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What Is the Nature of Hedge Fund Manager Skills? Evidence from the Risk-Arbitrage Strategy

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Abstract

To understand the nature of hedge fund managers' skills, we study the implementation of risk arbitrage by hedge funds using their portfolio holdings and comparing them with those of other institutional arbitrageurs. We find that hedge funds significantly outperform a naive risk-arbitrage portfolio by 3.7% annually on a risk-adjusted basis, whereas non–hedge fund arbitrageurs fail to outperform the benchmark. Our analysis reveals that hedge funds' superior performance does not reflect fund managers' ability to predict or affect the outcome of merger and acquisition deals; rather, hedge fund managers' superior performance is attributed to their ability to manage downside risk.

I. Introduction

The question of whether hedge funds deliver abnormal risk-adjusted returns has intrigued the finance profession since the foundation of the first hedge fund in 1949. The question has proved difficult to answer, partly because the evaluation of hedge fund performance is fraught with measurement problems. One problem is that hedge fund returns are self-reported and suffer from various biases, including selection bias, return manipulation, backfilling bias, and survivorship bias (e.g., Brown, Goetzmann, Ibbotson, and Ross (1992), Fung and Hsieh (2000), (2001), Liang (2000), Bollen and Pool (2009), and Edelman, Fung, and Hsieh (2013)).

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Another problem is the selection of appropriate benchmarks against which to evaluate the performance of hedge funds and other institutional investors (e.g., mutual funds). Different types of institutions pursue different objectives and strategies (active versus passive), employ different tools (leverage or derivatives), and have different payoff structures (nonlinear versus linear), making it extremely difficult to compare their performance. Although researchers have proposed advanced methods to address some of the problems inherent in measuring hedge fund performance (e.g., Kosowski, Naik, and Teo (2007), Jagannathan, Malakhov, and Novikov (2010)), the question of whether hedge fund managers can deliver alpha still remains hotly contested.

In this paper, we approach the question of evaluating hedge fund performance from a different perspective than previous studies. Rather than studying self-reported returns, we examine returns implied by the changes in hedge funds' equity positions around mergers and acquisitions (M&As). Specifically, we focus on the risk-arbitrage strategy (or merger-arbitrage strategy), which allows us to use information from hedge fund stock holdings to evaluate hedge fund performance. The risk-arbitrage strategy gives us two benchmarks against which we evaluate the performance of hedge fund managers: a passive portfolio of all merger deals and the portfolio of other institutional investors following the risk-arbitrage strategy.

There are several reasons to expect that hedge fund managers may outperform other institutional money managers. First, the contracts of hedge fund managers provide higher managerial incentives than those of other types of institutional investors because they include performance-based fees and option-like features such as high-watermark provisions. Goetzmann, Ingersoll, and Ross (2003) show that performance fees combined with high-watermark provisions are compensation contract features particularly suited to the type of investment strategies employed by hedge funds. These strategies require superior manager skill and high-watermark contracts, and they attract managers who are more likely to possess such skill into the hedge fund industry. They also demonstrate that the hedge fund compensation contract provides an incentive for managers to focus on performance rather than asset growth, which is particularly important for strategies that have limited investment opportunities and diminishing returns to scale, such as risk arbitrage.

Furthermore, hedge fund managers typically have higher levels of managerial ownership than other institutional investors and a greater degree of managerial discretion than the managers of other investment vehicles (e.g., mutual funds). Agarwal, Daniel, and Naik (2009) show that hedge funds with higher levels of managerial ownership and a greater degree of managerial discretion typically deliver superior performance. In addition, the hedge fund industry is loosely regulated, which allows managers to have greater flexibility in investing. For example, hedge funds can have a concentrated investment position, whereas others, such as mutual funds, are forced to diversify. Finally, as shown by Brown, Goetzmann, and Park (2001), hedge fund managers are incentivized by career concerns and intense competition for investor funds to deliver high returns without taking on excessive risk.

However, the empirical evidence on the performance of hedge funds so far has been mixed. On the one hand, studies that use self-reported returns frequently

find that hedge funds are able to outperform risk-adjusted benchmarks (e.g., Ackermann, McEnally, and Ravenscraft (1999), Liang (1999), Agarwal and Naik (2000), and Agarwal et al. (2009)), whereas other institutional investors, such as mutual funds and pension funds, are not (e.g., Carhart (1997), Busse, Goyal, and Wahal (2010)). In contrast, Griffin and Xu (2009) compare the holdings of hedge fund companies to those of mutual fund companies and conclude that "hedge funds seem to be no better at long-equity investment than mutual funds."

The risk-arbitrage strategy attempts to capitalize on the spread between the postannouncement prices of target shares and the final takeover prices in M&As. Arbitrageurs typically take long positions in target firm shares following takeover announcements, with the expectation that the prices of these shares will converge to the agreed acquisition price when the deal is completed. If shareholders approve the acquisition and the deal is completed, arbitrageurs earn the spread between the original target price and the acquisition price. However, if the acquisition is not allowed to proceed, the target share prices typically decline, and risk arbitrageurs stand to incur a loss.

In this paper, we examine hedge fund performance in risk arbitrage. Risk arbitrage provides an ideal setting to evaluate the performance of hedge funds and to understand the nature and source of their abnormal performance for several reasons. First, the strategy requires a degree of sophistication to identify undervalued deals, to make prompt decisions, and in the ability to bear and manage deal-completion risk. If hedge fund managers possess superior deal-selection skills, the risk-arbitrage strategy can be used to identify and quantify these skills.

Second, another dimension of hedge fund managers' skills in risk arbitrage can be their ability to manage risk associated with deal cancellation. Most merger announcements are made at a significant premium to the recent market prices of target firms because acquiring firms expect synergies due to economies of scale and cost savings. If merger plans are canceled and potential synergies do not materialize, the target stock price typically declines significantly. The magnitude of the decline depends on the takeover premium, the stand-alone value of the target, and the composition of the target firm's shareholder base. Bigger losses are frequently associated with investments in targets that have little value as a going concern in case the offer is withdrawn. The ability to manage downside risk is an important determinant of success in risk arbitrage (e.g., Mitchell and Pulvino (2001)). However, hedge fund managers' greater discretion may induce them to take on excessive risk. It is therefore an important empirical question whether hedge funds assume more downside risk in risk arbitrage than other institutional arbitrageurs.

Finally, the risk-arbitrage strategy's investment horizon is clearly defined by the merger announcement and completion (or withdrawal) dates. This allows us to measure hedge fund performance with greater precision and compare it with non–hedge fund performance. In contrast, prior studies that evaluate hedge fund performance using the reported equity holdings assume that hedge funds' investment horizons correspond to the quarter's end. However, many hedge funds pursue dynamic investment strategies with high portfolio turnover rates (e.g., Bollen and Whaley (2009)), making it difficult to capture hedge funds' true performance from the snapshots of quarterly holdings. We overcome these shortcomings of the

hedge fund holdings data by examining the portion of hedge fund portfolio holdings that is related to the risk-arbitrage strategy and therefore has a predictable investment horizon.

We identify a sample of financial institutions pursuing the risk-arbitrage strategy from the changes in their holdings of target shares after the announcements of M&As. Most institutional investors decrease their holdings of target shares following the announcements of M&As because they are unwilling to bear the risk of the deals not closing. In contrast, risk arbitrageurs are defined as institutional investors that typically increase their target shareholdings from 0 to a positive number following deal announcements. We then divide risk arbitrageurs into hedge fund and non–hedge fund groups to compare M&A-oriented hedge funds to those of other institutional investors pursuing the same strategy. Comparing the performance of M&A-oriented hedge funds with that of non–hedge fund M&A arbitrageurs, we find evidence in the time series and in the cross section of deals that hedge funds significantly outperform a naive risk-arbitrage portfolio by 3.7% annually on a risk-adjusted basis, whereas other institutions following a similar investment strategy fail to outperform the naive benchmark. This finding is consistent with the hypothesis that hedge fund managers possess superior skills.

Analyzing merger-arbitrage returns in the cross section, we show that the source of hedge fund outperformance is not a hedge fund's ability to identify the best deals in which to invest, but rather its ability to avoid the worst deals. Completed deals have, on average, the same excess returns, regardless of hedge fund involvement. In contrast, returns for deals that are subsequently withdrawn are significantly more negative if hedge funds are not involved. Contrary to the hypothesis that hedge fund managers may have an incentive to take on excessive risk, we find that hedge funds assume less downside risk in risk arbitrage than other institutional arbitrageurs. This result shows that although hedge fund managers follow investment strategies with option-like payoffs and large downside risk, they are able to manage and limit downside risk more successfully than other institutional investors that follow similar strategies. This is a potential source of superior hedge fund performance. Our findings suggest that hedge fund managers are compensated for expertly managing downside risk in following investment strategies that are inherently risky due to their option-like payoffs, such as merger arbitrage. Thus, our findings support the theory of Goetzmann et al. (2003) that the structure of hedge fund fees, including performance-based fees and high-watermark provisions, is particularly well suited to the types of investment strategies employed by hedge funds.

It is also important to understand the impact of arbitrageurs in the public merger market. Hsieh, Lyandres, and Zhdanov (2011) demonstrate that the public merger market influences companies as early as their initial public offering (IPO) strategies. We further analyze the impact of arbitrageurs' holdings on the probability of deal completion and on deal duration to uncover alternative sources of hedge fund outperformance. The seminal work of Hsieh and Walkling (2005) provides evidence of passive and active roles for arbitrageurs in the acquisition process. The authors show that the change in arbitrageur holdings is greater in successful offers and is related to the probability of success, the bid premium, and arbitrage returns. We therefore test the hypothesis that our results are driven by

hedge fund managers' ability to predict or influence deal outcomes. To address the endogenous relationship between arbitrageur investment and deal outcomes, we implement simultaneous equation estimations with instrument variables similar to those of Hsieh and Walkling (2005). Our implementation allows us to test for a differential impact between hedge fund and non–hedge fund arbitrageurs. We find no evidence to support the hypothesis that hedge funds have superior ability to predict or affect merger outcomes compared with other institutional arbitrageurs.

The remainder of the paper is organized as follows: Section II describes the unique data on hedge fund risk-arbitrage holdings that we manually collected. Section III shows the level of risk-arbitrageur investment and deal characteristics. In Section IV we present the risk-arbitrage returns and evaluate the performance of hedge funds and non–hedge fund institutions. Section V reports the results related to deal dynamics and measures the relation between hedge fund holdings and deal outcomes. Section VI explores the connection between hedge fund performance in risk arbitrage and the downside risk associated with the investment strategy. Concluding remarks are provided in Section VII.

II. Data

A. Acquirers and Targets

Merger targets typically trade at a discount to the announced merger prices because of the risk of the deals not completing and the target stock prices subsequently dropping. Risk arbitrage is an investment strategy that involves taking a long position in target firm stock following the announcement of a takeover. For stock deals, a short position in the acquirer stock can be used to hedge against stock price changes that are unrelated to deal completion risk. We measure institutional investors' returns from risk arbitrage using the institutional ownership (13F) holdings data for deals spanning the end of a quarter between the announcement date and the completion date. To estimate arbitrageurs' returns from each deal, we assume that they maintain long positions in target shares from deal announcement until deal completion or withdrawal. For deals spanning more than a single quarter, the holdings are adjusted at the time of each quarterly portfolio disclosure.

