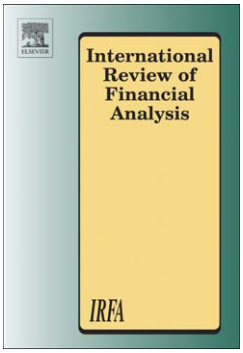

Takeover Rumors: Returns and Pricing of Rumored Targets

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Takeover Rumors: Returns and Pricing of Rumored Targets

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Takeover Rumors: Returns and Pricing of Rumored Targets

Abstract: Rumors can be classified into two types according to whether they can credibly predict impending events. An analysis of takeover rumors of publicly traded US companies shows that the types of rumors are statistically distinguishable by the returns of the rumored targets before the publications of respective rumors. However, market responses to rumors on the day of and the day after the rumor's publication are statistically indifferent. Trading on takeover rumors can be profitable. Moreover, rumored targets display a different return pattern than other takeover targets, and their takeover premiums cannot be explained by the markup pricing or substitution hypothesis.

Keywords: Takeover rumor, merger and acquisition, runup, markup, takeover premium

JEL Classification: G14, G34

1. Introduction

A financial rumor is an imprecise and unconfirmed message about an impending financial event. Rumors can be spread through word of mouth or newsletters by insiders, such as the senior managers or directors of a company, or by outsiders, such as investment gurus, professional speculators or financial journalists. They might be based on either undisclosed accounting and financial information or publicly available accounting and financial data and market information. By nature, not all rumors in financial markets are informative. Although some rumormongers are likely to be honest when disseminating their private information, more often, rumors contain deliberately added noise (Admati and Pfleiderer, 1986, 1990) intended to mislead or manipulate the market.[1] Thus, it is extremely important for an investor receiving a financial rumor to determine whether the rumor conveys a genuine piece of truthful information regarding an impending event or is just a false message intended to manipulate the market. It is also vital to know how and to what extent a rumor affects the market and the value of the associated financial assets.

This paper aims to address these issues by analyzing rumors of Mergers and Acquisitions (M&As) in the US market. Our first goal is to examine whether public information, such as the stock return of a rumored M&A target has predict power of the credibility of takeover rumors. Through the data we have collected, we find that although it is impossible to verify whether the context of each rumor is true or false at the time when the rumor is published, investors in the market can statistically distinguish the rumors that correctly predict impending takeover events from those rumors that will not materialize by analyzing the historical Cumulative Abnormal

[1] In information trading, Garcia and Sangiorgi (2011) show that selling imprecise information can be the optimal strategy for a monopolistic information seller.

Returns (CARs) of the rumored takeover targets. In a sense, it shows that market observables reveal fundamentals of a company. Specifically, if we classify takeover rumors into two groups according to whether the rumor is followed by a formal takeover announcement,[2] historical CARs before rumor publications are indicative of rumor type. This result suggests that the market price of a target stock can, at least partially, reveal the veracity of a takeover rumor.

Our second goal is to investigate market responses to takeover rumors. On the day of and the day after a rumor's publication, the abnormal returns of targets in the rumor-announced group are statistically indistinguishable from those of firms in the rumor-only group, although historical stock CARs of these two groups were quite different. Moreover, investors can trade on rumors to reap abnormal profits. A simple investment strategy is to buy the stock of a rumored target on the day of the rumor's publication if the target's CAR in the 42 or 21 trading days prior to the rumor's publication is larger than a threshold, and then to hold the position for a pre-specified period (such as one calendar month) or until a takeover bid for the target is announced, whichever comes first. We also apply the propensity score of a rumor being credible to select target stocks for investment, where the propensity score is estimated based on a logit regression of rumored targets' CARs and other accounting and financial variables. Our findings show that, for a wide range of return thresholds or propensity scores and pre-specified holding periods, investing in an equally weighted portfolio of selected rumored targets can earn an economically and statistically significant abnormal return. For instance, consider the strategy of buying rumored targets if their CARs over 21 trading days before rumor publication are greater than 10% and selling them when their takeovers are announced or at the end of a one-month holding

[2] We refer to the group in which rumors are followed by a formal takeover bid as the rumor-announced group and the other as the rumor-only group.

period. This strategy yields an Average Daily Abnormal Return (ADAR) of 0.59%. Pound and Zeckhauser (1990) argue that the "market is efficient at responding to published takeover rumor" as they find that trading on rumors cannot make excess returns. Their trading strategy is buying at the closing price on the day the rumor is published and selling in the open market at the closing of the first formal bid announcement day or one calendar year after the rumor day, whichever comes earlier. A key difference between their strategy and ours is that they do not distinguish "winners" — rumored target firms whose historical cumulative abnormal returns are greater than a specified threshold – from "losers". However, even investors do not select winner stocks but follow the Pound-Zeckhauser strategy to buy all rumored M&A targets, our sample still shows that the ADARs are significantly positive. Since selecting winners and/or trading on rumored firms are based on public information, our empirical evidence indicates the inefficiency of M&A markets.

The third goal of this paper is to investigate the effects of M&A rumors on the offer prices by testing the markup pricing and substitution hypotheses of takeovers. It is well documented in corporate control markets that bidder firms pay substantial premiums to acquire control (Schwert, 1996; Betton, Eckbo, Thompson and Thorburn, 2014). A target's stock price usually has an abnormal price runup before the first takeover bid announcement, and the markup is defined as the difference between the takeover premium and the price runup before the first bid. As Schwert (1996) noted, the way in which the price runup before the announcement affects the takeover premium can test two competing views of capital markets. The efficient markets view predicts that the markup should be independent of the runup because the target firm's stock price increase before takeover bidding reflects the good news about the value of the firm as a stand-alone entity, and such an increase should lead the bidder to increase the takeover premium

by an equal amount. On the other hand, the substitution hypothesis assumes that the price runup merely reflects the bidder's private information and does not imply that the market previously undervalued the target. Thus, runup and markup should be negatively correlated, keeping the takeover premium independent of runup. Many authors have argued that the runup of a target's stock price is likely to be driven by leaked private information from insiders or legitimate market anticipations (Jarrell and Poulsen, 1989; Schwert, 1996). Thus, the takeover rumor is largely responsible for the price runup before a bid is formally announced.[3] To pinpoint the effect of rumors on stock prices, we decompose the conventional runup of a target's abnormal return into two parts: the runup before the takeover rumor is published (hereafter pre-runup) and the runup between rumor publication and the announcement of the first bid (post-runup). Consistent with previous studies, our findings show that both the pre-runup and post-runup components have a significantly positive impact on the takeover premium. However, in contrast to prior research, our findings suggest that the impact is much larger in magnitude.[4] In particular, a 1% increase in the pre-runup (post-runup) of a target's CAR results in about a 1.6% (1.2%) increase in the takeover premium. Thus, neither the markup pricing hypothesis (efficient markets view) nor the substitution hypothesis is supported by our sample with M&A rumors. There are two reasons that can explain why our findings differ from previous findings. First, our sample is biased as it only includes takeovers preceded by rumors, whereas the samples of prior studies such as Schwert (1996), and Betton, Eckbo Thompson and Thorburn (2014) are much larger, including all takeovers with and without rumors. The second reason is that our runup period (pre-runup

[3] Betton, Eckbo, Thompson and Thorburn (2014) assume in their model that the rumor of a pending takeover results in price runup.

[4] For instance, Schwert (1996) finds that a 1% increase in the runup of the target's CAR leads to approximately a 1% rise in the total offer premium, supporting the efficient markets view and markup pricing hypothesis.

period plus post-runup period) varies across takeover targets; on average, it is longer than 42 trading days, which is the runup period adopted by the aforementioned studies. To be more comparable with previous studies, this paper also uses the same estimation window and event window as Schwert (1996) to test the hypotheses. Under these conditions, the substitution hypothesis is still rejected, and the markup pricing hypothesis is not consistent with our empirical evidence, at least for successful takeovers.

This paper contributes to the existing literature by shedding new insights into the effects of takeover rumors on stock return patterns and pricing of the rumored targets. First, we document that public information on a rumored M&A target, particularly its historical CAR before the initial rumor's publication, is indicative of whether the pending takeover will materialize. This finding is new to our knowledge. The second new finding of this paper is that abnormal returns on the day of and the day after the rumor's publication are statistically indistinguishable between the two groups, although the groups can be distinguished by their historical CARs and other publically available information. Furthermore, trading on rumors is profitable if an investor invests selectively according to the historical CARs of rumored targets or the propensity score of a rumor. The profitability of this trading strategy is in contrast to what has been documented in the prior literature. What is the likely cause for the market overreactions to false M&A rumors and the profitability from trading on M&A rumors? Van Bommel (2003) and Benabou and Larogue (1992) argue that there are rumor followers with bounded rationality, which makes market manipulation by rumormongers possible. These followers are likely to fail to utilize public information available before rumor publication, and they appear to act on the rumors irrespective of their veracity. Third, rumors are found to have substantial impacts on stock prices in takeover processes, leading to a relationship between

takeover premium and price runup that differs from those revealed by previous studies. For the rumored targets, the projection of takeover premium on the runup tends to be strictly greater than one, suggesting that bidders pay takeover targets "twice" since they revise the takeover offer upwards more than the runup. The difference between our findings and those of previous studies suggests that the very existence of takeover rumors can have some material impact on bidders' pricing strategies and the final realization of takeover premiums. Our findings of overreaction to M&A rumors, profitability of trading on rumors and invalidity of markup pricing hypothesis seem to jointly suggest the inefficiency of M&A markets.

In both theoretical and empirical analyses, the influence of takeover rumors on the stock prices of target firms is extensively examined. Jarrell and Poulsen (1989) find that the "presence of rumors in the news media about an impending bid is the strongest explanatory variable in accounting for unanticipated premiums and prebid runup" for 172 tender offers. Pound and Zeckhauser (1990) examine the effects of takeover rumors on the prices of target stocks using a sample of 42 rumors published in the Heard on the Street column of the Wall Street Journal (WSJ) from January 1983 to December 1985. Although the target stocks, on average, display significantly positive excess returns in the 20 trading days before rumor publication, they find that the market reacts to rumors efficiently as trading on rumors is not profitable. Zivney, Bertin and Torabzadeh (1996) extend Pound and Zeckhauser (1990) by documenting that rumors appear not only in the Heard on the Street column but also in the Abreast of the Market column of the WSJ. More recently, Clarkson, Joyce and Tutticci (2006) examine the market reaction to takeover rumor postings on the *Hotcopper* Internet discussion site. Their findings show that a rumor is often associated with an abnormal return and trading volume during the 10-minute posting interval and an abnormal trading volume in the 10 minutes immediately preceding its

posting. Related to these studies, Gao and Oler (2012) investigate the effects of rumors on the abnormal returns and trading volumes of M&A targets.

Theoretical analyses of rumors are usually normative. Benabou and Laroque (1992) develop a model where a rumormonger with access to private information and an incentive to manipulate the market strategically sends a message of the value of a risky asset to the public. The receivers update their beliefs based on the message received and their beliefs of the rumormonger's honesty, then take actions that determine the asset price in the market. The model demonstrates that the rumormonger can manipulate public information and the asset price and that such manipulation exists in the long run under certain conditions. Using a model from Kyle (1985) with private information diffusion, Van Bommel (2003) shows that an informed investor with limited investment capacity can benefit from spreading imprecise rumors about stock prices to an audience of followers. Following rumors is also beneficial in equilibrium, but uninformed liquidity traders incur losses because of rumors. In a similar model, Eren and Ozsoylev (2008) illustrate that the very existence of naïve investors makes the hype and dump manipulation an equilibrium outcome. For the effects of M&A rumors on takeover offer prices, Betton, Eckbo, Thompson and Thorburn (2014) develop a pricing model of takeover deals in which takeover rumors simultaneously affect takeover probabilities and conditional deal synergies. The model predicts that in a linear regression of takeover markup on runup, the slope coefficient is greater than -1 under the hypothesis of rational deal anticipation but it is strictly positive if there is a costly feedback loop from takeover runup to markup.

