

# Hedge Funds in M&A Deals: Is there Exploitation of Private Information?\*

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## Abstract

This paper investigates recent allegations regarding the misuse of private insider information by hedge funds prior to the public announcement of M&A deals. We analyze this issue by using a unique and comprehensive dataset which allows us to analyze the trading pattern of hedge funds around corporate mergers and acquisitions in both the equity and derivatives markets. In general, our results are consistent with hedge funds, with short-term investment horizons (henceforth, short-term hedge funds) taking advantage of private information and engaging in trading based on such information. We show that short-term hedge funds holdings of a target's shares in the quarter prior to the M&A announcement date are positively related to the profitability of the deal as measured by the target premium. In addition, we also find that the target price run-up before the deal announcement date is significantly greater for deals with greater short term hedge fund holdings. We also find evidence consistent with informed abnormal short selling and put buying in the corresponding acquirer's stock prior to M&A announcements. This is particularly evident when hedge funds take larger stakes in target firms. In addition, we show that such a strategy is potentially very profitable. We consider alternative explanations for such short term hedge fund holdings in target firms; however our results seem inconsistent with these alternative explanations. Overall, our results have important implications regarding the recent policy debate on hedge fund regulation.

JEL Classifications: D82, G30, G34

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\* We would like to thank Charles Cao, Victoria Ivashina, Andrew Lo, Keke Song, and seminar participants at the 6<sup>th</sup> RFS/NYU/NYFed conference on Financial Intermediation for helpful comments and discussions. Nadia Massoud would like to acknowledge funding from Schulich School of Business, York University; Nadia Massoud and Debarshi Nandy would like to acknowledge financial support from the Social Sciences and Humanities Research Council (SSHRC) of Canada. The usual disclaimer applies. Please address correspondence to Nadia Massoud, e-mail: [nmassoud@schulich.yorku.ca](mailto:nmassoud@schulich.yorku.ca) or Debarshi Nandy, e-mail: [dnandy@brandeis.edu](mailto:dnandy@brandeis.edu)

# **Hedge Funds in M&A Deals: Is there Exploitation of Private Information?**

## **Abstract**

This paper investigates recent allegations regarding the misuse of private insider information by hedge funds prior to the public announcement of M&A deals. We analyze this issue by using a unique and comprehensive dataset which allows us to analyze the trading pattern of hedge funds around corporate mergers and acquisitions in both the equity and derivatives markets. In general, our results are consistent with hedge funds, with short-term investment horizons (henceforth, short-term hedge funds) taking advantage of private information and engaging in trading based on such information. We show that short-term hedge funds holdings of a target's shares in the quarter prior to the M&A announcement date are positively related to the profitability of the deal as measured by the target premium. In addition, we also find that the target price run-up before the deal announcement date is significantly greater for deals with greater short term hedge fund holdings. We also find evidence consistent with informed abnormal short selling and put buying in the corresponding acquirer's stock prior to M&A announcements. This is particularly evident when hedge funds take larger stakes in target firms. In addition, we show that such a strategy is potentially very profitable. We consider alternative explanations for such short term hedge fund holdings in target firms; however our results seem inconsistent with these alternative explanations. Overall, our results have important implications regarding the recent policy debate on hedge fund regulation.

Keywords: Hedge funds, short term hedge funds, merger and acquisition, short-selling, long target holdings.

JEL Classifications: D82, G30, G34

## 1. Introduction

Recently, there has been a marked increase in allegations and prosecutions regarding the misuse of material non-public information in mergers and acquisitions (M&As) which has attracted the attention of regulatory authorities and researchers. For example, over the last couple of years it was revealed in the *Wall Street Journal* that the SEC has been investigating potential insider information leakages prior to the public announcement of takeover deals. As part of their investigation, the SEC sent subpoenas to more than 30 hedge funds, some of which were related to trading in Schering-Plough Corp. stock prior to its takeover by Merck & Co. in 2009, while others were related to MedImmune Inc.'s takeover by AstraZeneca PLC in 2007.<sup>1</sup> Additionally, in two other recent cases involving the Galleon and Jefferies hedge funds, the SEC arrested over a dozen people for leaking and trading on private insider information concerning M&A deals.<sup>2</sup> Indeed, in May 2011, Raj Rajaratnam, founder of the \$7 billion Galleon hedge fund was found guilty of 14 counts of securities fraud, many related to M&A activity.<sup>3</sup> However, so far, the question as to whether (and which) hedge funds are generally involved in such activities has not been established or examined systematically in the finance literature. The high turnover of their portfolios, their undiversified investment strategies, and the absence of reporting requirements make hedge fund illicit trading less conspicuous to market regulators; while the absence of

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<sup>1</sup> See *Wall Street Journal*, November 20, 2010, "U.S. in Vast Insider Trading Probe", by Pulliam, Rothfeld, Strasburg, and Zuckerman.

<sup>2</sup> According to the SEC, prosecutors brought a civil suit in New York (No. 09-cv-01043) of insider-trading against seven defendants, including Ramesh Chakrapani an M&A managing director at Blackstone and Joseph Contorinis a portfolio manager at Jefferies Group hedge fund. This case of unlawful insider trading from Nov. 2005 through Dec 2006 produced more than \$8 million in illegal profits. Details of this case are available at <http://www.sec.gov/litigation/complaints/2009/comp20884.pdf>.

<sup>3</sup> See *Wall Street Journal*, May 12, 2011, "Fund Titan Found Guilty", by Rothfeld, Pulliam, and Bray.

regulatory disclosures and intensive use of short selling and derivative trading strategies impede insightful investigation.<sup>4</sup>

In this paper, we address the issue of hedge fund trading on inside information around M&A announcements, by using a unique and comprehensive hedge fund dataset which allows us to analyze the trading patterns of hedge funds around corporate M&As in both equity and derivatives markets. Specifically, we investigate the extent to which hedge funds take both long positions in a target's stock and short positions in an acquirer's stock (as well as buying puts in the acquirer's stock) over relatively short periods prior to M&A announcements.

It has been shown in the prior literature that trading on private insider information not only leads to considerable profits around mergers and acquisitions but also imposes externality costs such as higher target premiums or lower probability of deal completion.<sup>5</sup> For example, in the weeks after a board meeting of First Federal Bancshares Inc. (FFBI), to consider offers from potential acquirers, its stock price jumped from \$18 to an 18-month high of \$24. First Federal's merger proxy said "[i]t was the board of directors' belief that the increase in the price of the stock most likely reflected speculation of a merger and not an actual increase in the intrinsic value of FFBI."

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<sup>4</sup> Echoing similar sentiments, in his testimony before the Subcommittee on Securities, Insurance, and Investment of the U.S. Senate Committee on Banking, Housing, and Urban Affairs, on July 15, 2009, Andrew J. Donohue, Director of the Division of Investment Management, U.S. Securities and Exchange Commission, said ".....the securities laws have not kept pace with the growth and market significance of hedge funds and other private funds and, as a result, the Commission has very limited oversight authority over these vehicles. Sponsors of private funds – typically investment advisers – are able to organize their affairs in such a way as to avoid registration under the federal securities laws." Available at: <http://www.sec.gov/news/testimony/2009/ts071509ajd.htm>

<sup>5</sup> According to a study of global M&A over 1994-2007 (Moeller and Omiros, 2009), only 49% of leaked deals are completed, whereas 72% of non-leaked deals are completed; leaked deals take 70% longer to complete than non-leaked deals. Further, the premium eventually paid to target shareholders in leaked deals, is approximately 13% lower than for non-leaked deals.

Given the magnitude of trading around takeovers, there is reason to believe that the primary informed traders are not individuals.<sup>6</sup> Among money managers, hedge funds constantly receive the most public scrutiny whenever suspicious trading price spikes are observed, partly because of their incentive fee structures and partly because of their opaque but aggressive investment strategies which makes it easier for them to avoid being detected by regulators.<sup>7</sup>

To investigate whether hedge funds are involved in trading on private information, prior to M&As, we focus on those hedge funds that acquire a long position in a target firm shortly before the public announcement of a proposed takeover. Specifically, we analyze hedge funds that had no equity stake in the target firm over the prior year, but acquired a significant holding in the firm within one quarter prior to the merger (henceforth short-term hedge fund). We hypothesize that such short-term pre-announcement entry of a hedge fund as a target shareholder is associated with its potential access to material non-public insider information about the likelihood of a merger.

Our strategy of identifying short-term hedge funds is partly motivated by the recent conviction of Galleon hedge fund founder Raj Rajaratnam on multiple cases of securities fraud. For example, in one case it was alleged that Rajaratnam received private insider information from a friend relating to the premium that would be paid to Hilton (the target) shareholders in the impending takeover by the Blackstone Group (which was publicly announced on July 3, 2007). The prosecution successfully argued that in this instance Rajaratnam proceeded to trade based on that information prior to the announcement, by taking a long position of 400,000 shares in Hilton

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<sup>6</sup> An article in the *Economist* on May 12, 2007 reports “[i]n the 17 biggest takeovers of the past year in America, options trading jumped to more than three times normal levels, on average, in the three days before the deal was made public...”. Additionally, according to a 2006 study of Measuredmarkets.com for *Bloomberg*, the aberrant trading patterns (potentially insider trading) prior to the announcement of deals are 41% for US and 63% for Canadian takeovers.

<sup>7</sup> Stephen Luparello, NASD’s senior executive vice president for regulatory operations, say “[m]ore sophisticated players have more tools... [w]hen it comes to catching insider trading, it makes it harder and harder because they can be working in the options, they can be working in the equities, [and] they can be doing a swap over the counter.”

through Galleon Tech funds, whose stated purpose was to make investments in the technology sector.<sup>8</sup> However, Galleon Tech Fund did not ever own any position in Hilton prior to this period immediately before the public announcement of the deal.

While in general, it may be difficult to identify which hedge funds routinely acquire private information about M&A deals, anecdotal evidence suggests that short-term hedge funds obtain such information through private connections in the industry. In the recent insider-trading charges initiated by the FBI “[o]ne focus of the criminal investigation is examining whether nonpublic information was passed along by independent analysts and consultants who work for companies that provide "expert network" services to hedge funds...”<sup>9</sup> Similarly, in the Galleon case described above, the insider information came to Rajaratnam via a friend who had in turn obtained it from her cousin’s roommate who was working as an analyst at Moody’s rating agency while it was evaluating Hilton’s debt in connection with the upcoming takeover deal.<sup>10</sup> If short-term hedge funds do indeed obtain such insider information, then we should be able to investigate the potential usage of this information to generate abnormal profits, not only by their long positions held in a target’s shares but also from short selling an acquirer’s shares in stock deals just prior to the public announcement of M&A deals.

In this paper we focus only on short-term hedge fund holdings rather than long-term hedge fund holdings in a target’s shares since short-term hedge fund holdings are more likely to

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<sup>8</sup> Galleon Tech funds ultimately sold their Hilton shares after the July 3 announcement for a profit of over \$4 million.

<sup>9</sup> *Wall Street Journal*, November 20, 2010, “U.S. in Vast Insider Trading Probe”, by Pulliam, Rothfeld, Strasburg, and Zuckerman.

<sup>10</sup> Lhabitan (2006) suggests that the relationship between investment bankers and hedge fund has witnessed interesting developments in recent years. Recently, providing prime brokerage service to hedge funds has been considered important business to investment banks who compete aggressively to obtain additional hedge funds as their clients. In addition, anecdotal evidence suggests that hedge funds and investment bankers maintain close relationship other than business. This supply-driven and personal relationship between hedge funds and investment bankers, makes one suspect whether material non-public information concerning M&A deals at investment banks are fire-walled properly from their hedge fund clients.

be associated with the leakage of insider information about M&A deals rather than shareholder activism, active monitoring or cherry-picking of investment strategies which have been shown to be associated with *long-term* holdings by institutional investors. Specifically, using M&A decisions, Chen, Harford, and Li (2007) argue that institutional investors benefit from short-term trading only if they have superior information concerning firm specific events, while independent long-term institutions actively monitor and benefit from their effort. Moreover, Bodnaruk, Massa, and Simonov (2009), suggest that financial advisors affiliated with investment banks are privy to insider information in takeovers by showing that their preannouncement stakes in targets are positively related to the probability of a successful bid and to the target's premium.<sup>11</sup>

Overall, our results are consistent with short term hedge funds trading on private insider information. Our results can be summarized as follows: First, we find that short-term hedge funds' holdings of target shares in the quarter prior to the public announcement of the M&A are positively related to the target's premium and negatively related to deal characteristics such as completion status. In addition, we also find that the target's price run-up, prior to a deal's public announcement date, is significantly greater for deals with greater short term hedge fund holdings. Second, we find evidence consistent with informed abnormal short selling and put buying in the corresponding acquirer's stock prior to the public announcement of the M&A, particularly when

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<sup>11</sup> Other related papers include Christophe, Ferri, and Angel (2004), who provide empirical evidence of informed trading prior to earnings announcements. They find evidence of abnormal short-selling that is significantly associated with negative post-announcement stock returns following earnings announcements. Also, Cao, Chen, and Griffin (2005) find evidence of informed trading in options market. They show that takeover targets with the largest preannouncement call-imbalance tend to experience the highest returns at announcement. At the same time, Gaspar, Massa, and Matos (2005) show that target firms with short-term shareholders are more likely to receive an acquisition bid with lower premiums. Yan and Zhang (2009) suggest that short-term institutions are better informed by documenting that future stock returns are driven by short-term institutional investors. Finally, Poteshman (2006) provides evidence of informed trading in advance of terrorist attacks by showing an unusually high level of put buying prior to September 11, 2001.

short term hedge funds take larger stakes in target firms. In addition, we show that such a strategy is potentially very profitable.

To rule out alternative explanations, we conduct our analysis in three distinct stages. In each stage we attempt to eliminate an alternative explanation or provide some evidence about the potential nature of information for short-term hedge fund trading prior to the public announcement of M&A deals. In the first stage, we investigate whether the pre-announcement entry of short term hedge funds around takeovers is based on publicly available information such as a firm's financial reports and market information. We do this by conducting tests using propensity score matching based on historical firm characteristics so as to match actual targets to potential targets with similar characteristics. This analysis helps to rule out the alternative explanation that short-term hedge fund trading patterns are based on historical publicly available firm characteristics and information.<sup>12</sup>

In the second stage of our tests we investigate whether short-term hedge funds possess superior skill or abilities to process publicly available information that leads them to being better able to identify a potential target prior to the public announcement of M&A deals. We investigate the trading pattern and profitability of short-term non-hedge fund institutional investors and compare them to short-term hedge funds trading pattern and profitability. We find that the short-term hedge funds hold a larger share in targets that have a higher premium and also in targets that have higher short-selling in the corresponding acquirer's stock. Moreover, the

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<sup>12</sup> Our paper is also related to the risk arbitrage literature, in which investors take long positions in the target stock and may take short positions in the acquirer's stock in non-cash deals. See, for example, Mitchell and Pulvino (2001), Baker and Savasoglu (2002), and Hsieh and Walking (2005) who document that such strategies tend to generate substantial excess returns. The primary distinction between this form of merger arbitrage and trading based on private insider information has to do with the timing of the long and short positions. In most merger arbitrages, the positions in the target and acquirer are entered into on the day of the public announcement, while in the case of informed trading these positions are taken significantly prior to the announcement of the deal and before any pre-announcements run up (run down) in target (acquirer) stock price has occurred.



price run-up of the target's stock, prior to the public announcement of the M&A, is significantly greater when short-term hedge funds hold a large share. Since these results may be indicative of short-term hedge funds having superior ability or skills compared to other institutional investors, we compare their past performance. Interestingly, we find that those short-term hedge funds that were associated with deals with the highest level of short-selling and with higher premiums or higher run-ups, did not out-perform their peers associated with deals having lower levels of short-selling and run-ups, in terms of past portfolio returns, as might be expected had they possessed superior skills.

