securities to marketable assets (Cornett et al., 2011). |
| *ChangeSize2Yrs* | The percentage change in the firm's total assets over the previous two years (Cornett et al., 2011). |
| *Concentration* | The ratio of the sales of the largest four firms to the total three-digit SIC industry sales of the target firm (Cornett et al., 2011). |
| *Dormancy* | The number of months since the last merger in the same three-digit SIC industry as the target firm (Cornett et al., 2011). |
| *EstAnnReturn* | The expected announcement return of the target firm if a takeover announcement does come true, estimated from a linear regression of target announcement day returns on target size, industry, and year fixed effects in a sample of 2,342 official merger announcements of public targets over the period from 2002 to 2011 as provided by the SDC database (Ahern and Sosyura, 2015). |
| *EstDealLikelihood* | The rumor date target firm return divided by the EstAnnReturn (Ahern and Sosyura, 2015). |
| *Infoasymm* | An indicator variable equal to one if a firm's stock price is both overvalued (with a market-to-book value greater than the industry median) and opaque (the share turnover is lower than the industry median) (Cornett et al., 2011). |
| *IBuys* | The aggregated dollar value of institutional purchases normalized by the firm's market capitalization, lagged by one year (Hendershott et al., 2015). |
| *ISales* | The aggregated dollar value of institutional sales normalized by the firm's market capitalization, lagged by one year (Hendershott et al., 2015). |
| *IOF* | The difference between institutional purchases, IBuys, and institutional sales, ISales (Hendershott et al., 2015). |
| *IOV* | The sum of institutional purchases, IBuys, and institutional sales, ISales (Hendershott et al., 2015). |
| *PrevMergers* | Count variable of the number of times a firm proposes or receives a merger bid in the prior two years (Cornett et al., 2011). |
| *PriorReturn2Yrs* | The change in a firm's stock price in the two years prior to a given quarter (Cornett et al., 2011). |
| *ResMismatch* | Dummy variable that equals one if either i) a firm's sales growth in the last two years is less than the industry median and the long-term debt ratio is greater than the industry median, or ii) the firm's sales growth in the last two years is greater than the industry median and the long-term debt ratio is less than the industry median; otherwise the variable equals zero (Cornett et al., 2011). |
| *ROA* | Ratio of net income before extraordinary (or nonrecurring) items to total assets at the end of the fiscal year prior to the control or pre-rumor period (Cornett et al., 2011). |
| *SalesGrowth2Yrs* | The percentage change in the firm's sales over the previous two years (Cornett et al., 2011). |

| | |
|---|---|
| *SalesShock* | The absolute value of the difference between the two-year median industry sales growth rate and the two-year median sales growth rate of all sample target firms (Cornett et al., 2011). |
| *SalesShockSq* | The square of sales shock (Cornett et al., 2011). |
| *ShareTurnover* | The ratio of the number of the firm's shares of stock traded to total shares outstanding (Cornett et al., 2011). |
| *ValuableBrand* | An indicator variable representing target firm inclusion in a list of the top 100 brands from the marketing consultancy firms Interbrand and BrandZ at any time between 2002 and 2011 (Ahern and Sosyura, 2015). |
| *#Institutions trading* | The daily number of institutions trading in a firm (Irvine et al., 2007). |

**Rumor content characteristics (rationales)**

| ***Variable*** | **Definition** |
|---|---|
| *AdvisorHired* | Rumor indicates that the target firm has retained the services of an investment bank or financial advisor. |
| *AnalystReport* | Rumor is the result of one or more analysts reasoning that a takeover seems logical. |
| *BidderDenied* | Rumor indicates that a potential bidding firm denies that parties are in negotiations. |
| *BidderMentioned* | Rumor indicates the name of one or more potential bidders. |
| *BlockPurchase* | Rumor indicates that 5% or more of shares outstanding have recently been purchased by a single entity. |
| *FinancingSource* | Rumor provides substantial details as to how financing for the deal would occur. |
| *IndustryActivity* | Rumor indicates that either a competitor is being taken over or that the target industry appears ripe for takeovers. |
| *Informative* | Rumor based on at least three rumor justifications, excluding those labeled as speculative. |
| *InsiderCited* | Rumor predicated on an anonymous source. |
| *MgmtConcerns* | Rumor indicates concerns with the current management. |
| *OptionsIncreased* | Rumor specifically mentions that an increase in call options is indicative of an impending takeover. |
| *PEFundInvolved* | Rumor indicates that a private equity or hedge fund has expressed interest in a potential takeover deal. |
| *Speculative* | Rumor based solely on either takeover chatter or an increase in option activity in the target firm, with no further justification provided. |
| *SynergyCited* | Rumor indicates that the target firm has specific attributes that would provide unique synergies to an acquirer. |
| *TakeoverChatter* | Rumor provides very few details yet mentions that the target firm is subject to ongoing takeover chatter. |
| *TargetDenied* | Rumor indicates that the target firm denies that parties are in negotiations. |
| *TargetDistress* | Rumor indicates that the target firm has been experiencing substantial financial and/or operating distress. |
| *TargetInitiated* | Rumor is initiated by the target firm itself. |
| *Undervalued* | Rumor indicates that the target firm can be seen as undervalued, prompting takeover interest. |
| *UnusualActivity* | Rumor indicates that something unusual has occurred that has led to takeover speculation (e.g., two chief executive officers simultaneously absent from a conference or other changes in executive team schedules or habits). |

# Internet Appendix for
# Institutional Trading in Firms Rumored to be Takeover Targets

Frederick Davis, Hamed Khadivar, Thomas J. Walker

This Internet Appendix has four parts. Section A-I presents the comparison of institutional order flow (IOF) within our sample to that of a control sample matched on proxies of takeover likelihood. Section A-II provides analysis of the bid-ask spread, the abnormal volume of transactions, and the activity of short-sellers to ensure evidence is consistent with the presence of informed trading around the rumor date. Section A-III supplements our main analysis of institutional order flow by ensuring that results are robust to various definitions of rumor accuracy. Finally, Section A-IV demonstrates the significance of institutional order flow according to the content of the rumor article.

## A-I. Control Sample Formation Based on Takeover Likelihood

To examine whether the unusual institutional trading activity we document may be due to institutions analyzing publicly available information, we use propensity score matching to construct a control sample based on common proxies of takeover likelihood. Specifically, we match on firm leverage, firm size, the market-to-book ratio, the return on assets, the presence of a blockholder, and the presence of same-industry (at the three-digit SIC code level) bids within the prior year (Hasbrouck, 1985; Palepu, 1986; Ambrose and Megginson, 1992; Cremers et al. 2009; Cornett et al., 2011).[39] We choose that firm as the control firm which has the closest takeover propensity score (the smallest Mahalanobis distance) relative to the rumored firm at the end of the fiscal year prior to the takeover rumor.

As presented in Table A1, we note that our control firms show no signs of abnormal IOF (Column 3). Moreover, the difference in IOF (i.e., the rumored firms' IOF minus the control firms' IOF) is significantly positive shortly prior to the rumor, and significantly negative shortly thereafter

[39] We define a blockholder as an institutional investor holding 5% or more of a firm's shares outstanding.

(Column 5), supporting our prior findings.

***Insert Table A1 about here***

**A-II. Intraday Analysis around the Rumor Date**

We perform additional analyses to provide insight into who is trading around the rumor date and whether such trading is informed. We begin by calculating abnormal daily bid-ask spreads prior to takeover rumors for rumored firms and their matched peers. We obtain the respective intraday information from Trade-and-Quote (TAQ) and follow the algorithm of Lee and Ready (1991) to distinguish between buyer-and seller-initiated transactions. We then follow Holden and Jacobsen (2014) and apply the filters and adjustments for withdrawn or canceled quotes and compute the effective bid-ask spread as the percentage increase in the ratio of the transaction price over the prevailing mid-quote prior to the transaction.[40] As per Peress and Schmidt (2020), for every firm in our sample we construct the abnormal spread measure by subtracting the average daily spread during the benchmark period (-90, -31) from its daily spread, scaled by the benchmark period average.

In order to ensure that our intraday analyses are not driven by takeover time-series clustering and industry-level variation (Mitchell and Mulherin, 1996), we match every rumored firm with a control firm with the same three-digit SIC code and the smallest Mahalonobis distance calculated along three dimensions: the firms' market capitalization (natural logarithm), their market-to-book ratio, and their past stock return (the average daily stock return during the last six months prior to the rumor, adjusted using the CRSP equally-weighted market index). We follow Gao and Oler (2012) and define the universe of possible matching firms as all firms in the intersection of CRSP and Compustat that have financial statement data available as of the most recent month-end at least 30 days before the rumor date.

***Insert Figure A1 about here***

Our results are plotted in Figure A1 and show that, shortly prior to the rumor, the abnormal

[40] The code for making these adjustments is available on Craig Holden's web page (http://kelley.iu.edu/cholden/). In addition, we find similar results when using share-weighted and dollar volume-weighted spread measures instead of the price spread.

spread is positive for rumored firms, indicating that market makers recognize adverse selection in potential takeover targets (Song and Walking, 2000). In addition, we find that over the last four days prior to the rumor, the abnormal daily spread of rumored firms increases significantly and becomes statistically different from the daily spread of their matched peers. This implies that market makers are demanding a higher margin in the presence of trading which is likely to be informed.

Next, we examine intraday buying and selling trading patterns of investors since earlier studies (e.g., Cready and Hurtt, 2002; Easley et al., 2008; Kaul et al., 2008) argue that the number of transactions captures the probability of informed trading.[41] For each firm in our sample, we define abnormal active buying and selling separately as follows:

$$AAB_{i,t} = (Buyer_{i,t} - \overline{Buyer_i})/\overline{Buyer_i} \quad (1^*)$$

$$AAS_{i,t} = (Seller_{i,t} - \overline{Seller_i})/\overline{Seller_i} \quad (2^*)$$

where $AAB_{i,t}$ ($AAS_{i,t}$) is the abnormal active-buying (active-selling) of firm *i* on day *t*, $Buyer_{i,t}$ ($Seller_{i,t}$) is the number of buyer-initiated (seller-initiated) transactions in the equity market for firm *i* on day *t*, and $\overline{Buyer_i}$ ($\overline{Seller_i}$) is the daily average number of buyer-initiated (seller-initiated) transactions of firm *i* during an estimation window of (-90, -31) relative to the rumor date. We then define the daily trade imbalance as follows:

$$Imbalance_{i,t} = AAB_{i,t} - AAS_{i,t} \quad (3^*)$$

where $AAB_{i,t}$ and $AAS_{i,t}$ are computed based on Equations 1* and 2*. Table A2 presents the cross-sectional daily averages of abnormal purchases and sales for rumored firms and their matched peers. We observe a significant increase in both buyer- and seller-initiated transactions of rumored firms starting eight days prior to the rumor date while there is no unusual trading pattern in the control group. The number of buy-side transactions in rumored firms becomes significantly higher than that within control firms shortly prior to the rumor and is significantly lower throughout the entire post-rumor period. These findings are indicative of institutions engaging in informed trading over these

[41] We find qualitatively similar results when using the number of shares or the dollar value of the transactions.

periods.

***Insert Table A2 about here***

Finally, we examine whether there is unusual short-selling activity prior to takeover rumors. We use data from Markit which collects short-selling activity directly from security lending desks at financial institutions. The database provides both the number of shares lendable and the number of shares on loan.[42] As per Ahern and Sosyura (2015), we define the short utilization ratio as the number of shares on loan divided by the number of shares lendable. For each firm in our sample, we compute the abnormal short utilization as the difference between the daily short utilization and its average over the (-90, -31) period relative to the rumor date.[43] Figure A2 plots the abnormal short utilization for rumored firms and their corresponding matched firms around the rumor date. The short utilization of rumored firms increases significantly within the week prior to rumors and is statistically different from that of the matched peers. This suggests that short-sellers are acting as a counterparty to ANcerno fund trades, and are thus not similarly informed.

***Insert Figure A2 about here***

**A-III. Institutional Order Flow According to Rumor Accuracy**

In this section, we wish to examine whether the institutional order flow (IOF) we have observed for accurately rumored firms depends on our definition of accuracy. We thus present in Table A3 (and display in Figure A3) the IOF for both smart and lucky funds when firms receive a bid within a period of 30 days (Columns 1 and 2), 31 to 90 days (Columns 3 and 4), and 91 to 180 days (Columns 5 and 6) after the initial rumor date.

***Insert Table A3 about here***

***Insert Figure A3 about here***

[42] For a detailed description of the Markit database, see Saffi and Sigurdsson (2011) and Engelberg et al. (2013).
[43] To account for the delay in settlement and delivery in short sales, we record short-selling activity for day $t$ using the data from Markit on day $t + 3$ (Geczy et al., 2002; Ahern and Sosyura, 2015).

Our results indicate that lucky funds do not engage in significant net-buying of accurately rumored firms over the pre-rumor period yet engage in significant net-selling over the post-rumor period, regardless of the definition of accuracy employed. This is consistent with our main results. Smart funds engage in significant net-buying of accurately rumored firms shortly prior to the rumor date, regardless of the definition of accuracy employed and this is also consistent with our main results.

The significant selling by smart funds over the post-rumor period predominately occurs when firms receive a bid within the next 30 days. This is likely due to the fact that institutions are known to sell shares in firms subject to takeover announcements (e.g., Bethel et al., 2009; Griffin et al., 2012).

Finally, we use different definitions of rumor accuracy and investigate whether the trades by smart and/or lucky funds are informative and robust to the definition of accuracy. Specifically, we fit different logit regressions where the dependent variables equal one if the rumored firm becomes subject to a takeover announcement within the following 30, 60, and 180 days. We include measures of fund trading as explanatory variables along with other control measures, and present results in Table A4. We find that, regardless of the definition of accuracy, trades of smart funds are a positively significant predictor of post-rumor bid announcements.

***Insert Table A4 about here***

**A-IV. Institutional Order Flow Based on Rumor Content**

We categorize rumors according to sixteen non-mutually exclusive takeover rationales as provided in the article text and separately examine institutional trading patterns in each category. We compute the buy-and-hold cumulative abnormal institutional order flow as follows:

$$BHAIOF_i(t_0, t_1) = \sum_{t_0}^{t_1}(IOF_i - IOF_{i,Benchmark})_t \qquad (4^*)$$

where $IOF_i$ is the institutional order flow of firm *i* and $IOF_{i,Benchmark}$ is the average daily institutional order flow calculated over the (-90, -31) window prior to the rumor date for firm *i*.

Table A5 presents the results for rumor categories with significant BHAIOF(-10, -1). We find a statistically significant buy-and-hold cumulative abnormal institutional order flow in five rumor categories including *AdvisorHired*, *BlockPurchase*, *InsiderCited*, *PEFundInvolved*, and *SynergyCited*. In general, these rumor types appear to offer institutions more opportunities to acquire private information, as the first four categories imply the existence of additional entities that are privy to bid prospects. In general, an increased number of individuals responsible for maintaining confidentiality increases the likelihood of leakage while reducing expectations of punishment as the source of leakage becomes more uncertain.

***Insert Table A5 about here***

## References


Ahern, K. R., & Sosyura, D. (2015). Rumor has it: Sensationalism in financial media. *The Review of Financial Studies*, *28*(7), 2050-2093.

Ambrose, B. W., & Megginson, W. L. (1992). The role of asset structure, ownership structure, and takeover defenses in determining acquisition likelihood. *Journal of Financial and Quantitative Analysis, 27*(4), 575-589.

Bethel, J. E., Hu, G., & Wang, Q. (2009). The market for shareholder voting rights around mergers and acquisitions: Evidence from institutional daily trading and voting. *Journal of Corporate Finance*, *15*(1), 129-145.

Brunnermeier, M. K. (2005). Information leakage and market efficiency. *The Review of Financial Studies*, *18*(2), 417-457.