The rest of the paper is organized as follows. Section 2 describes the sample used in our analysis. Section 3 demonstrates that asset prices before rumor publication can statistically identify the type of a rumor. The effects of takeover rumors on the returns of rumored stocks are

the focus of Section 4. Section 5 tests the markup pricing hypothesis and substitution hypothesis based on a sample of rumored takeover bids. Section 6 examines the robustness of our findings. The final section concludes the paper.

2. Data

A stylized timeline of M&A events is presented in Figure 1. In contrast to previous studies, we decompose the runup period into a pre-runup period and a post-runup period. The pre-runup period consists of the 42 or 21 trading days before the rumor's initial publication, and the post-runup period is determined by the observed dates of the rumor's initial publication and the first bid announcement. The markup period is standard, which is the time between the first bid announcement and either delisting or the 126th trading day, whichever comes first.

INSERT FIGURE 1 HERE

To construct our database, we first select takeover targets, which must be publicly listed US firms identified by Thomson Reuters SDC Platinum database as the subject of takeover rumors. The sample period ranges from January 1, 1990, to December 31, 2008. In total, 519 firms satisfy the criterion. Among them, 254 firms attracted at least one formal takeover bid (i.e., rumor-announced), whereas the other 265 firms had no bid offer according to SDC (i.e., rumor-only). The rumor information provided by SDC is not sufficient for our analysis because it only indicates whether a takeover activity is accompanied by rumors with a "flag" in the rumor column. For our study, the date when the first rumor was published is vital. Therefore, for all 519 firms identified from SDC, we manually search the Wall Street Journal (WSJ) to determine the dates when their takeover rumors were published. Among them, the rumor dates of 126 rumor-announced targets and 112 rumor-only targets in the group could not be determined from

the WSJ. In other words, our sample is reduced to 128 rumor-announced and 153 rumor-only targets for which the WSJ reported the underlying rumors and we have the date of the rumor's initial publication.[5] We dropped another 13 firms from the rumor-announced group because their rumor dates identified by the WSJ are the same as the first bid announcement dates or missing price data from CRSP, and 5 firms from the rumor-only group because their price information is not available from CRSP. Therefore, our main sample includes 115 rumor-announced targets and 148 rumor-only targets.[6, 7]

[5] Note that we slightly abuse the phrase of rumor publication date in this paper. Because the key issue is the time when a rumor is spread among the investors, if the newspaper explicitly states something that "Yesterday the market responded to the takeover rumor of ...", we use one day before the newspaper publication as the event day of rumor publication in our analysis.

[6] If a pre-runup period of 42 trading days is used, we have to drop another observation from each group because of insufficient price information. Then, the main sample has 114 and 147 targets for the two groups, respectively.

[7] We have also enlarged our manual search range to add Financial Times, New York Times and USA Today in identifying the rumor dates. The size of rumor-announced group then increases from 128 to 149 and the size of rumor-only group increases from 153 to 186. After dropping firms because their price data are missing from CRSP or the identified rumor dates are identical to their first bid announcement dates, we obtain a sample with 129 rumor-announced targets (vs 115 in the WSJ sample) and 170 rumor-only targets (vs 148 in the WSJ sample). As can been seen from these figures, the WSJ reports the majority rumors and the WSJ sample captures 87%-89% of enlarged sample. We conduct our analysis using both samples and obtain very similar results. In the paper, we report results

In the main sample, 13 and 14 rumors were followed by a takeover bid announcement on the next day and the day after, respectively. The effects of these rumors' publication are very likely to interact with the effects of corresponding takeover announcements. To ensure that the effects of a rumor are not contaminated by those of the subsequent takeover announcement, we require that the initial rumor publication is separated from the first bid announcement by at least two trading days. Therefore, these 27 rumors are excluded from the rumor-announced group in our analysis presented in Sections 3-5. However, we conducted a parallel analysis including these rumors in the rumor-announced group and found no substantial difference from the main results reported in Sections 3-5. Section 6 details the similarities and differences between these two samples.

Table 1 reports the distribution of trading days between the rumor's initial publication and the first takeover announcement if the rumor is eventually materialized. The time period between these two events varies significantly. There are 81 target firms that received a bid within 21 trading days of rumor publication, comprising 70.43% of the sample. This result is

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from the WSJ sample because the rumors in this sample are subject to a common public coverage and the usage of this WSJ sample is more consistent with existing studies in the literature. The results from the larger sample, corresponding to main tables of this paper are available from the authors upon request. We deliberately adopt a relatively stringent sample selection process to ensure that our selected rumors are interesting and significant enough to warrant publication in the main financial press, and that the rumored targets in our sample receive quite similar publicity. This criterion can prevent unnecessary confusion caused by variation in the spread range and media coverage of rumors.

quite different from that of Pound and Zeckhauser (1990), who find that only two out of 18 firms received bids within 50 calendar days. As Table 1 shows, all sample firms receive bids within one calendar year if they ever receive an M&A bid. Because our runup period is the sum of a certain period before rumor publication (42 or 21 trading days) and the period between rumor publication and the bid announcement, the runup period also varies from one takeover to another. This is quite different from previous studies.

INSERT TABLE 1 HERE

3. Can false rumors be detected?

Throughout the paper, we regard a takeover rumor as truthful or credible if the pending takeover is formally announced by a bidder after the rumor's publication. Otherwise, it is regarded as a false rumor. We investigate whether public information is indicative of the credibility of a takeover rumor. One of the main sources of public information is the abnormal returns of target firms during M&A processes. We apply the following market model for each target firm in our sample to estimate their abnormal returns:[8]

[8] Campbell, Lo and MacKinlay (1997) argue that the market model is preferred to other models such a multifactor economic model because gains from applying multifactor economic models are limited because of the marginal increase in explanatory power of additional factors beyond the market factor. However, to ensure the robustness of our results, we also considered other asset pricing models, including the Fama-French three-factor model (Fama and French, 1993) and a matching-pair approach. The results are very similar to those derived from the single-factor model of Equation (1). Discussion about results based on the three-factor model and matching-pair approach is given in Section 6. Using market model for CAR calculation is standard in event studies, in particular those related to M&A events such as Atkas, de Bodt and Roll (2004). Our main references, Pound and Zeckhauser (1990),

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

where R_{it} is the return to stock i and R_{mt} is the return to a market index at date t, and α_i and β_i are regression coefficients. Daily return data of target firms are obtained from CRSP, and the market index uses the data of the CRSP value-weighted market portfolio. Coefficients α_i and β_i are first estimated over an estimation window, then they are used to calculate the abnormal return, ε_{it}, over the pre-runup period leading to the event or an extended period after the event. Unless otherwise indicated, the event day in this study is the day when a rumor is published for the first time, and we consider both 42-day and 21-day pre-runup periods in our analysis. Thus, the estimation window used to estimate the coefficients in regression (1) is either t = -242 to -43 or t = -221 to -22. The cumulative abnormal return of firm i between dates t_1 and t_2 is given by the following:

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} \varepsilon_{it} \, . \quad (2)$$

In Table 2a, the first column reports the average CARs of 87 targets from the rumor-announced group in the periods of (-42, -1) to (-3, -1). The first column also reports the average abnormal return on the event day, *CAR*(0, 0), and the average CARs of the event day and the first two days after the event day, *CAR*(0, 1) and *CAR*(0, 2). The second column reports corresponding values for 147 rumor-only targets, and the third column documents the mean differences in CARs between the two groups. It is obvious that the average CARs of the rumor-announced group are consistently larger than those of the rumor-only group for periods (-42, -1) to (-3, -1). The results of t tests of mean differences reported in the fourth column confirm this as the differences

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Schwert (1996), Betton, Eckbo, Thompson and Thorburn (2014), also use the one-factor model. Thus, we report our results based on Equation (1) to make our analyses more directly comparable to these existing studies.

in all periods from (-42, -1) to (-3, -1) are significant at least at the 5% level. Columns five to seven in Table 2a are the CAR median counterparts of columns one to three while column eight documents the outcomes of Wilcoxon rank-sum tests for median differences. Once again, the rumor-announced group has much larger CAR medians and the differences are significant for periods (-42, -1) to (-15, -1), (-11, -1) and (-9, -1) to (-4, -1). Thus, although at an individual rumor level, an uninformed investor cannot be sure whether a takeover rumor will lead to a formal bid at the time when he/she receives the rumor, he/she still can statistically determine the credibility of the rumor by examining the potential target's historical CARs before the day of the rumor's publication. Accompanying the publication of a takeover rumor, regardless of its credibility, must be some private or public information about the underlying target. The stock price of this potential target seems to be able to correctly incorporate this information and, in turn, to predict the truthfulness of the rumor, at least in the statistical sense. It is worth noting that many M&A rumors are likely to be sourced from insider leaks, as suggested by the data in Table 1 that a substantial portion of rumors realize within a few days. The results in Table 2a demonstrate that even when rumors are mixed with insider information, their credibility can still be examined by public information such as historical stock returns.

INSERT TABLES 2A AND 2B HERE

To examine the robustness of this finding, we repeated our analysis using different estimation windows. The results are qualitatively similar, and we document the results based on the estimation window of (-221, -22) in Table 2b.[9] As seen from the table, the differences

[9] As a comparison, Pound and Zeckhauser (1990) report a *CAR*(-21, -1) of 7.78% based on their full sample that includes both materialized and immaterialized rumors. This figure is between our mean *CAR*(-21, -1) values of 8.68% for the rumor-announced group and 2.50% for the rumor-only group, as shown in Table 2b.

between the two groups' sample means of *CAR* are significant in all periods from (-21, -1) to (-3, -1), and the differences in medians are significant in (-21, -1) to (-15, -1), (-11, -1), and (-9, -1) to (-4, -1). In sum, analysis of market prices and their movements before the day of a rumor's publication can statistically distinguish a credible rumor from a false one.

The significantly higher CARs of stocks in the rumor-announced subsample are not at the expense of bearing higher risk than stocks in the rumor-only group because CAR is risk adjusted. However, to emphasize this point further, we estimated each stock's total risk by computing the variance of its daily returns from day -42 to day -1. The mean of 87 variances from the rumor-announced group is 0.00187, and the mean of 147 variances from the rumor-only group is 0.00169. Their t-statistic for the mean difference and Wilcoxon rank-sum statistic for median difference are 0.370 and 0.729, respectively, confirming that the difference in variances between the two groups is statistically insignificant.[10] Consequently, investment in rumor-announced stocks on average does not bear higher risk than investment in rumor-only stocks.

4. How does the market respond to takeover rumors?

Since market prices are able to statistically detect whether a takeover rumor is true or false, a natural question to ask is whether market players have utilized this predictive power. A takeover is usually considered good news for investing in the target firm and the market usually

[10] For daily returns on day -21 through day -1, the average variances of the two groups are 0.0018 and 0.0017, and the t-statistic for their mean difference and Wilcoxon rank-sum statistic for median difference are 0.284 and 0.914, respectively.

responds positively to an M&A announcement.[11] This positive effect is also reflected in the surge of stock prices in our sampled targets on the day of and the day after the rumor's publication, as shown by *CAR*(0, 0) and *CAR*(0, 1) in Tables 2a and 2b,[12] because the investors anticipate the impending takeover bids. Since the takeover rumors of the targets in the rumor-only group are false and the market can statistically identify such rumors, it is expected that their stock price increases should be smaller than their counterparts in the rumor-announced group if the M&A markets are efficient. However, the empirical evidence does not support this conjecture. Although the rumor-announced group has a greater average abnormal return on the rumor day than the rumor-only group does (i.e., 0.0523 vs. 0.0504 in Table 2a), the rumor-announced group's two-day cumulative abnormal return is actually smaller (i.e., 0.0554 vs. 0.0668). Moreover, both t tests of the mean differences between these sample means and Wilcoxon rank-sum tests for median differences show that the differences are not statistically significant. In other words, investors typically respond indifferently to these statistically distinguishable rumors on the event day and the day after. The market prices seem not to efficiently reflect the information available to the public when takeover rumors appear in the media. This conclusion is robust; we have estimated *CAR*(0, 0) and *CAR*(0, 1) with other estimation windows, but obtained qualitatively similar results. For instance, Table 2b reports the estimations based on the window of (-221, -22). The *CAR*(0, 0) of the rumor-announced group is

[11] Substantial increases in the target firm's stock price before and after a takeover announcement have been extensively documented. See, for example, Andrade, Mitchell and Stafford (2001), Jensen and Ruback (1983), and Keown and Pinkerton (1981). See also Betton, Eckbo and Thorburn (2008) for a review.

