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Determinants and implications of arbitrage holdings in acquisitions☆

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Abstract

We find evidence of passive and active roles for arbitrageurs in the acquisition process. Using a simultaneous-equation framework to recognize endogeneity, we analyze 608 acquisition bids over the 1992–1999 period. Our results indicate that the change in arbitrage holdings is greater in successful offers. However, changes in arbitrage holdings are also related to the probability of success, bid premia, and arbitrage returns. In addition, the change in arbitrage holdings is positively associated with both revision returns and the occurrence of subsequent bids. Overall, we find that merger arbitrageurs play an important role in the market for corporate control.

JEL classification: G34; G14; D82

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1. Introduction

Nearly 15 years after the era of Ivan Boesky, the role of arbitrageurs in the acquisition process is receiving renewed attention in the financial literature. Existing empirical studies report significant and substantial positive arbitrage returns (see, e.g., Dukes et al., 1992; Karolyi and Shannon, 1999; Mitchell and Pulvino, 2001; Baker and Savasoglu, 2002; Jindra and Walkling, 2004). However, the role of arbitrageurs in the acquisition process remains unclear. Larcker and Lys (1987) suggest a passive role for arbitrageurs, arguing that superior ability to predict offer outcomes leads to their abnormal returns.

Recent theoretical work by Cornelli and Li (2002) and Gomes (2001) suggests an active role for arbitrageurs. Cornelli and Li develop an information-based model in which the information advantage that an arbitrageur possesses arises from his or her own holdings, and these holdings influence offer outcomes and deal characteristics. Gomes shows that arbitrageurs are capable of attaining hold-out power by accumulating large blocks of target shares. This potential threat forces bidders to offer higher takeover premia ex-ante. Thus, while the existing empirical literature demonstrates positive abnormal returns to arbitrage, the theoretical studies suggest testable hypotheses concerning the active involvement of arbitrageurs in the takeover process. In particular, Cornelli and Li and Gomes suggest that the change in arbitrage holdings is positively related to both the probability of deal success and the level of bid premia.

The primary objective of our research is to examine the role of arbitrageurs in the takeover process, testing empirical implications of Larcker and Lys, Cornelli and Li, and Gomes while controlling for the inherent endogeneity of key acquisition characteristics. We also investigate the factors that motivate arbitrage trading during acquisitions and the relation between arbitrage holdings and key takeover variables such as bid premia and arbitrage returns. As one example, a higher level of holdings can facilitate a takeover and provide greater arbitrage returns. Alternatively, increased competition among arbitrageurs could reduce returns. In the model of Cornelli and Li, arbitrageurs' profits initially increase when more arbitrageurs decide to participate. However, at some point, profits decline with increased competition among arbitrageurs.

Our methodology relies on an empirically based definition of arbitrageurs similar to that of Baker and Savasoglu (2002): Arbitrageurs are defined as those institutions that regularly increase their holdings of firms targeted for acquisition. Analyzing 608 offers over the 1992 to 1999 period, we find empirical evidence of an endogenous link among the changes in arbitrage holdings, bid premia, arbitrage returns, and offer outcomes. Arbitrage holdings increase in offers that are likely to be successful, even after controlling for the market's assessment of offer success. This is consistent with the work of Larcker and Lys (1987). At the same time, the change in arbitrage holdings is positively correlated with the probability of bid success, bid premia, and arbitrage returns. Thus, our results are consistent with both passive and active roles played by arbitrageurs. To the best of our knowledge, this is the first evidence to test the active influence of arbitrageurs and contrast the passive versus active arbitrage models.

Furthermore, we find that after controlling for deal attributes, arbitrageurs purchase fewer shares in large deals. However, the change in arbitrage holdings is not materially different in multiple-bidder cases or across categories of target management attitude. We also find a positive relation between initial changes in holdings and revision returns. Deals with a greater increase in arbitrage holdings over the first quarter of an acquisition are more likely to be revised. Additional findings indicate that if the initial deal is cancelled, the possibility of the target firm receiving a subsequent bid within one year is significantly correlated with the change in arbitrage holdings. The last two results are consistent with active arbitrage theories.