Finally, in the third stage of our analysis, we employ multivariate tests to investigate whether the trading patterns of short-term hedge funds are consistent with trading on material nonpublic information. We utilize an approach from the prior literature (see, for example, Christophe, Ferri and Angel, 2004), by which we investigate the relationship between the pre-announcement short-selling of the acquirer shares and its post-announcement stock price change. If short-term hedge funds are able to predict perfectly the acquirer's stock price reaction to the M&A announcement, particularly for stock deals, then it is more likely that their trading patterns as short sellers in the equity market and in the option market, are more likely to be based on private information. Consistent with this, we find substantial evidence indicative of informed abnormal short-selling and put buying in acquirer's stock prior to a takeover announcement and especially when short-term hedge funds hold larger stakes in target firms. However, we do not find similar evidence for short-term non-hedge fund institutional investors. Overall, our

empirical findings have strong implications for the recent regulatory focus of the SEC on issues concerning potential insider trading by hedge funds prior to mergers and acquisitions.<sup>13</sup>

The remainder of this paper is organized as follows. In Section 2, we describe our data. In section 3, we outline and discuss our empirical strategy. In Section 4 we present our methodology and empirical results. Finally, Section 5 concludes.

## 2. Data Description

We consider all mergers deals (both completed and withdrawn) between January 1, 2000, and December 31, 2007 as identified by the Securities Data Corporation (SDC) M&A database. We apply the following filters commonly used in the prior M&A literature (see Betton, Eckbo, and Thorburn, 2008, Gaspar, Massa, and Matos, 2005). We keep all offers where the acquirer seeks to own 100% of a target's shares, while excluding divestitures, spin-offs, repurchases, self-tenders, and transactions whose value represents less than 1% of the acquirer's or target's stock market capitalization 46 trading days prior to the announcement, so as to ensure that the takeover has a reasonable probability of an impact on the stock prices of the firms involved in the deal. We then group each M&A deal into either a stock, cash, or mixed payment category according to its contract terms. We require that both acquirer and target firms be available on CRSP and Compustat, and that they be listed on NYSE, Amex, or Nasdaq. The above data screens leave us with 1,271 deals. For all deals, we manually check the announcement date of the M&A deal from news articles by searching through *Lexis Nexis*. Next, we obtain analyst coverage from I/B/E/S, option trading data from OptionMetrics, institutional holdings data from 13F

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<sup>13</sup> Elisse B. Walter, *Testimony Concerning Securities Law Enforcement in the Current Financial Crisis Before the United States House of Representatives Committee on Financial Services*, March 20, 2009, available at: [http://www.sec.gov/news/testimony/2009/ts032009ebw.htm#P134\\_41627](http://www.sec.gov/news/testimony/2009/ts032009ebw.htm#P134_41627)

CDA/Spectrum, and collect short selling data made available in the RegSHO period (January 2, 2005 to July 6, 2007).

To identify a hedge fund's long positions in an M&A transaction, we first identify hedge funds and hedge fund advisors. To do this, we construct a comprehensive database of hedge funds by combining seven databases used in the prior literature. Second, we collect information on hedge funds' long holding positions from three types of SEC ownership disclosure filings, 13D, 13F and 13G. We obtain the forms directly underlying these SEC filings since they provide greater detail about the identity of a firm's shareholders.<sup>14</sup> Finally, we integrate stock ownership data from these three different SEC filings into one dataset. Our data is organized quarterly due to the reporting nature of Form 13F. However, since 13D and 13G are not quarterly filings but rather filed as and when required, we define the quarter before the announcement as well as the days in the actual announcement quarter prior to the announcement day as quarter (-1); the days after the announcement day in the announcement quarter as quarter (0); and the remaining quarters as following the calendar quarters relative to the announcement date. For example, a merger on July 17<sup>th</sup> 2007 would have the days April 1st 2007 to July 16, 2007 in quarter -1. In addition, similar to our definition of a short-term hedge fund, we also define a short-term investor as a financial institution or individual who does not maintain a long-term relationship but takes a long (buy) position in the target firm shortly before the public announcement of the M&A deal. Specifically, we define an investor as a short-term investor if the following two criteria are satisfied. (1) the investor reports a positive holding in the target in either 13F and/or SC13D/G filing in quarter [-1], and (2) the investor reports no holdings in the target in each

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<sup>14</sup> We identify the identity of shareholders of the target firm (those holding the common stock) by using the 8-digit CUSIP numbers provided in the detailed 13F filings and merging it with that from CRSP.

quarter from quarter [-4] to quarter [-2].<sup>15</sup> Detailed descriptions of these steps are provided in Appendix A to the paper. We report the distribution of these data in Table I and Figure I.

[Insert Table I and Figure I]

Table I reports the number of beneficial owners of firms involved in M&A deals annually in our sample. Between 2000 and 2007, there are 716 M&A transactions with at least one institutional owner for the target and/or acquirer's shares between the period four quarters prior to two quarters after the M&A announcement. As can be seen from Figure I, there is a strong upward time trend of hedge fund beneficial ownership in our sample, especially in target firms. Conversely, the number of other institutional beneficial owners remains relatively unchanged during the sample period, consistent with prior evidence (Greenwood and Schor, 2009).

[Insert Table II]

Table II presents descriptive statistics of institutional holdings for our sample of 1,271 M&A transactions in the four quarters before and the two quarters after the announcement of the M&A deals. The first two columns of Table II provide the mean and median values for hedge fund and other institutional investor's ownership, respectively.<sup>16</sup> Column 3 presents the difference and a test of significance between the hedge fund and other institutional investor samples. More importantly, we also report the percentage change in aggregated ownership positions for each quarter relative to the holdings in the 4<sup>th</sup> quarter prior to the announcement, for both types of investor. Panel A of Table II shows that hedge funds in general tend to increase their stake more in target firms relative to non-hedge fund institutions. In particular, in quarter (-

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<sup>15</sup> Since Bodnaruk, Massa, and Simonov (2007) argue that investment banks possess private information and their stakes are related to target premium, to avoid the mixed effect from hedge funds affiliated to investment banks and to focus our study on the role played by short-term hedge funds, we remove several hedge funds from our sample, that are identified by our hedge fund database and are also identified as an investment bank by SDC in the 3 years before each M&A deal. This filter would exclude hedge funds associated with financial conglomerates such as JP Morgan, for example.

<sup>16</sup> Other institutional investors include commercial and investment banks, mutual funds, pension funds, insurance companies, and university endowments etc.

1) the increase in mean hedge fund holding relative to quarter (-4) is 37.88% while it is 18.4% for other institutional holders.

We collect our short sales data from the New York Stock Exchange (NYSE) TAQ database and the websites of the other major US Exchanges that are Self-Regulatory Organizations (SRO's), namely, the American Stock Exchange (AMEX), the National Association of Securities Dealers Automated Quotations (NASDAQ), the National Stock Exchange (NSX), Archipelago (ARCA), the Boston Stock Exchange (BSE), the Chicago Stock Exchange (CHX), the National Association of Securities Dealers (NASD) and the Philadelphia Stock Exchange (PHLX). On June 23, 2004, the SEC adopted Regulation SHO (REGSHO) under the Securities Exchange Act of 1934. Under the initial requirements of *REGSHO*, all SROs were obligated to make tick-by-tick short sales data available to the public after January 1, 2005. This short sales data include information on ticker name, short sale volume, short sale price, transaction time and date, exchange listing, and trade type (whether exempt market maker trades or not). These data are available from the first effective compliance day January 2, 2005 to July 6, 2007 after which date the mandatory public disclosure of short sales data was discontinued.

We start by aggregating the raw data at the transaction level to a daily level by ticker symbol, trading date, and the stock exchange on which the stock is traded (some stocks might be traded on more than one exchange). During this aggregation process we exclude exempt market maker trades as such trades are not information driven. We then merge this daily short sale database with CRSP daily price data by ticker and date, and verify our merged results by comparing the daily average short prices with CRSP stock prices. We then keep the short sales data for stocks listed on the NYSE, AMEX and NASDAQ and generate aggregated daily non-

exempted short sale volumes for each stock.<sup>17</sup> This leaves us with a short sale sample consisting of 3,117 NYSE stocks, 1,353 AMEX stocks, and 3,915 NASDAQ stocks.

### **3. Discussion of Empirical Strategy**

In this section, we discuss our approach to uncover whether the short term hedge fund trading patterns, prior to the public announcement of M&A deals, are consistent with trading based on private information. In general, one can classify trading based on the source of information into three categories: (i) available public information, (ii) superior ability or skill to process public information and (iii) private information. Our empirical strategy seeks to investigate each category separately and therefore provides us with the opportunity to address several alternative explanations of our main results.

In the first stage of our analysis we test whether short-term hedge fund trading patterns prior to M&A deal announcements are driven mainly by public information. Our main focus is on observable target characteristics such as historical accounting information and market information. We compare the trading pattern of short-term hedge fund stock holdings in targets prior to the announcement of M&A deals with that in similar matched firms (potential targets). If our results show that short-term hedge fund trading patterns are significantly different among the two comparable groups (based on public information), then this rules out the possibility that short-term hedge funds trade primarily on available public information prior to the announcement of M&A deals.

In the second stage of our analysis we investigate whether short-term hedge funds have superior ability or skill in processing public information. First, we investigate the trading pattern

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<sup>17</sup> Non-exempted short sales exclude short sales made by the market maker.

and profitability of short-term non hedge fund institutional investors as well as different groups of short-term hedge funds. Second, we investigate whether short term hedge fund holdings are positively related to the target's premium and the run-up in a target's price prior to the public announcement of a deal, which has been shown by the existing literature to be linked to trading based on private information (see for example Schwert, 1996 and Bodnaruk, Massa, and Simonov, 2009). Finally, we analyze whether those short-term hedge funds that were associated with higher premium deals and deals with higher short-selling in the acquirer's stock just prior to M&A deal announcements, have on average superior ability or skill. Such superior skill could then explain their higher returns around M&A announcements. However, if these short-term hedge funds did not out-perform their peers in terms of past portfolio returns, then it is less likely that their trading patterns and profitability prior to the public announcement of M&A deals, was associated with superior skill or ability to process public information.

In the third stage of our analysis, we investigate whether the trading patterns of short-term hedge funds is consistent with trading on material nonpublic information. We borrow an approach from the prior literature (see, for example, Christophe, Ferri and Angel, 2004), by which we investigate the relationship between the pre-announcement short-selling of the acquirer's shares and its post-announcement stock price change. If there is a significantly negative relationship between abnormal short-selling in the days prior to the M&A announcement and the immediate post-announcement change in stock prices, then it is consistent with the notion that a significant portion of the short-sellers are informed traders (Christophe, Ferri and Angel, 2004). Thus, if short-term hedge funds are able to perfectly predict the acquirer's stock price reaction to the M&A announcement, particularly for stock deals, then it is more likely that their trading patterns are linked to private information.

The empirical tests underlying the three stages of our analysis discussed above, allows us to ascertain whether the trading patterns of short-term hedge funds are consistent with trading on private insider information. To conduct the different tests, we examine the magnitude of short-term hedge fund involvement in M&A deals relative to other institutional investors by investigating the ownership stake in the target firms prior to the public announcement of M&A deals. We present our results in the next sub-section using alternate empirical methodologies based on propensity score matching, univariate portfolio analysis, and multivariate regressions.

## **4. Methodology and Results**

In this section we present our empirical results according to the three stages of our analysis as discussed above.

### **4.1 Stage One: Propensity Score Matching for Target Firms based on Observable Publicly available Information**

In the first stage of our analysis, we investigate whether short-term hedge funds adjust their ownership in target firms primarily based on public information regarding firm fundamentals. We do this by employing propensity score matching. The propensity score matching algorithm allows us to examine short-term hedge fund holdings of the treatment (actual target) firms, in comparison to their holdings in a matched control group of firms (similar firms but not takeover targets). These tests are implemented in four steps. In the first step, we use a logit regression where the binary dependent variable is one for takeover targets and zero for firms that are neither acquirers nor targets in any M&A deal during our sample period. This also allows us to identify the fundamental characteristics that make a firm more likely to be a potential takeover target. Following the standard M&A literature, see for example Schwert (2000), we include a number of



market and accounting variables as measures of firm fundamentals, such as sales growth, ROE, etc. In addition, we include the firm's aggregate level of institutional ownership from CDA/Spectrum 13F and Amihud's illiquidity ratio as additional control variables to proxy for firm specific information asymmetry.<sup>18</sup> In the second step, we calculate each firm's propensity score based on the probability that a firm with given fundamental characteristics will become a target. In the third step, firms are matched using Leuven and Sianesi's (2003) propensity score matching procedure to the nearest neighborhood within a 0.1 caliper. Specifically, we match the actual and potential target within the same Fama-French 49 industry category and year, and then compute the differences in the control variables between the treatment and control firms to establish the quality of our matches. In the final step, we employ univariate tests to compare the hedge fund and short-term hedge fund long positions in the actual and matched potential targets around M&A dates.

[Insert Table III]

Panel A of Table III reports the regression results from three logit models. Given the consistent results across these models, we choose Model (3), with highest pseudo R-square, to conduct the propensity score analysis and match the actual and potential targets. We report the quality of our matches in Panel B of Table III. The results of these tests show no significant difference among the market and accounting performance measures between matched pairs of treatment and control firms. Panel C of Table III shows that hedge funds tend to take larger stakes in actual targets compared to their matched control firms in all four quarters prior to the announcement. We analyze our main key variable, short-term hedge fund holdings in Panel D of Table III. The results in Panel D shows that short-term hedge funds hold significantly greater

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<sup>18</sup> A greater extent of institutional ownership of the firm's shares and lower stock illiquidity signals a lower degree of firm specific information asymmetry.

long positions in the actual target's shares in quarter(-1) relative to matched firms. This test therefore rules out the potential explanation that short-term hedge funds are able to identify target firms prior to the public announcements of M&A deals, purely based on historical market and accounting fundamentals.

#### **4.2 Stage Two: Do Short-term Hedge Funds Have Superior Ability or Private Information?**

In this stage, we investigate whether the trading patterns of short-term hedge funds are based on their superior ability to process public information or their possession of private insider information. We conduct a variety of tests to investigate the trading patterns of short-term hedge funds and the profitability of these trades prior to the public announcement of M&A deals. In some of these tests we compare their performance to different groups of other short-term investors. We first present our univariate tests followed by our multivariate analysis.

##### **4.2.1 Univariate Analysis of Short-term Hedge Fund positions in Target firms**

In this section we investigate whether short-term hedge funds could potentially construct a profitable strategy either due to their superior investment skills or by trading on private information. In Figure III, we present a graph depicting the Fama-French four-factor adjusted cumulative abnormal returns around M&A announcements of firms with high short-term hedge fund holdings versus firms with low short-term hedge fund holdings. We classify a firm in a deal as a firm with high (low) short term hedge fund holdings, if the short-term hedge fund ownership in the target firm is above (below) the 67th (33rd) percentile of the distribution of short-term hedge fund holdings in target firms in our sample.

[Insert Figure III]

Figure III suggests that target firms with high short-term hedge fund holdings also have high premiums relative to targets with low short-term hedge fund holdings. Conversely,

acquirers that have large short-term hedge fund holdings in their corresponding targets significantly underperform acquirers that have low short-term hedge fund holdings in their targets. This preliminary evidence seems consistent with short-term hedge funds trading based on private information (Bodnaruk, Massa, and Simonov, 2009). Additionally, as can be seen from the graph, for the high short-term hedge fund holding group there is a significant run-up of the target's stock price prior to the deal announcement date, in comparison to that for the low group, which is indicative of information leakage.<sup>19</sup>

#### *A. Measuring Potential Profitability from Target Premiums*

First, we evaluate the accuracy and profitability of short-term hedge funds investment strategies based on the characteristics of the deals they participate in. Based on Schwert's (2000) definition of target premium, and following Bodnaruk, Massa, and Simonov (2009), we measure the target premium as the Fama-French four-factor return of the target's stock from three months (63 trading days) prior to the deal announcement to two months (42 trading days) after the deal announcement or the resolution date, whichever comes first, i.e.:

$$premium = \sum_{-63}^{\min(42, \text{Resolution Date})} (R_{it} - \alpha_i - \mathbf{X}\beta)$$

where  $R_{it}$  is the continuously compounded return on target firm  $i$  on trading day  $t$  relative to the takeover announcement date and  $\mathbf{X}$  is a vector of the Fama-French four factors, MKT, SMB, HML, and UMD on trading day  $t$ . The coefficients are estimated on the 255 trading days ending

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<sup>19</sup> Interestingly, this run-up in the target's stock price is similar to that in several M&A deals currently under SEC investigation, such as Schering-Plough Corp's stock prior to its takeover by Merck & Co. in 2009, and MedImmune Inc.'s stock prior to its takeover by AstraZeneca PLC in 2007. See *Wall Street Journal*, November 20, 2010, "U.S. in Vast Insider Trading Probe", by Pulliam, Rothfeld, Strasburg, and Zuckerman.

at day -64. We also separate the Fama-French four factor returns into the previous month's "run-up" (-22,-1) and following 2-month (0, 42) "markup".<sup>20</sup>

### *B. Measuring Potential Profitability from Short-Selling and Put Buying on Acquirer Shares*

In addition to buying a target's shares in high premium deals, another component of a potentially profitable strategy for short-term hedge funds in a stock deal, is to short-sell the share or buy the puts of the acquirer *prior* to the public announcement of the deal. It is well known that in stock deals the acquirer's stock on average falls around the time of the M&A announcement (see, e.g., Boone and Mulherin, 2007). Figure IV indicates the average abnormal short-selling and abnormal put-buying prior to the M&A announcement for acquiring firms in stock deals, where "abnormal" is defined below. Similar to Figure III these results are also categorized by high and low short-term hedge fund holdings in corresponding target firms.