[12] This observation is noticeably different from the results of Pound and Zeckhauser (1990), who find that no significant excess returns occur on the rumor's publication day, but the volatility of excess returns on that day is high. More specifically, they report a mean excess return and standard deviation of 0.07% and 4.19%, respectively.

0.0523, which is greater than 0.0497, the *CAR*(0, 0) of the rumor-only group. For *CAR*(0, 1), the respective values are 0.0556 and 0.0658. The mean and median differences between these two sets of subsamples are statistically insignificant. One possible explanation for this seemingly puzzling phenomenon could be the existence of rumor followers in the market (see, e.g., Van Bommel, 2003; Benabou and Larogue, 1992). It is the very existence of rumor followers with bounded rationality that makes market manipulation by rumormongers possible. These followers seem not to utilize public information available before rumor publication, and they appear to act on the rumors irrespective of their veracity. In unreported charts (to conserve space), we graph the CAR dynamics, separately for rumor-announced group and rumor-only group, over the period from day -42 to day 252 or from day -21 to day 252. The charts verify that the differences of *CAR*(0,0) and *CAR*(0,1) between the two groups are very small. Moreover, we observe that in the post-rumor period average CARs of the rumor-announced target firms remain larger than those of the rumor-only targets, and the divergence of post-rumor average CARs between the two groups gradually increases over time.

To further gauge the market reaction to M&A rumors over a longer time horizon, we estimate the abnormal returns of investing in rumored stocks, which are more likely to be followed by a takeover bid. This investment strategy involves determining a threshold so that an investor buys one dollar worth of the rumored stock at the closing price on the rumor day, if the target firm's CAR in the past 42 or 21 days is greater than the specified threshold (hereafter winner stocks), then sells the stock in the open market at the closing price either on the date of the first formal takeover bid or when a pre-specified holding period matures,[13] whichever comes

[13] Some companies in our sample were delisted after rumor publication but before the pre-specified holding period expired. In this case, we presume the stock was sold at the closing price of the delisting day.

first. The investor takes no action if the target firm's CAR is below the chosen threshold (loser stocks). The profitability of this investment strategy is documented in Table 3 with the following features.[14]

- In the table, the Average Daily Abnormal Return (ADAR) is estimated by averaging daily abnormal returns of each invested stock over its holding period.[15] The table presents the sample mean of ADARs of selected stocks, their median, the percentage of ADARs of invested stocks being positive. For comparison purposes, Table 3 also reports the investment outcomes if the investor chooses loser stocks to invest, i.e., investing exclusively in stocks with its *CAR*(-42, -1) and *CAR*(-21, -1) below the specified thresholds. The last row of each panel documents the ADAR statistics of longing all rumored stocks (i.e. winner stocks plus loser stocks).
- There are two dimensions for an investor to consider: return threshold and holding period. Table 3 selectively reports the outcome of the investment strategy by setting the return threshold equal to 0%, 2%, 4%, and so on up to 12% for both CAR_i(-42, -1) and CAR_i(-21, -1). We have also specified holding period to be one, two, three, six or twelve months. One calendar month is obviously an important period; we can see from Table 1 that the median and average durations between the first rumor publication and the first takeover

[14] Investors adopting this investment strategy do not have to worry about potential "look-ahead bias" that is related to having to hold only rumored targets which eventually receive takeover bids. This strategy, on the other hand, recognizes the fact that rumor-announced targets have statistically significantly higher pre-rumor CARs, on average, as we documented in Section 3.

[15] We also used a calendar-time portfolio approach (Fama, 1998) to evaluate the investment strategy; see the discussion in Section 6.

announcement are 8 and 28.83 trading days, respectively. For longer periods, only the results for the one-year period are reported for the sake of space.

For the winner portfolio (i.e., all selected target stocks having CARs greater than the threshold) in Table 3, all sample means of ADARs are positive at the 10% or higher significance level, which means that the investment strategy performs quite well and investors can benefit from identifying target stocks by employing price information before rumors appear. There is a trend that a winner portfolio yields a higher CAR if its return threshold is higher. In contrast, no loser portfolio (i.e., stocks with CARs smaller than the threshold) has an ADAR mean significantly different from zero. Because of substantial gains from the winner portfolios, investing in all rumored stocks yields a significantly or marginally significantly positive ADAR for all holding periods.

INSERT TABLE 3 HERE

Since the CARs of rumored M&A targets are useful information for investors to identify if a rumor will materialize later, we employ logit regressions to test whether CAR and other accounting and financial variables of a firm can predict the type of its M&A rumor. Specifically, we consider

$$y_i = f(CAR_i, D_i, L_i, S_i, G_i, TD, ID), \tag{3}$$

where y_i is a binary variable taking the value of one if the M&A rumor is truthful and zero otherwise. In (3), CAR_i is the cumulative abnormal return of the target firm before the event date and can be either $CAR_i(-42, -1)$ or $CAR_i(-21, -1)$. Time dummies, *TD*, are used to control for time effects of 1990-1994, 1995-1999 and 2000-2004 and industry dummies, *ID*, to control for industry effects of manufacturing (SIC codes 30-39), communication (SIC codes 48 and 49), and service (SIC codes 72-82).

A financially distressed firm is more vulnerable, less likely to survive competition, and more likely to be taken over. Thus, in regression (3) we use two measures for a firm's financial distress D_i: the Zmijewski probit model (Zmijewski, 1984) and Ohlson bankruptcy model (Ohlson, 1980),[16] and a company is financially healthier if its Zmijewski or Ohlson probability is lower. In the analysis, annual data are used for financial distress so that the Zmijewski or Ohlson probability of a target firm is taken for the year immediately before the event day. Other firm characteristics associated with the target of an M&A deal include financial leverage L_i, measured as total debt divided by the sum of market value of equity and total debt,[17] and firm size S_i, measured as the logarithm of market value of equity. Because there are quarterly data on these variables, their observations in the quarter immediately before the event day are used. Companies with great potential for business growth can be favorable targets for takeover predators. Therefore, sales growth of a target firm, G_i, is also included, which is the average growth rate over a four-quarter period just before the rumor's publication.[18] The data used to

[16] Zmijewski's probability of bankruptcy is measured by the cumulative probability of the standard normal distribution at point X, where $X = -4.3 - 4.5 \times$ (Net income / Total assets) $+ 5.7 \times$ (Total liabilities / Total assets) $- 0.004 \times$ (Current assets /Current liabilities). Ohlson probability is calculated by the logistic function of point Y, where $Y = -1.3 - 0.4 \times$ (log(Total assets / GNP price-level index) $+ 6 \times$ (Total liability / Total assets) $- 1.4 \times$ (Working capital / Total assets) $+ 0.1 \times$ (Current liability / Current assets) $- 2.4 \times$ (Dummy of total liabilities exceeding total assets) $- 1.8 \times$ (Net income / Total assets) $+ 0.3 \times$ (Funds provided by operations / Total liabilities) $- 1.7 \times$ (Dummy of negative net income in the past two years) $- 0.5 \times$ (Net income growth rate), where the GNP index assumes a base value of 100 for 1998.

[17] Cremers, Nair and John (2009) show that firms with greater financial leverage are more vulnerable to takeover.

[18] Toehold has also been considered in some studies as an explanatory variable to indicate that a firm is a takeover target. However, in our sample, only 6 target firms are identified with a toehold. This toehold frequency is

calculate these financial and accounting variables are obtained from the Compustat database and Table 4 documents their descriptive statistics. Financial firms (SIC codes 60-69) have quite distinct characteristics and are excluded from Table 4 and the regression analysis of Equation (3). The mean differences between the two subsamples of rumor-announced and rumor-only firms in terms of their financial distress measures, financial leverage, firm size and sales growth are relatively small (below 15%). The firms in the rumor-announced group is financially healthier on average than their counterparts in the rumor-only group although their financial leverages are higher.

INSERT TABLES 4 and 5 HERE

The regression results of Equation (3) are reported in Panel A of Table 5. As indicated by Models 1 and 2, both CAR_i(-42, -1) and CAR_i(-21, -1) have some power to predict whether an M&A rumor leads to a formal announcement or just a false alarm. This result is in line with the conclusion obtained in the previous analysis in the sense that a larger CAR before the rumor's publication implies a greater probability that the rumor will be followed by a formal M&A bid. However, when firm characteristics of the rumored targets are included in the regression, the explanatory power of CAR_i is reduced. Although CAR_i(-21, -1) can still indicate the truthfulness of an M&A rumor, the predictive power of CAR_i(-42, -1) is insignificant. In contrast, the size of a rumored firm has a quite significant effect on determining the credibility of a rumor, and the negative sign of the coefficient is also intuitively correct; the larger the rumored firm is, the greater the possibility that the rumor is false. To a certain extent, this finding is consistent with the observation by Clark and Ofek (1994) that "the smaller (bigger) the target is relative to the

consistent with Betton, Eckbo and Thorburn (2009), who document toehold frequencies of 7% in the 1990s and 4% in the 2000s.

buyer, the higher (lower) is the likelihood of success". Financial distress can also predict the credibility of rumors but its effectiveness depends on the proxy for distress. If financial distress is measured by the Zmijewski probability, it is indicative of the truthfulness of an M&A rumor; i.e., for a more financially distressed firm, an M&A rumor is less likely to be true. This result is consistent with the explanation that the public views a financially weak firm as less likely to survive and speculates that it could fall prey to a future takeover. However, such a speculation or rumor is more likely to be wrong after controlling for CAR. Ohlson probability provides similar results but they are not statistically significant. Leverage and sales growth of a rumored firm are not effective indicators of a rumor's veracity.

While the explanatory power of individual variables is relatively low, the overall performance of the logit morel is reasonably good and this is particularly true for Models 1-3 and 5 in terms the model's Chi-squared. Therefore, we use the fitted logit model (3) to estimate the propensity scores of a rumor being credible. Based on the estimated propensity scores, an investment portfolio can be formed by choosing rumored stocks whose scores are greater than a cutoff score. If an investor follows the same investment rule mentioned in the earlier part of this section, the ADAR of each invested stock can be conveniently computed. Because the median of propensity scores is 0.35, Panels B and C of Table 5 document the sample means of the ADARs of stocks within an investment portfolio, where cutoff scores range from 0.35 through 0.65 and the holding periods are one month and one year respectively. Several facts are obvious from the panels. First, except for a couple of portfolios consisting of fewer than 10 stocks, the sample mean of the ADARs of selected investment portfolios are marginally or strongly significantly positive. This reconfirms the conclusion we obtained earlier that using market and other publically available information to select rumored stocks and invest in them is profitable.

Second, there is a trend that ADAR improves as the cutoff of propensity score rises. This again implies that the type of rumor and the performance of rumored stocks are predictable to a certain extent. But as the propensity score increases, the size of the selected portfolio (the number of stocks in the portfolio) becomes smaller, which is likely to lead to a less significant t-statistic of ADAR. Third, although most explanatory variables individually do not have a significant predictive power in logit regression (3), their presence improves portfolio selection as evidenced by the observation that ADARs in Models 3 and 4 are higher than their counterparts in Model 1 and Models 5 and 6's are better than Model 2's if investors apply the same cutoff score to choose their portfolios. Four, when propensity scores are estimated by logit model (3) with a single explanatory variable *CAR*, their standard deviation is very small. As a result they cluster around the median (the median and mean are close, approximate to 0.35). Therefore, the number of stocks selected for investment drops sharply as the propensity score rises.