The remainder of the paper is organized as follows. Section 2 discusses related literature. Section 3 details the sample selection procedure and describes the basic characteristics of the sample. Section 3 also describes the empirical identification and distribution of arbitrageurs. Section 4 analyzes the determinants of the change in arbitrage holdings. Recognizing the endogeneity issue, we present a multivariate analysis in Section 4 that investigates four variables of interest in a simultaneous-equations framework. Section 5 presents robustness checks and extensions. Section 6 concludes.

2. Background and testable implications

2.1. Arbitrage returns

Merger arbitrageurs purchase a target company's stock in the hope of profiting from the deal. If the deal succeeds, arbitrageurs profit from the difference between the purchase price and the final selling price. In stock-swap deals, the purchase of target shares is often accompanied by shorting the acquirer's stock simultaneously.[1] Empirical studies on arbitrage returns report positive (and generally large) excess returns. Dukes et al. (1992) and Jindra and Walkling (2004) document annualized returns to arbitrageurs of 117% and 46.5%, respectively, for samples of cash tender offers. Baker and Savasoglu (2002) report an average annualized risk-adjusted return of 9.6% for a sample of cash and stock deals from 1981 to 1996. Using a portfolio of 37 mergers in Canada in 1997, Karolyi and Shannon (1999) document a 26% annualized return. In contrast, Mitchell and Pulvino (2001) find that merger arbitrage generates a 4% annualized excess return after taking into account transactions costs and controlling for different returns in hot and cold markets.

[1]This process is called merger (or risk) arbitrage. By definition, classic arbitrage refers to a simultaneous transaction in two separate markets without incurring risks. Two differences are noticed in risk arbitrage. First, the transactions of buying and tendering are not simultaneous as in the traditional arbitrage process. Arbitrageurs typically buy the target shares, wait until the effective date of the deal, and then tender the shares to the bidder. Second, takeover transactions could be cancelled; thus, their profit is not secure. If this happens, the target prices may drop and arbitrageurs may suffer large losses.

2.2. Active vs. passive roles of arbitrageurs

The explanation for these abnormal returns to arbitrageurs can be categorized by the roles they play in the acquisition process. *Passive arbitrageurs* do not influence acquisition outcomes or terms. In contrast, *active arbitrageurs* do influence acquisition terms and outcomes. In the paragraphs below we expand our discussion of these roles and explain their empirical implications.

There are two roles the passive arbitrageur could play in the acquisition process. In the first passive role, arbitrageurs are naïve investors, investing in deals that the market expects to succeed. These include friendly deals, deals with high bidder toeholds, and deals with low first-quarter spreads. Spread is defined as the percentage difference between offer price and market price, so that a low value implies a high expectation of offer success. Arbitrageurs subsequently increase their holdings if the probability of success improves. Thus, for multiple-quarter deals that are ultimately successful, we would observe a gradual increase in arbitrage holdings over time. We would also find a correlation between observable indicators of expected success (the change in the spread from one quarter to the next) and the change in arbitrage holdings.[2] In this explanation, arbitrageurs do not utilize superior predictive abilities to select profitable acquisitions but they earn positive returns simply as a matter of "the limits to arbitrage" (Shleifer and Vishny, 1997). Arbitrageurs are passive in the sense that their accumulation of holdings do not influence offer outcomes or bid characteristics.[3] With the exception of Larcker and Lys (1987), the returns described as arbitrage returns by previous research are generated using strategies available to all investors. In this sense, all of these results are consistent with this first passive role of arbitrageurs.

Motivation for employing a purely passive investment behavior is apparent in the well-documented research that such a strategy earns abnormal returns. However, it seems likely that arbitrageurs are more selective in their investments, concentrating on deals where the expected benefits of success (i.e., earning the spread and any revision returns) outweigh the costs of investment (including possible losses). Thus, arbitrageurs would be more likely to participate in deals in which their assessment indicates a greater probability of success than that implied by the spread. This is the approach of Larcker and Lys (1987). Under their explanation, arbitrageurs earn abnormal returns because of their superior ability to predict offer outcomes. Note that this is also a passive role since arbitrageurs do not influence the terms or outcomes of a deal. Using a sample of 94 SEC 13D filings from 1977 to 1983, Larcker and Lys show that the deals in which arbitrageurs invest have higher success rates than the expected probability of success implied in the market. As a result, arbitrageurs generate average excess returns of 5.3% on their portfolio positions from the transaction date to the resolution date.