Cornett, M. M., Tanyeri, B., & Tehranian, H. (2011). The effect of merger anticipation on bidder and target firm announcement period returns. *Journal of Corporate Finance, 17*(3)*,* 595-611.

Cready, W. M., & Hurtt, D. N. (2002). Assessing investor response to information events using return and volume metrics. *The Accounting Review*, *77*(4), 891-909.

Cremers, K. M., Nair, V. B., & John, K. (2009). Takeovers and the cross-section of returns. *The Review of Financial Studies, 22*(4), 1409-1445.

Easley, D., Engle, R. F., O'Hara, M., & Wu, L. (2008). Time-varying arrival rates of informed and uninformed trades. *Journal of Financial Econometrics*, *6*(2), 171-207.

Engelberg, J. E., Reed, A. V., & Ringgenberg, M. C. (2012). How are shorts informed? Short sellers, news, and information processing. *Journal of Financial Economics*, *105*(2), 260-278.

Fich, E., Lantushenko, V., & Sialm, C. (2020). Institutional trading around M&A announcements. Working Paper No. w25814, National Bureau of Economic Research.

Gao, Y., & Oler, D. (2012). Rumors and pre-announcement trading: Why sell target stocks before acquisition announcements? *Review of Quantitative Finance and Accounting, 39(4),* 485-508.

Geczy, C. C., Musto, D. K., & Reed, A. V. (2002). Stocks are special too: An analysis of the equity lending market. *Journal of Financial Economics*, *66*(2-3), 241-269.

Griffin, J. M., Shu, T., & Topaloglu, S. (2012). Examining the dark side of financial markets: Do institutions trade on information from investment bank connections? *The Review of Financial Studies*, *25*(7), 2155-2188.

Hasbrouck, J. (1985). The characteristics of takeover targets: Q and other measures. *Journal of Banking and Finance, 9*(3), 351-362.

Holden, C. W., & Jacobsen, S. (2014). Liquidity measurement problems in fast, competitive markets: Expensive and cheap solutions. *The Journal of Finance*, *69*(4), 1747-1785.

Hu, G., Jo, K. M., Wang, Y. A., & Xie, J. (2018). Institutional trading and Abel Noser data. *Journal of Corporate Finance*, *52*, 143-167.

Jame, R. (2018). Liquidity provision and the cross section of hedge fund returns. *Management Science*, *64*(7), 3288-3312.

Kaul, G., Lei, Q., & Stoffman, N. (2008). Aiming at PIN: Order flow, information, and liquidity. Working Paper, University of Michigan.

Lee, C. M., & Ready, M. J. (1991) Inferring trade direction from intraday data. *The Journal of Finance,* 46:733-746

Mitchell, M. L., & Mulherin, J. H. (1996). The impact of industry shocks on takeover and restructuring activity. *Journal of Financial Economics*, *41*(2), 193-229.

Palepu, K. G. (1986). Predicting takeover targets: A methodological and empirical analysis. *Journal of Accounting and Economics, 8*(1), 3-35.

Peress, J., & Schmidt, D. (2020). Glued to the TV: Distracted noise traders and stock market liquidity. *The Journal of Finance*, *75*(2), 1083-1133.

Song, M. H., & Walkling, R. A. (2000). Abnormal returns to rivals of acquisition targets: A test of the acquisition probability hypothesis. *Journal of Financial Economics*, *55*(2), 143-171.

Van Bommel, J. (2003). Rumors. *The Journal of Finance*, *58*(4), 1499-1520.

**Figure A1. Bid-ask spread analysis**

This figure depicts the abnormal effective bid-ask spread for rumored firms and their matched peers around the rumor date. Control firms operate in the same industry (based on three-digit SIC codes) and have the smallest Mahalonobis distance to the sample firms based on three dimensions: the firms' market capitalization, their market-to-book ratio, and their past stock return. We obtain intraday data from the TAQ database and use the algorithm of Lee and Ready (1991) to determine the initiating side of the transaction (buyer vs. seller). We construct the abnormal spread measure by subtracting the average daily spread during the benchmark period (-90, -31) from the daily spread, scaled by the benchmark period average. To reduce the influence of outliers, we winsorize the top and bottom 1% of daily observations. The squares on the rumored firm line indicate abnormal spreads that are significantly different between rumored firms and their matched peers at the 5% level.

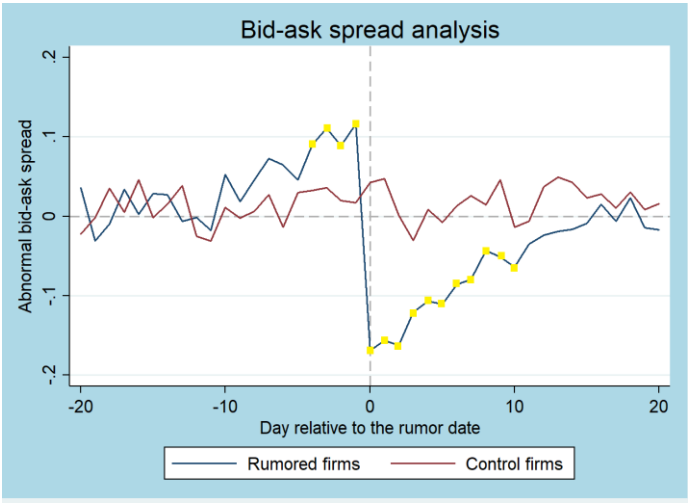
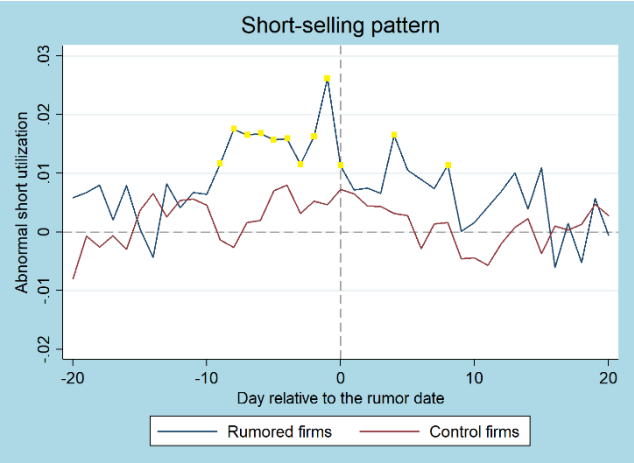


**Figure A2. Abnormal short utilization**

This figure depicts the abnormal short utilization for 1,317 firms that are rumored to be takeover targets, as well as for a corresponding sample of 1,317 matched firms, over the (-20, +20) period relative to the rumor date. Control firms operate in the same industry (based on three-digit SIC codes) and have the smallest Mahalonobis distance to the sample firms based on three dimensions: the firms' market capitalization, their market-to-book ratio, and their past stock return. We obtain short-selling data from Markit. Given that the earliest date available in Markit is July 2006, we lose 372 observations from the main sample. We define the short utilization ratio as the number of shares on loan divided by the number of shares lendable. For each firm in our sample, we compute the abnormal short utilization as the difference between the daily short utilization and its average over the (-90, -31) period relative to the rumor date. To reduce the influence of outliers, we winsorize the top and bottom 1% of daily observations. Panel A presents the results for all the rumored firms and their corresponding matched peers. The squares on the rumored firm line indicate abnormal short utilizations that are significantly different between rumored firms and their matched peers at the 5% level. Panel B presents the results based on rumor accuracy (accurate vs. inaccurate). Rumors are labelled as accurate if the rumored firms in question indeed become the target of a formal takeover bid within 365 calendar days after the initial scoop article; otherwise, they are labelled as inaccurate.

Panel A: Short-selling patterns for rumored firms and their matched peers




Panel B: Short-selling patterns for accurate and inaccurate rumors

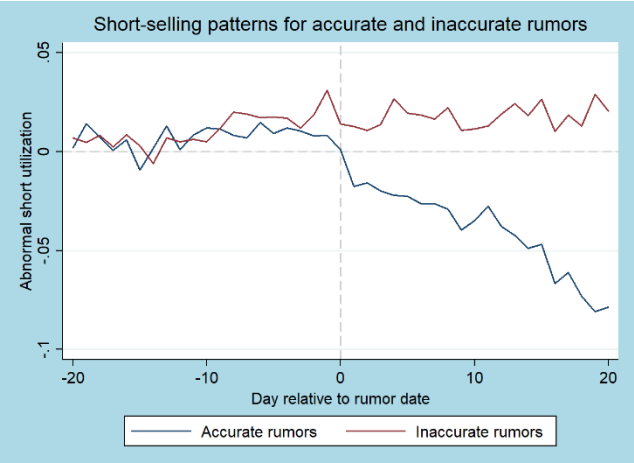
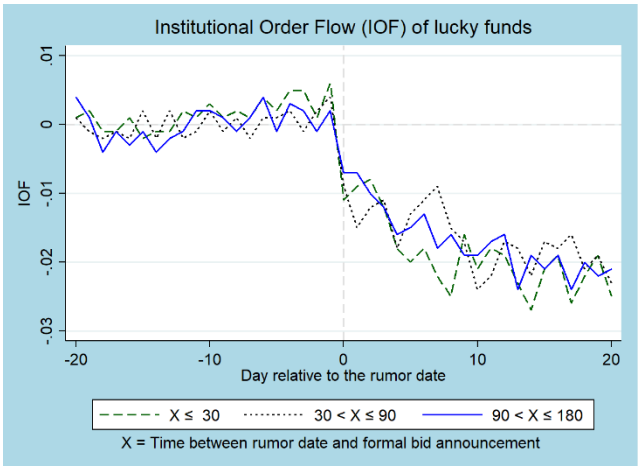


**Figure A3. Institutional trading patterns based on the time to the formal bid announcement**

This figure depicts the institutional order flow (IOF) around takeover rumors that are accurate (followed by a formal bid announcement). Precise quantities are reported in Table A3. Panel A presents the results for lucky funds and Panel B plots the results for smart funds, each defined in Section 4.5. Rumors are categorized into three groups according to the time between the takeover rumor and the formal bid announcement as indicated below by 'X'.

Panel A: Institutional order flow (IOF) of lucky funds




Panel B: Institutional order flow (IOF) of smart funds

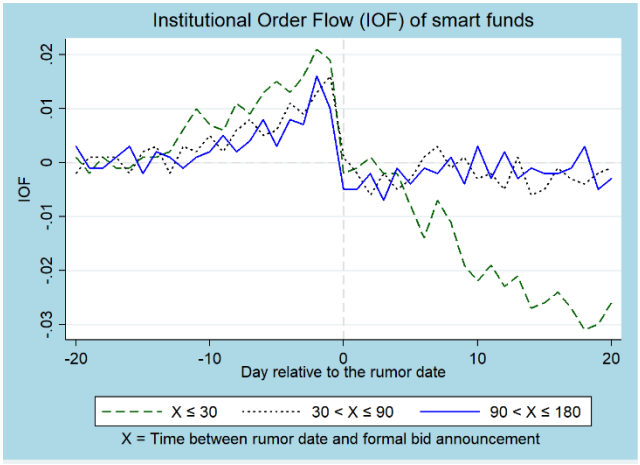


**Table A1. Institutional trading activity in rumored firms and their matched peers**

This table presents daily averages of the ANcerno-based institutional trading measures for 1,493 takeover-rumored firms and their matched peers. We lose 196 of our original 1,689 observations due to incomplete data availability from Compustat. The control sample is constructed based on propensity score matching along five dimensions: firm size, the market-to-book ratio, the return on assets, firm leverage, the presence of a blockholder, and the presence of same-industry (at the three-digit SIC code level) bids within the prior year. Tests of significance are based on t-tests of individual day observations relative to the (-90, -31) benchmark period distribution prior to the rumor. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| Relative day | Rumored firms | | Control firms | | Difference | |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (1) - (3) | (2) - (4) |
| | IOF | IOV | IOF | IOV | IOF | IOV |
| -30 to -21 | 0.001 | 0.101 | 0.001 | 0.099 | 0.000 | 0.002 |
| -20 | 0.001 | 0.105 | 0.001 | 0.102 | 0.000 | 0.003 |
| -19 | -0.002 | 0.104 | 0.002 | 0.099 | -0.004 | 0.005 |
| -18 | 0.001 | 0.099 | 0.001 | 0.105 | 0.000 | -0.006 |
| -17 | -0.001 | 0.104 | -0.001 | 0.102 | 0.000 | 0.002 |
| -16 | 0.001 | 0.105 | 0.002 | 0.103 | -0.001 | 0.002 |
| -15 | -0.002 | 0.101 | 0.002 | 0.101 | -0.004 | 0.000 |
| -14 | 0.002 | 0.106 | -0.001 | 0.099 | 0.003 | 0.007 |
| -13 | -0.001 | 0.105 | -0.002 | 0.103 | 0.001 | 0.002 |
| -12 | 0.004 | 0.103 | 0.003 | 0.108 | 0.001 | -0.005 |
| -11 | 0.006 | 0.107 | 0.003 | 0.106 | 0.003 | 0.001 |
| -10 | 0.009 | 0.115* | 0.001 | 0.101 | 0.008 | 0.014* |
| -9 | 0.006 | 0.110 | 0.000 | 0.105 | 0.006 | 0.005 |
| -8 | 0.018** | 0.115*** | -0.002 | 0.106 | 0.020** | 0.009* |
| -7 | 0.018** | 0.124*** | -0.003 | 0.101 | 0.021*** | 0.023** |
| -6 | 0.017** | 0.128*** | -0.001 | 0.103 | 0.018** | 0.025** |
| -5 | 0.023*** | 0.131*** | 0.001 | 0.098 | 0.022*** | 0.033*** |
| -4 | 0.016** | 0.120** | 0.001 | 0.103 | 0.015** | 0.017** |
| -3 | 0.021*** | 0.123*** | 0.005 | 0.103 | 0.016** | 0.020*** |
| -2 | 0.018*** | 0.125*** | 0.003 | 0.098 | 0.015*** | 0.027*** |
| -1 | 0.025*** | 0.129*** | 0.001 | 0.103 | 0.024*** | 0.026*** |
| 0 | 0.001 | 0.297*** | -0.002 | 0.104 | 0.003* | 0.193*** |
| +1 | -0.069*** | 0.302*** | 0.001 | 0.102 | -0.070*** | 0.200*** |
| +2 | -0.029*** | 0.141*** | -0.001 | 0.100 | -0.028*** | 0.041*** |
| +3 | -0.026*** | 0.129*** | 0.001 | 0.105 | -0.027*** | 0.024*** |
| +4 | -0.031*** | 0.156*** | -0.004 | 0.098 | -0.027*** | 0.058*** |
| +5 | -0.037*** | 0.148*** | -0.001 | 0.104 | -0.036*** | 0.044*** |
| +6 | -0.018*** | 0.125*** | -0.002 | 0.096 | -0.016*** | 0.029*** |
| +7 | -0.034*** | 0.159*** | 0.004 | 0.105 | -0.038*** | 0.054*** |
| +8 | -0.011** | 0.122*** | 0.001 | 0.103 | -0.012*** | 0.019*** |
| +9 | -0.051*** | 0.148*** | 0.001 | 0.101 | -0.052*** | 0.047*** |
| +10 | -0.022*** | 0.135*** | -0.002 | 0.101 | -0.020*** | 0.034*** |
| +11 | -0.010** | 0.127*** | -0.002 | 0.098 | -0.008** | 0.029*** |
| +12 | -0.046*** | 0.151*** | 0.001 | 0.103 | -0.047*** | 0.048*** |
| +13 | -0.032*** | 0.141*** | 0.002 | 0.104 | -0.034*** | 0.037*** |
| +14 | -0.035*** | 0.158*** | -0.001 | 0.101 | -0.034*** | 0.057*** |
| +15 | -0.021*** | 0.128*** | -0.002 | 0.104 | -0.019*** | 0.024*** |
| +16 | -0.034*** | 0.126*** | 0.005 | 0.105 | -0.039*** | 0.021*** |
| +17 | -0.005 | 0.142*** | -0.002 | 0.101 | -0.003* | 0.041*** |
| +18 | -0.011*** | 0.118* | -0.001 | 0.103 | -0.010** | 0.015** |
| +19 | -0.018*** | 0.121** | 0.002 | 0.099 | -0.020*** | 0.022** |
| +20 | -0.014** | 0.123 | -0.001 | 0.100 | -0.013** | 0.023** |
| +21 to +30 | -0.010 | 0.115 | 0.001 | 0.104 | -0.011** | 0.011* |
| Benchmark (-90, -31) | 0.001 | 0.104 | 0.001 | 0.103 | 0.000 | 0.001 |