Overall, our findings indicate that an investor can earn a substantially positive ADAR on his/her investment, by carefully selecting rumored stocks according to their historical CARs before rumor publication or propensity scores of rumor credibility. The profitability of this investment strategy, particularly the wide ranges of CAR threshold and propensity score for stock selection and various holding periods provide an evidence of inefficiency of M&A markets.

5. Do bidders mark up offer prices in responding to takeover rumors?

The stock prices of potential takeover targets usually run up in the period before the formal bid announcement. There are two views about this price runup. An implication of efficient markets view is that the stock price movement of a target firm, before takeover bidding, reveals its value changes unknown to bidders. Since the takeover bid represents the bidder's

willingness to pay for the impending takeover, the markup pricing hypothesis, drawing from efficient markets view, predicts that a one-dollar increase in the target's stock price in the runup period should, on average, result in a one-dollar rise in the takeover premium (Schwert, 1996).[19] A contrasting view is that runup merely reflects the anticipation of a planned takeover premium, and the offer premium should be independent of runup. By definition, premium equals the sum of runup and markup; this view implies a substitution hypothesis that any increase in runup will be eased by a decline in markup, leaving the premium unchanged. We revisit the relationship between runup and takeover premium and incorporate a new element: M&A rumors. Recalling the price effects of rumors, we are interested in identifying the new features of price runup if the underlying M&A activities have been rumored before their formal announcements and in examining whether the markup pricing or substitution theory holds for these rumored M&As. We depart from conventional analysis by decomposing runup into pre-runup and post-runup to better understand the effects of rumors on the takeover premium. The pre-runup of target *i* is calculated using its CAR between day -42 (or -21) and day -1, i.e.:

$$Pre-runup_i = \sum_{t=-42 or -21}^{-1} \varepsilon_{it} \ . \tag{4}$$

The post-runup is the CAR in the post-runup period, which can be calculated by the following:

[19] Although the theory predicts the relationship between takeover premium and runup in terms of dollar, the empirical analysis including Schwert (1996) and Betton, Eckbo, Thompson and Thorburn (2014) uses the rates of these variables. Following these studies, this paper also focuses on hypothesis tests using rates, that is, interpreting markup pricing hypothesis as that a 1% increase in the runup of the target firm results a 1% increase in its takeover premium and substitution hypothesis as that the premium rate is unchanged no matter how the rate of runup changes.

$$Post-runup_i = \sum_{t=0}^{T-1} \varepsilon_{it}\,, \tag{5}$$

where T is the date of the first bid announcement. Conventionally, the runup period is presumed to start 42 days before the first bid announcement (e.g., Schwart, 1996; Betton, Eckbo, Thompson and Thorburn, 2014). With a 42-day pre-runup period, our runup period is longer than the conventional one by the length of the post-run period. Markup is defined in the conventional way, which is the CAR from the day of the first bid announcement through delisting or the 126th trading day, whichever comes first:

$$Markup_i = \sum_{t=T}^{\min\{T+126,\,delisting\}} \varepsilon_{it}\,. \tag{6}$$

The total premium, $Premium_i$, is the sum of $Pre\text{-}runup_i$, $Post\text{-}runup_i$ and $Markup_i$. Based on the (-242, -42) estimation window, 65 out of 87 rumor-announced firms in our sample were taken over at the end of the takeover process, and we classify them into the successful subsample. The corresponding number of successful takeovers based on the (-221, -22) window is 66 out of 88. Table 6 reports the descriptive statistics of the pre-runup, post-runup, runup, markup and premium of these subsamples.

INSERT TABLE 6 HERE

Previous studies find that runup is substantially closer to the first bid announcement.[20] Table 6 shows a quite different runup pattern if M&A rumors are involved and price hiking appears much earlier than 21 or 42 trading days before the first M&A announcement (see also Figure 2 below). For both 42- and 21-day pre-runup periods, pre-runup on average dominates

[20] "The *CAR*s start to rise around day -42 (about two months before the first bid announcement), with the largest pre-bid rise occurring from days -21 to - 1." (Schwert, 1996, page 162). Note that day 0, the event day, in Schwert's analysis is the day of the first bid announcement.

post-runup for the successful subsamples, but they have similar sizes for the rumor-announced subsamples. Since the average length of the post-runup period is 28.83 trading days, the dominance of pre-runup in the successful samples is not entirely due to a shorter post-runup period. The average markups documented in the table are quite small in comparison with conventional markups and are not significantly different from zero.[21] The small markup seems to suggest that an M&A announcement no longer surprises the market because of widely spread rumors. Rumors may act as an early warning system so that the market is well prepared when the true announcement is issued.

To investigate the effect of runup on the premium or markup we, following Schwert (1996), consider a regression model that

$$Premium_i = a + b_1 \times Pre\text{-}runup_i + b_2 \times Post\text{-}runup_i + u_i. \quad (7)$$

This regression differs from Schwert (1996) in that it decomposes *Runup* into *Pre-runup* and *Post-runup*.[22] The results of the regressions are reported below in Table 7. As we can see from the table, both *Pre-runup* and *Post-runup* contribute significantly to takeover *Premium*. We can also strongly reject the hypothesis that $b_1 \leq 1$ for the successful subsamples. For instance, the heteroskedasticity-consistent t-statistics for the null hypothesis of $b_1 \leq 1$ of the successful subsamples are 4.104 and 4.318, respectively, and we can reject the null hypothesis at the 1% level. The hypothesis can also be rejected using the rumor-announced subsamples. However, the null hypothesis of $b_2 \leq 1$ cannot be rejected for the both subsamples. More importantly, the

[21] The average markup ranges from 0.44% to 2.5% for our samples, but Schwart (1996, Table 2) reports a markup of 10% to 16%.

[22] A test shows that the correlation between pre-runup and post-runup is statistically insignificant.

marginal effect of *Pre-runup* is considerably greater than that of its counterpart of *Post-runup* (i.e., $b_1 > b_2$), implying a greater impact of pre-runup than post-runup on the takeover premium.

INSERT TABLES 7 AND 8 HERE

To examine the markup pricing hypothesis further, we study a regression model that takes the same form as that in Schwert (1996):

$$Premium_i = a + b \times Runup_i + u_i. \quad (8)$$

The results in Panels A and B of Table 8 are the regression outcomes using the rumor-announced and successful subsample, respectively. The results demonstrate that the null hypothesis of $b \leq 1$ can be strongly rejected in all 4 scenarios using the heteroskedasticity-consistent t-statistics. Thus, we have empirical evidence against the markup pricing hypothesis. Note that our result of b being significantly greater than one also strongly rejects the substitution hypothesis because it requires $b = 0$. The estimates of b in Panels A and B are larger than Schwert's (1996) estimates. The estimates of b based on his Main and Successful samples are 1.075 and 1.018, respectively, and the null hypothesis of markup pricing ($b = 1$) cannot be rejected.

There are two potential reasons for why our results differ from those of previous studies. First, we focus on M&A deals preceded by relevant rumors, whereas the samples of Schwert (1996) include all target firms that are publicly traded in the U.S, which are much larger than ours. As a result, the impact of takeover rumors discovered by this paper might have been eased by the price dynamics of other target firms in those samples over the runup period. The second reason relates to the duration of the runup period. Our runup period is longer than the 42-day period used by Schwert (1996). Our runup period consists of 42 or 21 days of pre-runup period

plus an average post-runup period of 28.83 days, leading to an average total runup period of 70.83 or 49.83 trading days.

To resolve the second difference so that the effects of rumors can be shown more clearly, we re-run Equation (8) with a runup period of 42 days, irrespective of the different lengths of the actual post-runup periods. More specifically, we choose the first bid announcement day as the event day, and the estimation window starts on day -379 and ends on day -127 and the runup is the CAR over day -42 to day -1 (before the first bid announcement). The markup is the CAR from the first bid announcement through delisting or 126 trading days after the first bid, whichever comes first. We deliberately choose the estimation window, runup period and markup period in this way so that they are the same as those adopted by Schwert (1996).[23] The descriptive statistics of runup, markup and takeover premium under this specification are presented in Table 9, where Panel A includes all rumor-announced firms and Panel B includes only targets that have successfully been taken over. The average CARs of all rumor-announced firms from day -126 to day 252 are illustrated in Figure 2. A notable difference between Panels A and B in Table 9 and Table 6 is that the mean markups are now larger, although they are still insignificantly different from zero. Comparing Figure 2 with Figure 2 of Schwert (1996), we find substantially larger early runups in the rumored M&A processes. The average CAR starts to move up as early as day -120, whereas the average CAR of the Schwert sample does not show

[23] But this is likely to undermine the effect of R&A rumor because a runup period from 42 days before the first bid announcement through the announcement day may not completely capture stock price runup of a rumoured target as part of pre-runup is missed out.

substantial upward movement until day -42. This difference reconfirms the impact of rumors on runups, as demonstrated earlier.

INSERT TABLE 9 AND FIGURE 2 HERE

As a reference, we have also sampled M&A announcements recorded by SDC but without a rumor flag. To be consistent with the sample of rumored M&A announcements, the no-rumor sample covers the period from 1990 through 2008.[24] In comparing Panels C and D with Panels A and B in Table 9, it is obvious that M&A rumors make the runup of a target's stock price much higher on average but the markup much lower. This implies that the rumor publication by the widely circulated media such as the WSJ can potentially take the role of M&A announcement. The announcement effect in terms of price markup is partially absorbed by the publication of rumor.

The regression results using the takeover bid announcement as the event are reported in Panels C and D of Table 8. First, note that the heteroskedasticity-consistent t-statistic testing $b \leq 1$ tends to decline from Panels A and B to Panel C. This observation implies that the role played by early runups before and/or at the time of rumor publication has been partially diluted in Panel C. The estimate of b based on the successful subsample in Panel C is 1.442, which is significantly larger than one. It is also larger than the b estimate for the successful non-rumored takeovers in Panel D with a clear margin. However, our estimate based on the rumor-announced group in Panel C is (0.945) and the hypothesis of $b \leq 1$ cannot be rejected for this group. On the other hand, the estimation from the SDC no-rumor sample yields $b = 1.217$ and the hypothesis of

[24] Note the slight abuse of the term of "no-rumor" here because although SDC has not registered any rumors of an M&A it does not mean there were no rumors of the M&A before its formal announcement.

$b \leq 1$ can be strongly rejected. Thus, the evidence provided by Panels C and D shows that rumor does make a difference on takeover pricing.

In sum, our empirical evidence of M&A rumors rejects the substitution hypothesis and cannot be fully explained by the markup pricing theory, at least for the successful sample. The difference between our findings and those of previous studies and no-rumor samples indicates that the very existence of M&A rumors can have some material impact on bidders' pricing strategies and the final realization of takeover premiums.

6. Further robustness examinations

In addition to the robustness checks reported in the above analysis, we have conducted further robustness tests, including adopting alternative sampling for rumor-announced group, varying rumor dates, replacing market model of Equation (1) with the Fama-French three-factor model or the matching-pair approach to estimate abnormal returns, and using the Calendar-Time Portfolio (CTP) approach to estimate the abnormal return of the investment strategy specified in Section 4. This section briefly discusses the results of these robustness checks. These results are not tabulated to conserve space, but relevant tables are available upon request.