Risk arbitrageurs attempt to capture the spread between the postannouncement and final prices paid by the acquirer through purchasing target shares after the announcement of M&As. We identify all M&A offers recorded by the Securities Data Company (SDC) from 1994 to 2012 and examine those offers where both the target and acquirer firms are listed by the Center for Research in Security Prices (CRSP) and the target firms are listed by Compustat. Whereas the SDC database is available prior to 1994, the hedge fund databases used to identify hedge fund arbitrageurs do not retain dead funds until 1994, and data from the early period contain survivorship bias. Thus, we focus on the period from 1994 onward.

We exclude deals classified as leverage buyouts, spin-offs, recapitalizations, self-tenders, exchange offers, repurchases, minority stake purchases, acquisitions of remaining interest, and privatizations. We also exclude rumors and deals still pending final outcome. Next, we merge the M&A data with information on institutional holdings. To accommodate the holdings data, we examine offers only

where the duration of the deal, the time from the announcement to either completion or withdrawal, spans the end of a quarter.

When multiple bidders or deal revisions are listed for a single target, we extend the time from deal announcement to deal completion until the final offer is either completed or withdrawn. We include all simultaneous offers as a single observation and adjust returns for changes in offer characteristics, but our cross-sectional analysis uses the initial offer for examining arbitrageur investment. This allows for the returns in our sample to account for any revisions or new offers, so that our risk-arbitrage returns more closely resemble actual returns earned by investors. We consider a deal successful if one of the overlapping offers is completed. When multiple takeover attempts of the same target firm are not simultaneous, we exclude the announced deals from the sample if a previous offer had been made within the last 2 years, thus removing deals where holdings information would have been impacted by previous announcements.

B. Hedge Funds

Risk arbitrage is an investment strategy that is often associated with hedge funds. Despite the fact that risk arbitrage has grown exponentially over the past 3 decades, from small operations within Wall Street firms to stand-alone arbitrage funds, little is known about how hedge funds actually conduct risk-arbitrage transactions or how they manage risk. Unlike mutual funds, hedge funds are private investment vehicles that are generally not required to publicly disclose their investment strategies.[1] However, Section 13(f) of the Securities Exchange Act of 1934 requires that every manager who exercises investment discretion over at least $100 million of assets file Form 13F with the U.S. Securities and Exchange Commission (SEC) and report all equity positions greater than 10,000 shares or $200,000 in market value each quarter. Hedge funds are not exempt from quarterly disclosures of their equity holdings on Form 13F. The form is filed at the manager level and only long equity positions are reported.[2]

We use 13F data to obtain insights into the implementation of risk arbitrage by hedge funds and other institutional investors. To identify hedge fund manager names among the names of other 13F filers, we go through a labor-intensive process outlined as follows: First, we identify hedge fund management company names from multiple hedge fund databases, including the Lipper Trading Advisor Selection System (TASS), BarclayHedge, Hedge Fund Research (HFR), Morningstar, Center for International Securities and Derivatives Markets (CISDM), and Bloomberg. We then match these names with companies reporting their holdings on Form 13F.

Following Brunnermeier and Nagel (2004), Griffin and Xu (2009), and Cao and Petrasek (2014), we exclude matched companies whose holdings are not

[1] Although the SEC has recently required advisors to hedge funds and private equity groups to periodically file information regarding hedge fund assets, liabilities, and trading on Form PF under the Dodd–Frank Act of 2010, the SEC does not intend to make the information public. The information is collected exclusively for the assessment of systemic risk by the Financial Stability Oversight Council.

[2] We use the optimal short positions implied by the exchange ratio of acquirer to target stock as proxies for short positions in acquirers' stocks.

representative of hedge fund activities. To do so, we cross-check the registration documents (Form ADV) of all registered investment advisors and classify them as hedge fund managers only if they indicate that more than 50% of their clients are high-net-worth individuals and that they charge performance-based fees. About one-third of previously matched registered investment advisors, including Blackrock Advisors LLC and First Quadrant LP, are removed from the category of hedge fund managers because most of their clients are non–hedge fund institutions. Finally, all unregistered institutions that report to hedge fund databases are classified as hedge funds because they are not allowed to advise registered investment companies or other non–hedge fund clients.

C. Risk Arbitrageurs

We identify risk arbitrageurs as institutions that increase their holdings of target shares from 0 to a positive number upon the announcement of merger deals. Specifically, risk arbitrageurs are defined as institutions that i) increase their holdings of target shares from 0 to a positive number following at least 20 deal announcements out of our 2,186 deals during 1994–2012 and ii) increase their holdings in at least 50% of all deals in which they are invested between the quarter prior to the announcement to the quarter-end following the announcement.

The first requirement helps us identify institutional investors that typically invest in target shares after deal announcements and is adopted from Baker and Savasoglu (2002). The second requirement relates the increase in target shareholdings to an institution's total target shareholdings and allows us to exclude large institutions that do not normally act as arbitrageurs. Thus, institutions that are most frequently net sellers of target stock are not classified as arbitrageurs. Taken together, these requirements ensure that our metric of the change in risk-arbitrage holdings from the quarter prior to the announcement until the quarter following the announcement represents the actions of risk arbitrageurs.

In total, we classify 212 institutions as risk arbitrageurs during the 1994–2012 period. We find that 140 of the arbitrageurs are hedge funds and 72 are non–hedge fund financial institutions, such as broker–dealers, banks, and mutual funds. To verify that hedge funds classified as risk arbitrageurs based on their holdings indeed follow a risk-arbitrage strategy, we examine their self-reported investment strategies in the hedge fund databases. We find that our sample of risk-arbitrage hedge funds corresponds to funds that pursue "event-driven" or "merger-arbitrage" strategies as their primary or secondary strategies as listed in Lipper TASS, CISDM, BarclayHedge, HFR, or Morningstar.

D. Changes in the Ownership of Target Firms

We calculate the ownership fractions of different types of institutions by summing the shares held by the institutions in each quarter and then dividing by the total number of shares outstanding at the end of that quarter. The detailed classification of institutional investors allows us to identify the types of institutions that invest in takeover targets. For all takeover attempts spanning at least 1 reporting quarter, we examine the changes in the ownership structure of target companies after the takeover announcement.

Table 1 presents the average percentages of M&A target shares held by institutions in the quarter prior to the deal announcement and the quarter following the deal announcement. Institutional investors hold, on average, 40.2% of target shares in the preannouncement quarter, with 6.2% held by risk arbitrageurs, among which 3.7% is held by M&A hedge funds. Total institutional ownership drops to 37.4% in the quarter following the deal announcement. This decline is due to an 8.5% decrease in the target shareholdings of nonarbitrageurs, mitigated by a 5.7% increase in the holdings of risk arbitrageurs, an increase mostly driven by M&A hedge funds, which increase their holdings by 3.6%. Table 1 also shows that, on average, 74.8 institutions report target shareholdings in the preannouncement quarter, of which 9.6 institutions are classified as risk arbitrageurs. In the postannouncement quarter, the number of institutions that maintain holdings in target firm stocks increases to 75.5. This change is the result of a decrease of 7.5 in the number of nonarbitrage institutions holding shares, whereas the number of hedge funds holding target shares increases by 5.1 after an announcement.

TABLE 1

Institutional Holdings of Target Shares

Table 1 presents the average percentages of M&A target shares held by institutions and the average number of institutions holding target shares in the quarters before and after deal announcement. Institutional holdings are shown separately for 212 risk arbitrageurs and all other institutional investors. Risk arbitrageurs are defined as institutions that i) increase their target shareholdings from 0 to a positive amount following at least 20 deal announcements during 1994–2012 and ii) acquire at least 50% of the deals held by increasing their holdings from 0 to a positive number after an announcement. Risk arbitrageurs are further subdivided into M&A hedge funds (140) and non–hedge fund (72) arbitrageurs, such as broker–dealers, banks, and mutual funds. The hedge fund sample is constructed using 6 hedge fund databases (TASS, HFR, CISDM, BarclayHedge, Morningstar, and Bloomberg). The sample is made up of 2,186 merger deals announced between Jan. 1994 and Dec. 2012. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Institutions	Quarter before Announcement	Quarter after Announcement	Difference	*t*-Statistic
Panel A. Percentage of Target Shares Held by Financial Institutions				
Hedge fund arbitrageurs	3.69%	7.30%	3.62%	30.6***
Non–hedge fund arbitrageurs	2.47%	4.50%	2.03%	28.6***
Other institutions	34.08%	25.56%	−8.52%	25.2***
All institutions	40.24%	37.36%	−2.87%	8.7***
All arbitrageurs	6.16%	11.80%	5.65%	33.3***
Panel B. Number of Institutions Holding Target Shares				
Hedge fund arbitrageurs	5.6	10.7	5.1	33.3***
Non–hedge fund arbitrageurs	4.0	7.1	3.1	38.2***
Other institutions	65.2	57.7	−7.5	14.9***
All institutions	74.8	75.5	0.7	1.3
All arbitrageurs	9.6	17.8	8.2	37.5***

Table 2 further displays the remarkable changes in ownership structure upon deal announcement. We find that arbitrageurs, in the aggregate, increase their holdings in 81% of announced deals in our target sample. Each of the 212 institutions, on average, invests in 6% of the deals. Arbitrageurs that increase their holdings after announcements typically have 0 target shareholdings in the preannouncement quarter. For the 2,186 deal announcements in our sample, the 140 risk-arbitrage hedge funds increase their holdings in 1,586 target firms, whereas the 72 non–hedge fund arbitrageurs increase their holdings in 1,517 deals.

The level of investment by risk arbitrageurs substantially increases over the sample period. Figure 1 shows the average level of investment in target stock by

TABLE 2

Summary Statistics for Risk Arbitrageurs

Table 2 provides descriptive statistics on risk arbitrageurs' investments in merger deals. Risk arbitrageurs are defined as institutions that i) increase their holdings of target shares from 0 to a positive number following at least 20 deal announcements during 1994–2012 and ii) acquire at least 50% of the deals held by increasing their holdings from 0 to a positive number after an announcement. Risk arbitrageurs are further subdivided into M&A hedge funds and non–hedge fund arbitrageurs, where non–hedge fund arbitrageurs are institutions such as broker–dealers, banks, and mutual funds.

Variables	Hedge Fund Arbitrageurs	Non–Hedge Fund Arbitrageurs	All Arbitrageurs
Number of institutions	140	72	212
Total number of deals	2,186	2,186	2,186
Deals with increased holdings	1,586	1,517	1,767
Percentage of deals with increased holdings	72.6%	69.4%	80.8%
Deals held per institution	108	143	120
Percentage of deals held per institution	4.9%	6.5%	5.5%

M&A hedge funds, divided into 6 subperiods. In the earliest period, from 1994 to 1996, hedge fund risk arbitrageurs do not increase their holdings in over 45% of deals. They increase their holdings of target stock by more than 5% in less than 10% of deals. By the most recent period, from 2009 to 2012, risk-arbitrage hedge funds increase their holdings of target stock by over 5% in more than 65% of deals and do not increase their holdings in target stock in less than 10% of deals. There is a clear upward trend over time in the percentage of hedge funds that increase their holdings of target firms by more than 5%.