**Table A2. Abnormal intraday trading**

This table shows the daily active buy- and sell-side initiated transactions for rumored target firms around the rumor date. We obtain intraday data from the TAQ database and use the algorithm of Lee and Ready (1991) to determine the initiating side of the transaction (buyer or seller). Abnormal buying, abnormal selling, and trade imbalances are computed based on Equations 1* to 3*. To reduce the influence of outliers, we winsorize the top and bottom 1% of daily observations. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | Rumored firms | | | Control firms | | | Difference |
|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
| Relative day | Abnormal buying | Abnormal selling | Trade imbalance | Abnormal buying | Abnormal selling | Trade imbalance | (3) - (4) |
| -15 | 0.026 | 0.019 | 0.007 | 0.034 | 0.041 | -0.007 | 0.014 |
| -14 | 0.017 | 0.012 | 0.005 | 0.042 | 0.019 | 0.023 | -0.018 |
| -13 | -0.012 | 0.005 | -0.017 | 0.032 | 0.023 | 0.009 | -0.026 |
| -12 | 0.056 | 0.068* | -0.012 | 0.029 | 0.034 | -0.005 | -0.007 |
| -11 | 0.025 | 0.031 | -0.006 | -0.007 | 0.01 | -0.017 | 0.011 |
| -10 | 0.027 | 0.015 | 0.012 | 0.036 | 0.027 | 0.009 | 0.003 |
| -9 | 0.051 | 0.056 | -0.005 | 0.028 | 0.039 | -0.011 | 0.006 |
| -8 | 0.105** | 0.084* | 0.021 | 0.041 | 0.036 | 0.005 | 0.016 |
| -7 | 0.135*** | 0.108** | 0.027 | 0.046 | 0.024 | 0.022 | 0.005 |
| -6 | 0.127*** | 0.102*** | 0.025 | 0.019 | 0.031 | -0.012 | 0.037* |
| -5 | 0.162*** | 0.117*** | 0.045* | -0.008 | -0.023 | 0.015 | 0.030 |
| -4 | 0.155*** | 0.129*** | 0.026 | -0.018 | -0.033 | 0.015 | 0.011 |
| -3 | 0.193*** | 0.149*** | 0.044** | -0.011 | -0.005 | -0.006 | 0.050** |
| -2 | 0.216*** | 0.135*** | 0.081*** | 0.045 | 0.016 | 0.029 | 0.052*** |
| -1 | 0.459*** | 0.172*** | 0.287*** | 0.047 | 0.021 | 0.026 | 0.261*** |
| 0 | 0.617*** | 0.396*** | 0.221*** | 0.039 | 0.028 | 0.011 | 0.210*** |
| +1 | 0.564*** | 0.493*** | 0.071*** | 0.051 | 0.032 | 0.019 | 0.052*** |
| +2 | 0.516*** | 0.543*** | -0.027* | 0.012 | 0.018 | -0.006 | -0.021*** |
| +3 | 0.349*** | 0.481*** | -0.132*** | 0.014 | 0.035 | -0.021 | -0.111*** |
| +4 | 0.383*** | 0.493*** | -0.110*** | 0.051 | 0.043 | 0.008 | -0.118*** |
| +5 | 0.361*** | 0.473*** | -0.112*** | 0.023 | 0.034 | -0.011 | -0.101*** |
| +6 | 0.311*** | 0.473*** | -0.162*** | 0.048 | 0.048 | 0 | -0.162*** |
| +7 | 0.276*** | 0.379*** | -0.103*** | 0.015 | -0.009 | 0.024 | -0.127*** |
| +8 | 0.215*** | 0.361*** | -0.146*** | 0.018 | 0.012 | 0.006 | -0.152*** |
| +9 | 0.254*** | 0.409*** | -0.155*** | 0.038 | 0.036 | 0.002 | -0.157*** |
| +10 | 0.222*** | 0.392*** | -0.170*** | 0.026 | 0.037 | -0.011 | -0.159*** |
| +11 | 0.176*** | 0.351*** | -0.175*** | 0.015 | 0.025 | -0.01 | -0.165*** |
| +12 | 0.183*** | 0.372*** | -0.189*** | -0.013 | -0.007 | -0.006 | -0.183*** |
| +13 | 0.149*** | 0.354*** | -0.205*** | 0.022 | 0.009 | 0.013 | -0.218*** |
| +14 | 0.132*** | 0.319*** | -0.187*** | 0.047 | 0.031 | 0.016 | -0.203*** |
| +15 | 0.101*** | 0.348*** | -0.247*** | 0.013 | 0.028 | -0.015 | -0.232*** |

**Table A3. Institutional trading activity based on the time to bid announcement**

This table presents the institutional order flow (IOF) around takeover rumors that are followed by formal bid announcements. Results are segregated based on fund type (smart or lucky) as defined in Section 4.5. Rumors are categorized into three groups according to the time between the takeover rumor and the formal bid announcement as indicated below by 'X'. Tests of significance are based on t-tests of individual day observations relative to the (-90, -31) benchmark period distribution prior to the rumor. The significance of multiple-day periods, (-30, -21) and (+21, +30), is evaluated by comparing the daily means across all days in the multiple day period to the daily means of all days in the benchmark period. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| Time to formal bid announcement: X | X ≤ 30 days (N = 79) | | 30 < X ≤ 90 days (N = 67) | | 90 < X ≤ 180 days (N = 54) | |
|---|---|---|---|---|---|---|
| Relative day | Smart | Lucky | Smart | Lucky | Smart | Lucky |
| -30 to -21 | 0.002 | -0.001 | 0.001 | 0.001 | -0.001 | 0.002 |
| -20 | 0.001 | 0.001 | -0.002 | 0.001 | 0.003 | 0.004 |
| -19 | -0.002 | 0.002 | 0.001 | -0.001 | -0.001 | 0.001 |
| -18 | 0.001 | -0.001 | 0.001 | -0.002 | -0.001 | -0.004 |
| -17 | -0.001 | -0.001 | 0.001 | -0.001 | 0.001 | -0.001 |
| -16 | -0.001 | 0.001 | -0.002 | -0.002 | 0.003 | -0.003 |
| -15 | 0.001 | -0.002 | 0.002 | 0.002 | -0.002 | -0.001 |
| -14 | 0.001 | -0.001 | 0.003 | -0.002 | 0.002 | -0.004 |
| -13 | 0.002 | -0.001 | -0.002 | 0.002 | 0.001 | -0.002 |
| -12 | 0.006 | 0.002 | 0.003 | -0.002 | -0.001 | -0.001 |
| -11 | 0.010** | 0.001 | 0.002 | -0.001 | 0.001 | 0.002 |
| -10 | 0.007** | 0.003 | 0.005 | 0.002 | 0.002 | 0.002 |
| -9 | 0.006* | 0.001 | 0.002 | -0.001 | 0.005** | 0.001 |
| -8 | 0.011*** | 0.002 | 0.006 | 0.001 | 0.002 | -0.001 |
| -7 | 0.009*** | 0.001 | 0.008* | -0.002 | 0.004* | 0.001 |
| -6 | 0.013*** | 0.004 | 0.005 | 0.001 | 0.008** | 0.004 |
| -5 | 0.015*** | 0.002 | 0.006 | 0.001 | 0.003 | -0.001 |
| -4 | 0.013*** | 0.005 | 0.011** | 0.002 | 0.008*** | 0.003 |
| -3 | 0.016*** | 0.005 | 0.009** | -0.001 | 0.007*** | 0.002 |
| -2 | 0.021*** | 0.001 | 0.013*** | 0.002 | 0.016*** | -0.001 |
| -1 | 0.019*** | 0.006 | 0.016*** | 0.004 | 0.010*** | 0.002 |
| 0 | -0.002 | -0.011*** | 0.001 | -0.009*** | -0.005 | -0.007*** |
| +1 | -0.001 | -0.009*** | -0.002 | -0.015*** | -0.005* | -0.007*** |
| +2 | 0.001 | -0.008*** | -0.006** | -0.012*** | -0.002 | -0.010*** |
| +3 | -0.002 | -0.012*** | -0.002 | -0.011*** | -0.007* | -0.012*** |
| +4 | -0.002 | -0.018*** | -0.005** | -0.018*** | -0.001 | -0.016*** |
| +5 | -0.008** | -0.020*** | -0.003 | -0.013*** | -0.004 | -0.015*** |
| +6 | -0.014*** | -0.018*** | 0.001 | -0.011*** | -0.001 | -0.013*** |
| +7 | -0.007*** | -0.022*** | 0.003 | -0.009*** | -0.002 | -0.018*** |
| +8 | -0.011*** | -0.025*** | -0.001 | -0.015*** | 0.001 | -0.016*** |
| +9 | -0.019*** | -0.016*** | 0.001 | -0.017*** | -0.004* | -0.019*** |
| +10 | -0.022*** | -0.021*** | -0.003** | -0.024*** | 0.003 | -0.019*** |
| +11 | -0.019*** | -0.018*** | -0.002 | -0.022*** | -0.003 | -0.017*** |
| +12 | -0.023*** | -0.019*** | -0.005** | -0.017** | 0.002 | -0.016*** |
| +13 | -0.021*** | -0.023*** | 0.001 | -0.018*** | -0.003 | -0.024*** |
| +14 | -0.027*** | -0.027*** | -0.006** | -0.022*** | -0.001 | -0.019*** |
| +15 | -0.026*** | -0.021*** | -0.005** | -0.017** | -0.002 | -0.021*** |
| +16 | -0.024*** | -0.019*** | -0.001 | -0.018*** | -0.002 | -0.019*** |
| +17 | -0.027*** | -0.026*** | -0.003 | -0.016** | -0.001 | -0.024*** |
| +18 | -0.031*** | -0.022*** | -0.004 | -0.021*** | 0.003 | -0.020*** |
| +19 | -0.030*** | -0.019*** | -0.002 | -0.019** | -0.005** | -0.022*** |
| +20 | -0.026*** | -0.025*** | -0.001 | -0.023*** | -0.003 | -0.021*** |
| +21 to +30 | -0.028*** | -0.017*** | -0.005 | -0.014** | -0.003 | -0.005* |
| Benchmark (-90, -31) | 0.001 | 0.002 | 0.002 | 0.001 | 0.001 | 0.002 |

**Table A4. The predictive power of institutional trading based on the time to bid announcement**

This table reports results for a series of logit regressions in which the dependent variables (*Accurate30*, *Accurate60*, and *Accurate180*) are dummy variables that equal one if the rumor leads to a takeover announcement within 30, 60, or 180 days, respectively, following the initial rumor announcement. The main independent variable of interest is the buy-and-hold cumulative abnormal institutional order flow defined as $BHAIOF_i(t_0, t_1) = \sum_{t_0}^{t_1}(IOF_i - IOF_{i,Benchmark})_t$, where $IOF_i$ is the institutional order flow of firm *i* and $IOF_{i,Benchmark}$ is the average daily institutional order flow calculated over the (-90, -31) window prior to the rumor date for firm *i*. Appendix A provides other variable definitions. Some controls are insignificant and untabulated for brevity. They include the following variables: *ValuableBrand, EstDealLikelihood, Cashratio, Changesize2y, Concentration, Dormancy, Infoasymm, Prevmergers, Priorreturn2y, Resmismatch, ROA, Salesgrowth2y, Salesshock, SalesshockSq,* and *Shareturnover*. Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent: | *Accurate30* | | *Accurate60* | | *Accurate180* | |
| BHAIOF(-10, -1) $_{smart}$ | 4.315*** | | | | | |
| | (0.001) | | | | | |
| BHAIOF(-10, -1) $_{lucky}$ | | 2.483 | | | | |
| | | (0.516) | | | | |
| BHAIOF(+1, +10) $_{smart}$ | | | 3.784** | | | |
| | | | (0.032) | | | |
| BHAIOF(+1, +10) $_{lucky}$ | | | | -3.170 | | |
| | | | | (0.296) | | |
| BHAIOF(-10, +10) $_{smart}$ | | | | | 5.654** | |
| | | | | | (0.019) | |
| BHAIOF(-10, +10) $_{lucky}$ | | | | | | -1.052** |
| | | | | | | (0.694) |
| Informative | 1.156*** | 1.249*** | 0.792*** | 0.841*** | 0.756*** | 0.783*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| Speculative | -0.791** | -0.736** | -0.608** | -0.593** | -0.581** | -0.556** |
| | (0.021) | (0.025) | (0.028) | (0.030) | (0.038) | (0.041) |
| Size | -0.261*** | -0.256*** | -0.242*** | -0.249*** | -0.248*** | -0.239*** |
| | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) | (0.000) |
| CAR(0, +1) | 7.158*** | 7.254*** | 5.417*** | 5.764*** | 3.956** | 4.041*** |
| | (0.001) | (0.001) | (0.008) | (0.005) | (0.011) | (0.008) |
| CAR(-5,-1) | 1.522* | 1.372 | 0.962 | 0.986 | 0.508 | 0.563 |
| | (0.086) | (0.126) | (0.315) | (0.295) | (0.676) | (0.644) |
| CAR(-41,-1) | 0.328 | 0.261 | -0.021 | -0.039 | 0.081 | 0.089 |
| | (0.541) | (0.685) | (0.692) | (0.803) | (0.635) | (0.620) |
| Constant | 1.632* | 1.786* | 2.154** | 2.013** | 2.492** | 2.635** |
| | (0.076) | (0.071) | (0.035) | (0.038) | (0.026) | (0.024) |
| Industry / Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 | 1,459 |
| Pseudo $R^2$ | 0.174 | 0.161 | 0.143 | 0.136 | 0.181 | 0.177 |

**Table A5. Institutional trading patterns based on the content of the rumor article**

This table reports daily institutional order flow (IOF) for rumors with significant buy-and-hold cumulative abnormal IOF over the (-10, -1) period, relative to the rumor date (day 0). Buy-and-hold cumulative abnormal IOF is computed based on Equation 4*. Appendix A provides the definitions of individual rumor rationales. Tests of significance are based on t-tests of individual day observations relative to the (-90, -31) benchmark period distribution prior to the rumor. The significance of multiple day periods, i.e., (-30, -21) and (+21, +30), is evaluated by comparing the daily means across all days in the multiple day period to the daily means of all days in the benchmark period. Our methodology matches that of Corwin et al. (2004) and Irvine et al. (2007). Significance at the 10%, 5%, and 1% level is indicated by *, **, and ***, respectively.