6.1. Alternative sampling of rumor-announced group

As mentioned in Section 2, there are 27 rumor-announced targets in our main sample whose dates of initial rumor publication and first bid announcement are separated by one or two days. In Sections 3-5, these 27 observations are dropped from our analysis to isolate rumor publication effects from bid announcement effects. Adding these 27 targets back into the rumor-announced group does not change the main findings reported in the previous sections. We

summarize the results of using this alternative sampling approach as follows. (i) The average CARs of the rumor-announced group in the pre-runup period are still greater than the average CARs of the rumor-only group, and the two groups are statistically distinguishable. (ii) Both the rumor-announced group and the rumor-only group have a significant abnormal return on the rumor day, but their differences are still small and statistically indistinguishable.[25] The investment strategy specified in Section 4 yields substantial ADARs, and many of them are actually greater than the corresponding ADARs documented in Table 3. (iii) The regression outcomes of Equations (7) and (8) have no qualitative changes after more targets are added back into the sample.

6.2. Varying rumor dates

Another concern related to sampling is rumor dates. The takeover rumors reported by the WSJ or other newspapers may have reaches the markets prior to their publications although we have adjusted rumor dates in sampling if the press has explicitly indicated that the rumor hit the market one or two days before their publication. Researchers can hardly pinpoint the exact time when a rumor circulates among investors. To examine the robustness of our findings in relation to inaccurate dates of rumor spreading among investors, we push forward all rumor publication dates in our sample by one or two days; that is setting day -1 or day -2 as the event day. We then investigate CAR(-41, -1) to CAR(0, 1) and CAR(-21, -1) through CAR(0, 1) using these alternative event days. In comparison with the results reported in Tables 2a, CAR(-41, -1)

[25] Note that *CAR*(0, 1) is a noisy measure of the market responses to rumors if the rumor-announced group includes targets whose bids are announced within one day of rumor publication because *CAR*(0, 1) includes abnormal returns on the announcement day of these targets, which comprise the majority of markups.

through CAR(-3, -1) in the rumor-announced group are smaller and their differences from their counterparts in the rumor-only group are mostly significant. The differences of CAR(0, 0) and CAR(0, 1) between the two groups are positive and larger, and in some cases they are marginally significant. For the estimation window of (-221, -22) in relation to Table 2b, we can draw similar conclusions.

6.3. Analysis with the Fama-French three-factor model and matching-pair approach

We replace Equation (1) with the Fama-French three-factor model to estimate abnormal returns. Then, we repeat the analyses conducted in Sections 3 through 5. For results corresponding to Tables 2a and 2b, the average CARs of the rumor-only group become bigger. The differences between the CARs of the rumor-announced and rumor-only groups in most cases are significant. On the other hand, the mean differences between the two groups' *CAR*(0, 0) and *CAR*(0, 1) are still insignificant. The performance of the investment strategy specified in Section 4 is stronger in comparison to Table 3. Winner portfolios have a greater ADAR, and in many cases the increase is substantial. Turning to the tests of the markup pricing hypothesis and substitution hypothesis, the empirical evidence rejecting both hypotheses is stronger than that reported in Section 5.

In a similar process, we use the matching-pair approach instead of Equation (1) to estimate abnormal returns for the robustness check of the main findings of this paper. The matched pair of each rumored firm is the characteristic-based benchmark portfolio of Daniel, Grinblatt, Titman and Wermers (1997) and Wermers (2003). Based on these estimates of abnormal returns through this alternative approach, we duplicate the analyses from Section 3 to

Section 5, just as we did by using the abnormal returns estimated from the Fama-French three-factor model. Once again, we obtain results consistent with the main findings in Sections 3-5.

6.4. Calendar-time portfolio approach

In evaluating investment strategy (Section 4), the investment portfolio is aligned in event time, not calendar time. To evaluate the robustness of these results, we also consider the average CARs under the CTP approach. This approach was developed by Jaffe (1974) and Mandelker (1977) and later advocated by others, including Fama (1998), and Ziobrowski, Cheng, Boyd and Ziobrowski (2004), where a portfolio is formed on each trading day, including only the selected rumored targets with events on that day. Each chosen target is kept in the portfolio until the pre-specified holding period matures. The portfolio is rebalanced on a daily rolling basis, and the CARs are calculated based on a market model. In terms of the selection criterion used to form a portfolio, we identify all winner stocks that have $CAR_i(-42, -1)$ or $CAR_i(-21, -1)$ greater than a certain threshold (e.g., 10%). Overall, the findings from the CTP approach echo the main results presented in Table 3 and suggest that investors can earn abnormal returns by investing in selected rumored targets. In addition to average CARs, we also estimated buy-and-hold abnormal returns of the investment strategy using CTP and obtained similar results to the CAR results of CTP.

In sum, the adoption of alternative sampling and rumor dates, the Fama-French three-factor model or the matching-pair approach, and the CTP approach does not change the main findings of this paper.

7. Conclusions

Using the data of M&A rumors of publicly traded US target firms, we find substantial effects and implications of takeover rumors on the market competing for corporate control. The stock prices of these rumored firms before the rumor publications can be used to statistically distinguish a genuine prediction of a takeover from a false alarm, indicating that prices largely assemble and reflect market information. On the other hand, the market participants do not seem to fully utilize publicly available information, leaving some profitable opportunities unexplored. In addition, because of rumors, price runups in our sample seem to appear earlier than reported in previous studies. Pre-rumor runups dominate post-rumor runups in their marginal effects on takeover premiums. The markup pricing hypothesis can be rejected for rumored M&A deals if the runup period is extended to 42 or 21 trading days before rumor publication. Even with a standard runup period of 42 days before the first bid announcement, the markup pricing hypothesis still cannot fully explain the empirical evidence documented in this paper. The competing substitution hypothesis of takeover premiums is also not supported by our empirical evidence, irrespective of the length of the runup period.

An obviously puzzling observation is that the market carries the information to distinguish a true rumor from a false one on the one hand, but market players do not fully utilize this information to exploit all arbitrage opportunities on the other hand. A simple explanation could be the existence of rumor followers in the market who have bounded rationality. However, why do such opportunities last for such a long period in the market? Why do other rational and sophisticated investors not exhaust these opportunities? These questions remain to be answered in the future theoretical or empirical research.

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Figure 1. Stylized Timeline of Merger and Acquisition Events

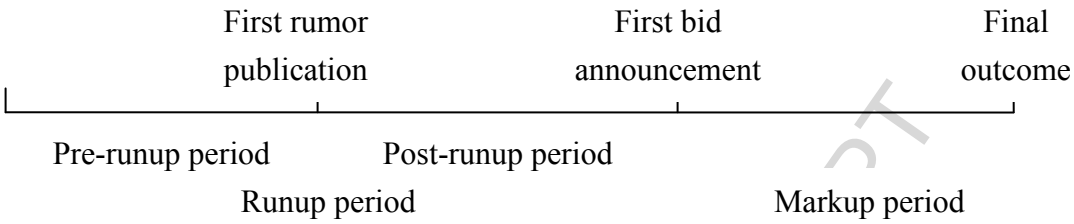

Figure 2. Average Cumulative Abnormal Return of the Rumor-announced Group

The average of cumulative abnormal returns to target firms in the rumor-announced group from trading day -126 to 252 is estimated based on the market model $R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$, where market index is the CRSP value-weighted market portfolio. The regression of the market model uses daily returns from day -379 to day -127. The event day, day 0, is the day when the first formal bid is announced.

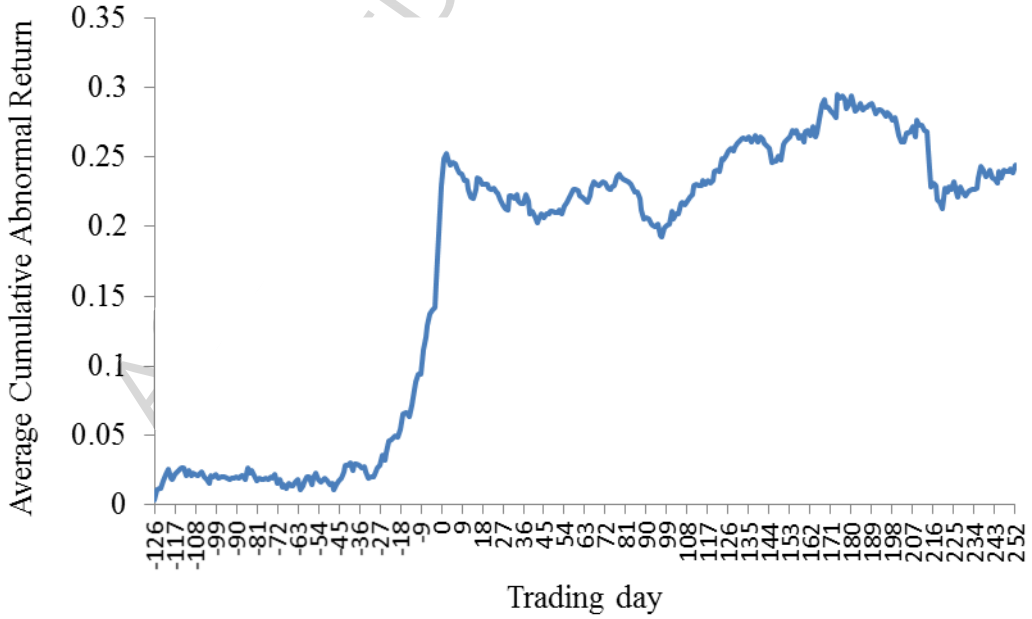

Table 1. Distribution of Trading Days between Initial Rumor's Publication and the First Takeover Announcement

Trading days between rumor and bid	Number of observations
1 and 2 days	27
3-21 days	54
22-42 days	8
43-100 days	15
101-200 days	10
201-252 days	1
Average length: 28.83 days	115
Median length: 8 days	115

The calculation is based on the original data from SDC Platinum database and the Wall Street Journal. The sample period is from January 1, 1990 to December 31, 2008.

Table 2a. Averages and Medians of CARs of Rumor-announced and Rumor-only Targets and Their Differences, Estimation Based on an Estimation Window of (-242,-43)