[2]Of course, to the extent that the market knows the level of arbitrage trading and believes it has an impact on offer outcomes, this would also be reflected in the spread. We will discuss this in more detail in our multivariate analysis.

[3]We thank the referee for suggesting this alternative.

In our work, a finding that the change in arbitrage holdings is higher in deals that are successful, while controlling for the (contemporaneously measured) spread, would be consistent with this second passive role. Also consistent with this role would be a finding that arbitrageurs invest more in deals that have higher returns. In an efficient market, the spread is compensation for the expected risks of the deal. Arbitrageurs increasing their holdings in deals that yield higher returns must (on average) be placing their bets wisely.

Active arbitrageurs influence the terms and outcomes of acquisitions. Ex ante, bidders increase premia in anticipation of arbitrage holdings. Other implications of active arbitrageurs include high correlations among the changes in arbitrage holdings, bid success, and bid revision while controlling for the inherent endogeneity.

An active role for arbitrageurs is modeled in two recent theoretical studies by Cornelli and Li (2002) and Gomes (2001). In these models, arbitrage holdings (and the anticipation of arbitrage holdings) influence the terms and outcome of an offer. Participation from arbitrageurs can influence the takeover process *irrespective of* their ability to predict takeover outcomes.

Unlike small shareholders or noise traders, arbitrageurs tend to accumulate blocks of target shares after an acquisition announcement and sell their shares to the bidder at resolution of the offer. As a result, their presence helps overcome the free-rider problem described by Grossman and Hart (1980), and facilitates the takeover process. In Cornelli and Li (2002), arbitrageurs possess an information advantage from knowing their own position and are capable of paying a higher price to persuade small shareholders to sell their shares to the arbitrageurs. The process of purchasing target shares continues as long as arbitrage profit is positive. In equilibrium, the size of arbitrage holdings and the purchase price are determined endogenously. The model further predicts that the increased presence of arbitrageurs is positively related to both the probability of offer success and a higher takeover premium.

In the context of freeze-out tender offers, Gomes (2001) develops a dynamic model in which arbitrageurs accumulate large blocks of target shares by trading with noise traders (e.g., current shareholders) as in Kyle and Vila (1991). After a majority of shareholders approve a tender offer, the remaining shareholders are required to tender their shares at the bid price even if they did not vote for the offer. Thus, they are *frozen out* of the takeover process. Because of the hold-out power derived from accumulated shares, arbitrageurs and other block shareholders can purposely delay their tenders until the bidder offers a higher premium. Bidders that anticipate increased arbitrage activity offer higher bid premia ex ante. Ex post, the increased price markup will also attract greater arbitrage holdings after deal announcements.

To some extent, arbitrageurs in Gomes' model (2001) are more active than in Cornelli and Li's (2002). It is difficult, however, to distinguish between these theories empirically. Both theories imply that ex ante, bidders are more likely to increase premia if they take into account the potential influence of arbitrageurs in the takeover process. Ex post, both theories suggest a positive relation between arbitrage holdings, the probability of success, and bid premia. However, an implication of the "more active" role of arbitrageurs is a significant relation between the change in arbitrage holdings, deal revisions, and the probability of subsequent takeover of failed deals.

The active and passive explanations for the abnormal returns to arbitrageurs are not mutually exclusive. It is possible, and indeed likely, that arbitrageurs play different roles in the acquisition process. To the best of our knowledge, however, this paper provides the first empirical test of the active arbitrageur hypothesis. At the same time, it updates the important work of Larcker and Lys (1987).

2.3. Testing the active vs. passive theories: The importance of endogeneity

More formally, we test the hypotheses of arbitrage trading in the following model:

$$\Delta holdings_j = \gamma_0 + \gamma_1 Premium_j + \gamma_2 Success_j + \sum_{i=3,k} \gamma_i X_{ij} + \varepsilon_j, \tag{1}$$

$$Premium_j = \alpha_0 + \alpha_1 \Delta holdings_j + \sum_{i=2,k} \alpha_i X_{ij} + e_j, \tag{2}$$

$$Success_j = \beta_0 + \beta_1 \Delta holdings_j + \sum_{i=2,k} \beta_i X_{ij} + \kappa_j, \tag{3}$$

where $\Delta holdings_j$ is the change in holdings for all arbitrageurs; $Premium_j$ is the premium in jth acquisition; $Success_j$ is a binary variable relating to the actual outcome of an offer j (Eq. (1)) or the arbitrageur's expected probability of success for the jth acquisition (Eq. (3)); and X_{ij} is a vector of control variables. We will use the phase 'the change in arbitrage holdings' and Δholdings (or ΔQ1hold) synonymously throughout the paper, for ease of exposition. Intercepts are α_0, β_0, and γ_0 while ε, e and κ are the error terms in each equation.