| | (1) | (2) | (3) | (4) | (5) |
|---|---|---|---|---|---|
| Relative day | *AdvisorHired* (N = 170) | *BlockPurchase* (N = 65) | *InsiderCited* (N = 236) | *PEFundInvolved* (N = 202) | *SynergyCited* (N = 77) |
| -30 to -21 | 0.002 | -0.002 | 0.001 | 0.001 | -0.002 |
| -20 | -0.003 | 0.002 | 0.002 | -0.001 | 0.003 |
| -19 | -0.002 | 0.001 | -0.002 | 0.001 | -0.002 |
| -18 | 0.003 | -0.005 | 0.001 | 0.002 | -0.001 |
| -17 | 0.003 | 0.006 | 0.003 | -0.001 | 0.004 |
| -16 | 0.001 | -0.001 | 0.001 | 0.006 | 0.000 |
| -15 | -0.001 | 0.001 | -0.003 | -0.001 | 0.002 |
| -14 | 0.002 | 0.004 | 0.000 | 0.002 | -0.001 |
| -13 | -0.001 | -0.005 | -0.004 | 0.003 | -0.002 |
| -12 | 0.001 | -0.003 | 0.002 | 0.004 | 0.002 |
| -11 | 0.005 | -0.006 | 0.002 | 0.002 | 0.005 |
| -10 | 0.006 | 0.004 | 0.003 | 0.009* | 0.002 |
| -9 | 0.007 | 0.010 | 0.015** | 0.007 | 0.005 |
| -8 | 0.011* | 0.006 | 0.007 | 0.012** | 0.006 |
| -7 | 0.013** | 0.015** | 0.019*** | 0.018** | 0.005 |
| -6 | 0.007 | 0.012 | 0.008** | 0.013*** | -0.001 |
| -5 | 0.015** | 0.016** | 0.009** | 0.008 | 0.012** |
| -4 | 0.018*** | 0.012* | 0.018*** | 0.017*** | 0.008* |
| -3 | 0.014** | 0.008* | 0.017*** | 0.014*** | 0.005 |
| -2 | 0.020*** | 0.017*** | 0.016*** | 0.011** | 0.018*** |
| -1 | 0.023*** | 0.029*** | 0.021*** | 0.019*** | 0.013** |
| 0 | -0.033*** | -0.021*** | -0.047*** | -0.029*** | -0.024*** |
| +1 | -0.055*** | -0.077*** | -0.041*** | -0.035*** | -0.041*** |
| +2 | -0.041*** | -0.057*** | -0.069*** | -0.072*** | -0.056*** |
| +3 | -0.035*** | -0.014* | -0.031*** | -0.029*** | -0.017*** |
| +4 | -0.035*** | -0.026** | -0.038*** | -0.027*** | -0.032*** |
| +5 | -0.024*** | -0.019** | -0.026*** | -0.036*** | -0.022*** |
| +6 | -0.020*** | -0.023** | -0.020** | -0.023*** | -0.021*** |
| +7 | -0.029*** | -0.012 | -0.017** | -0.011* | -0.025*** |
| +8 | -0.013** | -0.002 | -0.009 | -0.019*** | -0.017*** |
| +9 | -0.006 | -0.020** | -0.015** | -0.003 | -0.014** |
| +10 | -0.011 | -0.013* | -0.003 | -0.023*** | -0.009 |
| +11 | -0.010 | -0.018** | -0.007 | -0.002 | -0.011 |
| +12 | -0.015* | -0.009 | -0.005 | -0.016** | -0.007 |
| +13 | -0.014* | -0.004 | -0.016** | -0.007 | -0.010 |
| +14 | -0.017** | -0.011 | -0.006 | -0.004 | -0.018*** |
| +15 | -0.015* | -0.001 | -0.009 | -0.008 | -0.019*** |
| +16 | -0.019** | -0.007 | -0.014* | -0.013** | -0.005 |
| +17 | -0.002 | -0.004 | -0.007 | -0.009 | -0.015** |
| +18 | -0.005 | -0.003 | -0.003 | -0.003 | -0.009 |
| +19 | -0.001 | -0.006 | -0.005 | -0.006 | -0.007 |
| +20 | -0.011 | -0.001 | -0.006 | -0.004 | -0.006 |
| +21 to +30 | -0.004 | -0.002 | -0.005 | -0.005 | 0.001 |
| Benchmark (-90 to -31) | 0.001 | 0.002 | -0.002 | 0.002 | 0.001 |

# Chapter 4: Informed Options Trading Prior to Takeover Rumors

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## Abstract

We examine derivatives trading prior to takeover rumors in a sample of 1,638 publicly traded U.S. firms. The volume of options traded is abnormally high over the 5-day pre-rumor period, primarily due to the number of out-of-the-money call options traded. In addition, the direction of option trades (abnormal call volume minus abnormal put volume) prior to takeover rumors predicts forthcoming takeover announcements and rumor date returns. Identifying suspicious trades, we find evidence of individuals trading on knowledge of takeover rumor candidacy in the options market. Our results further indicate that informed traders prefer the options market to the equity market.

## 4.1. Introduction

Informed options trading prior to takeover announcements is both widespread and of considerable economic importance (Easley et al., 1998; Cao et al., 2005). However, few papers examine the sources of information which drive the abnormal trade volumes of equity options witnessed over the preannouncement period (Augustin et al., 2019). This is surprising, as insiders are prohibited from trading on material private information as per Section 10(b) of the 1934 Securities Exchange Act. Thus, a thorough analysis of the timing of trades in equity options with respect to the release of public information may prove fruitful in understanding whether investors are trading on private or public information.

In this paper we investigate and quantify the pervasiveness of informed trading in the equity options of firms that subsequently become the subject of a publicly announced takeover rumor. We also examine whether measures of informed trading can predict rumor 'accuracy' (i.e., a takeover bid follows within 365 days of the rumor) and/or changes in target returns upon rumor announcement and over the post-rumor period. We further assess whether the informed trading we observe is more prevalent in the options market or the equity market. Finally, we consider alternative explanations for the abnormal informed trading we uncover.

Previewing our results, we find abnormal options volume to be significant and positive over the 5-day period preceding takeover rumors and demonstrate that this is mainly driven by an increase in call options trading volume. Stratifying the results by moneyness, we observe significantly higher abnormal trading volume for out-of-the-money (OTM) call options compared to at-the-money (ATM) and in-the-money (ITM) call options, a pattern more prominent when rumors are accurate. In addition, we show that the direction of option trades (abnormal call volume minus abnormal put volume) prior to takeover rumors can predict forthcoming takeover announcements. Finally, we document that investors are more active in the options market than in the equity market for rumored firms over the pre-rumor period. Our evidence is consistent with investors using derivatives to trade on material private information prior to its public release in the form of a takeover rumor.

Trading on private information prior to a published takeover rumor provides a number of advantages compared to trading prior to a bid announcement. First, it allows traders to capture average returns ranging from 3% to 8% on the rumor date (Ahern and Sosyura, 2015; Betton et al.,

2018) depending on rumor accuracy. In addition, pre-rumor informed trading may offer a lower risk of prosecution (Ke et al., 2003) as well as an opportunity to evade firm-imposed blackout periods (Davis et al., 2020).

Our paper contributes to the literature in a number of ways. First, to the best of our knowledge our study is the first to provide evidence of informed options trading within a sample of firms that subsequently become the subject of a takeover rumor. Related studies examine informed trading in options prior to takeover announcements, but only consider rumors which lead to bid announcements. Our investigation is important in order to better understand the prevalence, sophistication, and potential illegality of informed trading occurring prior to both bids and potential bids for corporate control. Second, we contribute to the literature on takeover predictability and profitability by showing that various pre-rumor measures of informed options trading significantly predict bid announcements and can be useful in constructing profitable trading portfolios. Third, we contribute to the literature on price discovery by providing evidence that informed investors are more likely to trade in the options market than in the equity market during the pre-event period. Finally, by examining the types of rumors driving the observed trading volumes we demonstrate that our results are consistent with M&A advisors, hedge fund managers, and insiders engaging in the informed options trading we observe.

## 4.2. Literature Review

### 4.2.1. Informed Options Trading Prior to Takeover Announcements

There is a consensus in the literature that target-firm stock prices typically and substantially increase when a takeover is announced (e.g., Jensen and Ruback, 1983; Jarrell et al., 1988; Andrade et al., 2001; Betton et al., 2008). This provides a financially attractive trading opportunity for investors who are privately informed about a firm's takeover prospects in advance of the public release of this information. The high leverage and low transaction cost provided by the options market may make this prospect even more enticing (Black, 1975; Mayhew et al., 1995; Lee and Cheong, 2001; Cao et al., 2005).

Many studies note the importance of options trading throughout the preannouncement period. In early work, Jayaraman et al. (1991) and Levy and Yoder (1993) find that the option-implied

volatilities of target firms increase prior to takeover announcements. Jayaraman et al. (2001) document a significant increase in the trading activity in options around the announcement date of acquisitions, with the abnormal trading volume greater for call options than for put options and primarily concentrated in short-term OTM options. Cao et al. (2005) find that prior to takeover announcements, call-put option volume imbalances are better predictors of next-day stock returns than are buyer-seller initiated stock volume imbalances, and thus more useful when investigating informed trading. Using a sample of cash tender offers occurring during the period 1993–2002, Arnold et al. (2006) similarly determine that the options market has become the preferred venue for informed traders.

Ordu and Schweizer (2015) find that, prior to takeover announcements, higher abnormal put option trading volumes are related to higher wealth-to-performance sensitivities of acquiring firms' top executives. They argue that this evidence supports the view that top executives use the options market to hedge against short-term salary losses following acquisitions. Wang (2013) and Liu et al. (2015) find that the implied volatility spread of the equity options in target firms accumulates before merger announcements and leads stock price changes. Chan et al. (2015) show that, in general, the implied volatility spread (skew) is a significant positive (negative) predictor of cumulative abnormal returns. This relation becomes much stronger around takeover announcements, a result they attribute to the increased activity of informed traders during the pre-bid period. Finally, Acharya and Johnson (2010) show that having a large number of equity participants in leveraged buyouts is associated with greater levels of suspicious stock and options activity prior to bids for corporate control.

### 4.2.2. Takeover Rumors and Informed Options Trading

Few studies directly examine the role of published rumors within the context of informed options trading. Clements and Singh (2011) show that trading volumes of both call and put options significantly increase prior to takeover announcements. They attribute the increase in call option volumes to the activity of informed traders, and the increase in put option trading to contrarian traders (those betting against potentially informed traders on the basis that most rumors do not lead to a bid).

Augustin et al. (2019) examine options trading volume in a sample of 1,859 U.S. takeover targets over the 1996–2012 period. They find that 25% of sample deals have abnormal volumes of equity options over the 30-day preannouncement period, with the proportion higher for call options

than for put options. Using RavenPack News Analytics to flag deals with media coverage (including news and rumors of impending bids), they find no significant difference in abnormal options volume for samples with and without media coverage and associate only 8.57% of informed options trading with this coverage.

In a sample of 112 merger announcements having illegal insider trading as released by the SEC, Wang (2013) also observes significant abnormal options volume prior to takeover announcements. He shows that such trading is highly profitable and finds no significant difference between the samples with and without takeover rumors.[44]

### 4.2.3. Takeover Predictability and Trading Strategies

While the literature on takeover predictability and related trading strategies is vast, we note a few key papers. Cornett et al. (2011) assess the prior literature and develop a model to predict target firm candidacy using variables that measure management motives to generate shareholder value, opportunistic benefits, or both. These include a firm's cash ratio, size, change in size, concentration ratio, dormant period, previous mergers, price run-up, ROA, resource-growth-mismatch, sales growth, sales shock, sales shock squared, and share turnover (all defined in the Appendix).

Pound and Zeckhauser (1990) find that the market responds efficiently to a sample of 42 firms rumored within the "Heard on the Street" (HOTS) column of the Wall Street Journal (WSJ). Similarly, Zivney et al. (1996) examine 871 initial and subsequent rumor announcements using the "Abreast of the Market" column of the WSJ in addition to the HOTS column. In contrast to Pound and Zeckhauser, they present evidence of overreaction on the rumor date which appears to permit profitable trading strategies based on short selling. Similarly, Gao and Oler (2012) and Clements and Singh (2011) find evidence of significant overreaction to takeover rumors published in the WSJ and show that trades predicated on rumors not eventuating (i.e., not leading to a bid announcement) can be profitable.

More recently, Chou et al. (2015) document that trading on rumor targets can be profitable when relying on pre-rumor day abnormal returns as an indicator of bid likelihood. Ahern and Sosyura

[44]We note that our focus differs from that of Wang (2013) and Augustin et al. (2019) as we focus on informed options trading in firms rumored to be takeover targets even if the rumor does not result in a takeover announcement.

(2015) find that a journalist's age and degree, article characteristics, media sources, and firm returns prior to and on the rumor date act as positive predictors of forthcoming bids, while target newsworthiness acts as a negative predictor. Betton et al. (2018) contend that rumor article content which justifies its publication assists in the prediction of target firm bids as well as in the development of profitable trading strategies. Davis et al. (2020) show that registered insiders engage in passive net purchasing (i.e., selling less rather than buying more) of rumored firm shares within the year prior to the takeover rumor's publication. Such insider trading is found to be a significant predictor of takeover announcements occurring within the following year.

## 4.3. Data

We employ the dataset first used by Betton et al. (2018) as our base sample of target firm takeover rumors. As the authors explain, this sample consists of 2,074 firms identified as potential takeover targets between January 2002 and December 2011 based on articles retrieved from Capital IQ, Factiva, ProQuest, Standard & Poor's Takeover Talk, and/or Zephyr. In order to preserve a clear distinction between rumors and takeover announcements, the authors exclude rumors in which negotiations are confirmed to be underway. To correct for well-known Securities Data Company announcement date errors and omissions (e.g., Bharadwaj & Shivdasani, 2003; Faccio & Masulis, 2005; Barnes, Harp, & Oler, 2014), Betton et al. verify all takeover announcement dates using information retrieved from Factiva and Google. Notably, the dataset includes only published takeover rumors for which there was no prior instance of the same rumor for a period of at least 180 days. This permits the measurement of the initial market reaction to widely disseminated speculation.

We obtain options volume information from OptionMetrics, which covers all exchange-listed call and put options on U.S. equities. This database contains information on trading volume for each option contract and therefore enables us to classify trades according to both maturity and moneyness. Using nine-digit CUSIPs, we merge the sample of takeover rumors with OptionMetrics and exclude firms without valid option price and volume information during days (-90, -1) relative to the rumor. This results in the removal of 375 observations, leaving a total of 1,699 firms in our sample. Our analysis of options trading requires a control sample constructed based on firm fundamentals. Therefore, we drop firms without complete COMPUSTAT coverage (61 observations), yielding the final sample of 1,638 takeover-rumored firms.

Takeover rumors in our sample are coded by identifying non-mutually exclusive rationales provided within each rumor article that justify its publication. For example, rumors coded as *AdvisorHired* indicate that the target firm has retained the services of an investment bank or financial advisor, while rumors coded as *AnalystReport* indicate that one or more analysts assert that a takeover seems logical. Table A1, Part (b) of the Appendix lists the rationales behind takeover rumors.

Table 1 reports characteristics of the final sample, with Panel A presenting the distribution of rumors by year. We note that the number of rumors per year increases over the sample period, reaching a peak of 374 in 2011, and that 419 takeover rumors occur during the financial crisis of 2008–2009. Panel B outlines the sample distribution according to the Fama-French 17-industry classification and demonstrates that our sample includes firms from a wide range of industries.

Panel C of Table 1 presents the abnormal stock market reaction around the rumor date, with expected returns based on the Carhart (1997) four-factor model. We label rumors as 'accurate' if a takeover announcement occurs within 365 days after the initial publication of the rumor, and 'inaccurate' otherwise. We find that takeover rumors result in significantly positive CAARs of 3.63% over the (0, +1) rumor date period, with similar results found over the longer (–20, +20) rumor date window.[45] These findings are in line with prior research (e.g., Ahern & Sosyura, 2015; Betton et al., 2018) and demonstrate that it is reasonable to presume that, on average, trading in firms that will subsequently become the subject of a publicly announced takeover rumor is profitable. Furthermore, in untabulated tests, we find that the CAARs of firms associated with accurate rumors (6.97%) are significantly higher than those associated with inaccurate rumors (3.63%) over each of the above windows, implying insider trading, market anticipation, or both (Jensen & Ruback, 1983; Clements & Singh, 2011). Figure 1 plots the share price reaction around the rumor date.