FIGURE 1

Changes in Holdings of Target Shares after Deal Announcements by Risk-Arbitrage Hedge Funds

Figure 1 plots the distribution over time of the changes in target shareholdings by 140 risk-arbitrage hedge funds from the quarter prior to the deal announcement to the quarter following the deal announcement. Holdings are measured as the percentage of outstanding shares, and changes in target shareholdings are averaged each period. The sample is comprised of 2,186 merger deals announced and resolved between Jan. 1994 and Dec. 2012.

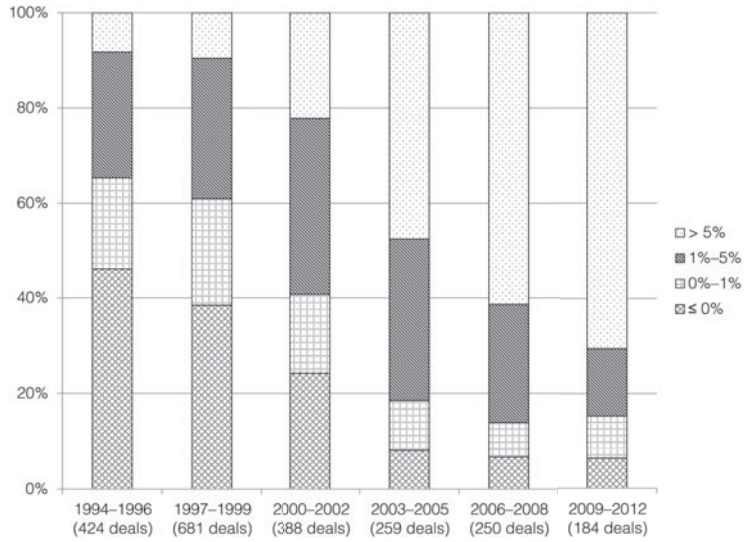


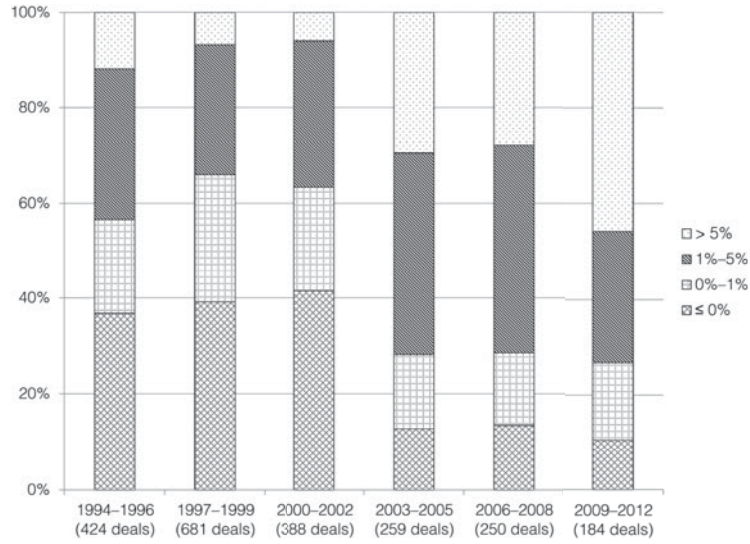
Figure 2 shows a less dramatic increase in risk-arbitrage holdings for non–hedge fund arbitrageurs. Between 2009 and 2012, the percentage of deals in which

non–hedge fund arbitrageurs increase their holdings by more than 5% is over 40%, which is much smaller than the percentage of deals for hedge fund arbitrageurs. Taken together, the 212 risk-arbitrage companies in our sample purchase 16.9% of the target stock for deals announced between 2009 and 2012. Thus, risk arbitrageurs play an increasingly impactful role in the M&A market over time.

FIGURE 2

Changes in Holdings of Target Shares after Deal Announcements by Non–Hedge Fund Arbitrageurs

Figure 2 plots the distribution over time of the changes in the target shareholdings of 72 non–hedge fund arbitrageurs from the quarter prior to the deal announcement to the quarter following the deal announcement. Holdings are measured as the percentage of outstanding shares, and changes in target shareholdings are averaged each period. The sample is comprised of 2,186 merger deals announced and resolved between Jan. 1994 and Dec. 2012.



III. Risk Arbitrageurs' Investments

A. Target and Deal Characteristics

In this section, we examine the relation between the characteristics of sample deals and arbitrageurs' investment decisions. Table 3 reports the summary statistics for the merger deal characteristics in our M&A sample. The variables are defined as follows:

HF_INCREASE: A dummy variable that takes a value of 1 if hedge funds increase their holdings of target shares from the quarter prior to the announcement to the quarter following the announcement of merger deals, and 0 otherwise.

NON_HF_INCREASE: A dummy variable that takes a value of 1 if non–hedge funds increase their holdings of target shares from the quarter prior to the announcement to the quarter following the announcement of merger deals, and 0 otherwise.

COMPLETED: A dummy variable that takes a value of 1 for completed offers, and 0 otherwise.

DURATION: The number of days between deal announcement and resolution.

ATTITUDE: An indicator variable for hostile deals as defined by the SDC.
ln(CASH): The natural logarithm of target firm cash holdings.
BLOCK_HOLDER: An indicator variable that equals 1 when a target firm has a single institutional shareholder that owns more than 5% of the firm in the quarter prior to the announcement, and 0 otherwise.
INDUSTRY: A dummy variable that equals 1 if both the target and acquiring firms have the same Fama–French (1997) industry classification, and 0 otherwise.
STOCK_DEAL: A dummy variable that equals 1 if the announced offer involves only stock considerations, and 0 otherwise.[3]
HYBRID_DEAL: A dummy variable that equals 1 if the announced offer involves stock and cash considerations, and 0 otherwise.
ln(SIZE): The natural logarithm of a target firm's market capitalization.
MARKET-TO-BOOK: The ratio of the market-to-book value of assets.
LEVERAGE: The book debt-to-assets ratio for the target firm.
ROA: The return-on-assets (ROA) ratio.
PREMIUM: The initial offer price minus the price 20 days prior to the takeover announcement standardized by the target price 2 days after the announcement.

TABLE 3

Summary Statistics for Merger Deals According to Arbitrageurs' Investments

Table 3 reports descriptive statistics of deal characteristics for announced M&As during 1994–2012. The variable HF_INCREASE (NON_HF_INCREASE) is the percentage of deals in which hedge fund (non–hedge fund) arbitrageurs increase their holdings in target shares from the quarter prior to the announcement to the quarter after the announcement; COMPLETED is the percentage of announced deals that are subsequently completed; DURATION is the number of days from deal announcement until deal resolution; ATTITUDE is the percentage of deals considered hostile, as measured by the SDC; CASH is cash and short-term investments; BLOCK_HOLDER is the percentage of deals that have a single institutional shareholder that owns more than 5% of the firm in the quarter prior to the announcement; INDUSTRY is the percentage of deals where both the target and acquiring firms have the same Fama–French (1997) industry classification; STOCK_DEAL is the percentage of announced deals that are 100% stock based; HYBRID_DEAL is the percentage of announced deals that are a combination of stock and cash; SIZE is the target firm's market capitalization (in $millions); MARKET-TO-BOOK is the market-to-book value of assets; LEVERAGE is the book debt-to-asset ratio; ROA is the return-on-asset ratio; and PREMIUM is equal to the offer price minus the price 20 days prior to the takeover announcement divided by the target price 2 days after the announcement. All accounting variables are measured at the end of the accounting year immediately preceding the deal announcement. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Hedge Fund Arbitrageurs			Non–Hedge Funds Arbitrageurs			
Variables	Increase	No Increase	*t*-Statistic	Increase	No Increase	*t*-Statistic	Overall Mean
HF_INCREASE				88.1%	37.4%	28.72***	72.5%
NON_HF_INCREASE	84.2%	30.2%	28.72***				69.4%
COMPLETED	89.2%	85.0%	2.72***	89.7%	84.5%	3.46***	88.0%
DURATION	137.3	146.3	1.82*	138.4	142.9	0.94	139.8
ATTITUDE	5.1%	1.8%	3.41***	4.9%	2.5%	2.58***	4.2%
ln(CASH)	2.22	1.88	4.13***	2.14	2.08	0.81	2.12
BLOCK_HOLDER	79.8%	60.7%	9.32***	80.6%	60.8%	9.96***	75.0%
INDUSTRY	66.9%	57.3%	4.18***	66.6%	59.0%	3.4***	64.0%
STOCK_DEAL	32.8%	47.5%	6.42***	32.6%	46.5%	6.27***	37.0%
HYBRID_DEAL	27.7%	16.0%	5.74***	27.1%	18.7%	4.23***	25.0%
ln(SIZE)	18.06	17.77	1.47	18.14	17.61	2.75***	17.98
MARKET-TO-BOOK	2.21	1.96	2.13**	2.22	1.95	2.33**	2.14
LEVERAGE	0.21	0.22	1.01	0.22	0.21	0.3	0.21
ROA	−0.03	−0.11	5.25***	−0.02	−0.13	7.23***	−0.06
PREMIUM	0.27	0.26	0.37	0.27	0.27	0.31	0.27
Number of deals	1,586	600		1,517	669		2,186

[3]Stock deals can be either fixed or floating rate. We combine all stock deals into one variable because we find no significant difference in risk-arbitrage returns or holdings between the two types of deals.

Table 3 shows that investments by hedge fund and non–hedge fund arbitrageurs are correlated with several target and deal characteristics. Both types of arbitrageurs tend to increase their holdings in deals with large block holders, which is consistent with the idea that large block holders are able to facilitate deal completion. They are also more likely to increase holdings in deals in which the target and acquirer are in the same industry. Arbitrageurs are less likely to increase their holdings in stock deals, potentially due to the costs associated with shorting acquirer stock. They also tend to invest in healthier firms, namely, firms with higher market-to-book ratios and ROAs.

B. Investment Timing

Risk arbitrage entails investing in target stock following the announcement of a merger or acquisition, whereas institutional holdings are released quarterly. Because we are unable to observe the exact timing of hedge fund trading, we measure returns to merger arbitrage from the close of the market in the day following a deal announcement until it is resolved by either completion or withdrawal. This assumption is used for both hedge fund and non–hedge fund arbitrageurs and represents the investment horizon for a typical risk-arbitrage investment.