To further examine potential insider trading, we investigate the abnormal short selling and abnormal put buying of acquirer stock in the 5-day and 10-day windows prior to the public announcement of the deal. Following Christophe, Ferri, and Angel (2004), we define abnormal short-selling as the difference between the average daily short selling in the acquirer's shares for the five (ten) trading days prior to the M&A announcement date and the average daily short selling in acquirers' shares during a non-event window prior to the merger. This average short selling, *AVESS*, is measured over 255 trading days ending at day -64 (i.e., -318 to -64). We

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<sup>20</sup> The Fama-French four factor model appropriately controls for both firm size and market momentum factors that have been shown by previous papers to systematically affect market premium. Among others, Gompers and Metrick (2001), shows that institutional investors tend to invest in large liquid firms. On the other hand, Moeller, Schlingemann, and Stulz (2004) documented that announcement return of small firms is significantly better than that of large firms in takeovers. Furthermore, Rosen (2006) provides empirical evidence that takeover returns is positively related to market momentum, particularly that mergers announced during hot stock markets tend to get a better reaction from the market than those announced in a cold market.

require short selling records for a minimum of 63 days during this window.<sup>21</sup> For example, the abnormal short-selling *ABSS* (-5,-1) of one stock during the five days prior to announcement is

formally measured as:  $ABSS(-5,-1) = \frac{SS(-5,-1)}{AVESS} - 1$ , where *SS*(-5,-1) is the average daily number of shares that are short sold during the five days prior to the announcement.

To investigate short-term hedge fund's potential trading on insider information using put options, we investigate their daily net long put option holdings. We calculate the net long put option volume for each type of put option for the underlying stock on each trade date by subtracting the long (short) put open interest on that trade date from the long (short) put open interest on the previous trade date. Following Poteshman's (2006) methodology, we define *ABLongPut*(-5,-1), for example, as the average of the -5 to -1 day abnormal net long put volume, which is measured as

$$ABLongPut_t = \frac{\sum_{j=1}^{N_{i,t}} NVOL_{i,j,t}^{LongPut} - (1/255) \sum_{k=64}^{318} \left( \sum_{j=1}^{N_{i,t}} NVOL_{i,j,t-k}^{LongPut} \right)}{std. \left( \sum_{j=1}^{N_{i,t}} NVOL_{i,j,t-k}^{LongPut}, k = 64, 65, \dots, 318 \right)}$$

where  $NVOL_{i,j,t}^{LongPut}$  is the daily net long volume on the  $j^{\text{th}}$  type put option on underlying security  $i$  on trade date  $t$ .

[Insert Figure IV]

Panel A of Figure IV shows that, when short-term hedge funds hold higher long positions in targets, the shares of the corresponding acquirers are more likely to be abnormally short sold *prior* to the M&A announcement than the shares of acquirers corresponding to targets in which

<sup>21</sup> For deals with less than 63 days of short selling data prior to day -64 the average short selling is measured over the 255 trading days after day 0. We consider this alternative window to keep the sample size relatively stable. We also used alternative windows, finding qualitatively similar results.

short-term hedge funds have lower long positions. Panel B of Figure IV also shows a similar pattern of trading on the acquirer's net long put options based on the same classification of high and low short-term hedge fund holdings in targets.

*C. Relationship between Intensity of Short term Hedge Fund and Potential Profit Measures*

In Table IV, we present target premiums, target run-up, risk arbitrage return, acquirer run-up and mark-up, deal characteristics, and abnormal short sales and put option trading volumes in the Reg. SHO period, a period in which we have all variables of interest available. Table IV describes how these variables differ across deals associated with short-term hedge fund and other short term non-hedge fund institutions' ownership of a target's shares. Panel A of Table IV examines all M&A deals, while Panel B only examines the deals with stock payments. Column 1 of Table IV provides the mean and median values for sample characteristics with positive short-term hedge fund ownership, while the following 2 columns provide statistics for subsamples associated with below median (low) and above median (high) short-term hedge fund stakes in a target's shares, respectively. Column 4 displays the level and significance of differences between the two subsamples. The remaining columns for other short term institutional holdings are constructed in same way.

[Insert Table IV]

Panel A shows that the target premium for high short-term hedge funds holdings is significantly higher. In particular, the mean (median) of target premium is 31.37% (26.57%) for targets in the high hedge fund group while it is 20.09% (19.96%) for targets in the low hedge fund group. The difference is significant at the 1% level. However, the difference is not significant for the other institutions short-term holdings of the target's shares. Similarly, the target run-up for the high short-term hedge fund holdings is also significantly higher than that of

the low group. While the difference is significant at the 5% level for the hedge fund groups, it is insignificant for the non-hedge fund short-term investor groups. Interestingly, the deal success rate is significantly lower in the high short-term hedge fund holding group. As expected, the results for the stock deals (see Panel B) show that compared to the low group, the high group has higher target premium and higher abnormal short selling of acquirer's shares for the different windows with the differences being statistically significant.<sup>22</sup> Such differences in target premium and abnormal short selling however does not exist between the high and low short-term non-hedge fund institutional investor group.

#### *D. Double Sorting on Target Premium and Abnormal Short-selling of Acquirer Shares*

In our next univariate test we double sort M&A deals by target premium and abnormal short selling. We first sort all the deals into above median and below median groups based on short-term hedge fund holdings in the quarter prior to the M&A announcement. Deals within each group are then assigned into above median and below median groups based on the level of abnormal short sales in the corresponding acquirer over the 10 day period prior to the M&A announcement date.

[Insert Table V]

In Table V, Panel A, we report the cross-sectional averages for firms in the Low-Low (below median class for both abnormal short selling and short-term hedge fund holdings subsamples) and in the High-High (above median class for both abnormal short selling and short-term hedge fund stakes subsamples) groups. In this table we also introduce one more measure of profitability, total return, which is measured by subtracting the acquirer's CAR from its target's

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<sup>22</sup> It is important to note however, that the risk arbitrage return (i.e., the return based on the traditional merger arbitrage strategy that many hedge funds employ) is not different and statistically insignificant between the high and the low groups. Thus, the potential higher returns that accumulate to the high group (due to the significantly higher premium and significantly heavier short-selling) cannot be explained by such merger arbitrage strategies.

premium measured over the same event window. We measure the abnormal profit from shorting acquirer's shares by aggregating the average of the potential daily profits calculated by short selling acquirer's shares during the window (-10, -1) or (-5,-1) and closing the positions during the window (0, 10) or (0, 5). Consistent with our previous results, the target premium, acquirer abnormal short selling and short term-hedge fund holdings of target's shares is larger for the high-high group for all deals (left panel) and for the stock deals (right panel). Further, we find that the total return is significantly greater for the high-high deals compared to the low-low deals. As expected, the profitability due to short selling the acquirer's shares is significantly larger for the high-high group for stock deals.

Further, in Table V Panel B, we report the average long term past performance of the hedge funds associated in the low-low as well as the high-high group using two alternative methodologies, namely, market adjusted returns and returns based on the standard seven-factor model used in the prior literature.<sup>23</sup> The market adjusted returns are computed by subtracting the observed return on the corresponding hedge fund database indices for month  $t$ ,  $R_{I,t}$ , from the return of the  $j^{th}$  hedge fund in that database on month  $t$ :

$$MAR_{j,t} = r_{j,t} - r_{I,t}.$$

We follow Kososki, Naik, and Teo (2007) to measure hedge fund performance or alpha using the standard seven-factor model commonly used in the prior literature. The seven factors are S&P 500 monthly total return minus risk-free rate (Equity Market), Russell 2000 index monthly total return cap minus S&P 500 monthly total return (Size Spread), change in the constant maturity yield of the 10-year Treasury (Bond Market), change in the spread of Moody's Baa minus the

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<sup>23</sup> We collect performance data for hedge funds from TASS, HFR, and CISDM. In case a short term hedge fund is matched as a target shareholder at the management company level, we take the average performance of all hedge funds under the management company as the measure of the performance for the management company. The hedge fund monthly performance data are primarily based on TASS, and the data from HFR or CISDM are used only when the monthly returns are not reported in TASS.



10year Treasury (Credit Spread), as well as bond, currency, and commodities trend following factors. These factors have been shown to strongly explain the variation in individual hedge fund returns. To evaluate the performance of hedge funds, we consider the model below:

$$r_t^j = \alpha^j + \sum_{k=1}^K \beta_k^j F_{k,t} + \varepsilon_k^j.$$

We use the intercept from the regression above to represent the abnormal performance of the hedge fund  $j$  after controlling for its risk exposures. In Table V Panel B, we report the abnormal returns based on the above regression for 2 and 5-year periods prior to the takeover announcement.

As can be seen from Panel B, the short-term hedge funds in the high-high group do not outperform those in the low-low group with respect to 2 year and 5 year past returns, which should have been expected if short-term hedge funds in the high-high group possessed superior ability or investment skills than those in the low-low group. For example, the market adjusted returns over five previous years for stock deals are lower for high-high group (-1.1%) than for the low-low group (4.4%), though the difference is not statistically significant. These results therefore provide strong evidence that short-term hedge fund trading patterns prior to the public announcement of M&A deals cannot be primarily based on the superior ability of processing available public information by short-term hedge funds in the high-high group, but rather is consistent with trading based on private insider information.

#### *E. Profitability of Short Selling Strategy*

So far our univariate results show that short-term hedge funds are more likely to hold larger stakes in a target's shares and that stake is positively related to its target premium. We also found that the corresponding acquirer's shares are more likely to experience a high level of

abnormal short selling during the period prior to the deal announcement date. A logical question is to ask whether these short selling activities, prior to the public announcement of M&A deals, are also profitable.

To answer this question we construct a simple naive strategy where we consider the daily actual average abnormal short-selling volume in the 20 days prior to the M&A announcement. In Table VI the first column called “shorting day” indicates the day of the abnormal short-selling relative to day zero (M&A announcement day). For each day, we allow short sellers to close their positions on either the announcement date, or one day, two days and up to 20 days *after* the takeover announcement. We call these “short position closing days”. Profit (in thousands of dollars) is defined as  $profit_t = (Short\ Price_t - Ask_n) \times Short\ Volume$ , whereas  $Short\ Price_t$  refers to the weighted average short selling price on shorting day  $t$ , and  $Ask_n$  refers to the close ask price on the  $n^{th}$  trading day after the M&A announcement.

The results in Panel B of Table VI show that short sellers, in the high short-term hedge fund sample, could make economically significant profits if they closed their positions on day 0 or after. For example the total abnormal short-selling in the high short-term hedge fund group on day -20 would make an *abnormal* profit of approximately \$14.9 million, \$13.4 million and \$12.3 million if it closed out its positions on day 0 (the M&A announcement date), day 1 (one day after the M&A announcement date) and day 2 (two days after the M&A announcement date), respectively. If we consider the actual short-selling volume rather than abnormal short-selling volume then total short-selling profits would also be even larger, e.g., on day -20 the total profits from actual short-selling the acquirers’ equity is approximately \$33.0 million if the positions were to be closed on day 0. In comparison, the short sellers of the low short term hedge fund group would mostly generate losses based on abnormal short selling or very low profits based on

actual short selling following a similar strategy, see Panel A of Table V. Both abnormal and actual short selling profits gradually diminish with the number of days to the takeover announcement, suggesting that the value of the private information is quickly exhausted.

[Insert Table VI]

In summary, our results in this section provide evidence consistent with short-term hedge fund trading based on material non-public information, prior to the announcement of M&A deals. In particular, short-term hedge funds' long positions in M&A targets are positively related to high target premiums and high run-ups in the target's stock. Further, the stocks of acquirers in M&A deals, that have large pre-announcement stakes of short-term hedge funds in the corresponding target firms, are more likely to be abnormally sold short prior to the public announcement of the M&A. In addition, we show that such strategies could be potentially very profitable for hedge fund participants.

#### 4.2.2. Multivariate Analysis

In this section, we investigate whether short-term hedge fund trading patterns are based on their superior ability to process public information or on their possession of private information using a variety of multivariate tests.

##### *A. Target premium and short-term hedge fund holdings*

We first investigate whether short-term hedge funds holding of target shares prior to the public announcements of an M&A is positively related to a target's premium and negatively related to the success rate of the M&A deal. We formally test this using the following model:

$$\begin{aligned}
 \text{Holding} = & \alpha + \beta_1 \text{Premium} + \beta_2 \text{Success} + \beta_3 \text{Markup} + \beta_4 \text{Runup} \\
 & + \mathbf{X}_{\text{Deal Characters}} \boldsymbol{\kappa} + \mathbf{X}_{\text{Controls}} \boldsymbol{\varphi} + \varepsilon
 \end{aligned} \tag{1}$$

where *Holdings* is the holdings for short-term hedge funds one quarter before the M&A announcement, *Premium* is the target premium, *Success* is a binary dummy variable relating to the actual outcome of the deal (i.e., completed versus withdrawn), *Runup* and *Markup* are acquirer stock price run-ups and mark-ups (i.e., the acquirer's return following the announcement) discussed above,  $\mathbf{X}_{Deal\ Characters}$  is the matrix for specific characters associated with M&A deals, and  $\mathbf{X}_{Controls}$  is the set of control variables commonly employed in the M&A literature (see for example, Schwert, 2000). Our analysis is focused on the size and sign of  $\beta_1$ .<sup>24</sup>

[Insert Table VII]

In Table VII, we present our results for hedge fund holdings for the full sample (Panel A), the pre-2003 subsample (Panel B), and the post-2003 subsample Panel (C). During the time period from 2000 to 2007 we have 791 observations of M&A deals out of 1,271 that have positive short-term hedge fund ownership. In each panel, we examine two regression specifications to show the robustness of our results by including firm characteristics as controls along with year fixed effects. As expected  $\beta_1$  is positive and significant in Panels A and C while it is insignificant in Panel B. The insignificance of  $\beta_1$  in Panel B (the period pre-2003) is mostly explained by the changes in the M&A trend that occurred around 2003. As shown in Figure I, in the US, M&A activity peaked during 2000 and declined dramatically to a trough in 2002, following two years of economic recession. Specifically, the dollar value of M&A transactions in 2002 was only 25.85% of that in 2000. The resurgence in M&A deals over the 2003-2007 period

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<sup>24</sup> Larcker and Lys (1987), argue that merger arbitragers may positively affect the expected probability of an M&A's success, namely  $\beta_1 > 0$  in (1), since they typically tender their shares to the acquirer. However, on the other hand, since the target price tends to adjust upward to the announced target premium rapidly around the M&A announcement date (see for example, Schwert, 1996), short-term hedge funds may not wait until the completion of an M&A to realize their profits. This in turn may reduce the probability of deal success since these shares are not tendered directly to the acquirers. Further, anecdotally it is also believed that short term hedge funds tend to sell most of their target stock holdings right after the M&A announcement date. Indeed, our results in Panel D of Table III support this anecdotal evidence. Thus, whether the impact on deal success, i.e.,  $\beta_2$  is positive or negative is ultimately an empirical question.

has been viewed as a new wave of M&A activity (see DePamphilis, 2009). In addition, Klein and Zur (2009) show that hedge fund filings increased dramatically in 2003 and after.<sup>25</sup> Interestingly, in the post-2003 period, in addition to a higher target premium and acquirer mark up, the acquirer run up is also positive and significant.