## 4.4. Results

### 4.4.1. Identifying Abnormal Trading Volumes

In this section, we examine whether abnormal options trading exists prior to takeover rumors. We follow Augustin et al. (2019) and calculate abnormal options volume using a market-model approach

[45]We employ a (0, +1) event window because some rumors in our sample are released after the market is closed.

that accounts for the market volume in options (median trading volume across all options in the OptionMetrics database), the Chicago Board of Options Exchange (CBOE) Volatility Index (VIX), as well as the contemporaneous returns of the underlying stock and the market.[46] We use an estimation window of (-90, -31) days before the takeover rumor date to obtain estimates of the model in order to compute abnormal volume in an event-window of (-30, -1) days relative to the rumor.

Table 2 presents the abnormal option volume statistics with results stratified by option moneyness. We find significantly positive cumulative average abnormal trading volumes for both call and put options, as shown in Panel A. This finding demonstrates the importance of the takeover rumor publication period in discovering abnormal trading activities in the options market.

Considering only options that expire after the rumor date, we further stratify our sample by moneyness. We follow the literature (e.g., Wang, 2013; Augustin et al., 2014) and define option moneyness as follows: call options are in-the-money (ITM) if the strike price is less than 95% of the underlying stock price; at-the-money (ATM) if the strike price falls between 95% and 105% of the stock price; and out-of-the-money (OTM) if the strike price is greater than 105% of the stock price.[47] We conduct an event study for each category to compute abnormal volumes and present the results in Table 2, with graphical representation depicted in Figure 2.

As displayed in Panel A, we find the abnormal trading volume in OTM call (OTM put) options within 30 days prior to the initial publication of takeover rumors to be significantly higher than that of either ATM call (ATM put) or ITM call (ITM put) options. We present the results for a series of paired t-tests for the differences in the means of respective categories in Columns (5) and (6). This evidence is in line with prior studies (Cao et al., 2005; Augustin et al., 2019) who find that prior to stock price jumps, informed traders are more likely to trade in OTM options than shares due to the higher expected profitability from options trading.

While we assert that the observed abnormal options trading prior to rumors is an indication of informed trading, an alternative proposition suggests that market participants speculating on

[46]We use the return on Standard & Poor's 500 Composite Index as a proxy for the market return. In addition, we control for lagged values of the dependent and all independent variables.

[47]We use the same cut-offs to define moneyness for put options: put options are out-of-the-money (OTM) if the strike price is less than 95% of the underlying stock price; at-the-money (ATM) if the strike price falls between 95% and 105% of the stock price; and in-the-money (ITM) if the strike price is greater than 105% of the stock price. For robustness we also use cutoff levels of 0.90 and 1.10, finding the vast majority of results to be qualitatively similar (untabulated).

potential takeover targets might trigger unusual pre-rumor trading in the options market. If this explanation is correct, we would expect to observe comparable levels of options trading activity in firms with similar characteristics to those firms soon to be subject to takeover speculation. Therefore, we use propensity score matching to construct a control sample based on the main proxies of takeover likelihood as documented in the literature (Hasbrouck, 1985; Palepu, 1986; Ambrose and Megginson, 1992; Cremers et al., 2009; Cornett et al, 2011). In particular, we match on firm size, the market-to-book ratio, ROA, firm leverage, the presence of a blockholder, and on the presence of bids made within the year prior and within the same industry (according to three-digit Standard Industrial Classification (SIC) codes).[48] In each case, we choose that firm as the control firm which has the closest takeover propensity score (the smallest Mahalanobis distance) relative to the rumored firm, at the end of the fiscal year previous to the takeover rumor.

Next, we compute abnormal option volumes for control firms constructed using the first best matches (PS1) of the propensity matching, with our results presented in Panel B of Table 2.[49] No category of moneyness is statistically significant for control firms. Further, in Panel C we report the results from paired t-tests for the differences in the means of the cumulative average abnormal volumes between rumored and control groups (i.e., the rumored firms' mean minus the control firms' mean). We find that for both OTM call options and OTM put options, this difference is significantly positive, as displayed in Column (4). Furthermore, the difference between rumored firms and their matched peers is significantly higher for OTM options (both calls and puts) than for respective ATM or ITM options, as displayed in Columns (5) and (6). Our results suggest that the increased volume of OTM options observed in firms which soon become subject to takeover speculation is unlikely to be driven by market anticipation based on public information.

Figure 2 graphically presents the evolution of both average abnormal and cumulative average abnormal trading volume for rumored firms and their matched peers within the 30-day trading window prior to a given rumor. While there is no obvious trading pattern in the control sample, the daily average abnormal call volume of the rumored sample increases 5 days prior to the rumor and

[48]We define a blockholder as an institutional investor holding 5% or more of a firm's outstanding shares.

[49]In an untabulated robustness test, we also use second best matches (PS2). We find the results to be qualitatively similar.

peaks the day before the rumor. The average abnormal put trading volume for rumored firms also increases over the same pre-rumor period, but to a lesser extent than that of call options.

We contend that the increase in OTM call option volume is a result of privately informed traders purchasing such options prior to expected share price increases resulting from rumor announcements. The observed increase in OTM *put* option volume may result from informed traders *writing* (not purchasing) these options, a strategy also likely to be profitable upon rumor announcement.[50] Moreover, Augustin et al. (2019) present a number of strategies for exploiting private information about an impending takeover using synthetic options and note that some of them require trading both call and put options simultaneously.

### 4.4.2. The Predictive Power of Informed Options Trading

If the abnormal options volume prior to takeover rumors is due to the activity of privately informed traders, as we assert, we would expect such volume to differ according to expectations of the rumor's publication. We do not know this likelihood, as our sample consists only of rumors that actually occurred. However, we surmise that accurate rumors are more likely to have been perceived as having potential to generate a rumor publication than are inaccurate rumors. Therefore, we proceed to examine whether unusual options volume prior to takeover rumors is correlated with the accuracy of rumors, with results displayed in Panels D and E of Table 2.[51]

Regardless of accuracy, pre-rumor abnormal options trading volume is significantly positive, as displayed in Column (1). However, the abnormal volume is higher when rumors are accurate, despite the considerably smaller sample size (320 compared with 1,318). This trend continues for each category of moneyness. Focusing on OTM options due to the leverage they offer investors, we find that both call and put option abnormal volumes are significantly higher when rumors are accurate than when they are inaccurate (t-test results are untabulated). This suggests that options trading is more pervasive in rumored firms having higher prospects to be the target of a takeover proposal.

[50]As our measure of abnormal trading represents volume, an increased demand in either the purchasing or writing of options contributes to a positive number of contracts traded.

[51]We note that rumors, regardless of accuracy, are known to generate positive abnormal returns on the rumor date and are thus of interest to investors.

A potential concern in our analysis is that rather than informed options trading occurring in anticipation of takeover rumors, takeover rumors may be a response to unusual activity in the options market that has already transpired. We address this issue of potential endogeneity by using the rationales provided within each rumor article (defined in Part (b) of Table A1 of the Appendix). We identify and remove 337 cases for which the article mentions that the rumor is at least partially inspired by activity in the options market (*OptionsIncreased*). Then, we compute abnormal options trading for the remaining 1,301 sample observations in an identical fashion to that above, with the robustness results presented in Table 2 Panel F. We again find significant evidence of an increase in abnormal trading prior to takeover rumors without finding any unusual pattern in the control firms (untabulated for brevity). This finding alleviates the concern that rumors are solely inspired by pre-rumor unusual trading activity in the options market. We consider additional robustness tests in Section 5.

We next examine whether pre-rumor abnormal options trading can predict rumor accuracy in a multivariate setting. Specifically, we fit a logit regression where the dependent variable equals one if the rumored firm becomes subject to a takeover announcement within the following 365 days. The main independent variable of interest is computed as the difference between the cumulative abnormal trading volume of call options minus that of put options:

$$\Delta CAVOL_{i,(-30,-1)} = CAVOL^{call}_{i,(-30,-1)} - CAVOL^{put}_{i,(-30,-1)} \quad (1)$$

where $CAVOL^{call}_{i,(-30,-1)}$ and $CAVOL^{put}_{i,(-30,-1)}$ are firm $i$'s cumulative abnormal trading volumes for call and put options, respectively, computed using a market-model over days (-30, -1) relative to the rumor announcement date (day 0). Our approach here is similar in sprit to that of Ordu and Schweizer (2015) who argue that $\Delta CAVOL_{i,(-30,-1)}$ is a proxy for the direction of the informational content of options trading volume, and thus correlated with informed traders' expectations of event period returns.

In our regression models, we include multiple proxies for managerial motivation to pursue a deal: target newsworthiness, abnormal returns surrounding the rumor date, and year and industry fixed effects (Cornett et al., 2011; Ahern and Sosyura, 2015; Betton et al., 2018). Furthermore, we include option moneyness in our analysis and separately compute $\Delta CAVOL_i$ for OTM ($\Delta CAVOL_{\text{OTM}}$),

ATM ($\Delta CAVOL_{\text{ATM}}$), and ITM ($\Delta CAVOL_{\text{ITM}}$) options in order to separately examine the predictive power of each category.

Columns (1) to (4) of Table 3 present the results of the logistic regressions. We find significant and positive coefficients for abnormal directional options trading prior to takeover rumors, even after controlling extensively for other determinants of takeover candidacy. Moreover, in line with our prior findings, this predictive power is mainly driven by OTM options as shown in Column (2). These results suggest that the observed abnormal trading activity stems from informed traders who are privately informed about the possibility of takeovers, as OTM options are considered to represent the most profitable mechanism to employ when utilizing private information (Cao et al., 2005; Augustin et al., 2019).

To further investigate the informativeness of options trading, we next use OLS regressions to examine whether abnormal option volume predicts rumor date returns. Over the pre-rumor period, we expect informed traders to increase their net position in derivatives of those firms which will experience higher rumor date returns. Therefore, we expect to observe a positive relation between the direction of abnormal options trading ($\Delta CAVOL$) and rumor date returns while controlling for other determinants of returns (Cornett et al., 2011; Ahern and Sosyura, 2015; Betton et al., 2018).

Columns (5) to (8) of Table 4 show the results of the regressions. We find significantly positive coefficients for $\Delta CAVOL_{\text{All}}$ as displayed in Column (5) and for $\Delta CAVOL_{\text{OTM}}$ as displayed in Column (6). This supports our hypothesis that the abnormal options trading volume prior to rumors is informative and can predict future price movements. It is also consistent with Cao et al. (2005) who argue that greater call-volume imbalances are associated with greater announcement returns.

In sum, we document multivariate support for our central premise that the increase in options trading volume prior to takeover rumors is due to the activity of informed traders who are privately informed about takeover negotiations. This informational advantage is substantial, as takeover rumors in general and accurate rumors in particular are found to result in significant positive short-term abnormal returns for target firms on the rumor day (Figure 1).

Ke et al. (2003) contend that the legal risks of informed trading are smaller the further removed the trades are from the principal informational event. In addition, DeMarzo et al. (1998) argue that it is more cost-effective and efficient for a resource-constrained SEC to prosecute informed

traders only after large price moves. Given that returns for firms targeted in bid announcements are much higher than those of rumored targets (Andrade et al., 2001; Betton et al., 2009), it seems reasonable that regulators of insider trading would focus their efforts accordingly. Thus, establishing a derivative position in advance of the rumor's publication would not only allow informed traders to capture rumor date abnormal returns, but would also mitigate the degree of unwanted scrutiny compared to establishing a trading position shortly before the takeover announcement

### 4.4.3. Trading Strategies

Given that information on options trading and takeover rumors is publicly available, it is interesting to examine whether such information can be utilized by market participants as part of an investment strategy to achieve statistically significant and economically meaningful returns. We can not determine trading profits, as we do not have access to trading costs and because both long and short positions can not be established simultaneously (only one event typically occurs on a given day). Instead, we demonstrate the economic significance of each predictive variable by outlining the relationship between abnormal option volume and post-rumor target-firm returns.

To this end, we first use equation (1) to compute $\Delta CAVOL_{(-30,-1)}$ for every rumored firm during the month preceding the rumor date. Next, we sort our sample firms into three terciles. The first tercile, T1, contains the target firms with the lowest $\Delta CAVOL_{(-30,-1)}$ prior to the rumor. The third tercile, T3, contains the target firms with the highest $\Delta CAVOL_{(-30,-1)}$ prior to the rumor. The center tercile, T2, contains all other rumored firms not in terciles T1 and T3.

We then construct a portfolio in which we establish a long position in firms in tercile T3 and a short position in firms in tercile T1. Given that informed traders are more likely to use target call options prior to takeovers (Cao et al., 2005; Augustin et al., 2019), we expect the long position of our portfolio to consist of many firms with accurate rumors and consequently significant positive post-rumor returns. The short position of our portfolio should consist of firms with lower rumor accuracy, and for these firms we expect post-rumor price reversals (negative post-rumor returns) as documented in the literature (Ahern and Sosyura, 2015; Betton et al., 2018). Firms are added to an equally weighted portfolio on the day after the initial publication of the rumor and are held in the portfolio

for a period of either six months or one year using monthly rebalancing, with portfolio returns presented in Table 4.

On average, this trading strategy leads to a significant monthly abnormal return of 0.683% (0.729%) within the six-month (one-year) period after the rumor. This demonstrates that trading in options prior to the rumor date may be profitable and provides further support for our hypothesis that informed traders are driving the observed pre-rumor abnormal options trading.

The long-term persistence of the excess returns suggests a lack of arbitrage in the market (Shleifer and Vishny, 1997). To investigate further, we follow Ahern and Sosyura (2015) and divide our sample into above- and below-median subsamples based on (a) Amihud illiquidity (a proxy for the cost of arbitrage, as per Amihud, 2002) and (b) idiosyncratic volatility (a measure of illiquidity, as per Shleifer and Vishny, 1997). The results in Table 4 show that illiquid firms drive the long-short portfolios returns, indicating that arbitrage frictions likely prevent the market from acting efficiently.

### 4.4.4. Trading Venue

We proceed to investigate which trading venue, the options market or the equity market, is preferred for those possessing private information regarding takeover rumor candidacy. Some studies suggest that informed traders prefer trading in the options market, as more lucrative opportunities are provided by the lower transaction costs and the higher leverage (Black, 1975; Beck 1993; Biais and Hillion, 1994; Cao, 1999). In addition, the options market offers contracts at a variety of strike prices, which assists in trading anonymously (Easley et al., 1998) and overcoming wealth constraints (John et al. 2003) as well as short-sale constraints (Figlewski and Webb, 1993; Ofek et al., 2004; Danielsen et al., 2011). However, other research notes the relative illiquidity (and thus higher trading cost) of the options market (Johnson and So, 2012; Muravyev et al., 2013). Furthermore, if traders are not confident in the information they possess, the high leverage of options may serve to disincline rather than to entice.

We follow Roll et al. (2010) and Johnson and So (2012) and use the ratio of option volume to equity volume, *O/S*, as a proxy for the relative trading intensity of the options market compared to the equity market. We define this measure for call options and put options separately as follows:

$$O_i^{call}/S_{i,t} = \frac{OPVOL_{i,t}^{call}}{EQVOL_{i,t}} \quad (2)$$

$$O_i^{put}/S_{i,t} = \frac{OPVOL_{i,t}^{put}}{EQVOL_{i,t}} \quad (3)$$

where $OPVOL_{i,t}^{call}$, $OPVOL_{i,t}^{put}$, and $EQVOL_{i,t}$ are the trading volumes in calls, puts, and stocks, respectively, for firm *i* on day *t*.[52]

Next, we follow standard event methodology and use a constant mean model in order to compute abnormal O/S volumes (Arnold et al., 2000; Ordu and Schweizer, 2015). First, we compute the daily benchmark O/S level for every rumored firm in our sample as the daily average of O/S volumes during an estimation window of (-240, -31) days relative to the rumor. Then, we define the daily abnormal O/S volume during the event period of (-30,-1) days relative to the rumor as the difference between the observed O/S volume and the benchmark O/S volume:

$$AO_i^{call}/S_{i,t} = O_i^{call}/S_{i,t} - \overline{O_i^{call}/S_{i,t}} \quad (4)$$

$$AO_i^{put}/S_{i,t} = O_i^{put}/S_{i,t} - \overline{O_i^{put}/S_{i,t}} \quad (5)$$

where $\overline{O_i^{call}/S_{i,t}}$ and $\overline{O_i^{put}/S_{i,t}}$ are the benchmark O/S levels for call options and put options, respectively, for firm *i* on day *t*.