Because the focus of this paper is on merger arbitrage, our sample of arbitrageurs excludes institutions that frequently report positive holdings of target shares before deal announcements. To further confirm that our measures of risk-arbitrage holdings are not driven by insider trading prior to deal announcements, we regress the run-up period returns in the preannouncement period on the change in risk arbitrageurs' holdings. The run-up excess returns are measured from 20 days prior to the announcement until 2 days prior to the announcement. The cross-sectional regression model is

$$(1) \qquad r_{i,[-20,-2]} = \alpha + \beta_1 \Delta \text{HF\_HLDGS}_i + \beta_2 \Delta \text{NON\_HF\_HLDGS}_i + \sum_{j=1,k} \gamma_j \text{CTRL}_{i,j} + e_i,$$

where r_i is the target firm's run-up period return minus the market return in the preannouncement period from day -20 to day -2, where day 0 is the announcement day. For ease of presentation, excess returns are multiplied by 100. The variable $\Delta\text{HF\_HLDGS}_i$ is the change in hedge fund risk arbitrageurs' holdings in the target firm from the quarter prior to announcement to the quarter after announcement, $\Delta\text{NON\_HF\_HLDGS}_i$ is the change in non–hedge fund risk arbitrageurs' holdings, and the subscript i refers to the ith deal. The set of control variables includes a number of target and deal characteristics that could affect run-up period returns. These variables are defined in Section III.A.

Table 4 provides the results of these regressions. We find no significant relation between hedge fund arbitrageurs' trading and the run-up returns while the coefficient for non–hedge fund trading is significant and positive. We find that a 1-standard-deviation increase in non–hedge fund arbitrageur investment is associated with a nearly 1% ($24.59 \times 10^{-2} \times 3.45\%$) increase in run-up returns prior to deal announcements. We repeat this process for announcement returns from

TABLE 4

Hedge Fund Involvement and Pre- and Postannouncement Excess Returns

Table 4 presents the results of cross-sectional regressions of target equity run-up excess returns and announcement excess returns on changes in target holdings by hedge fund (ΔHF_HLDGS) and non–hedge fund (ΔNON_HF_HLDGS) arbitrageurs and on other deal characteristics. The dependent variable in the left columns is the run-up excess return, measured as the return in excess of the market return from 20 days prior to the announcement to 2 days prior. The dependent variable in the right columns is the announcement excess return, measured as the return in excess of the market return from 1 day prior to the announcement to 1 day following it. All control variables are defined in Table 3. The sample is made up of 2,186 merger deals during our sample period. The coefficient estimates are presented with heteroskedasticity-robust standard errors in parentheses. For ease of presentation, excess returns are multiplied by 100. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Run-Up Excess Returns		Announcement Excess Returns	
Variables	1	2	3	4
ΔHF_HLDGS	−0.08	−8.22	68.73***	50.76***
	(9.19)	(9.61)	(11.95)	(14.09)
ΔNON_HF_HLDGS		24.59*		54.26**
		(13.68)		(22.41)
PREMIUM	11.54**	11.47**	19.86***	19.71***
	(5.58)	(5.56)	(7.26)	(7.21)
ATTITUDE	−7.59***	−7.76***	9.74***	9.36**
	(1.64)	(1.65)	(3.74)	(3.75)
ln(CASH)	0.04	0.01	0.60	0.55
	(0.29)	(0.29)	(0.40)	(0.39)
BLOCK_HOLDER	−0.42	−0.46	1.28	1.19
	(1.07)	(1.07)	(1.31)	(1.31)
INDUSTRY	−1.37	−1.31	0.44	0.57
	(0.92)	(0.92)	(1.15)	(1.14)
STOCK_DEAL	−0.45	−0.36	−6.59***	−6.39***
	(1.03)	(1.04)	(1.20)	(1.21)
ln(SIZE)	−0.81***	−0.83***	−2.43***	−2.48***
	(0.26)	(0.26)	(0.64)	(0.64)
MARKET-TO-BOOK	0.12	0.12	−0.03	−0.04
	(0.25)	(0.25)	(0.24)	(0.24)
LEVERAGE	1.28	1.32	1.95	2.04
	(1.85)	(1.85)	(3.77)	(3.74)
ROA	0.42	0.37	−1.45	−1.57
	(2.07)	(2.07)	(3.84)	(3.84)
YEAR_DUMMIES	Yes	Yes	Yes	Yes
R^2	0.10	0.10	0.21	0.21

day −1 to day +1 around deal announcements. In contrast to the preannouncement returns, we find that risk-arbitrage trading by both hedge funds and non–hedge funds is significantly and positively correlated with announcement returns. For both groups of arbitrageurs, we find that a 1-standard-deviation increase in arbitrageur holdings is associated with a 2%–3% (hedge funds, $50.76\times10^{-2}\times 5.79\%$; non–hedge funds, $54.26\times10^{-2}\times 3.45\%$) increase in returns at deal announcement. The positive relation between arbitrageurs' holdings and announcement returns provides evidence that the arbitrageurs are entering the bulk of the positions observed in the quarterly filings around the announcement dates rather than trading on rumors in the preannouncement period.

These results suggest that hedge fund arbitrageurs are more disciplined in merger arbitrage than non–hedge fund arbitrageurs are, because hedge funds base their investments on publicly announced deals rather than investing on preannouncement rumors. Such investment behavior is consistent with industry definitions of risk arbitrage as an investment strategy that seeks to exploit pricing inefficiencies that occur after the announcement of merger deals.

IV. Risk-Arbitrage Returns

We examine risk-arbitrage returns for hedge fund and non–hedge fund arbitrageurs. Risk-arbitrage returns are measured daily from the close of market on the day following a deal announcement until deal resolution. Deals are considered resolved either on the day they are completed or on the day following the announcement of offer withdrawal. If multiple bidders are present, we maintain the active status of the deal until the resolution of the final offer. This ensures that our measure of returns captures the effect of any information relative to deal completion or withdrawal until the last outstanding offer is resolved. Target returns are measured from the second postannouncement day to ensure that the returns to risk arbitrage are not influenced by announcement returns.

Our measure of risk-arbitrage returns is based on the long position in a target firm's shares for cash deals and the long position in a target firm's shares paired with a short position in an acquirer's shares for stock (and hybrid) deals. This measure of risk-arbitrage returns is consistent with the expected trading behavior of merger arbitrageurs. For cash deals, risk-arbitrage returns are equal to target returns for deal i on day t:

$$R_{it} = R_{\mathrm{TAR},it}, \tag{2}$$

where R_{it} is the risk-arbitrage return for deal i on day t, and $R_{\mathrm{TAR},it}$ is the return on target firm i on day t between the deal announcement and completion (or cancellation) day.

For stock and hybrid deals, a long–short portfolio provides a similar payoff structure to a long-only position for cash deals, namely, a fixed payoff when deals are completed and exposure to downside risk in the event of withdrawn deals. Although the actual short positions are not disclosed in regulatory filings, their optimal size can be determined by the need to provide a hedge against movements in the acquirer's share price. Assuming that arbitrageurs establish the optimal short position in acquirer shares, the risk-arbitrage returns for stock deals are determined as

$$R_{it} = R_{\mathrm{TAR},it} - (R_{\mathrm{ACQ},it} - R_f)\delta\frac{P_{\mathrm{ACQ},it-1}}{P_{\mathrm{TAR},it-1}}, \tag{3}$$

where R_{it} is the risk-arbitrage return for deal i on day t, $R_{\mathrm{TAR},it}$ is the return on target firm i on day t, $R_{\mathrm{ACQ},it}$ is the return on the acquiring firm i on day t, and R_f is the cost of borrowing for the short position and is set to be the risk-free rate. The exchange ratio of target stock for acquirer stock is represented by δ.[4] The ratio of the lagged acquirer stock price, $P_{\mathrm{ACQ},it-1}$, to the lagged target stock price, $P_{\mathrm{TAR},it-1}$, times δ yields the number of shares of acquirer stock to be shorted for the ownership of 1 share of target stock. Finally, the return for hybrid deals is calculated as a weighted average of the returns for cash and stock deals.

To determine whether hedge fund managers possess superior skill in risk arbitrage, we compare the risk-arbitrage returns of hedge fund with non–hedge

[4]The SDC does not report the exchange ratio of acquirer to target stock for all stock and hybrid deals. If the exchange ratio is missing, we estimate it based on the acquirer and target opening-day stock prices on the day of the announcement.

fund risk arbitrageurs. We also use a naive value-weighted portfolio of all merger deals as a comparison benchmark. Deals are considered active and included in the portfolio from 2 days following the announcement until they are either completed or withdrawn. The daily returns from merger arbitrage (R_{it}) are aggregated across all deals i using the appropriate weights (w_i) and then compounded within each month to create a time series of monthly returns:

$$R = \prod_{t=1,\text{ month end}} \left(1 + \sum_{i=\text{active}} w_{it} R_{it}\right) - 1. \tag{4}$$

To construct a benchmark that represents returns to the naive risk-arbitrage strategy of investing in all targets in proportion to their market value, we use the market capitalization of deal i relative to the market capitalization of all active deals as weight (w_i). Next, we create a portfolio based on hedge fund (non–hedge fund) arbitrageurs' net purchases of target shares and use the hedge fund (non–hedge fund) investment in deal i as portfolio weight (w_{it}). These portfolios are formed based on changes in the institutional holdings of target shares from the quarter prior to the deal announcement to the following quarter. The positions are entered 2 days following deal announcements and are held until the deals are either completed or withdrawn. For deals spanning more than 1 quarter-end, we update the portfolio weights to account for changes in portfolio holdings at the end of each quarter.

Our estimates of risk-arbitrage returns do not account for transaction costs. Admittedly, transaction costs, including the cost of trading in illiquid target stocks and the cost of short selling, could be a nonnegligible component of risk-arbitrage returns. The omission of transaction costs could lead us to overestimate the performance of risk-arbitrage strategies relative to the market. However, because we compare the performance of hedge funds against other risk-arbitrage benchmarks such as the value-weighted risk-arbitrage index and the performance of non–hedge fund arbitrageurs, we are assuming that hedge funds' transaction costs are the same as those of the benchmark strategies. To verify this assumption, we control in the cross-sectional tests for the deal characteristics, such as deal type and target firm size, between hedge funds and non–hedge funds and find that these characteristics do not explain the difference between the returns of hedge funds and those of the risk-arbitrage benchmarks.

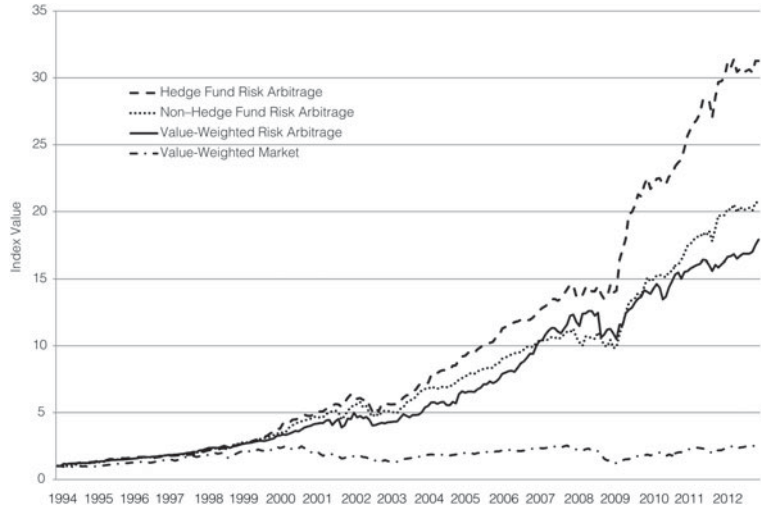
Figure 3 plots the time series of the cumulative returns for the hedge fund risk-arbitrage portfolio, the non–hedge fund risk-arbitrage portfolio, and the naive value-weighted risk-arbitrage portfolio. For comparison, the figure also shows the CRSP value-weighted index.