### *B. Preannouncement Short-Selling, Put-Buying and Short-term Hedge Fund Holdings*

In this section, using multivariate regressions, we investigate the relationship between the preannouncement abnormal short-selling of the acquirer's equity, the buying of puts on the acquirer in the options market and the short-term hedge fund holdings of a target's equity. In addition to the abnormal short selling  $ABSS(-5,-1)$ , we consider the total relative short-sell size  $RELSS(-5,-1)$  which is measured as the ratio of nominal (actual) short selling to trading volume for the stock over the interval of day -5 to -1. Following Christophe, Ferri, and Angel (2004) and Poteshman (2006), we construct three regression models as follows:

$$ABS(-5,-1) = \beta_0 + \varphi_1 Holding + \varphi_2 Stock \times Holding + \beta_2 RET(-5,-1) + \beta_3 ABVOL(-5,-1) + \varepsilon \quad (2)$$

$$RELSS(-5,-1) = \gamma_0 + \varphi_1 Holding + \varphi_2 Stock \times Holding + \gamma_2 RET(-5,-1) + \gamma_3 NORMRELSS + \varepsilon \quad (3)$$

$$ABLongPut(-5,-1) = \delta_0 + \varphi_1 Holding + \varphi_2 Stock \times Holding + \delta_2 RET(-5,-1) + \delta_3 ABVOL(-5,-1) + \delta_4 ABOPTVOL(-5,-1) + \varepsilon \quad (4)$$

where  $RET(-5,-1)$  is the return on the acquirer stock on days -5 to -1,  $ABVOL(-5,-1)$  is the average daily abnormal trading volume in the acquirer stock over the interval of day -5 to -1,  $NORMRELSS$  is the ratio of shorted shares to traded shares for the acquirer's stock during the pre-announcement period which is defined outside the event window, i.e., outside of days (-63, 0), and  $ABOPTVOL(-5,-1)$  is the average daily abnormal long(short) option position in the

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<sup>25</sup> This is consistent with our results in Figure I and Table I which shows that the short-term hedge fund holdings increased dramatically after 2002. Thus, we employ a Chow test to see whether the holdings of short-term hedge funds in M&A's are similar in the sub-period before and after 2003. The Chow test confirms significant differences between the regression coefficients in the two sub-period samples.

acquirer's stock (both put and call) over the interval of days -5 to -1. As suggested by Christophe, Ferri, Angel (2004) and Poteshman (2006), the variables  $RET(-5,-1)$ ,  $ABVOL(-5,-1)$  and  $ABOPTVOL(-5,-1)$  control for the contemporaneous movement of the stock price, stock trading volume, and option trading volume respectively. The variable  $NORMRELESS$ , is a cross sectional control for each firm's typical ratio of shorted shares to traded shares during the pre-announcement period. Our analysis is focused on the size and sign of  $\varphi_2$ , the coefficient on  $Stock \times Holdings$  which is the interaction term identifying the short-term hedge fund's holdings in a stock deal.

[Insert Table VIII]

Short selling data for the acquirer is only available for the Reg-SHO period, which leaves us with a sample of 277 firms. The results from regression 1, corresponding to equation (2) in Table VIII shows that there is a significantly positive relationship between preannouncement short-term hedge fund holdings of targets and abnormal short-selling of acquirers  $ABSS(-5,-1)$  shares in stock deals ( $\varphi_2$ ) during this period. Similar results are obtained when we consider an alternative measure of abnormal short selling, i.e., the relative short selling variable  $RELESS(-5,-1)$ ; see regression 2, corresponding to equation (3) in Table VIII.

For our analysis on abnormal put option buying, during the post-2003 and Reg-SHO periods, i.e., columns 4 and 5 of Table VIII, we find a significant and positive relationship between preannouncement hedge fund stakes in stock deals and put buying of acquirers one week prior to the actual M&A announcement date ( $\varphi_2$ ) However, this result does not hold for M&A deals in the sub-period prior to 2003 (see Column 3 of Table VIII). These results provide support to our earlier univariate results that acquirers in M&A stock deals in which short-term

hedge funds hold large stakes are more likely to be short sold (or have greater put buying in the acquirer) prior to the public announcement of the deal.

### 4.3 Stage Three: Relationship between Abnormal Short Selling and Post-announcement Stock Returns

In this stage, we propose to use multivariate tests to directly investigate whether short-term hedge fund trading patterns are consistent with trading on material nonpublic information prior to the public announcement of M&A deals. One common approach in the literature (see, for example, Christophe, Ferri and Angel, 2004), is to investigate the relationship between the pre-announcement short sales and put buying and the post-announcement stock price change. We already found a relationship of these variables with short-term hedge fund holding in sub-section 4.2.2.B above. Prior to the event, if traders are able to infer the degree of the stock price reaction to the announcement of an M&A event, then it is more likely that their trading patterns may reflect the exploitation of private insider information. Accordingly, we consider the following three models:

$$ABS(-5, -1) = \beta_0 + \beta_1 RET(0, +1) + \beta_2 RET(0, +1) \times Abv.Median + \beta_3 RET(-5, -1) + \beta_4 ABVOL(-5, -1) + \varepsilon \quad (5)$$

$$RELSS(-5, -1) = \gamma_0 + \gamma_1 RET(0, +1) + \gamma_2 RET(0, +1) \times Abv.Median + \gamma_3 RET(-5, -1) + \gamma_4 NORMRELSS + \varepsilon \quad (6)$$

$$ABLongPut(-5, -1) = \delta_0 + \delta_1 RET(0, +1) + \delta_2 RET(0, +1) \times Abv.Median + \delta_3 RET(-5, -1) + \delta_4 ABVOL(-5, -1) + \delta_5 ABOPTVOL(-5, -1) + \varepsilon \quad (7)$$

where the variable  $RET(t_1, t_2)$ , is measured as the return on equity from its closing prices on day  $t_1$  to  $t_2$ . The other variables are as explained above. Our proxies for informed short selling in equity and put buying in option markets are  $RET(0, +1)$  and  $RET(0, +1)$  interacted with above-median short-term hedge fund holdings (*abv Median*), i.e.  $\beta_1$  and  $\beta_2$ . The independent variable  $RET(0, +1)$  is the acquirer's announcement two-day return, which captures any element of

surprise in the announcement of the M&A deal. Thus, a negative two-day return means that the market views the M&A announcement as a negative event, and a positive return means that the M&A announcement was viewed as a positive event. Therefore, a statistically significant and negative  $\beta_1$  means that short-selling rises prior to announcements that lead to a decrease in acquirers' stock prices. Similarly, if the coefficient  $\beta_2$  on the interaction term of  $RET(0,+1)$  and the above-median short-term hedge fund dummy were negative and significant it would be consistent with short-term hedge funds with high stakes in a target's equity *ex-ante* perceiving a negative market reaction to M&A deal announcements and accordingly increasing their short selling in the acquirer's equity.

Following Christophe, Ferri and Angel (2004), our regressions also contain two control variables. The first control variable,  $RET(-5,-1)$ , represents the movement of the stock price during the five days prior to the announcement.<sup>26</sup> The second control variable,  $ABVOL(-5,-1)$ , accounts for the potential contemporaneous correlation between abnormal short-selling and spikes in volume, and for the possibility that stocks experiencing sudden increases in volume might be easier to short.

[Insert Table IX]

We use cross-sectional OLS regressions to estimate the three models in equations (5) to (7). There are 277 acquirer firms between January 3, 2005 and July 6, 2007 with short sale data while there are 221 acquirer firms with put option data during the same period. We considered an acquirer firm to be in the low (high) short-term hedge fund holding group if short-term hedge fund holdings of a target is below (above and equal to) the median of the distribution of all

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<sup>26</sup> This variable controls for the possibility that upward or downward changes in the stock price might affect the levels of short-selling in the days leading up to the announcement. A pre-announcement increase in stock price, for example, might affect short-selling by inducing some investors to short the potentially "over-valued" stock. By using this control variable, the model does not wrongly attribute all pre-announcement short-selling to expectations regarding the M&A deal.



takeover target firms in a given year. Panels A, B and C of Table IX present our results for equations (5), (6), and (7) respectively. As can be seen from Panels A and B, there is a significant negative relationship between the two-day announcement return,  $RET(0,+1)$ , and ex-ante abnormal short-selling,  $ABSS(-5,-1)$ , in the high short-term hedge fund group as well as with the interaction between  $RET(0,+1)$  and the high short-term hedge fund group dummy. Similar results are obtained for put option buying (see Panel C), though the results are significant for the two sub-sample periods (reg-SHO and post-2003 periods). We also repeat these regressions for short-term non-hedge fund institutional investors' holdings and do not find any significant relationship between post announcement return and abnormal short-selling for the high short-term non-hedge fund institutional investor group.

In summary, our results are therefore consistent with informed short trading by short-term hedge funds especially for the high short-term hedge fund holding subsample.<sup>27</sup>

## 5. Conclusion

In this paper, we investigate hedge fund trading activities in the equity and option markets prior to the public announcement of M&A deals. Our measure of short-term hedge fund holding is based on hedge fund holdings in targets in the quarter prior to the M&A deal when the same hedge fund held a zero stake in the target firms in the four quarters preceding the M&A deal. We label these hedge funds as short-term hedge funds. We focus on these hedge funds since they seem, a priori, to be the most likely recipients of material private information regarding an impending M&A deal and thus most likely to be associated with leakages of insider information.

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<sup>27</sup> Our findings for options are also consistent with the Cao, Chen and Griffin's (2006) study which documents a strong relation between preannouncement option trading activity and takeover returns.

We find that, on average, short-term hedge funds purchased 3.2% of a target's shares in the quarter immediately prior to the public announcement of M&A deals. Importantly, these stakes were positively related to the actual takeover premium. In addition, we find that abnormal short selling for the acquirers in the stock market and put buying in the option markets pre M&A announcement, is negatively related to the acquirer stock returns following the public M&A announcement date, especially for the high-short-term hedge fund holding group. These results are consistent with informed short selling activities (see for example, Christophe, Ferri, and Angel (2004)).

Overall, our results are consistent with the view that short-term hedge funds are able to obtain material non-public information concerning takeover deals prior to the actual public announcement of such deals. These findings raise important policy concerns with respect to hedge fund regulation especially regarding their trading activities around M&A deals.

## Appendix A

In this Appendix we provide detailed descriptions of how we identify long holdings by hedge funds in M&A transactions. We first identify hedge funds and hedge fund advisors by constructing a comprehensive database of hedge funds by combining seven databases used in the prior literature: 1) the TASS Hedge Funds Database (TASS), 2) Hedge Fund Research database (HFR), 3) Center for International Securities and Derivatives Markets database (CISDM), 4) *Nelson's Directory of Investment Managers* 2004 to 2006, 5) *Institutional Investor* magazine's annual Hedge Fund 100 List 2003 to 2007, 6) the database of Cottier, and 7) the Private Equity Information hedge fund database (which collects hedge fund data from the SEC's ADV forms). Each of the seven listed sources reports hedge fund and/or their advisors' names. We identify and remove duplicate hedge funds by manually checking their names and addresses. Specifically, we preserve the information from the Securities and Exchange Commission's (SEC's) Form ADV filings when the filing observations are duplicated by those from one or more of the other six sources.

Many hedge fund managing firms, especially large ones, have more than one functional area. According to *Institutional Investor* top 100 hedge fund list 2007, for example, J.P. Morgan Asset Management is ranked as the largest hedge fund firm. However, the company also manages different investment arms other than hedge funds, such as fixed income, currency, real estate, infrastructure, and private equity, etc. Therefore it is particularly difficult to define hedge funds at fund advisory level. During our sample period, investment advisers managing assets of \$25 million or more were generally required to register with the SEC and to file ADV forms

until the registration requirements were overturned by the courts in June 2006.<sup>28</sup> Using the information on the ADV forms and following Griffin and Xu (2007) and Huang (2008), we apply the following criteria to observations from ADV forms to define a hedge fund advisor: the company charges performance-based fees and at least 50% of its clients are either “high net worth individuals” or at least 50% of its clients are in “Other pooled investment vehicles (e.g., hedge funds)”. After excluding duplicates and hedge fund firms that do not meet these criteria, we end up with a comprehensive hedge fund sample comprising 9,525 unique hedge fund advisory firm names. It is important to note that our sample does not focus on the particular subset of hedge funds that file form ADV, since many hedge funds, particularly those that are non-U.S. domiciled did not file form ADV and many were exempt from the requirements. We simply use this form to “clean” our hedge fund data from the other sources since many of the management firms identified in TASS, HFR, or CISDM as hedge funds also have substantial operations that are not related to hedge fund activities. Thus, this issue could not be totally resolved, since the Form ADV sample does not comprise the universe of hedge funds and therefore the other six hedge fund databases may still contain hedge fund management companies with multiple functional areas, implying that we fail to remove certain management firms of investment companies from our sample with only a small hedge fund department. The presence of this random error in the data therefore would only bias against us finding significant results.

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<sup>28</sup> See, Brown, Goetzman, Liang and Schwarz (2008) who provide a detailed analysis on the benefits and drawbacks of mandatory disclosure as a regulatory tool, arising due to this controversial SEC policy requiring hedge funds to register. Overall, their findings suggest that hedge funds operated by managers who filed Form ADV had better past performance and had more assets than those operated by managers who did not file. Moreover, they find a strong positive association between potential conflicts identified in the Form ADV filing and past legal and regulatory problems.

We then collect information of the hedge funds' holding position from three types of SEC ownership disclosure filings. Currently there are five forms for large shareholders in SEC's filing universe: active beneficial ownership on Schedule 13D, passive beneficial ownership on Schedule 13G, quarterly institutional holding on Form 13F, quarterly mutual funds holdings on Forms N-1A, N-CSR, and N-Q, and insiders (directors, officers, and other 5% shareholders) under the Securities Exchange Act of 1934, § 16(b).<sup>29</sup> Since hedge funds are not under mutual fund regulations and 5% share holders must also report either 13G or 13D, a combination of Form 13F and Schedule 13D and 13G provides a nearly complete universe of SEC ownership filings for the hedge fund industry.

While, the previous literature has commonly used CDA/Spectrum data to identify equity holdings, one drawback of this approach is that only the name of the reporting entity, usually the ultimate parent company, is provided in CDA/Spectrum. This is problematic since some hedge funds report their holding jointly with its parents. By using CDA/Spectrum therefore, we will miss the holdings of such hedge funds in the 13F filings, when the parent firm is not a hedge fund.<sup>30</sup> Thus, in order to retrieve the name and precise ownership information for all hedge funds in our sample, we collect 171,806 original Form 13F files from SEC's Edgar database from 1999 to 2007 for 4,674 reporting entities along with the jointly reporting managers.

In addition, we also collect data on the ownership stake of beneficial owners, i.e., those owning more than 5% shares of a company. These beneficial owners need to file with the SEC a statement containing information that identifies their precise equity holdings. The passive

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<sup>29</sup> All institutions with greater than \$100 million of equity securities under discretionary management shall disclose their common stock positions greater than 10,000 shares or \$200,000 at the end of each quarter in their Form 13F filing.

<sup>30</sup> For example, the original Form 13F filing of Citigroup in Dec 31st, 2007 reports 45 financial manager names, including its alternative investment funds (which are the hedge funds), while CDA/Spectrum only reports the name of reporting managers' name, Citigroup Inc, for the same quarter.

beneficial owners that are merely investing in the ordinary course of their business file a Schedule 13G usually within 45 days after the end of the calendar year in which they exceed this ownership threshold.<sup>31</sup> On the other hand, the active beneficial owners, need to report Schedule 13D within 10 days of acquiring their stakes. To collect the detail data in Schedule 13D/13G, we collect all publicly available SC13G (391,368 forms) and SC13D (141,079 forms) from SEC for 16,045 and 18,732 reporting entities respectively from 1999 to 2007.