CAR	Rumor-announced Mean	Rumor-only Mean	Mean difference	t-statistic of mean difference	Rumor-announced Median	Rumor-only Median	Median difference	Wilcoxon rank-sum
CAR(-42,-1)	0.0813***	0.0192	0.0621	2.068**	0.0528***	0.0130	0.0398	2.192**
	(0.221)	(0.223)						
CAR(-41,-1)	0.0833***	0.0150	0.0683	2.289**	0.0521***	0.0103	0.0418	2.288**
	(0.228)	(0.126)						
CAR(-40,-1)	0.0871***	0.0186	0.0685	2.309**	0.0596***	0.0127	0.0469	2.318**
	(0.221)	(0.218)						
CAR(-39,-1)	0.0841***	0.0196	0.0645	2.177**	0.0518***	0.0155*	0.0363	2.214**
	(0.221)	(0.218)						
CAR(-38,-1)	0.0856***	0.0205	0.0651	2.234**	0.0498***	0.0120**	0.0378	2.140**
	(0.214)	(0.216)						
CAR(-37,-1)	0.0884***	0.0176	0.0708	2.544***	0.0605***	0.0157	0.0448	2.436***
	(0.195)	(0.212)						
CAR(-36,-1)	0.0879***	0.0207	0.0672	2.408***	0.0529***	0.0095*	0.0434	2.336***
	(0.204)	(0.207)						
CAR(-35,-1)	0.0850***	0.0197	0.0653	2.335**	0.0686***	0.0166	0.0520	2.256**
	(0.204)	(0.208)						
CAR(-34,-1)	0.0874***	0.0169	0.0705	2.582***	0.0598***	0.0154	0.0444	2.392***
	(0.191)	(0.208)						
CAR(-33,-1)	0.0915***	0.0137	0.0778	2.828***	0.0614***	0.0109	0.0505	2.760***
	(0.195)	(0.208)						
CAR(-32,-1)	0.0857***	0.0147	0.0710	2.581***	0.0538***	0.0194	0.0344	2.392***
	(0.192)	(0.210)						
CAR(-31,-1)	0.0929***	0.0131	0.0798	2.939***	0.0631***	0.0247**	0.0384	2.734***
	(0.198)	(0.202)						
CAR(-30,-1)	0.0971***	0.0152	0.0819	2.990***	0.0660***	0.0249	0.0411	2.758***
	(0.201)	(0.203)						
CAR(-29,-1)	0.0854***	0.0174	0.0680	2.886***	0.0680***	0.0170	0.0510	2.716***
	(0.202)	(0.199)						
CAR(-28,-1)	0.0922***	0.0189	0.0733	2.794***	0.0723***	0.0266*	0.0457	2.544***
	(0.192)	(0.195)						
CAR(-27,-1)	0.0881***	0.0147	0.0734	2.891***	0.0530***	0.0182*	0.0384	2.592***
	(0.186)	(0.189)						
CAR(-26,-1)	0.0868***	0.0145	0.0723	2.869***	0.0481***	0.0168**	0.0313	2.624***
	(0.182)	(0.188)						
CAR(-25,-1)	0.0813***	0.0148	0.0665	2.735***	0.0531***	0.0152*	0.0379	2.504***
	(0.177)	(0.181)						
CAR(-24,-1)	0.0878***	0.0223*	0.0655	2.698***	0.0591***	0.0247*	0.0344	2.390***
	(0.179)	(0.179)						
CAR(-23,-1)	0.0870***	0.0201*	0.0669	2.828***	0.0601***	0.0247**	0.0354	2.410***
	(0.169)	(0.178)						
CAR(-22,-1)	0.0871***	0.0239**	0.0632	2.726***	0.0601***	0.0280***	0.0321	2.420***
	(0.168)	(0.173)						
CAR(-21,-1)	0.0877***	0.0232**	0.0645	2.752***	0.0651***	0.0280***	0.0371	2.572***
	(0.178)	(0.170)						
CAR(-20,-1)	0.0896***	0.0255**	0.0641	2.813***	0.0633***	0.0301***	0.0332	2.420***
	(0.173)	(0.165)						
CAR(-19,-1)	0.0887***	0.0277**	0.0610	2.728***	0.0556***	0.0245**	0.0311	2.294***
	(0.174)	(0.160)						
CAR(-18,-1)	0.0917***	0.0301**	0.0616	2.690***	0.0643***	0.0240***	0.0403	2.384***

	(0.183)	(0.161)						
CAR(-17,-1)	0.0941***	0.0325***	0.0616	2.724***	0.0596***	0.0203**	0.0393	2.710***
	(0.175)	(0.163)						
CAR(-16,-1)	0.0845***	0.0333***	0.0512	2.468***	0.0528***	0.0268***	0.0260	2.054**
	(0.175)	(0.139)						
CAR(-15,-1)	0.0857***	0.0306***	0.0551	2.663***	0.0555***	0.0244***	0.0311	2.032**
	(0.179)	(0.135)						
CAR(-14,-1)	0.0738***	0.0288***	0.0450	2.273**	0.0446***	0.0243***	0.0203	1.718*
	(0.171)	(0.129)						
CAR(-13,-1)	0.0718***	0.0308***	0.0410	2.146**	0.0366***	0.0271***	0.0095	1.243
	(0.168)	(0.123)						
CAR(-12,-1)	0.0748***	0.0304***	0.0444	2.331**	0.0328***	0.0250***	0.0078	1.225
	(0.170)	(0.120)						
CAR(-11,-1)	0.0763***	0.0266***	0.0497	2.661***	0.0427***	0.0127***	0.0300	2.006**
	(0.163)	(0.121)						
CAR(-10,-1)	0.0745***	0.0271***	0.0474	2.617***	0.0376***	0.0164***	0.0212	1.770*
	(0.164)	(0.112)						
CAR(-9,-1)	0.0698***	0.0199**	0.0499	2.959***	0.0312***	0.0196***	0.0116	2.254**
	(0.151)	(0.106)						
CAR(-8,-1)	0.0617***	0.0146*	0.0471	2.883***	0.0320***	0.0171**	0.0149	2.340***
	(0.136)	(0.111)						
CAR(-7,-1)	0.0609***	0.0136*	0.0473	3.017***	0.0326***	0.0054	0.0272	2.614***
	(0.133)	(0.104)						
CAR(-6,-1)	0.0574***	0.0097	0.0477	3.155***	0.0316***	0.0066	0.0250	2.919***
	(0.125)	(0.103)						
CAR(-5,-1)	0.0555***	0.0108*	0.0447	3.031***	0.0227***	0.0098*	0.0129	2.859***
	(0.125)	(0.098)						
CAR(-4,-1)	0.0519***	0.0190***	0.0329	2.383***	0.0270***	0.0077*	0.0193	2.506***
	(0.123)	(0.087)						
CAR(-3,-1)	0.0467***	0.0171***	0.0296	2.384***	0.0129***	0.0114**	0.0015	1.696*
	(0.114)	(0.074)						
CAR(0,0)	0.0523***	0.0504***	0.0019	0.104	0.0269***	0.0233***	0.0036	1.163
	(0.143)	(0.143)						
CAR(0,1)	0.0554***	0.0668***	-0.0114	-0.377	0.0375***	0.0253***	0.0122	0.925
	(0.129)	(0.265)						
CAR(0,2)	0.0573***	0.0651***	-0.0078	0.263	0.0598***	0.0206***	0.0392	2.400***
	(0.0138)	(0.0213)						

Event day (day 0) is the day when the takeover rumor is published for the first time. Using the daily returns of target *i* from CRSP and daily returns of the CRSP value-weighted market portfolio over (-242,-43), coefficients α_i and β_i are estimated by the following market model:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}.$$

Then the estimated α_i and β_i are substituted into the model to calculate the abnormal returns, ε_{it}, over (-42, -1), using the observations of daily returns of target *i* and the CRSP market portfolio over this period. The CAR of firm *i* between dates t_1 and t_2 is given by:

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} \varepsilon_{it}.$$

There are 87 rumor-announced firms and 147 rumor-only firms in the sample. The first column reports the average CARs of rumor-announced firms in the periods of (-42, -1) to (-3, -1), the average abnormal return on the event day, *CAR*(0, 0), and the average CARs between the event day and the first two days after the event day, *CAR*(0, 1) and *CAR*(0, 2). The second column reports their counterparts for the rumor-only group and the third column documents the mean differences between the two groups. The results of t tests of mean differences are presented in the fourth columns. The fifth to seventh columns report the medians of the CARs for the two groups, and their differences. The eighth column presents Wilcoxon rank-sum tests of median differences. Standard deviations are reported in parentheses. Symbols ***, ** and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

Table 2b. Averages and Medians of CARs of Rumor-announced and Rumor-only Targets and Their Differences, Estimation Based on an Estimation Window of (-221,-22)

CAR	Rumor-announced Mean	Rumor-only Mean	Mean difference	t-statistic of mean difference	Rumor-announced Median	Rumor-only Median	Median difference	Wilcoxon rank-sum
CAR(-21,-1)	0.0868***	0.0250**	0.0618	2.615***	0.0583***	0.0267***	0.0316	2.247**
	(0.184)	(0.170)						
CAR(-20,-1)	0.0887***	0.0274**	0.0613	2.663***	0.0511***	0.0323***	0.0188	2.156**
	(0.179)	(0.166)						
CAR(-19,-1)	0.0878***	0.0289**	0.0589	2.603***	0.0420***	0.0226***	0.0194	2.081**
	(0.179)	(0.161)						
CAR(-18,-1)	0.0907***	0.0315***	0.0592	2.558***	0.0481***	0.0232***	0.0249	2.077**
	(0.188)	(0.161)						
CAR(-17,-1)	0.0931***	0.0340***	0.0591	2.579***	0.0554***	0.0235***	0.0319	2.414***
	(0.179)	(0.165)						
CAR(-16,-1)	0.0834***	0.0348***	0.0486	2.319**	0.0521***	0.0307***	0.0214	1.750**
	(0.179)	(0.139)						
CAR(-15,-1)	0.0845***	0.0321***	0.0524	2.513***	0.0455***	0.0295***	0.0160	1.736**
	(0.183)	(0.135)						
CAR(-14,-1)	0.0731***	0.0308***	0.0423	2.115**	0.0385***	0.0314***	0.0071	1.387*
	(0.175)	(0.130)						
CAR(-13,-1)	0.0711***	0.0329***	0.0382	1.966**	0.0383***	0.0320***	0.0063	0.940
	(0.172)	(0.124)						
CAR(-12,-1)	0.0737***	0.0324***	0.0413	2.148**	0.0334***	0.0253***	0.0081	0.987
	(0.173)	(0.122)						
CAR(-11,-1)	0.0752***	0.0288***	0.0464	2.455***	0.0443***	0.0130***	0.0313	1.720**
	(0.166)	(0.122)						
CAR(-10,-1)	0.0733***	0.0286***	0.0447	2.450***	0.0414***	0.0135***	0.0279	1.578*
	(0.167)	(0.113)						
CAR(-9,-1)	0.0685***	0.0217***	0.0468	2.751***	0.0330***	0.0191***	0.0139	2.046**
	(0.153)	(0.107)						
CAR(-8,-1)	0.0606***	0.0167**	0.0439	2.654***	0.0308***	0.0158***	0.0150	2.188**
	(0.137)	(0.113)						
CAR(-7,-1)	0.0600***	0.0158**	0.0442	2.781***	0.0333***	0.0084***	0.0249	2.440***
	(0.134)	(0.107)						
CAR(-6,-1)	0.0564***	0.0119*	0.0445	2.904***	0.0329***	0.0072	0.0257	2.665***
	(0.126)	(0.106)						
CAR(-5,-1)	0.0548***	0.0120*	0.0428	2.905***	0.0246***	0.0112	0.0134	2.651***
	(0.126)	(0.098)						
CAR(-4,-1)	0.0517***	0.0201***	0.0316	2.291**	0.0268***	0.0087*	0.0181	2.422***
	(0.123)	(0.087)						
CAR(-3,-1)	0.0462***	0.0184***	0.0278	2.239**	0.0146***	0.0115**	0.0031	1.561*
	(0.115)	(0.076)						
CAR(0,0)	0.0523***	0.0497***	0.0026	0.139	0.0270***	0.0230***	0.0040	1.212
	(0.133)	(0.139)						
CAR(0,1)	0.0556***	0.0658***	-0.0102	-0.342	0.0385***	0.0237***	0.0148	1.056
	(0.120)	(0.264)						
CAR(0,2)	0.0571***	0.0640***	-0.0069	0.233	0.0548***	0.0219***	0.0329	2.456***
	(0.0137)	(0.0213)						

The content of this table is similar to Table 2a, except for using an estimation window of (-221,-22) to estimate CAR. There are 88 rumor-announced firms and 148 rumor-only firms in the sample.