Finally, we compute the cumulative abnormal option volume to equity trading volume (CAO/S) for each firm *i* over the event period as:

$$CAO_i^{call}/S_{i,t} = \sum_{t=-30}^{-1} AO_i^{call}/S_{i,t} \quad (6)$$

$$CAO_i^{put}/S_{i,t} = \sum_{t=-30}^{-1} AO_i^{put}/S_{i,t} \quad (7)$$

A significantly positive deviation from zero in either CAO/S measure provides evidence that informed traders are more active in the options market than the equity market over the event period (Roll et al., 2010; Johnson and So, 2012). Therefore, we proceed to investigate whether CAO/S can

[52]We find similar results when computing the ratios using the dollar trading volumes (untabulated).

predict rumor accuracy and rumor period returns through a series of logit and OLS regressions. Table 5 presents the results.

We find $CAO^{call}/S$ to be a significantly positive predictor of rumor accuracy (Column (1)), rumor date returns (Column (3)), and post-rumor returns of rumored targets (Column (5)). This provides evidence that traders in possession of information which suggests that a takeover rumor is imminent are more likely to trade call options than to trade stocks. In addition, we find $CAO^{put}/S$ to be a significantly negative predictor of post-rumor returns (Column (6)) yet not rumor accuracy (Column (2)) or rumor date returns (Column (4)). This provides evidence that traders in possession of information which suggests that an *inaccurate* takeover rumor is imminent are more likely to trade put options than to trade stocks. Overall, our results indicate that the options market is the preferred venue for traders informed on takeover rumor candidacy and plays an important role in price discovery over the pre-event period.

## 4.5. Robustness

While we contend that the observed increase in pre-rumor abnormal options trading is a consequence of the trading activity of informed investors, there may yet be concerns that our results are instead driven by speculative trading. Therefore, we proceed to construct two alternative measures of informed options trading that are introduced by Acharya and Johnson (2010) and widely used in the options trading literature to help identify suspicious trading (Augustin et al., 2014; Gao and Huang, 2014; Ordu and Schweizer, 2015). Specifically, for every rumored firm we obtain residuals from two regression models as follows:

Unconditional regression:

$$VOL_{i,t}^{call} = \alpha + \varepsilon_{i,t}^{call}, \tag{8}$$

Conditional regression:

$$VOL_{i,t}^{call} = \alpha + \beta_1 . VOL_t^{market} + \beta_2 . RET_t^{market} + \beta_3 . VOL_{i,t-1}^{stock} + \beta_4 . RET_{i,t-1}^{stock} + \beta_5 . VOL_{i,t-1}^{call} + \varepsilon_{i,t}^{call}, \tag{9}$$

where $VOL_{i,t}^{call}$ is the standardized call option volume of firm *i* on day *t*; $VOL_t^{market}$ and $RET_t^{market}$ are the market volume and return on day *t*, respectively; $VOL_{i,t-1}^{stock}$ and $RET_{i,t-1}^{stock}$ are the volume and return of the underlying stock on day *t*-1, respectively; $VOL_{i,t-1}^{call}$ is the standardized call option volume of firm *i* on day *t*-1; and $\varepsilon_{i,t}^{call}$ are the regression residuals. We report results using call option volume and note that in untabulated analysis we find similar results when using put option volume.

We run the regressions using daily data over a three-month period prior to the rumors. Then, for every regression specification, we use the standardized regression residuals to construct measures of abnormal trading. "*MAX*" ("*SUM*") is the maximum (sum) of the daily standardized residuals over (-5, -1) trading days relative to the rumor date. *MAX* identifies the occurrence of suspicious activity and is sensitive to days with unusually large trading activity, but might miss the activity of strategic informed traders who behave similarly to Kyle-type monopolists (e.g., those engaging in stealth trading or order-splitting). *SUM* captures those activities that might be missed by *MAX* and is indicative of the overall level of suspicious trading. As a benchmark for our analysis, we also compute *MAX* and *SUM* over a five-day window (-90, -86), where day 0 represents the rumor date.

Panel A of Figure 3 shows the histogram of the conditional *MAX* computed over days (-5, -1) relative to the rumor date, while Panel B shows the histogram of the conditional *MAX* computed over the benchmark period (-90, -86).[53] The distribution in Panel A appears to have a fatter right tail than that in Panel B, which would indicate that more informed trading activity occurs during the five-day window prior to rumors than during the benchmark period. To confirm, we use a two-sample Kolmogorov-Smirnov[54] test and find that the distribution of the data in Panel A is significantly different from that of Panel B. For additional confirmation, we also calculate the Expected Shortfall (ES(1-α%)), a commonly used measure to analyze distribution tails, for the conditional *MAX* measure over the five-day window prior to the rumor and over the benchmark period (Panel C, Figure 3). We find that the Expected Shortfall for the conditional MAX measure is always higher for the distribution in Panel A than for the distribution in Panel B, offering further support of a fatter tail in Panel A. The

[53]The results are similar when using unconditional *MAX* distributions and remain valid when we use conditional or unconditional *SUM* distributions. For brevity, we only plot the conditional *MAX* distributions.

[54]The Kolmogorov-Smirnov test quantifies the maximum absolute difference between the cumulative distribution functions of the two data samples.

results of using two alternative measures of informed options trading are thus suggestive that suspicious (informed) trading occurs shortly prior to the rumor date.

Acharya and Johnson (2010) note that *MAX* and *SUM* measures could also be used to examine the variations in likelihood of informed trading across different events. Therefore, we proceed to use these measures to examine whether the type of takeover rumor published can assist in predicting the occurrence of informed options trading. Specifically, we regress the conditional and unconditional *MAX* and *SUM* measures on dummy variables which represent the rationales provided within each rumor article that justify its publication (see Part (b) of Table A1 of the Appendix). We also include takeover candidacy variables (Cornett et al., 2011) to control for market anticipation of the takeover.

Table 6 presents the results of using the unconditional or conditional *MAX* or the unconditional or conditional *SUM* as the dependent variable throughout models 1 to 4. We observe a positive relation between firm size and our measures of informed trading. This is consistent with Acharya and Johnson (2010) who argue that a higher number of individuals are involved in larger deals and that this increases the probability of information leakage and, consequently, informed trading. We also find significant positive coefficients for *AdvisorHired* (the rumor indicates that the target firm has retained the services of an investment bank or financial advisor) and *PEFundInvolved* (the rumor indicates that a private equity or hedge fund has expressed interest in a potential takeover deal) across all four models. This is consistent with prior studies that find evidence of informed trading by M&A advisors (Bodnaruk et al., 2009; Jegadeesh and Tang, 2010; Lowry et al., 2016) and by hedge fund managers (Masoud et al., 2011; Gao and Huang, 2014) prior to takeover announcements. In addition, we observe significant positive coefficients for *InsiderCited* (the rumor is predicated on an anonymous source) and *TargetInitiated* (the rumor has been initiated by the target firm itself), suggestive of a deliberate leakage of information to assist traders in generating a rumor publication and subsequently profit by trading in options.

## 4.6. Conclusion

We find abnormally high trading volume in the equity options of rumored takeover target firms shortly before the initial rumor date. This abnormal trading volume is concentrated in out-of-the-money options, particularly calls, which provide the highest leverage opportunity prior to stock price run-ups. Furthermore, we measure the direction of abnormal options trading and find that this

measure predicts takeover bids, rumor date target firm returns, and post-rumor target firm returns, even after extensively controlling for other determinants of takeover candidacy as motivated by the literature. After ruling out alternative explanations, we interpret our findings as evidence that privately informed individuals are aware of takeover rumor candidacy and trade on this information in the options market.

## References


Acharya, V. V., & T. C. Johnson, 2010, More insiders, more insider trading: Evidence from private-equity buyouts, *Journal of Financial Economics* 98, 500–523.

Ahern, K. R., & D. Sosyura, 2015, Rumor has it: Sensationalism in financial media, *Review of Financial Studies* 28, 2050–2093.

Ambrose, B. W., & W. L. Megginson, 1992, The role of asset structure, ownership structure, and takeover defenses in determining acquisition likelihood, *Journal of Financial and Quantitative Analysis* 27, 575–589.

Amihud, Y., 2002, Illiquidity and stock returns: Cross-section and time-series effects, *Journal of Financial Markets* 5, 31-56.

Andrade, G., M. Mitchell, & E. Stafford, 2001, New evidence and perspectives on mergers, *Journal of Economic Perspectives* 15*, 1*03–120.

Arnold, T., G. Erwin, L. Nail, & T. Nixon, 2006, Do option markets substitute for stock markets? Evidence from trading on anticipated tender other announcements, *International Review of Financial Analysis* 15, 247–255.

Augustin, P., M. Brenner, J. Hu, & M. G. Subrahmanyam, 2014, Are corporate spin-offs prone to insider trading? Working Paper, New York University.

Augustin, P., M. Brenner, & M. G. Subrahmanyam, 2019, Informed options trading prior to takeover announcements: Insider trading? *Management Science* 65, 5697–5720.

Barnes, B. G., N. Harp, & D. Oler, 2014, Evaluating the SDC mergers and acquisitions database, *Financial Review* 49, 793–822.

Beck, K., 1993, Asymmetric information and options, *Review of Financial Studies* 6, 435–472.

Betton, S., F. Davis, & T. Walker, 2018, Rumor rationales: The impact of message justification on article credibility, *International Review of Financial Analysis* 58, 271–287.

Betton, S., B. Eckbo, & K. S. Thorburn, 2008, Corporate takeovers, *Journal of Economic Perspective* 2, 49-69.

Betton, S., B. Eckbo, & K. S. Thorburn, 2009, Merger negotiations and the toehold puzzle, *Journal of Financial Economics* 91, 158–178.

Bharadwaj, A., & A. Shivdasani, 2003, Valuation effects of bank financing in acquisitions, *Journal of Financial Economics* 67, 113-148.

Biais, B., & P. Hillion, 1994, Insider and liquidity trading in stock and options markets, *Review of Financial Studies* 7, 743–780.

Black, F., 1975, Fact & fantasy in the use of options, *Financial Analysts Journal* 31, 36–72.

Bodnaruk, A., M. Massa, & A. Simonov, 2009, Investment banks as insiders and the market for corporate control, *The Review of Financial Studies* 22, 4989-5026.

Cao, C., Z. Chen, & J. M. Griffin, 2005, Informational content of option volume prior to takeovers, *Journal of Business* 78, 1073–1109.

Cao, H., 1999, The effect of derivative assets on information acquisition and price behavior in a rational expectations equilibrium, *Review of Financial Studies* 12, 131–163.

Carhart, M. M., 1997, On persistence in mutual fund performance, *The Journal of Finance* 52, 57-82.

Chan, K., L. Ge, & T. C. Lin, 2015, Informational content of option trading on acquirer announcement return, *Journal of Financial and Quantitative Analysis* 50, 1057–1082.

Chou, H. I., G. Y. Tian, & X. Yin, 2015, Takeover rumors: Returns and pricing of rumored targets, *International Review of Financial Analysis* 41, 13-27.

Clements, M., & H. Singh, 2011, An analysis of trading in target stocks before successful takeover announcements, *Journal of Multinational Financial Management* 21, 1–17.

Cornett, M. M., B. Tanyeri, and H. Tehranian, 2011, The effect of merger anticipation on bidder and target firm announcement period returns, *Journal of Corporate Finance* 17, 595–611.

Cremers, K. M., V. B. Nair, & K. John, 2009, Takeovers and the cross-section of returns, *The Review of Financial Studies* 22, 1409–1445.

Danielsen, B., & S. Sorescu, 2001, Why do option introductions depress stock prices? An empirical study of diminishing short-sale constraints, Working Paper, Texas A&M University.

Davis, F., H. Khadivar, K. Pukthuanthong, & T. Walker, 2020, Insider trading in rumored takeover targets, *European Financial Management*, forthcoming.

DeMarzo, P. M., M. J. Fishman, & K. M. Hagerty, 1998, The optimal enforcement of insider trading regulations, *Journal of Political Economy* 106, 602–632.

Easley, D., M. O'Hara, & P. S. Srinivas, 1998, Option volume and stock prices: Evidence on where informed traders trade, *The Journal of Finance* 53, 431–465.

Faccio, M., & R. W. Masulis, 2005, The choice of payment method in European mergers and acquisitions, *Journal of Finance* 60, 1345-1388.

Figlewski, S., & G. Webb, 1993, Options, short sales, and market completeness, *Journal of Finance* 48, 761–777.

Gao, M., & J. Huang, 2014, Capitalizing on capitol hill: Informed trading by hedge fund managers, AFA 2012 Chicago Meetings Paper.

Gao, Y., & D. Oler, 2012, Rumors and pre-announcement trading: Why sell target stocks before acquisition announcements, *Review of Quantitative Finance and Accounting* 39, 485-508.

Hasbrouck, J., 1985, The characteristics of takeover targets: Q and other measures, *Journal of Banking and Finance* 9, 351–362.

Jarrell, G. A., J. A. Brickley, & J. M. Netter, 1988, The market for corporate control: The empirical evidence since 1980, *Journal of Economic Perspectives* 2, 49-69.

Jayaraman, N., M. B. Frye, and S. Sabherwal, 2001, Informed trading around merger announcements: An empirical test using transaction volume and open interest in options market, *Financial Review* 36, 45–74.

Jayaraman, N., G. Mandelker, & K. Shastri, 1991, Market anticipation of merger activities: An empirical test, *Managerial and Decision Economics* 12, 439–448.

Jegadeesh, N., & Y. Tang, 2010, Institutional trades around takeover announcements: Skill vs. inside information, Unpublished Working Paper, Emory University.

Jensen, M. C., & R. S. Ruback, 1983, The market for corporate control: The scientific evidence, *Journal of Financial Economics* 11, 5–50.

John, K., A. Koticha, R. Narayanan, & M.G. Subrahmanyam, 2003, Margin rules, informed trading in derivatives and price dynamics, Working Paper, New York University.

Johnson, T. L., & E. C. So, 2012, The option to stock volume ratio and future returns, *Journal of Financial Economics* 106, 262–286.

Ke, B., S. Huddart, & K. Petroni, 2003, What insiders know about future earnings and how they use it: Evidence from insider trades, *Journal of Accounting and Economics* 35, 315–346.

Lee, J., & H. Y. Cheong, 2001, Trade size and information-motivated trading in the options and stock markets, *Journal of Financial and Quantitative Analysis* 36, 485–501.

Levy, H. & J. A. Yoder, 1993, The behavior of option implied standard deviations around merger and acquisition announcements, *The Financial Review* 28, 261–272.

Liu, D., P. P. Lung, & J. Lallemand, 2015, Anticipation of takeovers in stock and options markets, *International Review of Economics and Finance* 39, 19–35.

Lowry, M., M. Rossi, & Z. Zhu, 2016, Informed trading by adviser banks? A look at options holdings ahead of mergers, SSRN Working Paper 2579463.

Massoud, N., D. Nandy, A. Saunders, & K. Song, 2011, Do hedge funds trade on private information? Evidence from syndicated lending and short-selling, *Journal of Financial Economics* 99, 477–499.

Mayhew, S., A. Sarin, & K. Shastri, 1995, The allocation of informed trading across related markets: An analysis of the impact of changes in equity-option margin requirements, *The Journal of Finance* 50, 1635-1653.

Muravyev, D., N. D. Pearson, & J. P. Broussard, 2013, Is there price discovery in equity options? *Journal of Financial Economics* 107, 259–283.

Newey, W., & K. West, 1987, A simple, positive semi-definite, heteroskedasticity and autocorrelation consistent covariance matrix, *Econometrica* 55, 703–708.