Consistent with the recent 13D literature (e.g. Greenwood and Schoar, 2009; Clifford, 2009), we remove all Schedule 13D/A records that do not document any acquisition or change in ownership position but attach only a letter of intent or statement amendment to an issuer's management team and board members. To focus solely on the institutional investors, we further remove Schedule 13D for non-institutional investors, such as directors and officers; if the reporting entities never report Form 13F nor SC 13G as exempted institutional investors; if the SIC Code of the reporting entity does not belong between 6000 and 6999, (the SIC code of money management industry); and if the name of the entity does not match with those in our

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<sup>31</sup> According to Securities Exchange Act of 1934 Rule 13d-1 & 13d-2, any active beneficial owners, who hold more than 5% of any equity security with purpose or with the effect of changing or influencing corporate control, shall file with SEC a Schedule 13D within 10 days after the acquisition. The active beneficial owners shall also file with SEC Schedule 13D amendment promptly, when they change their position of beneficial ownership of securities in an amount equal to 1% or more of the class of securities. The passive beneficial owners who has acquired more than 5% of such securities in the ordinary course of his business and will not involve in corporate decision in any form shall file with SEC a Schedule 13G. If the passive beneficial owners are qualified financial institutions such as most brokers, banks, and insurance companies, they are required to report within 45 days after the end of the calendar year in which they obtained beneficial ownership. For this group of passive beneficial owners, they shall file a Schedule 13D amendment within 10 days after the end of the first month in which the reporting entity's direct or indirect beneficial ownership exceeds 10% of the class of equity securities. If the passive beneficial owners are not exempted institutions, then need to file with SEC within 10 days after an acquisition. The non-exempted group of beneficial owners also shall file with the SEC Schedule 13G amendments promptly when they increase or decrease their beneficial ownership by more than 5% of the class of equity securities; as well as a Schedule 13D promptly when they hold greater than 10% of a class of equity securities. Under the Rule 13d, hedge funds are, therefore, mostly likely to file with the SEC Schedule 13D and 13G as non-exempted investors (13D Rule C).

hedge fund database.<sup>32</sup> Finally, we remove Schedule 13D filings for tender offers and entries where Schedule 13D is also reported as a third party tender offer statement, Form SC TO-T.

Finally, we integrate ownership data from three different SEC filings into one dataset. Since Schedule 13D/13G forms are filed only when the 5% threshold is breached, our data is organized quarterly by the reporting nature of Form 13F. Form 13F provides a snapshot of ownership positions at the end of each quarter. Therefore, relying on Form 13F alone would reduce the magnitude of observed trading activity in target stocks.<sup>33</sup> Including Schedule 13D and 13G, therefore, provides us with an additional source to measure the amount and timing of potentially large trading activities in target firms more accurately.

We define the quarter before the announcement as well as the days in the actual announcement quarter prior to the announcement day as quarter (-1), the days after the announcement day in the announcement quarter as quarter (0), and the remaining quarters as following the calendar quarters relative to announcement. We then take the maximum amount of hedge fund holdings from Form 13F, Schedule 13G (SC13G) and 13D (SC13D) in each quarter as the ownership of institutional investors holdings in that quarter. Since most reporting entities are ultimate parents of other members in the cases of joint SC13D/G or 13F combination filings,

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<sup>32</sup> We also manually checked the most frequently observed activists and risk arbitrageurs that are not covered in our hedge fund database. We use “Hedge Fund” as keyword along with the reporting entity’s name to search in Lexis/Nexis, Bloomberg, and Businessweek. We consider the individuals as hedge funds, if they are well-known hedge fund general partner, such as Roth Michael, and keep the hedge funds that report a similar but not exactly the same name in our hedge fund database, such as Ziff Asset Management LLP.

<sup>33</sup> For example, on April 20, 2006, Sprint Nextel announced a proposal to acquire Ubiquitel for more than \$1.3 billion in cash and debt. Deephaven Capital Management LLP, a hedge fund advisor, which had reported a 2.05% and 2.63% ownership position in the target in its 13Fs filed in the two quarters prior to announcement, disclosed a 9.98% beneficial ownership position exactly on the M&A announcement date in its Schedule 13G filing. Further, on May 11, 2006, the same hedge fund filed a Schedule 13D disclosing its 18.0% beneficial ownership stake in the target. During the M&A negotiation process, Deephaven got actively involved in the Sprint Nextel M&A decision, proposing, for example, a slate of nominees to the board of directors. However, when the acquisition agreement was reached on Jun 27, 2006, Deephaven did not report any ownership in Sprint Nextel in its Jun 30, 2006 Form 13F filing.

we consider the aggregated amount of such filings as a hedge fund's holding, if the reporting entities' names are found in our hedge fund database. When the filing entity is not identified, but some of the jointly reporting entities are identified as hedge funds, we treat the holding positions in Schedule 13D/G and Form 13F according to the nature of their filing requirements. We consider the aggregated positions as hedge fund positions if the reporting entities jointly report beneficial ownership (Schedule 13D/G) with hedge funds.<sup>34</sup> For the cases, in which the hedge funds report their investment holdings (13F combination reporting) with non-hedge funds, we separate the hedge funds' positions from other non-hedge fund ownership.<sup>35</sup> Importantly, our results are also robust to alternate ways of measuring institutional holdings in the prior literature.<sup>36</sup>

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<sup>34</sup> This is consistent with the beneficial ownership disclosure requirement of the SEC. The SEC defines a beneficial owner as one or a group of investors holding directly or indirectly more than 5% of a firm. A member of joint filing is required to understand that such statement is filed on behalf of all such persons.

<sup>35</sup> Different from beneficial ownership filing, a 13F combination reporting is less likely to be considered by the SEC as an investment filing to be behalf of all members in a group. According to the SEC, only part of the securities with respect to which a money manager has investment discretion is reported by the reporting entity in a combination reporting.

<sup>36</sup> The maximum amount is going to be different from Form 13F holding when an institutional investor with a significant amount of ownership reduces the position before the end of the quarter. The maximum holding amount, therefore, offers us a better understanding for the ownership position truly held by hedge funds around M&A events. In an unreported table, for example, we compare our data with that of 13F. We find that while the quarterly differences in mean and median institutional holding between our database and CDA/Spectrum 13F for acquirers are not significant, the differences are significant for the target firms in each of the three quarters prior to public announcement of the M&A deal.

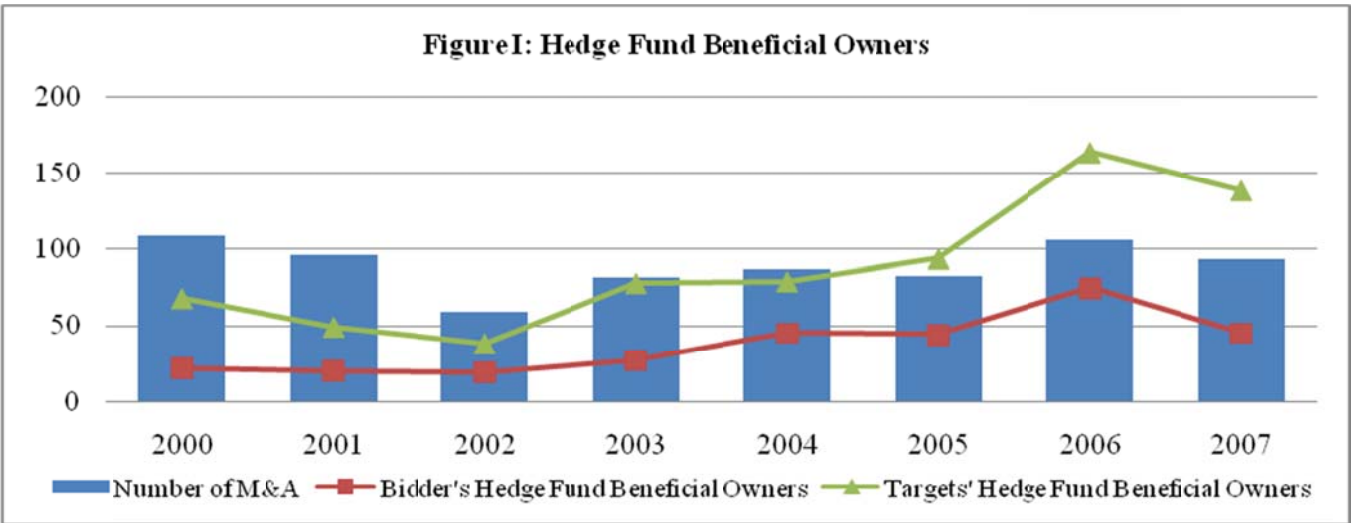


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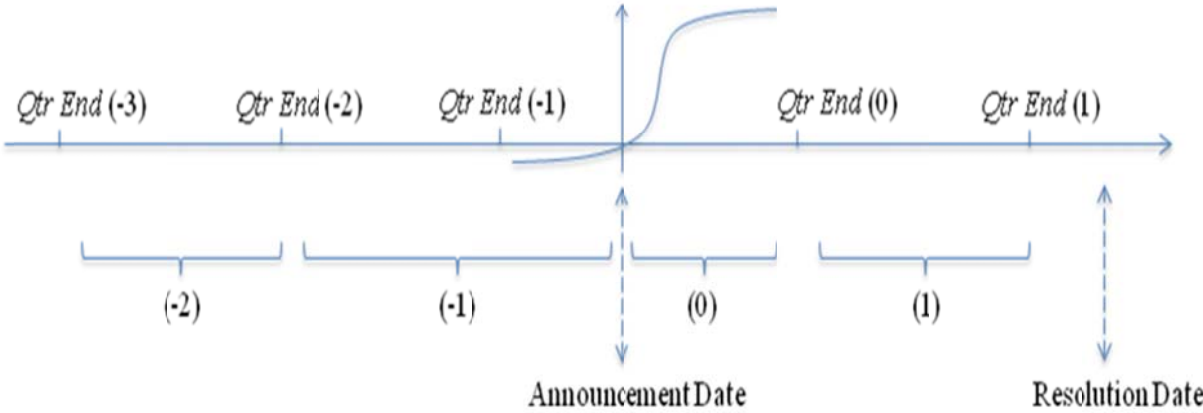
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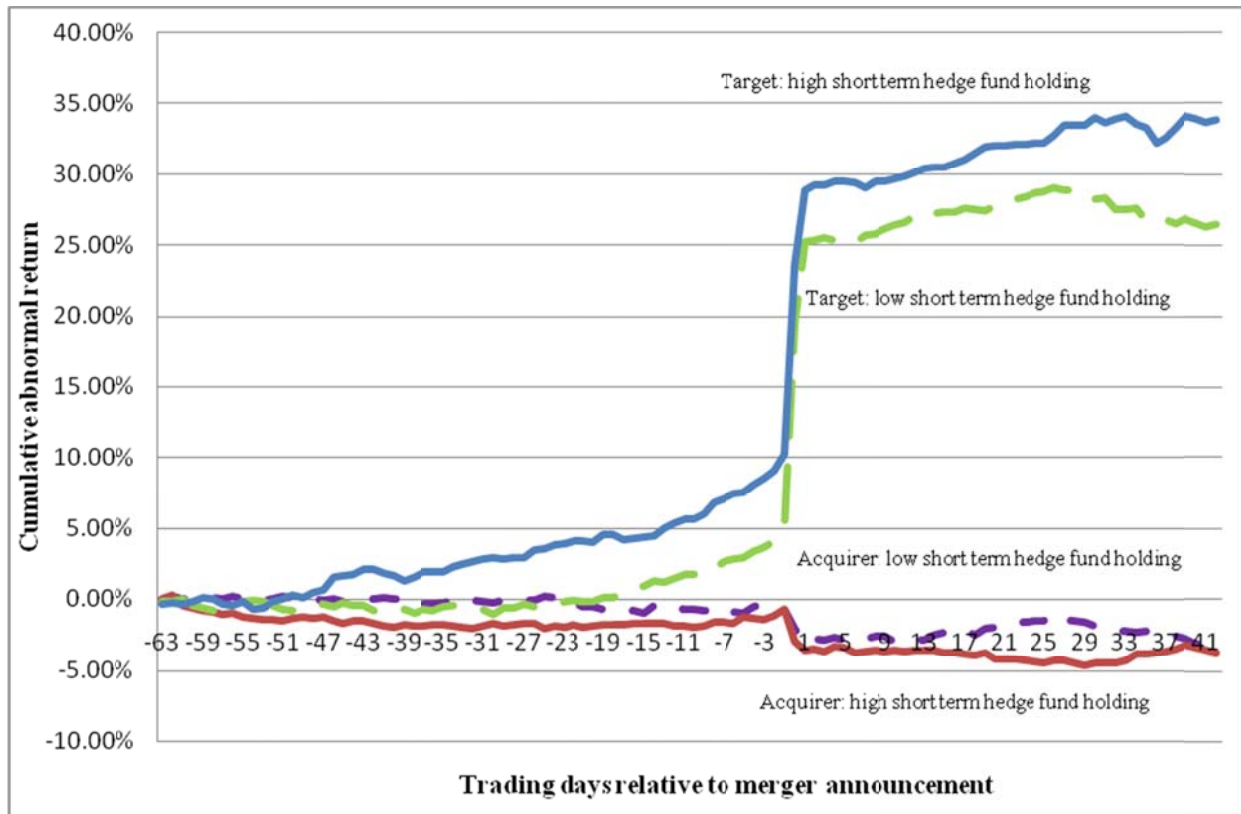
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**Figure II: Definition of Quarters Relative to the Announcement**



**Figure III: Cumulative abnormal return around acquisition announcement: Firms with high short-term hedge fund holdings versus firms with low short-term holdings**

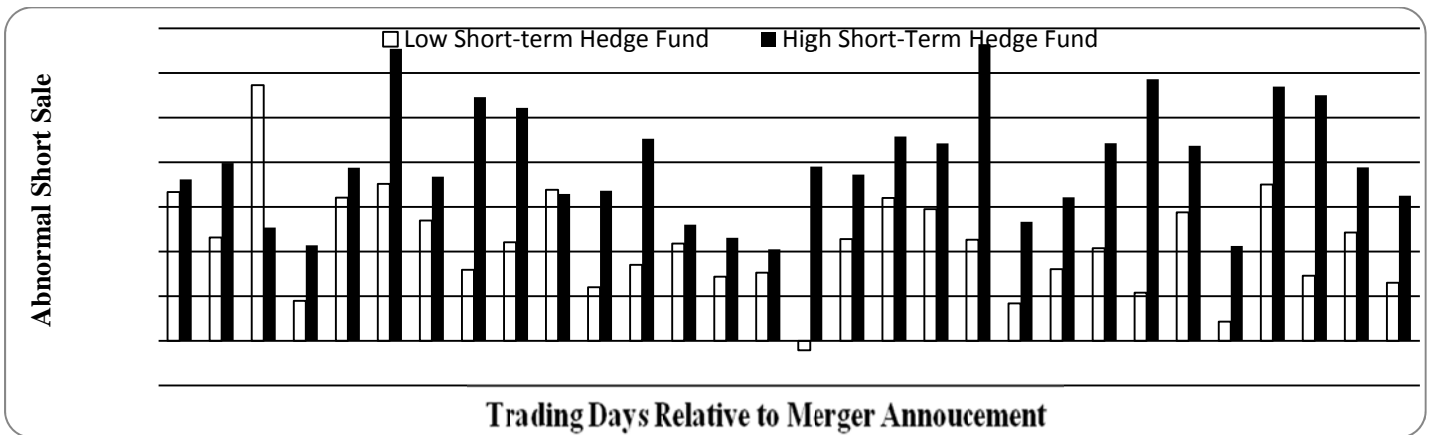


Cumulative abnormal returns for target and acquirer firms are measured by Fama-French four-factor model (including momentum) using 255 trading day prior to -42 before the announcement date. According to their short-term hedge fund holdings, we separate our data into three groups in a given year. A target (acquirer) is considered in high short-term hedge fund holding group if its short-term hedge fund holdings are in the top group of the distribution of all takeover target (acquirer) firms in a given year. Inversely, a target (acquirer) is considered in low short-term hedge fund holding group if its short-term hedge fund holdings is in the bottom group of the distribution of all takeover target (acquirer) firms in a given year.