Figure 3 reveals a striking performance difference between hedge fund and non–hedge fund arbitrageurs. Whereas the terminal value of investing $1 in the hedge fund risk-arbitrage strategy from 1994 to 2012 is $31.27, the terminal value of investing $1 in the non–hedge fund risk-arbitrage strategy over the same time period is only $20.69. The figure also illustrates that each of the risk-arbitrage portfolios outperforms the market over our sample period. For example, the terminal value of investing $1 in the CRSP value-weighted index at the beginning of 1994 through the end of 2012 is $2.54, whereas the terminal value of investing $1 in the naive risk-arbitrage strategy is $17.90. Although the naive risk-arbitrage

FIGURE 3

Cumulative Returns from Hedge Fund and Non–Hedge Fund Risk Arbitrage

Figure 3 plots the value of $1 invested at the beginning of 1994 through Dec. 2012 in a hedge fund risk-arbitrage portfolio. For comparison, we also plot the following: i) a hedge fund risk-arbitrage portfolio, ii) a non–hedge fund risk-arbitrage portfolio, iii) a naive value-weighted risk-arbitrage portfolio, and iv) a CRSP value-weighted index. The hedge fund and non–hedge fund risk-arbitrage portfolios are replicated based on the institutional holdings of target stocks from quarterly 13F reports. It is assumed that arbitrageurs invest in targets 2 days after a deal announcement and hold target shares until the deals are either completed or withdrawn. Value-weighted risk-arbitrage returns are calculated under the assumption that investors hold all active deals in proportion to their market value. The portfolios are rebalanced quarterly and when deals are announced, completed, or withdrawn.



returns are consistent with prior research on the risk-arbitrage strategy (e.g., Mitchell and Pulvino (2001), Baker and Savasoglu (2002)), which finds that risk-arbitrage strategy significantly outperforms the market, we document an intriguing difference in performance between hedge fund and non–hedge fund arbitrageurs.

Next, we examine the time series of the risk-arbitrage returns of each portfolio to investigate whether there is a significant difference in risk-adjusted returns (alphas) between the hedge fund and non–hedge fund portfolios and between the hedge fund and naive risk-arbitrage portfolios. Specifically, we regress the portfolio risk-arbitrage returns on the Fama–French (1992)–Carhart (1997) 4 factors:

$$(5) \qquad R_{pt} - R_{ft} = \alpha + \beta_{\text{MKT}}\left(R_{\text{MKT}_t} - R_{ft}\right) + \beta_{\text{SMB}}R_{\text{SMB}_t} + \beta_{\text{HML}}R_{\text{HML}_t} + \beta_{\text{MOM}}R_{\text{MOM}_t} + \varepsilon_t,$$

where R_{MKT} is the monthly return on the CRSP value-weighted portfolio of all New York Stock Exchange, American Stock Exchange, and NASDAQ stocks; R_{SMB}, R_{HML}, and R_{MOM} are the returns on value-weighted, zero-investment, and factor-mimicking portfolios for size, book-to-market equity, and 1-year momentum in stock returns, respectively; and R_f is the risk-free rate.

Table 5 presents the coefficient estimates from the time-series regressions. The hedge fund portfolio delivers the highest risk-adjusted return, of 1.18% per month (15.12% annually), followed by the non–hedge fund portfolio (0.95% per month, or 12.01% annually) and the naive risk-arbitrage portfolio (0.89% per month, or 11.22% annually). The difference between the hedge fund and

TABLE 5

Time-Series Regression of Target Returns on Common Risk Factors

Table 5 reports the results of time-series regressions of risk-arbitrage excess returns from 2 days postannouncement until either deal completion or withdrawal on common risk factors. The portfolios are rebalanced quarterly and when deals are announced, completed, or withdrawn. New deals enter the portfolio 2 days following deal announcement and leave the portfolio upon deal completion or withdrawal. The description of risk-arbitrage returns can be found in Section IV. The Fama–French (1992)–Carhart (1997) 4-factor model used is

$$R_{pt} - R_{ft} = \alpha + \beta_{MKT}(R_{MKTt} - R_{ft}) + \beta_{SML}R_{SMBt} + \beta_{HML}R_{HMLt} + \beta_{MOM}R_{MOMt} + \varepsilon_t.$$

The hedge fund arbitrage returns (HF) replicate the performance of the target portfolio held by hedge funds as measured by their holdings disclosed in 13F filings. The non–hedge fund arbitrage returns (NON_HF) replicate the target portfolio held by non–hedge fund arbitrageurs. Both portfolios are weighted by the change in arbitrageur holdings in the target firm from the quarter before deal announcement until the quarter following announcement. VW_ARB represents the value-weighted portfolio returns for all deals. The coefficient estimates are presented with Newey–West (1987) standard errors in parentheses. The 7 lags are used to determine the reported standard errors. The coefficient α is measured in percentages per month. There are 228 monthly observations from 1994 to 2012. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Category	α	β_{MKT}	β_{SMB}	β_{HML}	β_{MOM}	R^2
Panel A. Arbitrage Returns						
HF	1.18***	0.29***	0.10	−0.04	−0.05	0.27
	(0.20)	(0.06)	(0.06)	(0.06)	(0.03)	
NON_HF	0.95***	0.34***	0.05	0.06	−0.06*	0.36
	(0.16)	(0.05)	(0.06)	(0.05)	(0.03)	
VW_ARB	0.89***	0.32***	0.00	0.09	0.03	0.16
	(0.16)	(0.05)	(0.07)	(0.08)	(0.04)	
Panel B. Spread Returns						
HF − VW	0.30*	−0.02	0.11	−0.13*	−0.08**	0.05
	(0.16)	(0.05)	(0.07)	(0.07)	(0.04)	
NON_HF − VW	0.07	0.03	0.05	−0.03	−0.08***	0.03
	(0.15)	(0.05)	(0.07)	(0.07)	(0.03)	
HF − NON_HF	0.23**	−0.05	0.05	−0.10***	0.01	0.04
	(0.11)	(0.03)	(0.03)	(0.03)	(0.02)	

non–hedge fund returns is positive and significant at the 5% level, showing that M&A hedge funds significantly outperform non–hedge funds pursuing the risk-arbitrage strategy by 0.23% per month (2.8% annually). Hedge funds also significantly outperform the naive risk-arbitrage benchmark by 0.30% per month (3.7% annually), whereas non–hedge funds fail to outperform the naive benchmark. When we analyze risk-arbitrage returns during 1994–2006 and 2007–2012, we find that the spread between hedge fund and non–hedge fund risk-arbitrage performance remains close to 0.30% per month and statistically significant at the 5% level in both subperiods.

V. Explanations of Investment Performance: Do Hedge Funds Affect the Outcome of Merger Deals?

We turn next to the determination of the sources of superior hedge fund performance in risk arbitrage. One possible explanation of hedge funds' success at investing in risk arbitrage is that their managers possess superior skills and buy into mergers that are most likely to succeed. According to this explanation, hedge funds earn abnormal returns because of their superior ability to predict acquisition outcomes. Another explanation is that hedge funds cannot predict the outcomes of acquisitions, but their involvement in the acquisitions affects the outcomes. For example, Cornelli and Li (2002) argue that the very presence of uninformed

arbitrageurs causes an increase in the likelihood of merger deal completion, because arbitrageurs are more likely to tender. Gomes (2012) develops a dynamic model of tender offers in which the accumulation of shares by arbitrageurs increases their bargaining power vis-à-vis the bidder, forcing the acquirer to pay a higher takeover premium. Both these theories suggest a positive relation between risk-arbitrage holdings, the probability of deal completion, and takeover premiums.

Analyzing the aggregate holdings of arbitrageurs, Hsieh and Walking (2005) find evidence of both the passive investing and active influence of arbitrageurs on the terms and outcomes of acquisitions. We extend the authors' pioneering approach to examine whether hedge fund arbitrageurs earn higher returns than non–hedge fund arbitrageurs because of hedge fund managers' superior investment skills or hedge funds' greater impact on the outcomes of acquisitions. Similar to Hsieh and Walking, we use a simultaneous equation framework with 2-stage least-squares (2SLS) estimation to recognize the endogeneity of hedge fund holdings and deal outcomes.[5] However, rather than seeking an explanation of abnormal returns in risk arbitrage, we focus our attention on explaining the performance difference between hedge fund and non–hedge fund arbitrageurs. Specifically, we estimate the following model:

$$\begin{aligned}
(6)\quad \Delta\text{HF_HLDGS}_i &= \gamma_o + \gamma_1\text{PREMIUM}_i + \gamma_2\text{COMPLETION}_i \\
&\quad + \gamma_3\text{DURATION}_i + \sum_{j=4,k} \gamma_j X_{ij} + \varepsilon_i, \\
(7)\quad \Delta\text{NON_HF_HLDGS}_i &= \delta_o + \delta_1\text{PREMIUM}_i + \delta_2\text{COMPLETION}_i \\
&\quad + \delta_3\text{DURATION}_i + \sum_{j=4,k} \delta_j X_{ij} + \tau_i, \\
(8)\quad \text{PREMIUM}_i &= \alpha_o + \alpha_1\Delta\text{HF_HLDGS}_i \\
&\quad + \alpha_2\Delta\text{NON_HF_HLDGS}_i + \sum_{j=2,k} \alpha_j X_{ij} + e_i, \\
(9)\quad \text{COMPLETION}_i &= \eta_o + \eta_1\Delta\text{HF_HLDGS}_i \\
&\quad + \eta_2\Delta\text{NON_HF_HLDGS}_i + \sum_{j=2,k} \eta_j X_{ij} + \kappa_i, \\
(10)\quad \text{DURATION}_i &= \theta_o + \theta_1\Delta\text{HF_HLDGS}_i \\
&\quad + \theta_2\Delta\text{NON_HF_HLDGS}_i + \sum_{j=2,k} \theta_j X_{ij} + \xi_i.
\end{aligned}$$

In this system, ΔHF_HLDGS is the change in hedge fund arbitrageurs' ownership from the quarter prior to deal announcement until the following quarter, and ΔNON_HF_HLDGS is a similar measure for other arbitrageurs; PREMIUM is the takeover premium calculated as the offer price minus the price 20 days prior to the takeover announcement standardized by the target price 2 days after the announcement; COMPLETION is an indicator variable that takes a value of 1

[5]We also estimate the equations with 3-stage least squares (3SLS) and find similar results. These results are available from the authors.

for a completed offer, and 0 otherwise; DURATION is the natural logarithm of 1 plus the number of days between deal announcement and deal resolution; and the vector X_{ij} contains control variables, including ln(CASH), INDUSTRY, an indicator for STOCK_DEAL, MARKET_TO_BOOK, LEVERAGE, and ROA, with i referring to the ith deal.