The first passive arbitrage argument implies that $\gamma_2 = 0$. This argument does not rely on the superior predictive powers of arbitrageurs to determine their investments, but instead suggests that they utilize the same publicly available indicators of success as average traders. These indicators include target managerial attitude (hostile or friendly), the size of the bid premium, and the size of the speculation spread (the percentage difference between the offered price and the post-announcement market price). The passive arbitrage argument of Larcker and Lys (1987), on the other hand, asserts that arbitrageurs utilize their superior abilities to predict offer outcomes. Thus, the change in arbitrage holdings is positively related to the expected probability of success: $\gamma_2 > 0$.

In contrast, the active arbitrageur models suggested by Cornelli and Li (2002) and Gomes (2001) imply $\alpha_1 > 0$ and $\beta_1 > 0$. That is, deal attributes are actually correlated with the participation of arbitrageurs. Here, bid premia and offer success are both related to the change in arbitrage holdings. In sum, Eq. (1) is a test of the two passive hypotheses while Eqs. (2) and (3) are tests of the active hypothesis.

There are two important points to note from this discussion. First, as we have discussed, the passive hypothesis of Larcker and Lys and the active hypothesis of

Cornelli and Li and Gomes are by no means mutually exclusive. Both could exist simultaneously in practice. Arbitrageurs could have the ability to predict deal outcomes and/or exert influence in the takeover process. Second, the models and the theoretical literature outlined above emphasize the simultaneous, endogenous nature of many key aspects in the process. The theoretical literature also argues that toeholds and arbitrage returns are endogenous in addition to the three dependent variables above (premia, Δholdings, and acquisition outcomes). Correspondingly, we perform endogeneity tests among these variables and then further expand our system of estimation to include returns. Since ordinary least squares estimates ignore the endogeneity problem and produce biased coefficients, we perform extensive sensitivity tests to examine and mitigate the problem. Our research design recognizes the possibility of endogeneity, testing and controlling for it empirically with the appropriate methodology. Nevertheless, our conclusions are similar using OLS or more sophisticated approaches.

3. Sample description and preliminaries

3.1. Sample of acquisition bids

Our initial sample of acquisitions is taken from the Securities Data Corporation (SDC) Mergers and Acquisitions database for the period 1992–1999. Specific trading strategies used by arbitrageurs are inherently linked to form of payment. Thus, we are careful to incorporate three different methods of payment: cash, stock, and collar offers. The collar offer is a new, relatively unexplored innovation in form of payment that combines elements of stock and cash offers (i.e., contingent and fixed payouts) utilizing option-like features. Fuller (2003) and Officer (2002) provide additional details and note important differences among these three methods of payment. SDC began recording merger agreements with collars in 1992. Although collar offers are relatively unknown before the 1990s, we find that they comprise more than 20% of our sample. To avoid sample selection bias by including years before these data were recorded, we begin our analysis in 1992.

To be included in our initial sample, an acquisition must meet four criteria. (1) Both target and bidding firms must be covered on CRSP for at least 100 days before the deal announcement and have stock prices available to calculate arbitrage returns. (2) The transaction is pure cash, pure stock, or pure stock with collar terms. Mixed forms of payment (e.g., convertible preferred, convertible notes, etc.) are excluded because it is impossible to determine the appropriate hedge ratios for hybrid securities unless their market values are known. Mitchell and Pulvino (2001) examine the robustness of omitting deals with mixed forms, concluding that their results are not affected by this exclusion. (3) The acquirer owns less than 50% of the target stock before the announcement and is seeking control of the target company. (4) One firm is clearly identified as the target. Thus, 32 mergers of equals are excluded from the sample. We further exclude 13 cases classified by SDC as divestitures, restructurings, and bankruptcy takeovers.