Table 3. Profitability of Investing the Selected Target Stocks

Investment strategy	Obs.	ADAR			Investment strategy	Obs.	ADAR		
		Mean	Median	Positive			Mean	Median	Positive
Panel A. One-Month Holding Period									
CAR(-42,-1)>0%	136	0.0028**	0.0004	53%	CAR(-21,-1)>0%	155	0.0031***	0.0003	51%
		(0.0013)					(0.0013)		
CAR(-42,-1)>2%	123	0.0029**	0.0005	54%	CAR(-21,-1)>2%	134	0.0032***	0.0009	54%
		(0.0015)					(0.0013)		
CAR(-42,-1)>4%	108	0.0030**	0.0005	54%	CAR(-21,-1)>4%	114	0.0039***	0.0012	56%
		(0.0016)					(0.0015)		
CAR(-42,-1)>6%	98	0.0029*	0.0004	52%	CAR(-21,-1)>6%	98	0.0044***	0.0012*	57%
		(0.0018)					(0.0016)		
CAR(-42,-1)>8%	90	0.0030*	0.0005	52%	CAR(-21,-1)>8%	84	0.005***	0.0018	57%
		(0.0019)					(0.0018)		
CAR(-42,-1)>10%	82	0.0030*	0.0005	52%	CAR(-21,-1)>10%	69	0.0059***	0.0020	58%
		(0.0021)					(0.0021)		
CAR(-42,-1)>12%	76	0.0033*	0.0005	53%	CAR(-21,-1)>12%	58	0.0070***	0.0022	59%
		(0.0023)					(0.0024)		
CAR(-42,-1)<0%	98	0.00014	-0.0017***	38%	CAR(-21,-1)<0%	81	0.0004	-0.0003	47%
		(0.0016)					(0.0022)		
CAR(-42,-1)<2%	111	0.00028	-0.0018***	38%	CAR(-21,-1)<2%	102	0.0008	-0.0005	44%
		(0.0014)					(0.002)		
CAR(-42,-1)<4%	126	0.00054	-0.0013**	40%	CAR(-21,-1)<4%	122	0.0005	-0.0008*	43%
		(0.0013)					(0.0017)		
CAR(-42,-1)<6%	136	0.00076	-0.0012*	43%	CAR(-21,-1)<6%	138	0.0006	-0.0006	44%
		(0.0012)					(0.0016)		
CAR(-42,-1)<8%	144	0.00087	-0.0012**	42%	CAR(-21,-1)<8%	152	0.0006	-0.0005	45%
		(0.0012)					(0.0014)		
CAR(-42,-1)<10%	152	0.00095	-0.0009*	43%	CAR(-21,-1)<10%	167	0.0006	-0.0004	46%
		(0.0011)					(0.0014)		
CAR(-42,-1)<12%	158	0.00092	-0.0009*	44%	CAR(-21,-1)<12%	179	0.0006	-0.0003	47%
		(0.0011)					(0.0013)		
All rumored firms	234	0.0017*	-0.0003	47%	All rumored firms	236	0.0022**	-0.00003	50%
		(0.0010)					(0.0011)		

Panel B. One-Year Holding Period

CAR(-42,-1)>0%	136	0.0032***	0.0008***	65%	CAR(-21,-1)>0%	155	0.0029***	0.0006***	82%
		(0.0012)					(0.0010)		
CAR(-42,-1)>2%	123	0.0033***	0.0009***	66%	CAR(-21,-1)>2%	134	0.0030***	0.0007***	63%
		(0.0013)					(0.0011)		
CAR(-42,-1)>4%	108	0.0033**	0.0012***	68%	CAR(-21,-1)>4%	114	0.0031***	0.0007***	62%
		(0.0015)					(0.0013)		
CAR(-42,-1)>6%	98	0.0036**	0.0013***	66%	CAR(-21,-1)>6%	98	0.0038***	0.0011***	64%
		(0.0016)					(0.0015)		
CAR(-42,-1)>8%	90	0.0038**	0.0013***	68%	CAR(-21,-1)>8%	84	0.0047***	0.0013***	65%
		(0.0018)					(0.0016)		
CAR(-42,-1)>10%	82	0.0038**	0.0013***	66%	CAR(-21,-1)>10%	69	0.0046***	0.0013***	67%
		(0.0019)					(0.0018)		
CAR(-42,-1)>12%	76	0.0040**	0.0013***	67%	CAR(-21,-1)>12%	58	0.0052***	0.0017***	69%
		(0.0021)					(0.0021)		
CAR(-42,-1)<0%	98	0.0005	-0.0002	46%	CAR(-21,-1)<0%	81	0.0004	-0.000002	51%
		(0.0013)					(0.0017)		
CAR(-42,-1)<2%	111	0.0007	-0.0001	48%	CAR(-21,-1)<2%	102	0.0007	-0.00004	49%
		(0.0012)					(0.0015)		
CAR(-42,-1)<4%	126	0.0009	-0.0001	48%	CAR(-21,-1)<4%	122	0.0011	0.00009	52%
		(0.0011)					(0.0013)		
CAR(-42,-1)<6%	136	0.0010	0.00004	51%	CAR(-21,-1)<6%	138	0.0008	0.00009	52%
		(0.0010)					(0.0011)		
CAR(-42,-1)<8%	144	0.0010	0.00004	51%	CAR(-21,-1)<8%	152	0.0006	0.0001	53%
		(0.00097)					(0.0010)		
CAR(-42,-1)<10%	152	0.0011	0.00007	53%	CAR(-21,-1)<10%	167	0.0010	0.0002	53%
		(0.0009)					(0.0010)		
CAR(-42,-1)<12%	158	0.0011	0.00007	53%	CAR(-21,-1)<12%	178	0.0010	0.0002	53%
		(0.0009)					(0.0010)		
All rumored firms	234	0.0021**	0.0004**	57%	All rumored firms	236	0.0020**	0.0005**	57%
		(0.0009)					(0.0009)		

This table reports the outcomes of investment in the selected rumored target stocks whose CARs over day -42 to day -1 or over day -21 to day -1 are greater than or smaller than a particular threshold. The outcomes of investing in all rumored targets are also reported in the end of each panel. Selected stocks are bought at the closing price on the rumor publication day and then are sold in the open market on the day when the first takeover bid is announced or the pre-specified holding period matures, whichever comes first. *ADAR* averages the daily abnormal return of an invested stock over its holding period. In addition to the means and medians of *ADAR*s, the percentages of *ADAR*s being positive in the invested portfolios are reported in the "Positive" column. Symbols ***, ** and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

Table 4. Descriptive Statistics of CARs and Firm Characteristics

	Number of firm	Mean	Standard deviation	Min	25%	Median	75%	Max
Panel A: Rumor-announced group								
CAR(-42,-1)	63	0.0889	0.236	-0.698	-0.039	0.069	0.210	1.115
CAR(-21,-1)	64	0.0996	0.203	-0.240	-0.001	0.060	0.164	1.069
Zmijewski Prob	56	0.326	0.317	0.00001	0.039	0.202	0.522	0.999
Ohlson Prob	52	0.565	0.296	0.075	0.287	0.596	0.849	0.989
Leverage	58	0.235	0.234	0	0.025	0.181	0.335	0.972
Firm Size	58	7.455	2.136	1.016	6.200	7.813	8.935	10.632
Sales Growth	57	0.074	0.108	-0.063	0.011	0.037	0.099	0.486
Panel B: Rumor-only group								
CAR(-42,-1)	113	0.020	0.211	-0.708	-0.077	0.013	0.142	0.489
CAR(-21,-1)	114	0.030	0.162	-0.680	-0.038	0.023	0.113	0.731
Zmijewski Prob	96	0.350	0.364	0.00001	0.019	0.185	0.769	0.999
Ohlson Prob	82	0.548	0.299	0.0119	0.332	0.589	0.809	0.999
Leverage	95	0.226	0.231	0	0.022	0.155	0.377	0.884
Firm Size	101	8.164	1.662	4.160	6.950	8.132	9.310	12.536
Sales Growth	101	0.064	0.129	-0.090	0.006	0.033	0.074	0.985

The descriptive statistics of CAR**s** are based on data in Tables 2a and 2b with the exclusion of financial firms (SIC codes 60-60). The statistics of firm characteristics are calculated using data from Compustat from 1990 to 2008. *Zmijewski Probability* of bankruptcy is measured by the cumulative probability of the standard normal distribution at point X, where $X = -4.3 - 4.5 \times$ (Net income/ Total assets) $+ 5.7 \times$ (Total liabilities / Total assets) $- 0.004 \times$ (Current assets / Current liabilities). *Ohlson Probability* is calculated by the logistic function of point Y, where $Y = -1.3 - 0.4 \times$ (log(Total assets / GNP price-level index) $+ 6 \times$ (Total liability / Total assets) $- 1.4 \times$ (Working capital / Total assets) $+ 0.1 \times$ (Current liability / Current assets) $- 2.4 \times$ (Dummy of total liabilities exceeding total assets) $- 1.8 \times$ (Net income / Total assets) $+ 0.3 \times$ (Funds provided by operations / Total liabilities) $- 1.7 \times$ (Dummy of negative net income in the past two years) $- 0.5 \times$ (Net income growth rate). *Leverage* is measured as total debt divided by the sum of market value of equity and total debt, *Firm Size* is the logarithm of market value of equity, *Sales Growth* is the average growth rate of sales of the four quarters just before the rumor publication.

Table 5. Logit Regressions of M&A Rumors and Investment Profitability

Panel A. Logit Regressions of M&A Rumors

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
CAR(-42,-1)	0.333*		0.300	0.253		
	(0.172)		(0.201)	(0.233)		
CAR(-21,-1)		0.514**			0.517*	0.47
		(0.213)			(0.289)	(0.342)
Zmijewski Prob			-0.335*		-0.315*	
			(0.172)		(0.169)	
Ohlson Prob				-0.234		-0.311
				(0.207)		(0.207)
Leverage			0.189	0.02	0.228	0.11
			(0.261)	(0.268)	(0.257)	(0.265)
Firm Size			-0.073***	-0.073**	-0.060**	-0.065**
			(0.025)	(0.029)	(0.027)	(0.032)
Sales Growth			0.246	-0.119	0.162	-0.179
			(0.375)	(0.432)	(0.363)	(0.437)
Industry Dummy	No	No	Yes	Yes	Yes	Yes
Time Dummy	No	No	Yes	Yes	Yes	Yes
Log likelihood	-112.80	-113.19	-80.76	-75.122	-82.57	-76.15
Chi-squared	3.72**	5.85**	22.62**	14.67	20.11**	13.11
Number of Firms	176	178	143	126	145	128

Panel B. Profitability of Investing the Selected Target Stocks with One-Month Holding Period

Investment	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
strategy	Obs.	ADAR	Obs.	ADAR	Obs.	ADAR	Obs.	ADAR	Obs.	ADAR	Obs.	ADAR
P-Score > 0.35	99	0.0038***	91	0.0036**	69	0.0045**	67	0.0058***	72	0.0051**	69	0.0061**
		(0.0014)		(0.0017)		(0.0021)		(0.0022)		(0.0025)		(0.0026)
P-Score > 0.40	46	0.003**	42	0.0087***	59	0.0055**	57	0.0066***	61	0.0058**	58	0.0068**
		(0.0019)		(0.0031)		(0.0025)		(0.0025)		(0.0029)		(0.0031)
P-Score > 0.45	19	0.0064*	21	0.0121**	49	0.0077***	45	0.0065**	53	0.0068**	44	0.0083**
		(0.0038)		(0.0054)		(0.0029)		(0.0029)		(0.0032)		(0.0039)
P-Score > 0.50	5	0.0198	10	0.0266***	41	0.0079***	32	0.0085**	44	0.0083**	36	0.0077**
		(0.015)		(0.0094)		(0.0034)		(0.0038)		(0.0037)		(0.0042)
P-Score > 0.55			7	0.0254*	33	0.0084**	24	0.0090**	30	0.0134***	26	0.0108**
				(0.0135)		(0.0041)		(0.0051)		(0.0050)		(0.0054)
P-Score > 0.60			4	0.0431*	24	0.0113**	22	0.0096**	23	0.0151**	16	0.0143**
				(0.0198)		(0.0054)		(0.0055)		(0.0064)		(0.008)
P-Score > 0.65			3	0.0520*	19	0.0069**	15	0.0044	15	0.0083**	12	0.0076*
				(0.0251)		(0.0039)		(.0051)		(0.0043)		(0.0052)

Panel C. Profitability of Investing the Selected Target Stocks with One-Year Holding Period