The issue of endogeneity arises in testing whether hedge fund and non–hedge fund ownership has a causal effect on acquisition outcomes.[6] Econometrically, the endogeneity problem amounts to a nonzero correlation between the disturbances of equations (6) through (10). For example, if hedge fund arbitrageurs conduct extensive research and have superior skill in processing information that is related to deal completion probability, the error term in equation (9) will have a nonzero correlation with the error term in equation (6). Consequently, the estimated coefficient η_1 will be biased.

To obtain identification, we need instrumental variables that predict hedge fund holdings but do not affect outcome variables other than through the effect of hedge funds. Following Hsieh and Walkling (2005), we instrument for the change in hedge fund (non–hedge fund) holdings by the number of hedge fund (non–hedge fund) arbitrageurs who stand ready to invest in risk arbitrage at each point in time and by deal size. In combination with deal size, the number of arbitrageurs predicts the fraction of outstanding shares that arbitrageurs can purchase in each deal. Target run-up returns prior to deal announcement are used to instrument for the deal premium, and deal attitude as measured by the indicator of hostile deals in the SDC database is used as an instrument for deal completion. To instrument for deal duration, we use an indicator for the presence of a large institutional block holder. Large block holders are able to facilitate deals and sell large blocks, allowing for a faster transaction process, but they do not directly impact other deal characteristics such as the takeover premium or the completion probability.[7]

If hedge fund managers possess superior skill in predicting acquisition outcome, the changes in hedge fund ownership from the quarter prior to deal announcement until the quarter following deal announcement should be positively related to deal completion. In that case, the coefficient of deal completion in equation (6) should be positive ($\gamma_2 > 0$). In addition, hedge fund managers may have the ability to select acquisitions that are likely to be completed quickly and result in the payment of a large takeover premium, implying that $\gamma_3 > 0$ or $\gamma_1 > 0$. We therefore test the null hypothesis $\gamma_1 = 0$, $\gamma_2 = 0$, and $\gamma_3 = 0$ against the alternative hypothesis that hedge fund managers possess superior skill in predicting deal outcomes.

On the other hand, the argument that hedge fund involvement affects the outcomes of acquisitions implies a causal relation between the change in hedge fund holdings and the takeover premium, completion probability, or deal duration. Econometrically, such an argument implies that the slope coefficients of the change in hedge fund holdings are positive in equation (8), (9), or (10); that is,

[6]Roberts and Whited (2012) provide an excellent review of the methods used to address endogeneity concerns in corporate finance.

[7]We acknowledge that no exogenous variable is likely to perfectly satisfy the exclusion restriction. The simultaneous equation estimation mitigates but may not fully address the endogeneity problem.

$\alpha_1 > 0$, $\eta_1 > 0$, or $\theta_1 > 0$. Thus, we test the null hypothesis that $\alpha_1 = 0$, $\eta_1 = 0$, and $\theta_1 = 0$ against the alternative hypothesis that hedge fund ownership affects the outcomes of takeover deals.

An important question for explaining hedge funds' superior performance in risk arbitrage is whether the holdings of hedge fund arbitrageurs differ from the holdings of non–hedge fund arbitrageurs in relation to acquisition outcomes. We therefore include in the system an equation for non–hedge fund holdings (equation (7)). As for hedge fund holdings, we test the null hypothesis that $\delta_1 = 0$, $\delta_2 = 0$, and $\delta_3 = 0$ against the alternative hypothesis that non–hedge fund managers possess superior skill in predicting deal outcomes and the null hypothesis that $\alpha_2 = 0$, $\eta_2 = 0$, and $\theta_2 = 0$ against the alternative hypothesis that non–hedge fund ownership affects the outcomes of takeover deals.

The estimation results of the simultaneous equations are reported in Panel A of Table 6, separately for hedge funds and other institutional arbitrageurs (columns 4 and 5). Overall, the coefficient estimates reveal several interesting facts about the relation between the positions of arbitrageurs and acquisition outcomes. We first turn to the examination of the causal effect of hedge fund risk-arbitrage positions on deal outcomes. As shown in the first three columns in Panel A, the change in hedge fund holdings from the quarter-end prior to deal announcements to the quarter-end following the deal announcements is significantly related to the probability of deal completion, whereas there is no significant relation with the takeover premium or the deal duration after accounting for the endogeneity of hedge fund holdings. This finding is consistent with the hedge fund activism literature (e.g., Brav, Jiang, Partnoy, and Thomas (2008)), in that hedge fund involvement affects the outcome of takeover deals.

Turning now to the examination of hedge funds' deal-selection skills, as shown in column 4 in Table 6, there is no significant relation between the changes in hedge fund holdings and the probability of deal completion or takeover premiums. Thus, the findings do not support the hypothesis that hedge fund managers are able to select deals that are more likely to be completed or invest in deals that pay a high takeover premium when completed. However, we find a significant negative coefficient of -7.74 on deal duration in column 4. This finding supports the view that hedge funds are informed about deal durations and are able to invest in deals with faster resolutions.

We do not find a significant causal relation between the changes in non–hedge fund holdings after acquisition announcements and any of the deal outcomes in columns 1–3 of Table 6. The estimates for non–hedge fund arbitrageurs are shown in column 5. Similar to hedge funds, we find evidence in column 5 that non–hedge fund arbitrageurs are informed about deal duration.

In Panel B of Table 6, we present the results for tests in the difference of the coefficients between the effects of hedge fund and non–hedge fund holdings on deal outcomes (activism) and between the deal-selection abilities of hedge fund and non–hedge fund managers (information). First we test for a difference between hedge fund and non–hedge fund arbitrageurs in the effect on deal outcomes, including the merger premium, deal-completion probability, and duration. In all three instances we fail to reject the hypothesis that hedge funds have a different effect on deal outcomes than on non–hedge funds.

TABLE 6

Simultaneous Equation Estimation of Arbitrageur Holdings and Deal Characteristics by Arbitrageur Type

Table 6 presents the simultaneous equation estimation results of the takeover premium, probability of deal completion, merger deal duration, and risk-arbitrageur holdings for both hedge funds and non–hedge funds. The 2SLS method is used to estimate the system. A linear model is used to estimate the probability of deal success. The dependent variable for deal completion equals 1 if the announced deal is completed, and 0 otherwise. The variable DAYS is the number of days from deal announcement until deal completion or withdrawal. The change in holdings (ΔHF_HLDGS, ΔNON_HF_HLDGS) is the difference between the percentages of target shares held in the quarter-ends following and prior to the deal announcement. The number of arbitrageurs (NO_OF_HF, NO_OF_NON_HF) represents the number of hedge fund and non–hedge fund arbitrageurs, respectively, that increase their holdings in the target stock from the quarter prior to the deal announcement until the quarter following. Panel A presents the results of simultaneous equation estimation, and Panel B tests for differences in the coefficient estimates. The sample is made up of 2,186 merger deals during our sample period. All other control variables are described in Table 3. The standard errors are in parentheses. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. Simultaneous Equation Estimation

Variables	PREMIUM 1	COMPLETION 2	ln(1 + DAYS) 3	ΔHF_HLDGS 4	ΔNON_HF_HLDGS 5
PREMIUM		0.09 (0.07)	−0.29*** (0.11)	−1.82 (1.18)	−0.31 (0.64)
COMPLETION	0.04 (0.17)		−0.5** (0.22)	2.86 (2.14)	2.27 (1.17)
ln(1 + DAYS)	−0.38*** (0.14)	−0.27** (0.12)		−7.74*** (2.66)	−2.59* (1.37)
ΔHF_HLDGS	−0.00 (0.00)	0.01*** (0.00)	0.00 (0.01)		−0.03 (0.03)
ΔNON_HF_HLDGS	0.01 (0.01)	0.01 (0.01)	0.01 (0.01)	−0.02 (0.11)	
RUN-UP	0.63*** (0.06)				
ATTITUDE		−0.17*** (0.03)			
BLOCK_HOLDER			−0.1*** (0.03)		
ln(1 + NO_OF_HF)				3.54*** (0.21)	
ln(1 + NO_OF_NON_HF)					2.15*** (0.12)
ln(SIZE)				−0.24*** (0.04)	−0.12*** (0.02)
ln(CASH)	−0.02* (0.01)	−0.01 (0.01)	−0.05*** (0.01)	−0.24 (0.16)	0.02 (0.08)
INDUSTRY	0.05** (0.02)	0.04* (0.02)	0.09*** (0.03)	0.26 (0.34)	−0.23 (0.18)
STOCK_DEAL	0.04 (0.03)	0.06*** (0.02)	0.14*** (0.03)	0.12 (0.45)	−0.22 (0.24)
MARKET-TO-BOOK	−0.01 (0.00)	0.00 (0.00)	−0.01* (0.01)	−0.17*** (0.06)	−0.09** (0.03)
LEVERAGE	0.04 (0.06)	0.09* (0.05)	0.26*** (0.06)	0.73 (0.86)	0.11 (0.46)
ROA	−0.04 (0.03)	−0.02 (0.03)	0.02 (0.04)	0.27 (0.42)	0.12 (0.22)

Panel B. Tests for Differences in Coefficients

Coefficients	*F*-Statistic	*p*-Value
Activism: ΔHF_HLDGS versus ΔNON_HF_HLDGS Affecting Deal Outcomes		
PREMIUM	0.72	0.40
COMPLETION	0.00	0.95
ln(1 + DAYS)	0.10	0.75
Information: Deal Outcomes Affecting ΔHF_HLDGS versus ΔNON_HF_HLDGS		
PREMIUM	1.28	0.26
COMPLETION	0.06	0.81
ln(1 + DAYS)	2.98	0.08*

Next we test for differences between how informed hedge funds and non–hedge funds are about deal outcomes by comparing the outcome coefficients (premium, completion, duration) between the hedge fund and non–hedge fund equations. We fail to find a difference between how informed hedge funds and non–hedge funds are about the deal premium and deal-completion probability. Although both groups of arbitrageurs are informed about deal duration, the test for the difference in the coefficients shows that hedge funds are more informed about deal duration than non–hedge funds, but the difference is significant only at the 10% level. Overall, we find no significant difference between the informativeness of hedge fund and non–hedge fund risk-arbitrage positions about the merger premium and deal-completion probability, and we fail to reject the hypothesis that hedge funds affect any of the deal outcomes differently than non–hedge funds.

So far we have used the 2SLS method and estimated both the probability of deal completion and deal duration with linear models. We note that linear models may generate nonplausible fitted values. To address this concern, we estimate nonlinear models that are better suited to fit binary or censored dependent variables. Specifically, we estimate the probability of deal completion with a probit model with a dependent variable that takes a value of 1 for a completed deal, and 0 otherwise. The estimated model is

$$\Phi^{-1}(\text{COMP}_i) = \beta_1 + \beta_2 \Delta\text{HF\_HLDGS}_i^* + \beta_3 \Delta\text{NON\_HF\_HLDGS}_i^* + \sum_{j=1,k} \gamma_j \text{CTRL}_{i,j} + e_i, \tag{11}$$

where the variables $\Delta\text{HF\_HLDGS}_i^*$ and $\Delta\text{NON\_HF\_HLDGS}_i^*$ are the fitted values for the change in arbitrageur holdings for deal i. These fitted values are from a first-stage regression that uses the number of arbitrageurs and deal size as instruments and includes the other exogenous variables listed in Table 6.