Newey, W., & K. West, 1994, Automatic Lag Selection in Covariance Matrix Estimation, *Review of Economic Studies* 61, 631-653.

Ofek, E., M. Richardson, & R. Whitelaw, 2004, Limited arbitrage and short sales restrictions: Evidence from the options markets, *Journal of Financial Economics* 74, 305–342.

Ordu, U., & D. Schweizer, 2015, Executive compensation and informed trading in acquiring firms around merger announcements, *Journal of Banking and Finance* 55, 260–280.

Palepu, K. G., 1986, Predicting takeover targets: A methodological and empirical analysis, Journal *of Accounting and Economics* 8, 3–35.

Pound, J., & R. Zeckhauser, 1990, Clearly heard on the street: The effect of takeover rumors on stock prices, *Journal of Business* 63, 291–308.

Roll, R., E. Schwartz, & A. Subrahmanyam, 2010, O/S: The relative trading activity in options and stock, *Journal of Financial Economics* 96, 1–17.

Shleifer, A., & R. W. Vishny, 1997, A survey of corporate governance, *Journal of Finance* 52, 35–55.

Wang, X., 2013, What does the SEC choose to investigate? *Journal of Economics and Business* 65, 14–32.

Zivney, T., W. J. Bertin, & K. M. Torabzadeh, 1996, Overreaction to take-over speculation, *Quarterly Review of Economics and Finance* 36, 89–115.

**Figure 1. Stock Returns Relative to the Initial Takeover Rumor Date**

This figure plots the market price reaction around the rumor day for our sample of 1,638 takeover-rumored firms from December 2002 through September 2011. Rumors are labeled as accurate (*Accurate*) if the rumored firm in question is the target of a formal takeover bid within 365 calendar days after the initial scoop article, and inaccurate (*Inaccurate*) otherwise. We use the Carhart (1997) four-factor model to calculate abnormal returns.

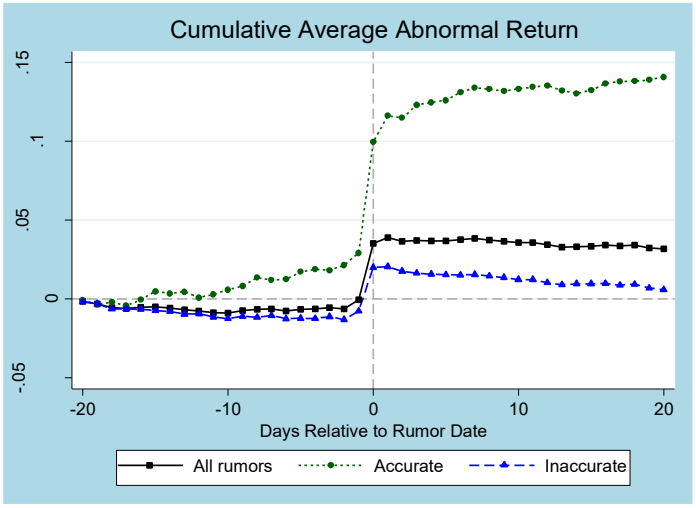
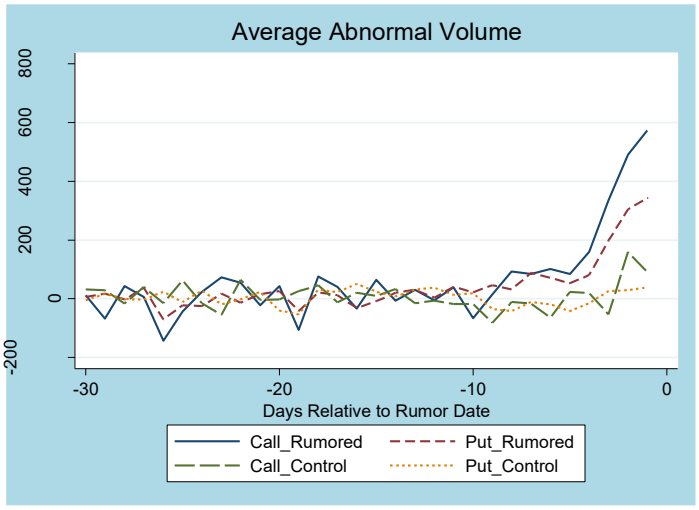


**Figure 2. Abnormal Options Trading Prior to the Initial Takeover Rumor Date**
This figure depicts abnormal trading volumes of both call and put options for rumored and control firms during the 30-day period prior to the initial published takeover rumor. Abnormal volumes are computed using a market model as discussed in Section 4.4. Control firms are chosen based on a propensity score matching algorithm along six dimensions: firm size, market-to-book ratio, ROA, firm leverage, presence of a blockholder, and presence of same industry (three-digit SIC code) bids within the year prior. Panel A plots the average abnormal trading volume while Panel B plots the cumulative average abnormal trading.

(A)




(B)

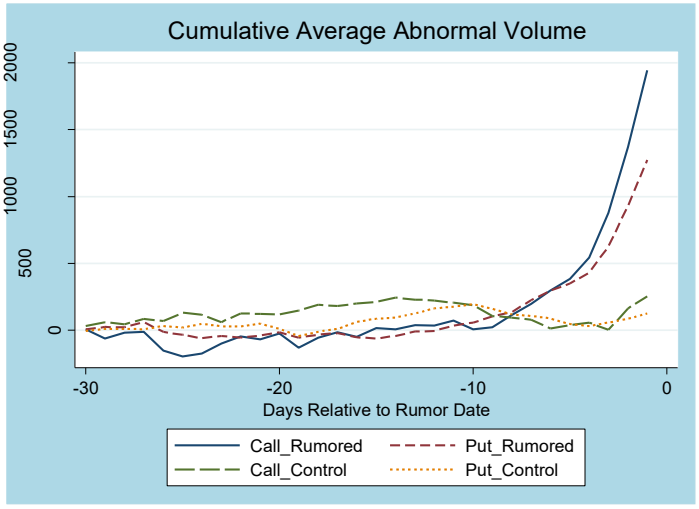
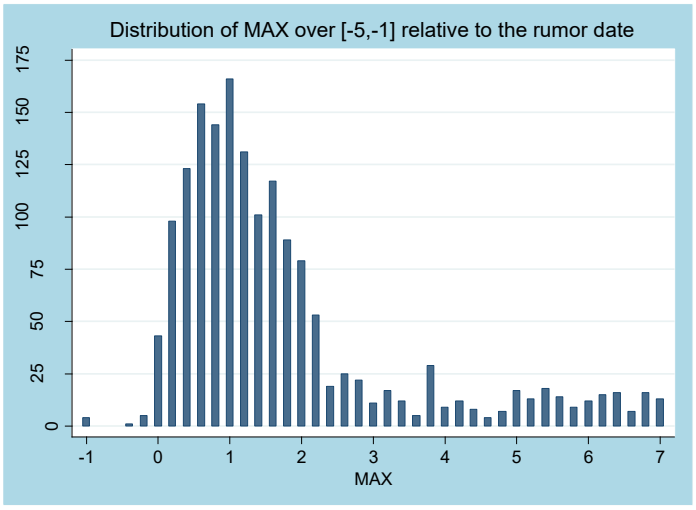


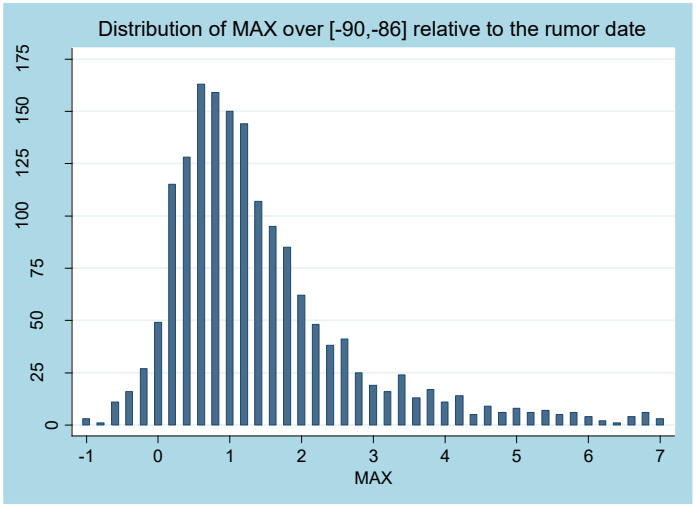
**Figure 3. Characteristics of the Conditional MAX-measure**

This figure provides histograms of the conditional MAX-measure for call option volumes based on standardized regression residuals as discussed in Section 4.5. Panel A presents the results based on a 5-day trading window preceding the initial published takeover rumor, (-5, -1). Panel B presents the results based on a 5-day window beginning three months prior to the initial published takeover rumor, (–90, –86). Panel C presents Expected Shortfall (ES) estimates for different (1-α%) levels according to the MAX distributions presented in Panels A and B.

(A)




(B)




(C)

| | Distribution in Panel A | Distribution in Panel B |
|---|---|---|
| ES[80%] | 4.8 | 4.5 |
| ES[85%] | 5.2 | 4.8 |
| ES[90%] | 5.6 | 5.2 |
| ES[95%] | 6.5 | 5.7 |

**Table 2. Summary Statistics of Rumored Target Firms**

Panel A shows the time distribution of 1,638 takeover-rumored firms during the period from January 2002 to September 2011. Panel B reports the industry distribution of the sample based on the Fama-French 17-industry classification. Panel C presents cumulative average abnormal returns (CAARs) of the rumored firms around the rumor date computed using the the Carhart (1997) four-factor model. We label rumors as '*accurate*' if a takeover announcement occurs within 365 days after the initial publication of the rumor, and '*inaccurate*' otherwise. *P*-values are reported in parentheses.

**Panel A: Distribution by Year**

| Year | Rumor Count | % of Total Count |
|---|---|---|
| 2002 | 33 | 2.0 |
| 2003 | 61 | 3.7 |
| 2004 | 82 | 5.0 |
| 2005 | 77 | 4.7 |
| 2006 | 146 | 8.9 |
| 2007 | 152 | 9.3 |
| 2008 | 133 | 8.1 |
| 2009 | 286 | 17.5 |
| 2010 | 294 | 17.9 |
| 2011 | 374 | 22.8 |
| **Total** | **1,638** | **100** |

**Panel B: Industry Distribution**

| Fama-French 17-Industry Classification | Rumor Count |
|---|---|
| Food | 65 |
| Mining and Minerals | 50 |
| Oil & Petroleum Products | 131 |
| Textiles, Apparel & Footwear | 38 |
| Consumer Durables | 26 |
| Chemicals | 20 |
| Drugs, Soap, Perfumes, Tobacco | 135 |
| Construction & Construction Materials | 39 |
| Steel Works, etc. | 50 |
| Fabricated Products | 1 |
| Machinery & Business Equipment | 218 |
| Automobiles | 21 |
| Transportation | 51 |
| Utilities | 6 |
| Retail Stores | 102 |
| Banks, Insurance Companies, & Other Financials | 10 |
| Other | 675 |
| **Total** | **1,638** |

**Panel C: Rumored Target Abnormal Event Returns**

| Rumor Type | *N* | CAAR (0, +1) | CAAR (-20, -1) | CAAR (+2, +20) | CAAR (-20, +20) |
|---|---|---|---|---|---|
| All | 1,638 | 3.70*** | -0.05 | -0.46 | 3.54*** |
| | | (<0.001) | (0.819) | (0.509) | (<0.001) |
| Accurate | 320 | 8.57*** | 2.92*** | 1.79** | 14.09*** |
| | | (<0.001) | (<0.001) | (0.006) | (<0.001) |
| Inaccurate | 1,318 | 2.53*** | -0.76 | -1.06 | 0.58** |
| | | (<0.001) | (0.524) | (0.234) | (0.034) |

**Table 2. Abnormal Options Trading Volume – Constant Mean Model**

This table presents average cumulative abnormal options trading volumes for our sample of rumored firms (Panel A) and their matched peers (Panel B) over an event-window of (-30, -1) days relative to the rumor publication date. Abnormal volume is computed using a market model approach as discussed in Section 4.4. Results stratified by moneyness (ITM = in the money, ATM = at the money, and OTM = out of the money) are based only on those options expiring after the rumor date (Columns (2) to (4)). Columns (5) to (7) report the results of t-tests for the differences in the cumulative average abnormal volumes between categories of moneyness. Control firms are selected using propensity score matching as discussed in Section 4.4. Panel C reports the results of t-tests of the differences in means of the cumulative average abnormal volumes between the rumored and control groups (i.e., the rumored firms' mean minus the control firms' mean). Panel D presents results for a subsample of rumored firms which become the target of a formal takeover bid within 365 calendar days after the rumor date, whereas Panel E presents results for those which do not. Panel F presents cumulative average abnormal options trading for a subsample of rumored firms after removing those coded as *OptionsIncreased* (see Part (b) of the Appendix). *P*-values are reported in parentheses.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|---|---|---|---|---|---|---|
| | All | ITM | ATM | OTM | OTM-ATM | OTM-ITM | ATM-ITM |
| Panel A: Rumored Firms (N = 1,638) | | | | | | | |
| Call | 1929** | 590** | 263 | 1017** | 754** | 427** | -327* |
| | (0.024) | (0.047) | (0.285) | (0.011) | (0.023) | (0.016) | (0.093) |
| Put | 1275** | 328 | 158 | 685** | 526** | 357* | -169 |
| | (0.037) | (0.105) | (0.179) | (0.027) | (0.045) | (0.096) | (0.216) |
| Panel B: Control Firms (N = 1,638) | | | | | | | |
| Call | 305 | 139 | -46 | 258 | 304 | 119 | -185 |
| | (0.710) | (0.424) | (0.437) | (0.366) | (0.121) | (0.241) | (0.482) |
| Put | 126 | 47 | -25 | 124 | 149 | 77 | -72 |
| | (0.405) | (0.570) | (0.831) | (0.321) | (0.185) | (0.508) | (0.621) |
| Panel C: Differences in Cumulative Abnormal Trading Between Rumored and Control Firms | | | | | | | |
| Call | 1624** | 451* | 309 | 759** | 450** | 308** | -142 |
| | (0.035) | (0.061) | (0.256) | (0.018) | (0.034) | (0.027) | (0.172) |
| Put | 1149** | 281 | 198 | 801** | 603** | 520** | -83 |
| | (0.045) | (0.152) | (0.164) | (0.023) | (0.041) | (0.085) | (0.281) |
| Panel D: Rumored Firms: Accurate Rumors (N = 320) | | | | | | | |
| Call | 2961*** | 707** | 492** | 1563*** | 1071*** | 856** | -215 |
| | (0.008) | (0.011) | (0.036) | (0.002) | (0.005) | (0.013) | (0.192) |
| Put | 1893** | 519* | 135 | 972** | 837** | 453* | -384 |
| | (0.031) | (0.071) | (0.239) | (0.026) | (0.033) | (0.088) | (0.163) |
| Panel E: Rumored Firms: Inaccurate Rumors (N = 1,318) | | | | | | | |
| Call | 1679** | 561* | 207 | 884** | 677** | 323** | -354* |
| | (0.031) | (0.056) | (0.369) | (0.016) | (0.029) | (0.025) | (0.088) |
| Put | 1125** | 281 | 164 | 615** | 451* | 334 | -117 |
| | (0.043) | (0.127) | (0.161) | (0.032) | (0.050) | 0.107 | (0.254) |
| Panel F: Rumored Firms: All Except Those Coded as *OptionsIncreased* (N = 1,301) | | | | | | | |
| Call | 1783** | 516* | 205 | 918** | 713** | 402** | -311* |
| | (0.036) | (0.052) | (0.386) | (0.017) | (0.026) | (0.021) | (0.096) |
| Put | 1159** | 299 | 154 | 631** | 477* | 332 | -145 |
| | (0.046) | (0.127) | (0.181) | (0.030) | (0.059) | (0.104) | (0.252) |

**Table 3. The Predictive Power of Abnormal Options Trading**

Columns (1) to (4) display logit regression results in which the dependent variable is a dummy variable equal to one if the rumor leads to a takeover announcement wihin 365 days. Columns (5) to (8) display coefficients of OLS regressions in which the dependent variable is the cumulative abnormal return of rumored target firms computed over the (0, +1) rumor date period using the Carhart (1997) four-factor model. The main independent variables of interest are measures of abnormal options trading ($\Delta CAVOL_{\text{All}}$, $\Delta CAVOL_{\text{OTM}}$, $\Delta CAVOL_{\text{ATM}}$, and $\Delta CAVOL_{\text{ITM}}$, with ITM = in the money, ATM = at the money, and OTM = out of the money) that are computed based on equation 1 and are expressed in thousands of contracts ('000). Some insignificant controls are untabulated for brevity. They include the following variables: *CashRatio, ChangeSize2Yrs, Concentration, Dormancy, InfoAsym, PrevMergers, PriorReturn2Yrs, ResMismatch, ValuableBrand, SalesGrowth2Yrs, SalesShock, SalesShockSquared, Size, and ShareTurnover*. Heteroskedasticity-robust standard errors are clustered at the firm level and associated *p*-values are reported in parentheses. Table A1 of the Appendix provides additional definitions.