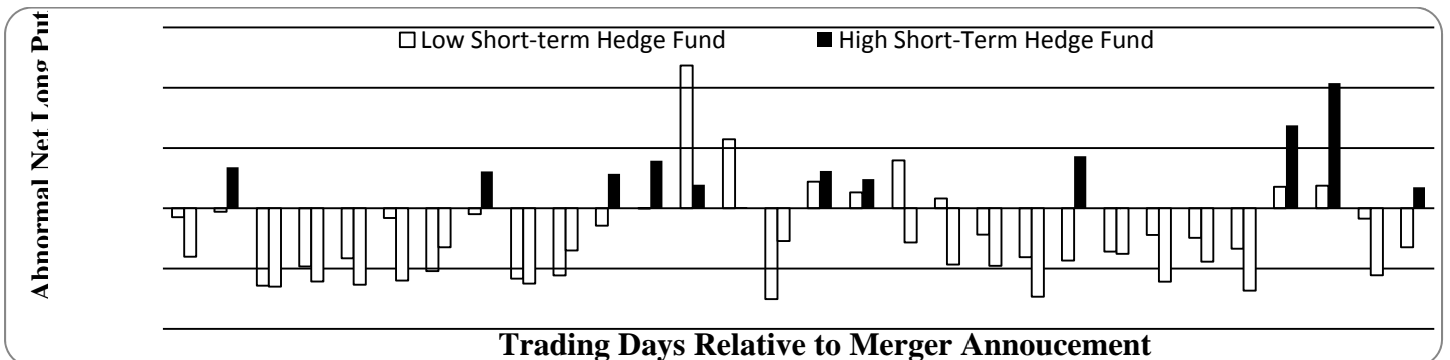
**Figure IV: Acquirer Abnormal Short Selling and Net Long Put Option volume in stock Acquisitions: Firms with high short-term hedge fund holdings versus firms with low short-term holdings**

The daily abnormal short is measured as the ratio between the difference in short sale in a given day and the average short sale outside the event window (-63, 42) scaled by the average short sale outside the event window (-63, 42). The daily abnormal put option buying is measured similar to that in Poteshman (2006). Based on their short-term hedge fund holdings in target, we separate our data into three groups in a given year. An acquirer is considered in high short-term hedge fund holding group if the short-term hedge fund holdings of its target is in the top group of the distribution of all takeover target (acquirer) firms in given year. Inversely, an acquirer is considered in low short-term hedge fund holding group if the short-term hedge fund holdings of its target in the bottom group of the distribution of all takeover target (acquirer) firms in given year.

**Panel A:**



**Panel B:**



**Table I: The Number of 13D/G Filing Activities of M&A Firms across Sample Period**

This Table reports the number of beneficial ownership filings for our final sample of hedge funds and other institutional investors who report Schedule 13D and 13G filings as non-exempted institutional investors (13G(C)) for the M&A firms. Non-exempted owners are the hedge funds or other non-hedge fund institutional investors who file a Form 13D and/or 13G(C) for an M&A company in four quarters before and two quarters after public announcement, while activist owners are the hedge funds or other non-hedge fund institutional investors who file a Form 13D for an M&A company during the period four quarters before and two quarters after the public announcement of the deal. Panel A (B) summarizes the number of activists and non-exempted owner of M&A acquirer (target) firms in each of sample year.

Year	Number of M&A Transactions	Hedge Fund Activist Owners	Other Institutional Activist Owners	Hedge Fund Non-Exempted Owners	Other Institutional Non-Exempted Owners
<i>Panel A: M&amp;A Acquirer</i>					
2000	109	8	36	22	54
2001	96	7	33	20	56
2002	59	4	19	19	32
2003	82	15	17	27	31
2004	87	18	19	45	38
2005	83	15	16	44	28
2006	106	15	16	75	32
2007	94	13	19	45	34
Total	716	95	175	297	305
<i>Panel B: M&amp;A Target</i>					
2000	109	40	40	68	45
2001	96	32	35	49	49
2002	59	17	19	38	26
2003	82	45	22	78	42
2004	87	37	40	79	59
2005	83	32	19	94	37
2006	106	61	26	164	52
2007	94	58	31	139	51
Total	716	322	232	709	361

**TABLE II: Hedge Fund and Non-Hedge Fund Institutional Investor Ownership in Targets**

We report the descriptive statistics for ownership of target shares by all hedge funds and other non-hedge fund institutional investors surrounding M&A from 4 quarters before to 2 quarters after the public announcement. The institutional ownership of an M&A firm in each quarter is calculated by aggregating maximum holding from three types of SEC filings, Form 13F, and Schedule 13D/G. We test the difference between the subgroup of ownership in means and medians using the two-sided *t*-test and the Wilcoxon rank sum test. (\*\*\*) (\*\* and \*) indicate significance at 1%, 5%, and 10% levels, respectively. Panels A, B, and C report the descriptive statistics for full, completed and withdrawn deals, respectively. Change percentages are measured by the mean (median) of aggregated holdings.

	Hedge Fund	Other Investors	Difference		Hedge Fund	Other Investors	Difference
	Aggregated Holdings				Change Percentage Based on Quarter (-4)		
<i>Panel A – Full Sample</i>							
Qtr(-4)	11.28%	31.19%	19.91%	***			
	[7.39%]	[24.01%]	[16.62%]	***			
Qtr(-3)	12.09%	32.63%	20.54%	***	7.21%	4.62%	2.59%
	[7.91%]	[26.49%]	[18.58%]	***	[7.02%]	[10.35%]	[-3.33%]
Qtr(-2)	13.48%	35.08%	21.60%	***	19.47%	12.46%	7.01%
	[10.29%]	[29.89%]	[19.60%]	***	[39.22%]	[24.50%]	[14.72%]
Qtr(-1)	15.55%	36.93%	21.38%	***	37.88%	18.41%	19.47%
	[11.49%]	[31.71%]	[20.22%]	***	[55.50%]	[32.09%]	[23.41%]
Qtr(0)	18.89%	26.35%	7.46%	***	67.44%	-15.53%	82.98%
	[14.25%]	[22.14%]	[7.88%]	***	[92.84%]	[-7.80%]	[100.64%]
Qtr(1)	10.27%	12.35%	2.09%	***	-8.97%	-60.39%	51.42%
	[1.08%]	[0.58%]	[-0.50%]		[-85.38%]	[-97.59%]	[12.22%]
Obs.	1122	1122			1122	1122	
<i>Panel B – Completed Deals</i>							
Qtr(-4)	11.12%	30.57%	19.44%	***			
	[7.32%]	[23.31%]	[15.99%]	***			
Qtr(-3)	11.95%	32.05%	20.11%	***	7.44%	4.87%	2.57%
	[7.75%]	[25.87%]	[18.12%]	***	[5.98%]	[11.01%]	[-5.03%]
Qtr(-2)	13.24%	34.45%	21.21%	***	19.07%	12.71%	6.36%
	[10.07%]	[29.19%]	[19.12%]	***	[37.66%]	[25.24%]	[12.42%]
Qtr(-1)	15.32%	36.31%	21.00%	***	37.73%	18.80%	18.92%
	[11.32%]	[31.01%]	[19.69%]	***	[54.69%]	[33.05%]	[21.64%]
Qtr(0)	18.54%	25.29%	6.75%	***	66.73%	-17.27%	83.99%
	[13.92%]	[20.74%]	[6.82%]	***	[90.27%]	[-11.00%]	[101.27%]
Qtr(1)	8.90%	10.07%	1.17%	***	-19.97%	-67.05%	47.08%
	[0.07%]	[0.01%]	[-0.06%]		[-99.00%]	[-99.95%]	[0.95%]
Obs.	1005	1005			1005	1005	
<i>Panel C – Withdrawn Deals</i>							
Qtr(-4)	12.64%	36.56%	23.92%	***			
	[9.15%]	[32.42%]	[23.27%]	***			
Qtr(-3)	13.32%	37.60%	24.27%	***	5.42%	2.84%	2.58%
	[9.16%]	[36.38%]	[27.22%]	***	[0.17%]	[12.22%]	[-12.04%]
Qtr(-2)	15.48%	40.48%	25.00%	***	22.49%	10.71%	11.78%
	[12.32%]	[39.39%]	[27.08%]	***	[34.65%]	[21.50%]	[13.15%]
Qtr(-1)	17.57%	42.25%	24.68%	***	39.02%	15.57%	23.45%
	[13.82%]	[39.32%]	[25.50%]	***	[51.08%]	[21.29%]	[29.79%]
Qtr(0)	21.84%	35.43%	13.59%	***	72.85%	-3.09%	75.93%
	[18.13%]	[32.34%]	[14.21%]	***	[98.17%]	[-0.26%]	[98.43%]
Qtr(1)	22.02%	31.97%	9.95%	***	74.20%	-12.56%	86.77%
	[18.17%]	[29.55%]	[11.38%]	***	[98.61%]	[-8.86%]	[107.47%]
Obs.	117	117			117	117	



### TABLE III: Short-term Hedge Fund Ownership in Target Firms after Propensity Score Matching

This Table reports the characteristics of firms during the sample period from 2000 to 2007 that are propensity score matched to targets with short term hedge fund holdings. We conduct propensity score matching (PSM) based on the logistic regression of the probability of becoming a target using model (3) in Panel (A) within a nearest neighbourhood of 0.1 caliper. After PSM, we have 1094 observations in each of the treatment (actual target) and the matched sample (potential target) after removing M&As without either completion or withdrawal dates. Panel (B) summarizes the actual and potential target companies' characteristics. Panels (C) and (D) report the difference between the hedge fund holdings in the treatment and matched firms, with Panel C reporting both long and short-term and Panel D reporting only short-term hedge fund holdings. *Market capitalization* is defined as  $\log(1 + \text{price} \times \text{number of shares outstanding})$  using the closing price 46 trading days prior to announcement. *Return on Equity* (ROE) is the ratio of earnings to average equity, defined as  $(\text{COMPUSTAT items data20}/(\text{data60} + \text{data60}(t - 1))/2)$ . *Market to Book* (M/B) is the market-to-book ratio, defined as  $(\text{COMPUSTAT items 9}/60)$ . *Growth of sales* (Growth) is the log of current annual sales scaled by previous year sales, defined as  $(\log(1 + \text{COMPUSTAT items data12}/\text{data12}(t - 1)))$ . *Accounting liquidity* (Liquidity) is the ratio of net liquid assets to total assets, defined as  $(\text{COMPUSTAT items } (\text{data4} - \text{data5})/\text{data6})$ . *Price to Earnings* (P/E) is the ratio of the year-end stock price to earnings per share, defined as  $(\text{COMPUSTAT items data24}/\text{data58})$ . *Debt to Equity* (D/E) is the ratio of debt to equity, defined as  $(\text{COMPUSTAT items data9}/\text{data60})$ . *Herfindahl-Hirschman index* (HHI) is calculated using industry sales data (COMPUSTAT item data12). Market Liquidity (*Amihud*) is the Amihud (2002) illiquidity measure, defined as the average (using daily data) of  $1000 \sqrt{|\text{Return}| / (\text{Dollar Trading Volume})}$  half year prior to the end of the previous year.

	Panel(A): Probability of Becoming a Target						Panel(B): Propensity score matching					
	Model (1)		Model(2)		Model(3)		Treatment		Match		Difference	
	Est.	t-stat.	Est.	t-stat.	Est.	t-stat.	Mean	Std.	Mean	Std.	Mean	Std.
<b>Institutional Holding</b>	0.95	2.60 ***	1.20	7.30 ***	1.25	7.56 ***	42.77%	30.56%	42.30%	30.68%	0.46%	23.43%
<b>Market Capitalization</b>	-0.10	-4.68 ***	-0.09	-4.11 ***	-0.09	-4.36 ***	19.29	1.80	19.21	1.90	0.08	2.24
<b>Return on Equity (ROE)</b>	0.11	0.58	0.10	0.79	0.09	0.80	0.03	0.35	0.02	0.45	0.02	0.45
<b>Sale Growth</b>	0.07	2.10 **	0.07	3.40 ***	0.08	3.55 ***	0.55	1.21	0.52	1.26	0.03	1.49
<b>Accounting Liquidity</b>	0.62	2.99 ***	0.61	4.82 ***	0.61	4.94 ***	0.27	0.23	0.27	0.23	0.00	0.24
<b>Debt to equity ratio (D/E)</b>	0.06	1.61	0.06	3.19 ***	0.05	2.68 ***	0.82	1.49	0.86	1.63	-0.04	1.94
<b>Market to Book Ratio (M/B)</b>	-0.04	-0.52	-0.13	-1.97 **	-0.11	-1.78 *	1.18	0.56	1.19	0.59	-0.01	0.71
<b>Price-Earnings ratio (P/E)</b>	0.00	-0.24	0.00	-0.64	0.00	-0.53	12.31	47.30	9.29	40.95	3.01	62.19
<b>Herfindahl on Sale</b>	-1.89	-3.46 ***	-1.23	-2.47 **	-1.28	-2.51 **	0.18	0.16	0.17	0.15	0.00	0.16
<b>Buy-and-Hold</b>	-0.02	-0.51	0.01	0.80	0.00	-0.08	-0.01	0.70	-0.05	0.80	0.04	0.97
<b>Amihud Illiquidity</b>	-0.18	-2.82 ***	-0.21	-3.86 ***	-0.20	-3.64 ***	0.44	0.67	0.47	0.74	-0.03	0.75
<b>Year</b>	Yes			Yes								
<b>Industry</b>			Yes		Yes							
<b>Pseudo R-Square</b>	0.042		0.055		0.073							
<b>Number of Cases</b>	59128		59044		59044		1094		1094		1094	

Quarters Relative to M&A Announcement	Panel(C): Hedge fund holding in Target						Panel(D): Short-term hedge fund holding in Target					
	Treatment		Match		Difference		Treatment		Match		Deference	
	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.	Mean	Std.
<i>qtr(-4)</i>	12.36%	13.49%	10.35%	10.71%	2.78%	13.74% ***						
<i>qtr(-3)</i>	12.82%	13.11%	11.03%	11.17%	2.29%	13.40% ***						
<i>qtr(-2)</i>	13.67%	13.02%	11.55%	11.60%	2.78%	13.64% ***						
<i>qtr(-1)</i>	15.77%	16.01%	12.01%	12.20%	4.37%	16.52% ***	3.19%	6.82%	1.74%	3.80%	1.41%	7.48% ***
<i>qtr(0)</i>	19.43%	17.09%	12.23%	12.04%	7.89%	16.18% ***	1.65%	3.74%	1.19%	2.65%	0.47%	4.48% ***
<i>qtr(1)</i>	13.92%	17.28%	12.28%	12.58%	1.62%	19.60% **	1.06%	3.00%	1.01%	2.58%	0.01%	3.83%
<i>Obs.</i>	1094						927					

**TABLE IV: Summary Statistics of Deal Characteristics by Short-Term Hedge Fund and Non-Hedge Fund Holdings**

This Table reports deal characteristics by short-term hedge fund and non-hedge fund holdings. A short-term investor in a takeover is a financial organization or individual who does not maintain a long-term relationship but establishes the long position of target in an M&A shortly before the public announcement. We divide the short-term investors into hedge fund or non-hedge fund category, depending on whether their names are in our hedge fund database. *Target Premium* is constructed as the Fama-French four-factor (including momentum) compounded cumulative abnormal return on the target's stock from three months (63 trading day) before the bid announcement to two months (42 trading day) after the deal announcement or resolution date, whichever comes first. *Acquirer Run-up return* is defined as the Fama-French four-factor compounded cumulative abnormal return of acquirer in the previous month (21 trading day) to public announcement. *Acquirer Mark-up return* is defined as the Fama & French four-factor compounded cumulative abnormal return of acquirer in the two months (42 trading day) after the public announcement. *Risk arbitrageurs return* is constructed by following Hsieh, and Walkling (2005). The arbitrageur

return of cash deal is defined as  $R_t = \left( \frac{P_{i,t}^T + D_{i,t}^T}{P_{i,t-1}^T} - 1 - r_{f,t} \right)$  where superscript  $T$  stands for target. The arbitrageur return of stock deal is defined as  $R_t = \left[ \left( \frac{P_{i,t}^T + D_{i,t}^T}{P_{i,t-1}^T} - 1 - r_{f,t} \right) - \delta \left( \frac{P_{i,t-1}^A}{P_{i,t-1}^T} \right) \left[ \left( \frac{P_{i,t}^A + D_{i,t}^A}{P_{i,t-1}^A} - 1 - r_{f,t} \right) \right] \right]$ , where superscript  $A$  stands for acquirer,  $\delta$  is the hedge ratio, and  $r_f$  is the risk free rate. An acquirer's Abnormal short selling during 10 or 5 trading days prior to the M&A announcement, is measured based on the approach proposed by Christophe, Ferri, and Angel (2004). The *Abnormal put option buying* is defined similar to that in Poteshman (2006). *Duration* is measured by the calendar days between the announcement date and deal effective or withdrawal date. Our approach in measuring acquirer's Abnormal short selling prior to the M&A announcement is also similar to that in Christophe Ferri and Angel (2004). We test the difference between the subgroup in means and medians using the two-sided t-test and the Wilcoxon rank sum test. (\*\*\*) (\*\* and \*) indicate significance at 1%, 5%, and 10% levels, respectively.