We also use an exponential duration model to measure the impact of hedge fund ownership on deal-completion duration, which is measured as the number of days between deal announcement and resolution:

$$S(t)_i = \exp\left\{\beta_1 + \beta_2 \Delta\text{HF\_HLDGS}_i^* + \beta_3 \Delta\text{NON\_HF}_i^* + \sum_{j=1,k} \gamma_j \text{CTRL}_{ji}\right\} + u_i, \tag{12}$$

where $S(t)_i$ denotes the survival time of deal i, or the time from announcement until deal resolution, and the fitted values for the change in the arbitrageur's holdings are represented by $\Delta\text{HF\_HLDGS}_i^*$ and $\Delta\text{NON\_HF\_HLDGS}_i^*$.

Similar to the 2SLS estimation, we account for the endogenous relationships between institutional holdings and the outcome variables in the estimation of the probit and exponential duration models. Specifically, we instrument for the changes in hedge fund (non–hedge fund) holdings with the fitted values from the first-stage regressions of the changes in hedge fund (non–hedge fund) holdings on the number of hedge fund (non–hedge fund) arbitrageurs and deal size.

The results from nonlinear estimations of the duration and deal completion models are reported in Table 7. The estimation results differ from those from the 2SLS in that we find evidence that non–hedge fund investments affect deal outcomes. In particular, the probability of deal completion is positively and significantly related to the changes in non–hedge fund holdings, and deal duration is negatively and significantly related to the changes in non–hedge fund holdings. After we take into account the endogenous relationship between hedge fund holdings and deal outcome, we find no evidence that hedge funds affect deal outcome with their investments in acquisition targets in nonlinear models of merger outcome. Thus, the ability to affect the outcome of merger deals does not appear to be the source of superior hedge fund performance.

TABLE 7

Nonlinear Models of Deal Duration and Deal Completion

Column 1 of Table 7 presents the estimation of an exponential duration model for deal duration as a function of changes in arbitrageurs' holdings and other deal characteristics. A change in holdings is the difference between the percentages of target shares held in the quarter-ends following and prior to the deal announcement. Column 2 presents the estimation results of a probit regression of merger success on changes in target holdings by risk arbitrageurs and other deal characteristics:

$$S(t)_i = \exp\left\{\beta_1 + \beta_2 \Delta\text{HF\_HLDGS}_i^* + \beta_3 \Delta\text{NON\_HF\_HLDGS}_i^* + \sum_{j=1,k} \gamma_j \text{CTRL}_{ji}\right\} + u_i,$$

$$\Phi^{-1}(\text{COMP}_i) = \beta_1 + \beta_2 \Delta\text{HF\_HLDGS}_i^* + \beta_3 \Delta\text{NON\_HF\_HLDGS}_i^* + \sum_{j=1,k} \gamma_j \text{CTRL}_{ji} + e_i.$$

The dependent variable equals 1 if the announced deal is completed, and 0 otherwise. The changes in hedge fund and non–hedge fund arbitrageurs' holdings are instrumented with fitted values from first-stage regressions where deal size and the number of arbitrageurs investing in a merger deal are used as instrumental variables. The first-stage regression also includes the other exogenous variables used in the second-stage model presented. The estimated marginal effects for each variable are presented, with heteroskedasticity-robust standard errors in parentheses. All control variables are described in Table 3. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	Duration	Completion
Variables	1	2
COMPLETION	−9.51	
	(5.97)	
ln(1 + NO_OF_DAYS)		0.02**
		(0.01)
ΔHF_HLDGS	76.33	0.00
	(70.68)	(0.39)
ΔNON_HF_HLDGS	−484.97***	3.03***
	(129.19)	(0.73)
BLOCK_HOLDER	−9.95*	
	(5.44)	
ATTITUDE		−0.20***
		(0.04)
PREMIUM	−1.50	0.01
	(4.56)	(0.01)
ln(CASH)	−5.30***	0.00
	(0.99)	(0.00)
INDUSTRY	9.20***	0.02
	(2.57)	(0.01)
STOCK_DEAL	2.24	0.02
	(2.85)	(0.01)
MARKET-TO-BOOK	−1.30***	0.00
	(0.35)	(0.00)
LEVERAGE	30.05***	0.00
	(6.23)	(0.03)
ROA	9.62***	−0.04
	(3.23)	(0.02)

VI. Downside Risk in Merger Arbitrage

In a simple model of risk arbitrage, expected returns can be written as follows:

$$\mathrm{E}(R_a) = \mathrm{E}(R_c)\pi + \mathrm{E}(R_w)\,(1-\pi)\,, \tag{13}$$

where R_a is the arbitrage return, R_c is the return if the deal is completed, R_w is the return if the deal is withdrawn, and π is the probability of deal success. All three determinants of expected risk-arbitrage returns are unknown to investors ex ante. In the previous section we found that hedge funds do not have superior estimates of π compared with other institutional arbitrageurs. In this section we explore whether the superior performance of hedge funds in risk arbitrage comes from their ability to more precisely estimate R_c or R_w.

Mitchell and Pulvino (2001) argue that excess returns to risk arbitrage could compensate investors for downside risk. The downside risk stems from deal withdrawals, when the merger fails to materialize and target stock price drops to the target's stand-alone value. We investigate whether hedge fund managers possess skills to manage downside risk better than those of other arbitrageurs and possess a superior ability to estimate risk-arbitrage returns when deals are withdrawn (R_w).

In addition to the time-series analysis of risk-arbitrage returns, we compare the performance of hedge fund and non–hedge fund arbitrageurs in the cross section of merger deals. This test allows us to measure the impact of the level of arbitrageur holdings on deal returns and to understand why hedge fund arbitrageurs are able to outperform non–hedge fund arbitrageurs. The risk-arbitrage returns used in the cross-sectional analysis are measured similarly to those used in the time-series analysis and described in Section IV. Because each deal spans a different time interval, the returns are converted to a monthly return based on 21 trading days per month, as follows:

$$R_{\mathrm{RA,monthly}} = \left(1 + R_{\mathrm{RA,total}}\right)^{21/\mathrm{NO\_OF\_DAYS}}, \tag{14}$$

where NO_OF_DAYS is the deal duration measured by the number of trading days used to create the risk-arbitrage returns.

The returns are measured while the deals remain active, during a period that starts 2 days after deal announcement and ends with deal resolution, through either completion or withdrawal.[8] As a result, the returns span different periods and extend over different event-window lengths. Equation (14) converts risk-arbitrage returns to a monthly basis, allowing for better comparison. The risk-arbitrage returns used in the cross-sectional analysis are measured in excess of the market return.

To examine the relationship between downside risk in risk arbitrage and arbitrageur investment, we estimate the following cross-sectional regression model for the cumulative market excess returns to each target over the risk-arbitrage investment period:

[8]We also perform a robustness check using the quarter before deal resolution as the final quarter and find similar results.

$$
\begin{aligned}
(15) \qquad R_i - R_b \;=\; & \beta_1 + \beta_2 \Delta \text{HF\_HLDGS}_i \times \text{WITHDRAWN}_i \\
& + \beta_3 \Delta \text{HF\_HLDGS}_i \times \text{COMPLETED}_i \\
& + \beta_4 \Delta \text{NON\_HF\_HLDGS}_i \times \text{WITHDRAWN}_i \\
& + \Delta \text{NON\_HF\_HLDGS}_i \times \text{COMPLETED}_i \\
& + \beta_6 \text{COMPLETED}_I + \sum_{j=1,k} \gamma_j \text{CTRL}_{ij} + e_i,
\end{aligned}
$$

where R_i is the monthly risk-arbitrage returns to deal i, R_b is the monthly market return, and ΔHF_HLDGS$_i$ and ΔNON_HF_HLDGS$_i$ are the changes in hedge fund and non–hedge fund holdings, respectively. The changes in arbitrageurs' holdings are interacted with deal outcome (completion or withdrawal), which allows us to determine whether hedge funds are able to avoid deals with the largest downside in risk arbitrage. For ease of presentation, excess returns are multiplied by 100. The set of control variables, listed in Section III.A, includes a number of target and deal characteristics that can affect returns to risk arbitrage.

The results without the interaction term are presented in the first column of Table 8. These results confirm the earlier findings of our paper that risk-arbitrage excess returns are positively associated with hedge fund arbitrageurs' holdings, but not with non–hedge fund arbitrageurs' holdings. The coefficient estimate for the change in hedge fund arbitrageur holdings is 3.98 and significant at the 5% level. This means that for a 1-standard-deviation increase in hedge fund ownership, the monthly risk-arbitrage return increases by 0.23% ($3.98 \times 10^{-2} \times 5.79\%$). The relationship between non–hedge fund arbitrageur investment and risk-arbitrage returns is not significant.

Column 2 of Table 8 reports the estimates that allow for an interaction between arbitrageur holdings and deal outcome. These estimates reveal a more nuanced relation between arbitrageur holdings and risk-arbitrage returns. The coefficient for hedge fund investment in withdrawn deals is 32.73 and significant at the 5% level. Conditional on a deal withdrawal, a 1-standard-deviation increase in hedge fund holdings increases the monthly risk-arbitrage return by 1.42% ($32.73 \times 10^{-2} \times 4.34\%$). Clearly, the effect of hedge funds' investment in deals that are subsequently withdrawn is 6 times larger than the effect of hedge funds' investment in the sample of all deals (0.23%, as indicated earlier). In addition, there is a negative and significant coefficient (-4.25) for the change in non–hedge fund arbitrageur holdings when deals are completed, but we do not find a significant result for hedge funds. This result indicates that non–hedge fund arbitrageurs may be facing the limits of arbitrage in their investments because greater non–hedge fund holdings result in diminishing returns, whereas hedge funds do not face diminishing returns.

Based on the results reported in column 2 of Table 8, we find a significant performance difference (at the 5% level) between hedge fund and non–hedge fund investments for deals that are ultimately withdrawn, but not for completed deals. Thus, hedge fund managers appear to be more skillful at managing the downside risk associated with deal withdrawals than non–hedge fund managers are. It is this ability of hedge fund managers to limit downside risk that explains hedge funds' superior performance in risk arbitrage.