Investment	Model 1		Model 2		Model 3		Model 4		Model 5		Model 6	
strategy	Obs.	ADAR	Obs.	ADAR	Obs.	ADAR	Obs.	ADAR	Obs.	ADAR	Obs.	ADAR
P-Score > 0.35	99	0.0038***	91	0.0027**	69	0.0051***	67	0.0061***	72	0.0044**	69	0.0055***
		(0.0012)		(0.0014)		(0.002)		(0.0021)		(0.0020)		(0.0021)
P-Score > 0.40	46	0.0045**	42	0.0059**	59	0.0058***	57	0.0069***	61	0.0056***	58	0.0068***
		(0.0019)		(0.0028)		(0.0023)		(0.0024)		(0.0023)		(0.0024)
P-Score > 0.45	19	0.0075**	21	0.0115**	49	0.0076***	45	0.0070***	53	0.0064***	44	0.0086***
		(0.0037)		(0.0049)		(0.0028)		(0.0027)		(0.0026)		(0.0037)
P-Score > 0.50	4	0.0199	10	0.0229***	41	0.0082***	32	0.0085**	44	0.0078***	36	0.0081**
		(0.0156)		(0.0092)		(0.0032)		(0.0037)		(0.0030)		(0.0034)
P-Score > 0.55			7	0.0217*	33	0.0089**	24	0.0101**	30	0.0111***	26	0.0119***
				(0.0134)		(0.0039)		(0.0048)		(0.0043)		(0.0045)
P-Score > 0.60			4	0.0365*	24	0.0113**	22	0.0111**	23	0.0127**	16	0.0148**
				(0.0215)		(0.0053)		(0.0052)		(0.0055)		(0.0069)
P-Score > 0.65			3	0.0497*	19	0.0072**	15	0.0064*	15	0.0087**	12	0.0088*
				(0.0238)		(0.0038)		(0.0046)		(0.0047)		(0.0062)

Penal A of the table reports the results of the logit regression of M&A rumor types. The dependent variable is a binary variable, which equals one if the rumor is truthful and zero otherwise. Explanatory variables are presented in Table 4, while control variables include industry dummies: manufacturing (SIC codes 30-39), communication (SIC codes 48 and 49) and service (SIC codes 72-82), and time dummies. Financial firms (SIC codes 60-69) are excluded. Panels B and C report the sample means of ADARs across selected stocks for a holding period of one month and one year respectively. A stock is selected for investment if its

P-score (propensity score) of the rumor being truthful is greater than the corresponding cut-off point, where P-score is estimated using the logit model in Panel A. Heteroskedasticity-consistent standard errors are reported in parentheses. Symbols ***, ** and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

Table 6. Descriptive Statistics of Pre-runup, Post-runup, Runup, Markup and Takeover Premium

	Mean	Standard deviation	Min	25%	Median	75%	Max
Panel A: Rumor-announced group with (-242, -43) estimation window, 87 observations							
Pre-runup	0.081***	0.221	-0.698	-0.040	0.053***	0.209	1.115
Post-runup	0.090***	0.245	-1.396	0.014	0.096***	0.191	0.764
Runup	0.171***	0.327	-1.428	0.042	0.158***	0.328	0.978
Markup	0.0044	0.47	-1.697	-0.101	0.0012	0.243	1.108
Premium	0.175***	0.651	-1.752	-0.023	0.173***	0.517	1.796
Panel B: Successful subsample of rumor-announced group with (-242, -43) estimation window, 65 observations							
Pre-runup	0.097***	0.238	-0.698	-0.043	0.071***	0.213	1.115
Post-runup	0.064**	0.255	-1.396	0.012	0.095***	0.153	0.673
Runup	0.161***	0.350	-1.428	0.047	0.148***	0.328	0.978
Markup	0.015	0.313	-0.976	-0.098	-0.0115	0.216	0.528
Premium	0.176***	0.553	-1.752	0.0045	0.165***	0.468	1.235
Panel C: Rumor-announced group with (-221, -22) estimation window, 88 observations							
Pre-runup	0.087***	0.184	-0.240	-0.002	0.058***	0.130	1.069
Post-runup	0.089***	0.229	-1.348	0.019	0.096***	0.188	0.685
Runup	0.175***	0.277	-1.384	0.037	0.166***	0.311	0.910
Markup	0.0107	0.459	-1.513	-0.102	0.004	0.249	1.149
Premium	0.186***	0.587	-1.685	-0.0106	0.162***	0.45	1.452
Panel D: Successful subsample of rumor-announced group with (-221, -22) estimation window, 66 observations							
Pre-runup	0.098***	0.197	-0.240	-0.001	0.062***	0.176	1.069
Post-runup	0.064**	0.237	-1.348	0.012	0.087***	0.147	0.651
$Runu_i$	0.163***	0.284	-1.384	0.016	0.171***	0.309	0.876
Markup	0.025	0.304	-0.911	-0.101	0.004	0.208	0.606
Premium	0.188***	0.492	-1.685	0.019	0.169***	0.404	1.257

Pre-runup is equal to the CAR of a target's stock from day -42 to day -1 (or day -21 to day -1), *Post-runup* is the target's CAR from the day of initial rumor's publication through the day before the first bid announcement, *Runup* is the sum of *Pre-runup* and *Post-runup*, *Markup* is the CAR from the day of the first bid announcement through delisting or 126 trading days, whichever comes first, *Premium* is the sum of *Runup* and *Markup*. Panels A and B report the descriptive statistics of the rumor-announced group and its successful subsample, respectively, using an estimation window of (-242, -43). Panels C and D report the same items but using an estimation window of (-221, -22). Symbols ***, ** and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

Table 7. Least Squares Regressions of Takeover Premium against Pre-runup and Post-runup

Sample	Sample size	Pre-runup	t-statistic for $b_1 > 1$	Post-runup	t-statistic for $b_2 > 1$	Intercept	R^2
Panel A: Pre-runup$_i$ = CAR$_i$(-42, -1)							
Rumor-announced	87	1.619***	2.824***	1.305***	1.548	-0.0734	0.5236
		(0.219)		(0.197)		(0.0544)	
Successful	65	1.602***	4.104***	1.132***	0.961	-0.0521	0.7437
		(0.147)		(0.137)		(0.0385)	
Panel B: Pre-runup$_i$ = CAR$_i$(-21, -1)							
Rumor-announced	88	1.515***	1.951*	1.285***	1.341	-0.0593	0.4098
		(0.264)		(0.212)		(0.0574)	
Successful	66	1.742***	4.318***	1.228***	1.601	-0.0623	0.7000
		(0.172)		(0.142)		(0.039)	

The table reports the results of the following regression,

$$Premium_i = a + b_1 \times Pre\text{-}runup_i + b_2 \times Post\text{-}runup_i + u_i.$$

Dependent variable $Premium_i$ is equal to the sum of $Pre\text{-}runup_i$, $Post\text{-}runup_i$ and $Markup_i$. $Pre\text{-}runup_i$ is measured by the CAR of target i's stock from day -42 to day -1 in Panel A and from day -21 to day -1 in Panel B. $Post\text{-}runup_i$ is the CAR from the day of the first rumor date through the day before the first bid announcement. $Markup_i$ is the CAR from the day of the first bid announcement through delisting or 126 trading days, whichever comes first. Each panel includes a sample of all rumor-announced targets and a sample of targets being successfully taken over. Heteroskedasticity-consistent standard errors are reported in parentheses. Symbols ***, ** and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

Table 8. Least Squares Regressions of Takeover Premium against Runup

Sample	Sample size	Runup	t-statistic for $b > 1$	Intercept	R^2
Panel A: Pre-runup$_i$ = CAR$_i$(-42,-1) with rumor publication day as the event day					
Rumor-announced	87	1.445***	3.007***	-0.0719	0.5228
		(0.148)		(0.054)	
Successful	65	1.351***	3.39***	-0.0418	0.7255
		(0.103)		(0.039)	
Panel B: Pre-runup$_i$ = CAR$_i$(-21,-1) with rumor publication day as the event day					
Rumor-announced	88	1.372***	2.139**	-0.0546	0.4131
		(0.174)		(0.0569)	
Successful	66	1.428***	3.502***	-0.044	0.6753
		(0.122)		(0.040)	
Panel C: *Runup$_i$ = CAR$_i$*(-42,-1) with takeover announcement day as the event day, rumor-announced group and its successful subsample					
Rumor-announced	85	0.945***	-0.266	0.035	0.1979
		(0.203)		(0.056)	
Successful	64	1.442***	2.53**	-0.035	0.5392
		(0.167)		(0.044)	
Panel D: *Runup$_i$ = CAR$_i$*(-42,-1) with takeover announcement day as the event day, SDC no-rumor sample and its successful subsample					
SDC no-rumor	7305	1.217***	5.28***	0.171***	0.3829
		(0.041)		(0.007)	
Successful	5735	1.139***	4.16***	0.208***	0.3597
		(0.034)		(0.007)	

This table reports the results of the following regression,

$$Premium_i = a + b \times Runup_i + u_i.$$

Dependent variable *Premium$_i$* is equal to the sum of *Runup$_i$* and *Markup$_i$*. In Panels A and B, event day (day 0) is the day when the rumor is published for first time and *Runup$_i$* is the sum of *Pre-runup$_i$* and *Post-runup$_i$*, where *Pre-runup$_i$* is the CAR of target *i* from day -42 to day -1 in Panel A and from day -21 to day -1 in Panel B, and *Post-runup$_i$* is the CAR from the event day through the day before the first bid announcement. In panels C and D, day 0 is the day when the first bid is announced and *Runup$_i$* is measured by the CAR of target *i* from day -42 to day -1. While the sample in Panel C includes rumored targets with a takeover announcement, the sample in Panel D contains targets in SDC with a takeover announcement but no rumor flag. *Markup$_i$* in all four panels is the CAR from the day of the first bid announcement through delisting or 126 trading days, whichever comes first. The Successful group in each panel is the corresponding subsample where the announced takeovers are successful. Heteroskedasticity-consistent standard errors are reported in parentheses. Symbols ***, ** and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

Table 9. Descriptive Statistics of the Runup, Markup and Takeover Premium When Event Day is the First Bid Announcement Day

Sample	Mean	Standard deviation	Min	25%	Median	75%	Max
Panel A: *Rumor-announced group with 85 observations*							
Runup	0.171***	0.217	-0.316	0.036	0.142	0.259	1.054
Markup	0.026	0.401	-1.591	-0.096	-0.015	0.229	0.828
Premium	0.197***	0.451	-1.401	0.001	0.203	0.440	1.354
Panel B: *Successful subsample of rumor-announced group with 64 observations*							
Runup	0.160***	0.211	-0.316	0.035	0.140	0.259	1.054
Markup	0.036	0.292	-1.258	-0.091	-0.014	0.226	0.607
Premium	0.195***	0.411	-1.401	0.014	0.203	0.421	1.045
Panel C: SDC no-rumor sample with 7305 observations							
Runup	0.091***	0.314	-1.979	-0.054	0.058	0.208	7.812
Markup	0.191***	0.491	-4.680	-0.025	0.153	0.378	6.279
Premium	0.282***	0.619	-5.792	-0.008	0.240	0.537	12.494
Panel D: Successful subsample of SDC no-rumor sample with 5735 observations							
Runup	0.093***	0.285	-1.599	-0.047	0.061	0.204	4.225
Markup	0.221***	0.436	-2.551	0.005	0.172	0.385	6.279
Premium	0.314***	0.543	-3.392	0.034	0.263	0.548	6.011

Event day is the day when the first M&A bid is announced. Estimation window extends from day -379 to day -127. *Runup* is equal to the CAR of a target stock from day -42 to day -1. *Markup* is the CAR from the event day through delisting or 126 trading days, whichever comes first. *Premium* is the sum of *Runup* and *Markup*. Panels A and B report respectively the descriptive statistics of the rumor-announced group and its subsample where announced takeovers are successful. Panel C documents the descriptive statistics of a sample containing all targets in SDC with a takeover announcement but no rumor flag while Panel D is the counterpart of Panel C where takeovers are successful. Symbols ***, ** and * indicate significance at the 0.01, 0.05 and 0.1 levels, respectively.

Highlights

- M&A rumors are statistically distinguishable in terms of rumor credibility.
- Market initial responses to rumors are statistically indifferent.
- Selectively investing M&A rumors makes abnormal profits.
- The markup pricing and substitution hypotheses are rejected or not supported.