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
|---|---|---|---|---|---|---|---|---|
| Dependent Variable: | Accurate | Accurate | Accurate | Accurate | CAR (0, +1) (%) | CAR (0, +1) (%) | CAR (0, +1) (%) | CAR (0, +1) (%) |
| $\Delta CAVOL_{\text{All}}$ ('000) | 0.705** | | | | 5.028** | | | |
| | (0.032) | | | | (0.036) | | | |
| $\Delta CAVOL_{\text{OTM}}$ ('000) | | 1.782*** | | | | 7.672*** | | |
| | | (0.007) | | | | (0.003) | | |
| $\Delta CAVOL_{\text{ATM}}$ ('000) | | | 0.267 | | | | 3.821 | |
| | | | (0.619) | | | | (0.794) | |
| $\Delta CAVOL_{\text{ITM}}$ | | | | 3.492* | | | | 12.385* |
| | | | | (0.075) | | | | (0.096) |
| CAR (-5, -1) | 0.352 | 0.424 | 0.228 | 0.269 | -4.133 | -4.211 | -5.267 | -5.171 |
| | (0.604) | (0.535) | (0.744) | (0.701) | (0.223) | (0.220) | (0.132) | (0.141) |
| CAR (-41, -1) | 0.402* | 0.405* | 0.430* | 0.452* | 0.339 | 0.450 | 0.653 | 0.652 |
| | (0.088) | (0.087) | (0.071) | (0.058) | (0.774) | (0.705) | (0.587) | (0.589) |
| Informative | 1.065*** | 1.050*** | 1.080*** | 1.099*** | 3.161*** | 3.048*** | 2.975*** | 3.066*** |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (<0.001) |
| Speculative | -0.762*** | -0.795*** | -0.778*** | -0.803*** | -2.009** | -2.095** | -2.131** | -2.095** |
| | (0.002) | (0.002) | (0.002) | (0.001) | (0.021) | (0.018) | (0.017) | (0.020) |
| Year and Industry FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 3.106*** | 3.159*** | 3.098*** | 3.062*** | -4.139 | -4.420 | -4.077 | -4.045 |
| | (0.001) | (0.001) | (0.001) | (0.001) | (0.414) | (0.387) | (0.430) | (0.437) |
| Observations | 1638 | 1638 | 1638 | 1638 | 1638 | 1638 | 1638 | 1638 |
| Pseudo $R^2$ | 0.101 | 0.132 | 0.095 | 0.104 | – | – | – | – |
| Adjusted $R^2$ | – | – | – | – | 0.034 | 0.045 | 0.031 | 0.035 |
| $\chi^2$ Test/$F$-test ($p$-value) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

**Table 4. Long-short Portfolio Returns**

This table provides the monthly returns of long-short portfolios based on abnormal options trading. The portfolio establishes a long position in firms in tercile T3 and a short position in firms in tercile T1 as discussed in Section 4.4. Firms are added to the equally weighted portfolio on the day after the initial publication of the rumor and are held in the portfolio for up to six months (one year) using monthly rebalancing. Returns are calculated using the market model with the CRSP value weighted market return as a benchmark. Following Amihud (2002) and Ahern and Sosyura (2015), *Amihud illiquidity* is calculated as the average of ($|r_t|/Volume_t$). The *proportional bid-ask spread* is calculated as 100 ∗ (ask-bid) / M, where M is the midpoint of the bid and ask, using closing prices from CRSP (Betton et al., 2018). For each subsample, *Low* and *High* represent observations relative to the medians. Newey and West (1987) *p*-values are reported in parentheses. We follow Newey and West (1994) to compute lags.

| | All | Amihud Illiquidity | | Proportional Bid-Ask Spread | |
|---|---|---|---|---|---|
| Portfolio Duration | | Low | High | Low | High |
| Six Months | 0.729*** | -0.036 | 0.854*** | 0.035 | 0.782*** |
| | (0.007) | (0.681) | (0.002) | (0.549) | (0.001) |
| One Year | 0.683** | 0.082 | 0.752** | -0.107 | 0.840** |
| | (0.023) | (0.414) | (0.012) | (0.685) | (0.018) |

**Table 5. The Predictive Power of O/S**

Note: Columns (1) and (2) display logit regression results in which the dependent variable is a dummy variable equal to one if the rumor leads to a takeover announcement wihin 365 days. Columns (3) to (6) display coefficients of OLS regressions in which the dependent variable is the cumulative abnormal return of rumored target firms computed using the Carhart (1997) four-factor model over the (0, +1) or (+2, +20) rumor date period. The main independent variables of interest are abnormal levels of $CAO^{call}/S$ and $CAO^{put}/S$ that are computed based on equations (6) and (7), respectively. Some insignificant controls are untabulated for brevity. They include the following variables: *CashRatio, ChangeSize2Yrs, Concentration, Dormancy, InfoAsym, PrevMergers, PriorReturn2Yrs, ResMismatch, SalesGrowth2Yrs, SalesShock, SalesShockSquared, Size, and ShareTurnover*. Heteroskedasticity-robust standard errors are clustered at the firm level and associated *p*-values are reported in parentheses. Table A1 of the Appendix provides additional variable definitions.

| | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| Dependent Variable: | Accurate | Accurate | CAR (0, +1) (%) | CAR (0, +1) (%) | CAR (+2, +20) (%) | CAR (+2, +20) (%) |
| $CAO^{call}/S \times 10^{+1}$ | 1.163*** | | 6.278** | | 3.857** | |
| | (0.005) | | (0.025) | | (0.012) | |
| $CAO^{put}/S \times 10^{+1}$ | | 3.159 | | 5.461 | | -14.694*** |
| | | (0.352) | | (0.583) | | (0.008) |
| CAR (-5, -1) | 0.266 | 0.251 | -5.185 | -5.108 | 7.472 | 7.715 |
| | (0.704) | (0.720) | (0.139) | (0.150) | (0.140) | (0.131) |
| CAR (-41, -1) | 0.453* | 0.462* | 0.655 | 0.658 | 5.173*** | 5.054*** |
| | (0.058) | (0.053) | (0.587) | (0.590) | (0.002) | (0.003) |
| Informative | 1.098*** | 1.107*** | 3.060*** | 3.023*** | 0.308 | 0.535 |
| | (<0.001) | (<0.001) | (<0.001) | (<0.001) | (0.768) | (0.616) |
| Speculative | -0.752*** | -0.728*** | -2.069** | -2.134** | -2.110* | -2.027* |
| | (0.003) | (0.004) | (0.021) | (0.020) | (0.070) | (0.087) |
| Valuable Brand | -0.484** | -0.436** | 0.895 | 0.846 | 0.227 | 0.238 |
| | (0.020) | (0.038) | (0.357) | (0.396) | (0.854) | (0.851) |
| Year and Industry FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Constant | 3.068*** | 3.054*** | -3.772 | -4.154 | -6.990 | -7.280 |
| | (0.001) | (0.001) | (0.470) | (0.433) | (0.398) | (0.386) |
| Observations | 1638 | 1638 | 1638 | 1638 | 1638 | 1638 |
| Pseudo $R^2$ | 0.134 | 0.135 | – | – | – | – |
| Adjusted $R^2$ | – | – | 0.038 | 0.031 | 0.033 | 0.029 |
| $\chi^2$ Test/*F*-test (*p*-value) | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 | <0.001 |

**Table 6. Characteristics of Abnormal Options Trading**

This table presents a series of OLS regressions where the dependent variable is the measure of suspicious options trading as discussed in Section 4.5. Individual rumor types that we found to be insignificant and thus omitted for brevity include: *AnalystReport, BidderDenied, BidderMentioned, BlockPurchase, FinancingSource, IndustryActivity, MgmtConcerns, OptionsIncreased, SynergyCited, TakeoverChatter, TargetDistress TargetDenied, Undervalued,* and *UnusualActivity*. Similarly, additional controls are untabulated for brevity and consist of the following variables: *CashRatio, ChangeSize2Yrs, Concentration, Dormancy, PrevMergers, PriorReturn2Yrs, ResMismatch, SalesGrowth2Yrs, SalesShock, SalesShockSquared, and ShareTurnover*. Heteroskedasticity-robust standard errors are clustered at the firm level and associated *p*-values are reported in parentheses. Table A1 of the Appendix provides additional variable definitions.

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Dependent Variable: | $MAX^{\text{Unconditional}}_{(-30,-1)}$ | $MAX^{\text{Conditional}}_{(-30,-1)}$ | $SUM^{\text{Unconditional}}_{(-30,-1)}$ | $SUM^{\text{Conditional}}_{(-30,-1)}$ |
| AdvisorHired | 0.515** | 0.455** | 0.781** | 0.673** |
| | (0.015) | (0.012) | (0.011) | (0.012) |
| InsiderCited | 0.416*** | 0.376*** | 0.582** | 0.570*** |
| | (0.008) | (0.005) | (0.012) | (0.006) |
| PEFundInvolved | 0.572*** | 0.439*** | 0.758*** | 0.607*** |
| | (0.002) | (0.005) | (0.005) | (0.009) |
| ShareTurnover | 0.124 | 0.097 | 0.230 | 0.208 |
| | (0.183) | (0.214) | (0.259) | (0.226) |
| Size | 0.046** | 0.035** | 0.068** | 0.059** |
| | (0.035) | (0.039) | (0.028) | (0.024) |
| TargetInitiated | 0.567*** | 0.512*** | 0.831*** | 0.791*** |
| | (0.006) | (0.004) | (0.006) | (0.003) |
| Year and Industry FE | Yes | Yes | Yes | Yes |
| Constant | 0.693*** | 0.720*** | 0.549** | 0.535*** |
| | (<0.001) | (<0.001) | (0.019) | (0.009) |
| Observations | 1638 | 1638 | 1638 | 1638 |
| Adjusted $R^2$ | 0.051 | 0.064 | 0.082 | 0.079 |
| *F*-test (*p*-value) | <0.001 | <0.001 | <0.001 | <0.001 |

## Appendix

**Table A1. Variable Definitions**

| | |
|---|---|
| **(a) Variables of Interest and Control Variables** | |
| *Accurate* | Dummy variable that equals one if the rumored target firm becomes the subject of a formal takeover announcement within one calendar year after the initial rumor date; otherwise the variable equals zero (Ahern and Sosyura, 2015; Betton et al., 2018). |
| *CAR* | Cumulative abnormal return on the rumor date, with expected returns based on Carhart's (1997) four-factor model. |
| *CashRatio* | The ratio of cash and marketable securities to marketable assets (Cornett et al., 2011). |
| *ChangeSize2Yrs* | The percentage change in the firm's total assets over the previous two years (Cornett et al., 2011). |
| *Concentration* | The ratio of the sales of the largest four firms to the total three-digit SIC industry sales of the target firm (Cornett et al., 2011). |
| *Dormancy* | The number of months since the last merger in the same three-digit SIC industry as the target firm (Cornett et al., 2011). |
| *Size* | Natural logarithm of the firm's market capitalization, defined as the number of common shares outstanding multiplied by the closing price on the last trading day during the fiscal year ending before the control or pre-rumor period (Acharya and Johnson, 2010). |
| *PrevMergers* | Count variable of the number of times a firm proposes or receives a merger bid in the prior two years (Cornett et al., 2011). |
| *PriorReturn2Yrs* | The percentage change in a firm's stock price in the two years prior to a given quarter (Cornett et al., 2011). |
| *ResMismatch* | Dummy variable that equals one if either i) a firm's sales growth in the last two years is less than the industry median and the long-term debt ratio is greater than the industry median, or ii) the firm's sales growth in the last two years is greater than the industry median and the long-term debt ratio is less than the industry median; otherwise the variable equals zero (Cornett et al., 2011). |
| *ROA* | Ratio of net income before extraordinary (or nonrecurring) items to total assets at the end of the fiscal year prior to the control or pre-rumor period (Cornett et al., 2011). |
| *SalesGrowth2Yrs* | The percentage change in the firm's sales over the previous two years (Cornett et al., 2011). |
| *SalesShock* | The absolute value of the difference between the two-year median industry sales growth rate and the two-year median sales growth rate of all sample target firms (Cornett et al., 2011). |
| *SalesShockSquared* | The square of sales shock (Cornett et al., 2011). |
| *ShareTurnover* | The ratio of the number of the firm's shares of stock traded to total shares outstanding (Cornett et al., 2011). |
| *ValuableBrand* | An indicator variable representing target firm inclusion in a list of the top 100 brands from the marketing consultancy firms Interbrand and BrandZ at any time between 2002 and 2011 (Ahern and Sosyura, 2015). |
| **(b) Rumor Content Characteristics (Rationales)** | |
| *AdvisorHired* | Rumor indicates that the target firm has retained the services of an investment bank or financial advisor. |
| *AnalystReport* | Rumor is the result of one or more analysts reasoning that a takeover seems logical. |
| *BidderDenied* | Rumor indicates that a potential bidding firm denies that parties are in negotiations. |
| *BidderMentioned* | Rumor indicates the name of one or more potential bidders. |
| *BlockPurchase* | Rumor indicates that 5% or more of shares outstanding have recently been purchased by a single entity. |
| *FinancingSource* | Rumor provides substantial details as to how financing for the deal would occur. |
| *IndustryActivity* | Rumor indicates that either a competitor is being taken over or that the target industry appears ripe for takeovers. |
| *Informative* | Rumor based on at least three rumor justifications, excluding those labeled as speculative. |
| *InsiderCited* | Rumor predicated on an anonymous source. |
| *MgmtConcerns* | Rumor indicates concerns with the current management. |
| *OptionsIncreased* | Rumor specifically mentions that an increase in call options is indicative of an impending takeover. |

| | |
|---|---|
| *PEFundInvolved* | Rumor indicates that a private equity or hedge fund has expressed interest in a potential takeover deal. |
| *Speculative* | Rumor based solely on either takeover chatter or an increase in option trading activity in the target firm, with no further justification provided. |
| *SynergyCited* | Rumor indicates that the target firm has specific attributes that would provide unique synergies to an acquirer. |
| *TakeoverChatter* | Rumor provides very few details yet mentions that the target firm is subject to ongoing takeover chatter. |
| *TargetDenied* | Rumor indicates that the target firm denies that parties are in negotiations. |
| *TargetDistress* | Rumor indicates that the target firm has been experiencing substantial financial and/or operating distress. |
| *TargetInitiated* | Rumor is initiated by the target firm itself. |
| *Undervalued* | Rumor indicates that the target firm can be seen as undervalued, prompting takeover interest. |
| *UnusualActivity* | Rumor indicates that something unusual has occurred that has led to takeover speculation (e.g., two chief executive officers simultaneously absent from a conference or other changes in executive team schedules or habits). |