	Split of Median of Short-term Investors									
	Hedge Funds				None Hedge Funds					
	All	< Median	≥ Median	Difference	All	< Median	≥ Median	Difference		
	(1)	(2)	(3)	(3)-(2)	(4)	(5)	(6)	(6)-(5)		
Mean	Mean	Mean	Mean	Mean	Mean	Mean	Mean			
[Median]	[Median]	[Median]	[Median]	[Median]	[Median]	[Median]	[Median]			
<i>Panel A: All M&amp;A in Regulation SHO Period</i>										
Target Premium (-63, 42)	25.73%	20.09%	31.37%	11.29%	***	25.96%	25.33%	26.59%	1.25%	
	[23.47%]	[19.96%]	[26.57%]	[6.60%]	***	[23.17%]	[21.98%]	[23.54%]	[1.56%]	
Target Run Up (-63, -1)	4.91%	2.28%	7.53%	5.25%	**	4.82%	4.78%	4.86%	0.08%	
	[3.71%]	[2.82%]	[4.80%]	[1.98%]	**	[3.59%]	[2.73%]	[4.47%]	[1.75%]	
Acquirer Run Up (-22, -1)	0.08%	-0.50%	0.66%	1.16%		-0.04%	-0.09%	0.01%	0.10%	
	[-0.79%]	[-0.71%]	[-0.90%]	[-0.20%]		[-0.86%]	[-0.97%]	[-0.78%]	[0.18%]	
Acquirer Mark Up (0, 42)	-2.70%	-3.07%	-2.33%	0.74%		-2.33%	-2.04%	-2.62%	-0.58%	
	[-2.95%]	[-2.97%]	[-2.78%]	[0.19%]		[-2.75%]	[-2.99%]	[-2.00%]	[0.99%]	
Risk Arbitrage Return (1, 42)	22.66%	21.95%	23.35%	1.41%		22.51%	22.95%	22.09%	-0.86%	
	[20.64%]	[20.63%]	[21.16%]	[0.53%]		[20.64%]	[20.72%]	[20.10%]	[-0.62%]	
Duration	128.22	134.76	121.69	-13.07		128.05	134.85	121.28	-13.57	
	[109.00]	[114.00]	[101.50]	[-12.50]	**	[113.00]	[124.50]	[100.00]	[-24.50]	***
Deal status (success rate)	87.85%	92.36%	83.33%	-9.03%	**	87.70%	89.87%	85.53%	-4.34%	
	[100%]	[100%]	[100%]	[0.00%]	***	[100%]	[100%]	[100%]	[0.00%]	
Abnormal Short Sale (-5, -1)	40.17%	38.65%	41.68%	3.03%		43.83%	39.23%	48.49%	9.25%	
	[6.66%]	[0.32%]	[8.74%]	[8.42%]		[7.43%]	[4.83%]	[10.18%]	[5.35%]	
Abnormal Short Sale (-10, -1)	39.34%	37.27%	41.40%	4.13%		41.84%	38.00%	45.73%	7.73%	
	[12.25%]	[8.53%]	[17.54%]	[9.01%]		[12.92%]	[12.92%]	[13.60%]	[0.68%]	
Abnormal Put Buying (-5, -1)	0.32%	5.09%	-4.11%	-9.20%		-0.16%	-0.34%	-0.01%	0.33%	
	[5.04%]	[4.89%]	[5.13%]	[0.24%]		[4.90%]	[5.13%]	[4.55%]	[-0.57%]	
Abnormal Put Buying (-10, -1)	2.48%	7.97%	-2.63%	-10.59%		2.22%	4.92%	-0.06%	-4.97%	
	[3.80%]	[7.21%]	[-0.14%]	[-7.35%]	*	[3.80%]	[3.41%]	[4.16%]	[0.76%]	
<i>Panel B: All Stock Payment M&amp;A in Regulation SHO Period</i>										
Target Premium (-63, 42)	23.75%	10.78%	36.38%	25.60%	***	23.61%	18.88%	28.35%	9.47%	
	[19.82%]	[13.07%]	[28.24%]	[15.18%]	***	[17.02%]	[14.65%]	[22.32%]	[7.67%]	
Target Run Up (-63, -1)	3.82%	-0.89%	8.40%	9.29%		4.75%	3.16%	6.34%	3.18%	
	[3.44%]	[3.82%]	[2.89%]	[-0.94%]		[3.95%]	[3.45%]	[6.18%]	[2.73%]	
Acquirer Run Up (-22, -1)	1.35%	2.78%	-0.05%	-2.83%		1.05%	0.15%	1.96%	1.81%	
	[0.42%]	[1.46%]	[-1.60%]	[-3.06%]	**	[0.24%]	[-1.10%]	[1.90%]	[3.01%]	*
Acquirer Mark Up (0, 42)	-5.08%	-9.48%	-0.79%	8.69%	**	-4.41%	-5.25%	-3.57%	1.68%	
	[-3.94%]	[-7.04%]	[-0.11%]	[6.93%]	***	[-3.96%]	[-4.57%]	[-2.64%]	[1.93%]	
Risk Arbitrage Return (1, 42)	20.93%	18.67%	23.19%	4.51%		19.06%	18.40%	19.73%	1.33%	
	[21.66%]	[21.37%]	[21.94%]	[0.56%]		[20.04%]	[19.19%]	[21.37%]	[2.18%]	
Duration	151.60	149.97	153.18	3.21		148.12	143.83	152.40	8.57	
	[141.00]	[144.00]	[136.00]	[-8.00]		[139.50]	[134.50]	[141.00]	[6.50]	
Deal status (success rate)	89.33%	91.89%	86.84%	-5.05%		88.10%	92.86%	83.33%	-9.52%	
	[100%]	[100%]	[100%]	[0.00%]		[100%]	[100%]	[100%]	[0.00%]	*
Abnormal Short Sale (-5, -1)	52.37%	23.16%	80.78%	57.62%	**	55.73%	50.94%	60.64%	9.70%	
	[14.96%]	[-4.18%]	[60.73%]	[64.91%]	***	[16.54%]	[16.54%]	[29.52%]	[12.98%]	
Abnormal Short Sale (-10, -1)	51.72%	23.48%	79.19%	55.71%	**	52.27%	52.54%	51.99%	-0.55%	
	[26.23%]	[4.48%]	[49.12%]	[44.64%]	***	[26.23%]	[24.23%]	[33.40%]	[9.17%]	
Abnormal Put Buying (-5, -1)	1.55%	0.30%	2.91%	2.60%		0.14%	-19.01%	15.33%	34.34%	*
	[5.14%]	[3.97%]	[5.34%]	[1.37%]		[5.14%]	[8.34%]	[4.94%]	[-3.40%]	
Abnormal Put Buying (-10, -1)	-1.99%	-4.09%	0.29%	4.38%		-3.72%	-12.82%	3.50%	16.32%	
	[2.58%]	[3.41%]	[1.75%]	[-1.66%]		[1.61%]	[-1.11%]	[5.43%]	[6.53%]	

### **Table V: Target premium and Abnormal Profit from Shorting: double sorting on Short Selling and Short Term HF Holdings**

This Table consists of all completed and withdrawn M&A deals with positive short-term hedge fund holdings during the period January 3, 2005–July 6th, 2007. We first sort all the deals into above median and below median groups based short-term hedge fund holdings in the quarter prior to the M&A announcement. Deals within each group are then assigned to above median and below median classes based on abnormal short sales 10 days prior to the announcement. We report the cross-sectional averages for firms in the Low-Low (below median class for both abnormal short selling and short-term hedge fund holding subsamples) and in the High-High (above median class for both abnormal short selling and short-term hedge fund holding subsamples) groups. The target premium is measured by the Fama-French four-factor compounded cumulative abnormal return on the target's stock from three months (63 trading day) before the bid announcement to two months (42 trading day) after the deal announcement or resolution date, whichever comes first. The Abnormal Short Sale(-10,-1) is the average daily abnormal short sales for stock in the pre-announcement period, measured as the average daily short sale from day -10 to -1 divided by the average daily short sale in the non-announcement period, all minus one. CARs are measured by using market model with an estimation window of 255 days up to 63 days prior to announcement. A Total Return is measured by subtracting an acquirer CAR from its target premium over the same event window. Abnormal Profits from shorting acquirer's shares are measured by the average daily dollar profit from closing the preannouncement daily abnormal amount of shares sold short for each acquirer in the days after the announcement. We measure the abnormal profit from shorting acquirer's shares by aggregating abnormal volume of short selling acquirer's shares during the window (-10, -1) or (-5,-1) then taking the average of the potential profits that can be earned from closing the positions on any day during the window (0, 10) or (0, 5). In Particular, Abnormal Profit from shorting acquirers shares during (-10,+10) = Mean(Abnormal short sale<sub>-10</sub> \*( Price<sub>-10</sub>-Price<sub>1</sub>) + Abnormal short sale<sub>-10</sub> \*(Price<sub>-10</sub>-Price<sub>2</sub>) + ... + Abnormal short sale<sub>-10</sub> \*( Price<sub>-10</sub>-Price<sub>10</sub>)). We test the difference between the subgroup of ownership in means and medians using the two-sided t-test and the Wilcoxon rank sum test. (\*\*\*) (\*\* and \*) indicate significance at 1%, 5%, and 10% levels.

	All Deals			Stock Deals		
	Low-Low	High-High		Low-Low	High-High	
<i>Panel A: Company Performance Measures</i>						
Abnormal Short Sale (acquires) (-10, -1)	-39.34%	105.73%	***	-37.06%	161.08%	***
	[-37.86%]	[76.49%]	***	[-31.91%]	[119.41%]	***
Short Term HF Holdings (Targets) Qtr(-1)	1.29%	11.70%	***	0.97%	7.92%	***
	[1.25%]	[6.77%]	***	[0.73%]	[5.66%]	***
Target Premium	14.98%	32.62%	***	8.17%	36.06%	**
	[15.02%]	[26.95%]	***	[10.31%]	[29.44%]	**
Total Return (-10,10)	16.74%	24.56%	**	16.48%	25.40%	
	[15.85%]	[22.18%]	**	[19.15%]	[22.54%]	
Total Return (-5,5)	16.55%	22.16%	**	18.34%	22.74%	
	[16.34%]	[21.23%]	*	[20.76%]	[20.96%]	
Abnormal Profit from Shorting (Acquirers) (-10,10)	-31,408	-31,394		-409,138	67,100	**
	[-7,670]	[938]	*	[-162,810]	[23,525]	***
Abnormal Profit from Shorting (Acquirers) (-5,5)	-23,377	-88,388		-385,784	115,928	***
	[-12,256]	[1,081]		[-118,786]	[13,354]	***
Number of Obs.	68	70		18	19	
<i>Panel B: Hedge Fund Performance Measures</i>						
Market Adjusted Return over 2 Previous Years	0.027	0.009		0.010	-0.012	
	[-0.013]	[-0.007]		[-0.038]	[-0.005]	
Market Adjusted Return over 5 Previous Years	0.127	0.091		0.044	-0.011	
	[-0.034]	[0.084]		[0.010]	[0.016]	
7-Factor Alpha over 2 Previous Year	4.251	4.747		4.997	5.695	
	[3.659]	[4.114]		[3.254]	[4.581]	
7-Factor Alpha over 5 Previous Year	1.704	1.997		3.251	2.270	
	[1.686]	[1.884]		[1.482]	[2.181]	
Number of Obs.	52	59		12	15	

**Table VI: Dollar Profit from Short Selling Acquirers in Stock Deals**

This table summarizes the profits (in thousands of dollars) that short sellers could potentially make around M&A announcement dates for stock deals based on short-term hedge fund ownership position in targets during the sample period from January 3<sup>rd</sup> 2005 to July 6<sup>th</sup> 2007. Shorting Day refers to the day on which short sellers start their shorting position and day 0 is defined as the announcement date, or the next trading day if the announcement date is not a trading day. Short Position Closing Day refers to the number of days after the takeover announcement when short sellers close their shorting position by purchasing back the securities they short sold before. Closing Day0 means that short sellers will close all their shorting position on the announcement day of the takeover. Profit (in thousands of dollars) is defined as  $profit_t = (Short\ Price_t - Ask_n) \times Short\ Volume$ , whereas  $Short\ Price_t$  refers to the weighted average short selling price at shorting day  $t$ , and  $Ask_n$  refers to the close ask price on the  $n^{th}$  trading day after the announcement. Profit from abnormal short selling is calculated for abnormal short volume, which refers to the abnormal number of shares being shorted on day  $t$ , while profit from total short selling calculated for total short volume, which refers to the total actual number of shares being shorted on day  $t$ .

Shorting Day	Dollar profit from abnormal short selling						Dollar profit from total short selling					
	Short Position Closing Day Post Announcement						Short Position Closing Day Post Announcement					
	0	1	2	10	15	20	0	1	2	10	15	20
	<b>Group 1: the acquirers in the deals with low short-term hedge fund target ownership</b>											
-20	-1632.83	-3598.40	-3543.39	-5424.01	-4329.65	-6453.81	1794.22	5199.43	6227.68	7904.14	13645.76	12769.62
-19	-1688.65	-4031.81	-3838.61	-6409.80	-5826.65	-7161.30	2604.39	5859.87	7178.25	7750.49	13123.33	12846.80
-18	-7460.76	-8556.16	-7323.85	-12640.17	-8936.68	-9950.89	-2932.45	2883.36	6133.58	4211.21	11152.45	11447.42
-17	-5146.82	-6278.28	-5360.14	-8683.30	-3392.72	-3927.29	-1363.65	5274.56	8782.91	7592.50	16657.37	16716.59
-16	-3398.76	-5278.33	-5287.12	-4885.47	-1358.99	-3899.88	4508.17	9737.49	11878.41	15415.19	22302.98	20906.52
-15	-2769.83	-5012.80	-4990.46	-10634.87	-7141.02	-10049.40	6325.89	10624.09	12417.65	10739.59	17239.91	15949.07
-10	-3707.65	-5548.64	-4576.21	-8481.38	-4904.61	-6944.43	3434.82	8227.37	10994.70	11289.76	17828.05	17429.85
-5	-1842.75	-4587.03	-5215.07	-9043.37	-8086.63	-9912.42	10472.35	13952.66	14846.89	15728.42	19391.09	19547.70
-1	-4094.59	-4514.19	-4834.79	-7639.87	-6779.51	-8336.29	10635.44	16640.31	17976.87	19855.17	23549.85	23800.86
sum(-20,-1)	-70778.89	-96611.60	-91974.72	-169824.53	-119816.94	-161586.57	122667.12	225054.63	262966.59	267880.40	380114.46	371164.68
	<b>Group 2: the acquirers in the deals with high short-term hedge fund target ownership</b>											
-20	14983.27	13441.15	12299.10	13797.56	16358.12	17640.17	32959.10	33005.28	29840.78	26348.75	30970.41	24688.65
-19	13399.09	14741.73	12576.35	7440.69	17233.52	13677.41	32794.16	35725.10	31537.27	21411.12	33265.05	22145.13
-18	6242.17	9952.02	6915.92	-1310.64	13845.53	10222.28	24287.04	29585.20	24526.65	11309.59	28526.87	17339.80
-17	7228.47	11708.15	7863.09	1644.19	12661.50	12764.11	22945.75	29013.73	23146.22	11936.83	25015.24	17554.03
-16	-152.56	3202.54	903.97	-1499.49	8186.91	10390.22	17546.20	22489.61	18168.58	10774.63	22522.14	17161.64
-15	4425.11	6013.51	4267.92	-2370.94	2692.19	-2985.37	23532.23	26708.95	22940.90	11311.55	18435.79	5194.41
-10	-1297.16	575.04	-1107.97	-5790.08	253.08	1174.32	15467.79	18954.78	15250.33	5579.48	13653.22	7048.48
-5	-5148.72	-2584.85	-4528.84	-6658.03	-1466.71	-774.00	9599.09	13777.75	9812.32	2694.38	9916.29	3083.03
-1	1057.76	4335.24	2070.29	1163.75	6793.34	8026.55	19186.30	24078.57	19792.19	13896.90	21557.08	15264.32
sum(-20,-1)	27275.76	69891.25	20696.66	-79675.03	45084.74	14417.78	367546.92	442226.54	352576.28	152371.22	318048.84	136511.60

**Table VII: Multivariate Analysis of Short-term Hedge Fund holdings and Target Premium**

This table presents the results from the OLS estimations of short-term hedge fund holdings prior to public announcement. The regression model is specified as follows:  $Holding = \alpha + \beta_1 Premium + \beta_2 Success + \beta_3 Markup + \beta_4 Runup$

$$+ \mathbf{X}_{Deal\ Charactors} \mathbf{K} + \mathbf{X}_{Controls} \mathbf{\varphi} + \varepsilon \quad (1)$$

*Target premium* is defined as the Fama-French four-factor compounded cumulative abnormal return on the target's stock from three months (63 trading day) before the announcement to two months (42 trading day) after the deal announcement or resolution date, whichever comes first. *Acquirer Runup* is defined as the Fama & French and momentum 4-factor compounded cumulative abnormal return on the target's stock from one month (21 trading day) before the announcement. *Acquirer Markup* is defined as acquirer's Fama & French and momentum 4-factor compounded cumulative abnormal return 42 trading day after the announcement. *Institutional Holdings in Acquirer* is an aggregated ownership of institutional investors in the acquirer in the quarter prior to the public announcement of the M&A deal. *Number of Analyst Covered* is defined by the number of analysts covered the firm one year prior to public announcement in I/B/E/S. The remaining variables are defined in Table II. White's (1980) heteroskedasticity-consistent *t*-values are in bracket below the coefficients in OLS results. (\*\*\*), (\*\*) and (\*) indicate significance at 1%, 5%, and 10% levels, respectively.