TABLE 8

Cross-Sectional Regressions of Target Stock Return on Arbitrageurs' Investment

Table 8 provides the results from the cross-sectional regressions of risk-arbitrage market excess returns from 2 days after the announcement until deal completion or withdrawal on changes in risk-arbitrageur holdings and on other deal characteristics. Column 1 shows the effect of arbitrageurs' investments on excess returns across all deals, whereas column 2 shows the effect separately for completed (COMPLETED) and withdrawn (WITHDRAWN) deals. The descriptions of the other variables are provided in Table 3. The sample is made up of 2,186 merger deals during our sample period. Heteroskedasticity-robust standard errors are in parentheses. For ease of presentation, excess returns are multiplied by 100. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

	1	2
ΔHF_HLDGS	3.98**	
	(1.83)	
ΔNON_HF_HLDGS	−1.38	
	(2.61)	
ΔHF_HLDGS × WITHDRAWN		32.73**
		(15.27)
ΔHF_HLDGS × COMPLETED		0.49
		(1.40)
ΔNON_HF_HLDGS × WITHDRAWN		7.44
		(22.62)
ΔNON_HF_HLDGS × COMPLETED		−4.25*
		(2.19)
COMPLETED		3.91***
		(0.85)
PREMIUM	0.32	0.30
	(0.63)	(0.60)
ATTITUDE	1.56***	2.34***
	(0.52)	(0.59)
ln(CASH)	0.13*	0.11
	(0.07)	(0.07)
BLOCK_HOLDER	0.28	0.35
	(0.29)	(0.28)
INDUSTRY	−0.06	−0.10
	(0.22)	(0.21)
STOCK_DEAL	0.26	0.25
	(0.26)	(0.25)
ln(SIZE)	0.15***	0.19***
	(0.04)	(0.04)
MARKET-TO-BOOK	−0.10**	−0.12**
	(0.05)	(0.05)
LEVERAGE	−0.03	−0.11
	(0.45)	(0.44)
ROA	−0.96	−1.01
	(1.08)	(1.08)
R^2	0.01	0.05

To understand how hedge funds estimate arbitrage returns for withdrawn deals, we have sorted all failed takeovers in our sample by whether the target firm is subsequently bid for by another acquirer within 1 year following the original failed takeover attempt. We present these results in Table 9. The table shows that returns are significantly greater for failed deals if the target firm becomes an acquisition target again within a year from the original deal failure. The table also documents that hedge funds are significantly more likely to invest in deals with future acquisition bids than in other deals. In contrast, non–hedge fund investments in future targets and other deals are not significantly different.

In summary, these results suggest that the source of hedge funds' outperformance of other institutional arbitrageurs comes from their ability to successfully manage the downside risk that is associated with deal cancellations. Hedge fund

TABLE 9

Arbitrageurs' Investments and Future Takeover Activity of Failed Targets

Table 9 presents the average monthly risk-arbitrage returns for failed takeovers sorted by whether the target company is subsequently bid for by another acquirer in the year following the initial failed takeover. Also shown is the average change in arbitrageurs' investments for hedge funds and other institutional arbitrageurs. Differences between the subsequent takeover targets and other failed deals are presented, along with tests for their statistical significance. ***, **, and * indicate significance at the 1%, 5%, and 10% levels, respectively.

Variables	Future Targets	Other Failed	Difference	*t*-Statistic
RETURN	2.37%	−4.45%	6.82%	5.05***
ΔHF_HLDGS	4.01%	1.82%	2.19%	3.96***
ΔNON_HF_HLDGS	1.59%	1.19%	0.41%	1.20
N	87	174		

arbitrageurs are more likely to invest in targets with greater expected returns conditional on a withdrawal. These targets frequently become subjects to future acquisition bids if the current offer fails. Although hedge funds follow investment strategies such as risk arbitrage with option-like payoffs and large downside risk, there is evidence that they are able to manage and limit the downside risk in risk arbitrage more successfully than other institutional investors that follow a similar strategy. These findings suggest that the management of downside risk is a potential source of superior hedge fund performance.

VII. Conclusions

Two important research questions have generated considerable debate in the hedge fund literature: i) Can hedge fund managers deliver superior performance, and ii) if yes, what are the nature and source of superior performance? Whereas some researchers find evidence of superior hedge fund performance based on self-reported returns, others use hedge fund holdings data and fail to find evidence that hedge funds outperform other institutional investors. This paper reconciles the conflicting findings from two strands of the literature and evaluates the performance of hedge funds against that of other institutional investors using the holdings data on a single investment strategy, namely, risk arbitrage. This approach allows us to use the holdings data more selectively and to conduct a better-suited comparison of the investment performance of sophisticated hedge fund managers and other institutional arbitrageurs.

In this paper, we use hand-collected data on arbitrageurs' holdings of target shares to study how risk arbitrage is implemented by hedge funds and other institutional investors such as broker–dealers, banks, and mutual funds. We find that hedge funds significantly outperform both non–hedge fund institutions and a naive risk-arbitrage portfolio on a risk-adjusted basis, whereas non–hedge funds fail to outperform a naive portfolio, suggesting that hedge fund managers can deliver superior performance.

We further examine the sources of hedge funds' superior performance and find no evidence that hedge funds are able to predict or affect the probability of deal completion any better than are non–hedge fund institutions. Furthermore, hedge funds' excess returns from risk arbitrage are not compensation for bearing greater risk. Our findings reveal that hedge fund managers follow strategies with

a lower risk profile than other risk arbitrageurs. Contrary to the view that hedge funds earn abnormal returns by taking on more risk than other investors, hedge funds' risk-arbitrage portfolios exhibit significantly less downside risk when deals are withdrawn than do non–hedge funds' risk-arbitrage portfolios. We conclude that hedge funds outperform other institutional arbitrageurs not by their ability to select the best deals, but rather by their ability to avoid the deals that experience the most negative returns in case of failure.

Finally, our results reconcile the conflicting findings between return-based and holdings-based evaluations of hedge fund performance regarding hedge funds' ability to outperform non–hedge fund institutions. This paper shows how the different findings can be reconciled by using the data on hedge fund holdings in a more targeted way to compute the actual returns associated with a specific hedge fund strategy. Our paper also contributes to the literature on risk arbitrage by showing that hedge funds play an increasingly important role in M&As; however, contrary to conventional wisdom, their role in risk arbitrage is not limited to accepting the downside risk that other investors avoid. Whereas hedge funds invest in target firms after announcements of mergers and takeovers, they eschew targets with the greatest downside risk. These findings call into question our understanding of the risk-bearing function of hedge funds in risk-arbitrage activities.

References

Ackermann, C.; R. McEnally; and D. Ravenscraft. "The Performance of Hedge Funds: Risk, Return, and Incentives." *Journal of Finance*, 54 (1999), 833–874.

Agarwal, V.; N. Daniel; and N. Naik. "Role of Managerial Incentives and Discretion in Hedge Fund Performance." *Journal of Finance*, 64 (2009), 2221–2256.

Agarwal, V., and N. Naik. "Multi-Period Performance Persistence Analysis of Hedge Funds." *Journal of Financial and Quantitative Analysis*, 35 (2000), 327–342.

Baker, M., and S. Savasoglu. "Limited Arbitrage in Mergers and Acquisitions." *Journal of Financial Economics*, 64 (2002), 91–115.

Bollen, N., and V. Pool. "Do Hedge Fund Managers Misreport Returns? Evidence from the Pooled Distribution." *Journal of Finance*, 64 (2009), 2257–2288.

Bollen, N., and R. Whaley. "Hedge Fund Risk Dynamics: Implications for Performance Appraisal." *Journal of Finance*, 64 (2009), 985–1035.

Brav, A.; W. Jiang; F. Partnoy; and R. Thomas. "Hedge Fund Activism, Corporate Governance, and Firm Performance." *Journal of Finance*, 63 (2008), 1729–1775.

Brown, S.; W. Goetzmann; R. Ibbotson; and S. Ross. "Survivorship Bias in Performance Studies." *Review of Financial Studies*, 5 (1992), 553–580.

Brown, S.; W. Goetzmann; and J. Park. "Careers and Survival: Competition and Risk in the Hedge Fund and CTA Industry." *Journal of Finance*, 56 (2001), 1869–1886.

Brunnermeier, M., and S. Nagel. "Hedge Funds and the Technology Bubble." *Journal of Finance*, 59 (2004), 2013–2040.

Busse, J.; A. Goyal; and S. Wahal. "Performance and Persistence in Institutional Investment Management." *Journal of Finance*, 65 (2010), 765–790.

Cao, C., and L. Petrasek. "Liquidity Risk and Institutional Ownership." *Journal of Financial Markets*, 21 (2014), 76–97.

Carhart, M. "On Persistence in Mutual Fund Performance." *Journal of Finance*, 52 (1997), 57–82.

Cornelli, F., and D. Li. "Risk Arbitrage in Takeovers." *Review of Financial Studies*, 15 (2002), 837–868.

Edelman, D.; W. Fung; and D. Hsieh. "Exploring Unchartered Territories of the Hedge Fund Industry: Empirical Analysis of Mega Hedge Fund Firms." *Journal of Financial Economics*, 109 (2013), 734–748.

Fama, E., and K. French. "The Cross-Section of Expected Stock Returns." *Journal of Finance*, 47 (1992), 427–465.

Fama, E., and K. French. "Industry Costs of Equity." *Journal of Financial Economics*, 43 (1997), 153–193.

Fung, W., and D. Hsieh. "Performance Characteristics of Hedge Funds and CTA Funds: Natural versus Spurious Bias." *Journal of Financial and Quantitative Analysis*, 35 (2000), 291–307.

Fung, W., and D. Hsieh. "The Risk in Hedge Fund Strategies: Theory and Evidence from Trend Followers." *Review of Financial Studies*, 14 (2001), 313–341.

Goetzmann, W.; J. Ingersoll; and S. Ross. "High-Water Marks and Hedge Fund Management Contracts." *Journal of Finance*, 58 (2003), 1685–1717.

Gomes, A. "Takeovers, Freezeouts, and Risk Arbitrage." Working Paper, Washington University in St. Louis (2012).

Griffin, J., and J. Xu. "How Smart Are the Smart Guys? A Unique View from Hedge Fund Stock Holdings." *Review of Financial Studies*, 22 (2009), 2531–2570.

Hsieh, J.; E. Lyandres; and A. Zhdanov. "A Theory of Merger-Driven IPOs." *Journal of Financial and Quantitative Analysis*, 46 (2011), 1367–1405.

Hsieh, J., and R. A. Walkling. "Determinants and Implications of Arbitrage Holdings in Acquisitions." *Journal of Financial Economics*, 77 (2005), 605–648.

Jagannathan, R.; A. Malakhov; and D. Novikov. "Do Hot Hands Exist among Hedge Fund Managers? An Empirical Evaluation." *Journal of Finance*, 65 (2010), 217–255.

Kosowski, R.; N. Naik; and M. Teo. "Do Hedge Funds Deliver Alpha? A Bayesian and Bootstrap Analysis." *Journal of Financial Economics*, 84 (2007), 229–264.

Liang, B. "On the Performance of Hedge Funds." *Financial Analysts Journal*, 55 (1999), 72–85.

Liang, B. "Hedge Funds: The Living and the Dead." *Journal of Financial and Quantitative Analysis*, 35 (2000), 309–326.

Mitchell, M., and T. Pulvino. "Characteristics of Risk and Return in Risk Arbitrage." *Journal of Finance*, 56 (2001), 2135–2175.

Newey, W. K., and K. D. West. "A Simple, Positive Definite, Heteroskedasticity and Autocorrelation Consistent Covariance Matrix." *Econometrica*, 55 (1987), 703–708.

Roberts, M., and T. Whited. "Endogeneity in Empirical Corporate Finance." In *Handbook of the Economics of Finance.* Amsterdam, The Netherlands: Elsevier (2012).