Our selection criteria produce a sample of 680 offers. Seventy-two of these deals are deleted when we match with our sample of arbitrageurs. (Further details are described in the next section.) The first five columns of Panel A in Table 1 show the distribution of the sample by year and by the form of payment. The total number of deals ranges from 39 in 1992 to 120 in 1998, increasing steadily over the sample period, except for 1999. The decline in this last year is due to our requirement that all deals be resolved by the end of 1999. We then are able to track subsequent acquisition activity for at least two years following failed bids.

Stock offers account for more than half of the sample while cash and collar offers comprise 19% and 23%, respectively. However, it does not appear that the proportion of each method of payment varies significantly over time. One exception is that collar offers represent about 41% of the sample in 1993 (i.e., 16 of 39 offers). Collar offers are close to the average of 23% in other years. The overall pattern is consistent with those in Fuller (2003) and Officer (2002) who examine collar offers but not arbitrage. Andrade et al. (2001) also document the popularity of stock deals during the 1990s; they do not explicitly separate collar offers from their stock sample.

Data on announcement dates, agreement dates, withdrawal dates, deal values, and target manager's attitude are collected from SDC. However, SDC usually does not reveal a detailed description of collar offers or classify them as fixed-exchange-rate (FX) or fixed-value (FV) offers. This classification is important in estimating arbitrage returns. The payoff in collar offers typically varies as a function of the bidder's stock price at the end of the offer. In the fixed-value offer, the amount of payment is fixed within specified boundary prices. In the fixed-exchange-rate offer, the exchange ratio is fixed within these boundaries. See Appendix A for the detailed estimation of arbitrage returns. We collect detailed transaction terms on collar offers and double check original data accuracy using Lexis/Nexis Business News (Mergers & Acquisitions) or the SEC Edgar Database. Before providing additional descriptive statistics on our sample of acquisitions, we turn to the identification of arbitrageurs.

3.2. *Identification of arbitrageurs*

Since no database of arbitrageurs is currently available, the identity of arbitrageurs is, of necessity, an empirical one. Our procedure, similar in spirit to that of Baker and Savasoglu (2002), is designed to recognize institutions *actively involved in the purchase of shares during acquisitions*. Following Baker and Savasoglu, our procedure starts with the SEC 13F filings of institutional ownership recorded by Spectrum over the period from 1992 to 1999. The Spectrum Database provides information about quarterly holdings of financial institutions with investment discretion over $100 million in equity securities. These institutions are required to disclose all common stock positions greater than $200,000 or 10,000 shares.

There are four limitations of using the Spectrum Database to identify arbitrageurs. First, institutions are not required to disclose holdings below the threshold of $200,000 or 10,000 shares. This introduces a downward bias in the measure of total arbitrage holdings in each deal. An alternative source is SEC 13D filings as in

Table 1
Distribution of acquisitions, arbitrage holdings and arbitrageurs, 01/1992 to 12/1999

Table 1 reports the distribution of our sample of mergers and summary statistics of identified arbitrageurs. The sample sources are Securities Data Corporation (SDC), Lexis/Nexis, and SEC Edgar filings. In order to be included in the sample, the deals must be for at least $10 million with both the acquiring and the target firms listed in the CRSP database and at least 100 daily returns available to estimate the market model. "Collar" offers are 100% stock offers with a collar provision identified by SDC. The identification of arbitrageurs and the change of arbitrage holdings in each deal are derived as follows. First, we calculate the net change of institutional ownership in the target firm from the quarter immediately before to the quarter immediately after a takeover announcement. Second, to be identified as a risk arbitrageur, the institution needs to have positive net changes in holdings for more than 60% of deals in which they are involved and participate in at least six deals in our sample. Finally, we calculate the change of holdings in all of our sample deals for the identified arbitrageurs. The net change of holdings is calculated by summing all holdings in the quarter ending before the deal resolution and subtracting the reported holdings the quarter before the deal announcement. Panel A presents the time-series distribution of mergers, Δholdings, and number of arbitrageurs during our sample period. Panel B presents a summary of identified arbitrageurs according to the types of asset managers. The five different types are classified by Spectrum. Panel C reports sample statistics of the number of arbitrageurs and the estimated arbitrage holdings in each deal. Level of arbitrage holdings is calculated as arbitrage holdings divided by the target firm's total shares outstanding. Change of arbitrage holdings is the change from the quarter before deal announcement either to the quarter after announcement ($\Delta Q1$Hold) or to the quarter right before the deal is closed (Δholdings).