OLS – Dependent Variable: Short-term Hedge Fund Holding						
	Panel (A)		Panel (B)		Panel (C)	
	Full Sample		Pre-2003 Sub		Post-2003 Sub	
	(1)	(2)	(3)	(4)	(5)	(6)
Target Premium	0.012**	0.010*	0.002	0.002	0.024***	0.021**
	[2.174]	[1.835]	[0.296]	[0.295]	[2.746]	[2.382]
Acquirer Mark Up (0, 42)	-0.026**	-0.028**	-0.013	-0.010	-0.053**	-0.060***
	[-2.427]	[-2.430]	[-1.204]	[-0.844]	[-2.434]	[-2.615]
Acquirer Run Up (-22, -1)	0.030*	0.028	0.015	0.012	0.067**	0.064**
	[1.744]	[1.642]	[0.950]	[0.731]	[2.483]	[2.330]
Success Dummy	-0.004	-0.005	0.008	0.008	-0.009	-0.009
	[-0.597]	[-0.622]	[1.099]	[1.048]	[-0.827]	[-0.755]
Deal Duration	-0.000**	-0.000***	0.000	0.000	-0.000**	-0.000**
	[-2.486]	[-2.593]	[-1.211]	[-0.729]	[-2.107]	[-2.428]
Stock Deal	-0.008**	-0.009**	-0.009*	-0.012**	-0.007	-0.008
	[-1.981]	[-2.241]	[-1.652]	[-1.998]	[-1.245]	[-1.530]
Hostile Deal	0.005	0.005	0.008	0.010	0.004	0.004
	[0.528]	[0.569]	[0.608]	[0.704]	[0.345]	[0.340]
Tender Offer	0.000	-0.001	0.005	0.005	-0.003	-0.002
	[-0.026]	[-0.077]	[0.540]	[0.446]	[-0.305]	[-0.213]
Institutional Holdings in Acquirer	0.043***	0.040***	0.043***	0.042**	0.038**	0.034*
	[3.282]	[2.841]	[2.603]	[2.479]	[2.249]	[1.907]
Market Capitalization		-0.001		0.000		-0.001
		[-1.364]		[-0.676]		[-1.377]
Herfindahl on Sale		0.031*		0.014		0.050**
		[1.911]		[0.567]		[2.253]
Market to Book Ratio (M/B)		0.000**		0.000		0.000
		[2.382]		[0.091]		[1.623]
Return on Equity (ROE)		-0.001		-0.003		0.000
		[-1.183]		[-0.443]		[-0.633]
Sale Growth		0.000		0.000		0.000
		[0.241]		[-0.532]		[0.669]
Accounting Liquidity		-0.005		0.017		-0.017
		[-0.573]		[1.326]		[-1.312]
Debt to equity ratio (D/E)		-0.001		-0.001		0.000
		[-0.802]		[-1.068]		[0.120]
Price-Earnings ratio (P/E)		0.000		0.000		0.000
		[1.181]		[-0.079]		[1.213]
Number of Analyst Covered		0.000		0.000		0.000
		[1.084]		[0.848]		[0.862]
Amihud Illiquidity		0.006		0.004		0.009
		[1.576]		[0.862]		[1.185]
Constant	0.029***	0.038**	0.019*	0.018	0.027*	0.042*
	[2.895]	[2.549]	[1.817]	[1.065]	[1.678]	[1.939]
Year Control	Yes	Yes	Yes	Yes	Yes	Yes
Chow Test p-value					<0.019	<0.028
Number of Observations	796	796	283	283	513	513
Adjusted R <sup>2</sup>	0.077	0.081	0.049	0.032	0.068	0.078



**TABLE VIII: Multivariate Analysis of Abnormal Short Sales, Abnormal Relative Short Sales, and Abnormal Put Buying Prior to M&A Announcements**

$$ABS(-5, -1) = \beta_0 + \varphi_1 Holding + \varphi_2 Stock \times Holding + \beta_2 RET(-5, -1) + \beta_3 ABVOL(-5, -1) + \varepsilon \quad (2)$$

$$RELSS(-5, -1) = \gamma_0 + \varphi_1 Holding + \varphi_2 Stock \times Holding + \gamma_2 RET(-5, -1) + \gamma_3 NORMRELSS + \varepsilon \quad (3)$$

$$ABLongPut(-5, -1) = \delta_0 + \varphi_1 Holding + \varphi_2 Stock \times Holding + \delta_2 RET(-5, -1) + \delta_3 ABVOL(-5, -1) + \delta_4 ABOPTVOL(-5, -1) + \varepsilon \quad (4)$$

This table presents the results of OLS estimation of above equations. *Holding* is the short-term hedge fund holding of target one quarter prior to the announcement. The variable *ABSS(-5,-1)* is the average daily abnormal short sales for stock in the pre-announcement period, measured as the average daily abnormal short sale from day -5 to -1 divided by the average daily short sale in the non-announcement period, all minus one. The variable *RELSS(-5, -1)* is the ratio of daily shorted shares to traded volume in the stock from day -5 to -1 period. The variable *ABLongPut(-5,-1)* is the average daily abnormal put option buying for acquirer in pre-announcement period, measured as the average abnormal put buying of acquirer from day -5 to -1. The variable *RET(-5, -1)* is the stock's return before the M&A announcement and measured from the closing price on day -6 to -1. The variable *ABVOL(-5, -1)* is the stock's abnormal volume in the preannouncement period, measured as the difference between the average daily volume in the pre-announcement period and the average daily volume in the non-announcement window (-266, -11), scaled by the average daily volume in the non-announcement window (-266, -11). The variable *NORMRELSS* is the ratio of shorted shares to traded shares in the non-announcement period. *ABOPTVOL(-5,-1)* is the average daily abnormal net option volume in the stock over the interval of day -5 to -1 (i.e., it is the average abnormal net option open interest of the put and call). White's (1980) heteroskedasticity-consistent *t*-values are reported in brackets below the coefficients. (\*\*\*) , (\*\*) and (\*) indicate significance at 1%, 5%, and 10% levels, respectively.

	Equation 2 Regression (1)	Equation 3 Regression 1 (2)	Equation 4 Regression (3)	Equation 4 Regression (4)	Equation 4 Regression (5)
	Reg. SHO	Reg. SHO	Prior to 2003	Post to 2003	Reg. SHO
<i>Holding</i>	-0.285 [-0.27]	0.049 [-0.76]	-0.838 [-0.79]	-1.03 [-1.40]	-1.665* [-1.71]
<i>Stock×Holding</i>	4.003** [-2.17]	0.286** [-2.26]	0.483 [-0.14]	1.850** [-2.37]	2.057* [-1.76]
<i>RET(-5,-1)</i>	1.189 [-0.55]	0.228* [-1.85]	1.167 [-0.68]	-2.028*** [-2.66]	-2.777* [-1.86]
<i>ABOVL(-5,-1)</i>	0.048*** [-3.16]	---	0.005 [-0.22]	0.000 [-0.01]	0.007 [-0.37]
<i>NORMRELSS</i>	---	0.906*** [-8.97]	---	---	---
<i>ABOPTVOL(-5,-1)</i>	---	---	0.000* [-1.92]	0.000*** [-5.40]	0.000*** [-4.64]
<i>Constant</i>	0.432*** [-5.1]	0.019 [-0.86]	-0.006 [-0.02]	0.017 [-0.42]	0.086 [-1.30]
<i>N</i>	277	277	209	401	221
<i>Adj. R<sup>2</sup></i>	0.057	0.31	-0.017	0.29	0.295

**TABLE IX: Relationship between abnormal short selling and post-announcement stock returns**

$$\begin{aligned} ABS(-5, -1) = & \beta_0 + \beta_1 RET(0, +1) + \beta_2 RET(0, +1) \times Abv.Median \\ & + \beta_3 RET(-5, -1) + \beta_4 ABVOL(-5, -1) + \varepsilon \end{aligned} \quad (5)$$

$$\begin{aligned} RELSS(-5, -1) = & \gamma_0 + \gamma_1 RET(0, +1) + \gamma_2 RET(0, +1) \times Abv.Median \\ & + \gamma_3 RET(-5, -1) + \gamma_4 NORMRELSS + \varepsilon \end{aligned} \quad (6)$$

$$\begin{aligned} ABLongPut(-5, -1) = & \delta_0 + \delta_1 RET(0, +1) + \delta_2 RET(0, +1) \times Abv.Median \\ & + \delta_3 RET(-5, -1) + \delta_4 ABVOL(-5, -1) + \delta_5 ABOPTVOL(-5, -1) + \varepsilon \end{aligned} \quad (7)$$

This table presents the results of OLS estimation of the above equations, both for the full sample and for specific sub-samples determined by short-term hedge fund holdings. The variable  $ABS(-5, -1)$  is the average daily abnormal short sales for stock in the pre-announcement period, measured as the average daily abnormal short sale from day -5 to -1 divided by the average daily short sale in the non-announcement period, all minus one. The variable  $RELSS(-5, -1)$  is the ratio of daily shorted shares to traded volume in the stock from day -5 to -1 period. The variable  $ABLongPut(-5, -1)$  is the average daily abnormal net long put option for acquirer in pre-announcement period, measured as the average abnormal put option buying of acquirer from day -5 to -1. The variable  $RET(-5, -1)$  is the stock's return before the M&A announcement and measured from the closing price on day -6 to that on day -1. The variable  $ABVOL(-5, -1)$  is the stock's abnormal volume in the preannouncement period, measured as the difference between the average daily volume in the pre-announcement period and the average daily volume in window (-266, -11), scaled by the average daily volume in window (-266, -11). The variable  $NORMRELSS$  is the ratio of shorted shares to traded shares in the non-announcement period, (-266, -11).  $ABOPTVOL(-5, -1)$  is the average daily abnormal net option volume in the stock over the interval of day -5 to -1 (i.e., it is the average abnormal net option open interest of the put and call). An acquirer is considered to be below (above) the median if the short-term hedge fund holding of its target is below (above or equal to) the median for the distribution of all takeovers in a given year. White's (1980) heteroskedasticity-consistent  $t$ -values are in bracket below the coefficients. (\*\*\*) (\*\* and \*) indicate significance at 1%, 5%, and 10% levels, respectively.

<i>Panel A: Equation (5)</i>							
Rank by short term Hedge fund Holdings	$\beta_0$	$\beta_1$	$\beta_2$	$\beta_3$	$\beta_4$		<i>Adj. R</i> <sup>2</sup>
All	0.451***	-0.727		1.331	0.048***		0.049
[n=277]	[-7.03]	[-0.85]		[-0.62]	[-3.14]		
All	0.453***		-2.288*	1.261	0.049***		0.056
[n=277]	[-7.1]		[-1.92]	[-0.59]	[-3.18]		
≥ Median	0.462***	-2.506**		-1.442	0.057***		0.067
[n=146]	[-5.46]	[-2.23]		[-0.67]	[-3.37]		
< Median	0.451***	1.127		4.737	0.039**		0.065
[n=131]	[-4.45]	[-0.83]		[-1.30]	[-2.17]		
<i>Panel B: Equation (6)</i>							
Rank by short term Hedge fund Holdings	$\gamma_0$	$\gamma_1$	$\gamma_2$	$\gamma_3$	$\gamma_4$		<i>Adj. R</i> <sup>2</sup>
All	0.014	-0.229***		0.225*	0.941***		0.326
[n=277]	[-0.65]	[-3.28]		[-1.78]	[-9.49]		
All	0.013		-0.324***	0.224*	0.953***		0.328
[n=277]	[-0.59]		[-3.1]	[-1.77]	[-9.57]		
≥ Median	-0.015	-0.322***		0.279	1.104***		0.377
[n=146]	[-0.44]	[-3.11]		[-1.53]	[-7.39]		
< Median	0.038	-0.174		0.169	0.797***		0.278
[n=131]	[-1.38]	[-1.64]		[-1.07]	[-6.66]		
<i>Panel C: Equation (7)</i>							
Rank by short term Hedge fund Holdings	$\delta_0$	$\delta_1$	$\delta_2$	$\delta_3$	$\delta_4$	$\delta_5$	<i>Adj. R</i> <sup>2</sup>
<i>All Sample Prior to 2003</i>							
All	0.076	2.843		1.61	0.007	0.000***	0.010
[n=209]	[0.576]	[1.127]		[0.890]	[0.316]	[3.872]	
All	-0.016		1.391	1.398	0.006	0.000***	0.002
[n=209]	[-0.072]		[1.060]	[0.815]	[0.286]	[3.756]	
≥ Median	-0.025	1.214		-0.29	0.01	0.000***	0.110
[n=102]	[-0.348]	[1.439]		[-0.626]	[1.165]	[5.394]	
< Median	0.183	4.833		4.405	-0.007	0.000**	0.000
[n=107]	[0.704]	[0.951]		[0.945]	[-0.116]	[2.605]	
<i>All Sample Post to 2003</i>							
All	-0.066*	-0.687		-1.886**	-0.007	0.000***	0.274
[n=401]	[-1.839]	[-1.584]		[-2.477]	[-0.668]	[5.516]	
All	-0.063*		-1.035*	-1.848**	-0.007	0.000***	0.275
[n=401]	[-1.766]		[-1.662]	[-2.442]	[-0.684]	[5.519]	
≥ Median	-0.126**	-1.357*		-1.878	-0.007	0.000***	0.212
[n=201]	[-2.032]	[-1.891]		[-1.468]	[-0.401]	[3.122]	
< Median	-0.009	-0.004		-1.711**	-0.005	0.000***	0.426
[n=200]	[-0.254]	[-0.008]		[-2.303]	[-0.584]	[6.556]	
<i>All Sample in Regulation SHO Period</i>							
All	-0.07	-1.580**		-2.522*	0	0.000***	0.280
[n=221]	[-1.240]	[-2.049]		[-1.753]	[-0.008]	[4.419]	
All	-0.059		-2.650*	-2.485*	0.001	0.000***	0.282
[n=221]	[-1.070]		[-1.915]	[-1.725]	[0.036]	[4.438]	
≥ Median	-0.194**	-3.259**		-3.401	-0.005	0.000**	0.234
[n=114]	[-1.994]	[-2.034]		[-1.240]	[-0.144]	[2.580]	
< Median	0.06	0.064		-1.175	0.004	0.000***	0.519
[n=107]	[1.213]	[0.090]		[-1.353]	[0.278]	[5.341]	