Panel A. Distribution of sample and change in arbitrage holdings by year

Year	Number of deals	By form of payment			N_{arbs}		Δholdings	
		Cash	Stock	Collar	Mean	Median	Mean	Median
1992	39	9	21	9	6.2	5.0	2.69%	1.23%
1993	39	7	16	16	8.3	5.0	3.09%	1.96%
1994	73	11	38	24	8.1	5.0	3.17%	1.59%
1995	83	15	49	19	9.2	5.0	5.13%	2.75%
1996	79	23	46	10	9.3	6.0	4.65%	2.12%
1997	109	13	72	24	10.2	8.0	6.86%	4.91%
1998	120	18	78	24	12.6	7.0	4.33%	2.14%
1999	66	17	33	16	8.7	4.0	2.70%	0.96%
Total	608	113	353	142				
(Percentage)	(100%)	(18.6%)	(58.1%)	(23.4%)				

Panel B. Summary of identified arbitrageurs

Type of asset managers	Number of arbitrageurs	Percentage (%)	Mean (median) Number of deals	The range of Number of deals
1. Banks	10	8.9	88.2 (26.5)	(7, 380)
2. Insurance companies	5	4.5	48.6 (45.0)	(26, 88)
3. Invest. companies & their managers	5	4.5	24.0 (20.0)	(16, 44)
4. Independent investment advisors	74	66.1	53.4 (32.5)	(7, 354)
5. Others	18	16.1	36.6 (25.5)	(9, 188)
	112	100.0	52.3 (29.5)	(7, 380)

Table 1 (*continued*)

Panel C. Summary statistics of change in holdings per deal in the full sample (N = 608 deals)

	Mean	Min	$Q1$	Std. Dev.	Median	$Q3$	Max
Number of arbitrageurs (N_{arbs})	9.63	0.00	2.00	10.92	6.00	13.00	63.00
Level of holdings (holdings)	15.6%	0.0%	4.6%	14.3%	11.2%	23.3%	72.5%
Change in holdings (Δholdings)	4.4%	−4.1%	0.3%	5.9%	2.4%	6.7%	51.9%
Level of holdings (first quarter only)	15.4%	0.0%	4.6%	13.9%	11.1%	23.1%	72.8%
Change in holdings (first quarter only)	4.2%	−4.1%	0.3%	5.5%	2.2%	6.3%	37.9%

Larcker and Lys (1987). However, only 20 of 135 collar offers during the period of 1992 and 1996 are found in the Insider's Chronicle which reports 13D filings each week. The second limitation is that institutions are only required to report their holdings in an aggregate level. The arbitrage position of one department of a firm could be cancelled out by the selling position of a separate department, negating the need to report.

Third, since institutions only report their holdings on a quarterly basis, information about arbitrage holdings between the latest reporting date and the final resolution date is unattainable. As a result, it is assumed that arbitrageurs' positions at quarters' ends closest to (but before) the resolution are indicative of their positions until the deal resolution. Finally, Section 13(f)(3) of the Securities Exchange Act stipulates that institutions, excluding business trusts and investment companies, can be exempted from the 13F filing requirements. This is the so-called "confidential treatment" (CT) rule.[4] In general, to support its CT application, an institution must provide sufficient evidence that disclosure of its security holdings would harm the institution's competitive position or would simply reveal its investment strategy. CT is usually applicable only for a limited period of time (e.g., within one year) but is available to a merger arbitrage position through the end of the quarterly period in which an acquisition is resolved. It is particularly attractive to arbitrageurs who do not want to disclose their holdings. The rules of CT will lower our estimate of arbitrage holdings. To the extent that these limitations reduce the precision of our estimates of arbitrage holdings, they bias against our finding significant results.

Existing hedge fund database(s) such as Tremont Advisory Shareholders Services (TASS) and Hedge Fund Research, Inc. (HFR) are not suitable for this study. Unlike mutual funds, hedge funds are not required to disclose their asset holdings to the SEC. Reporting to TASS and HFR is purely voluntary for hedge fund companies. Even more important, neither database provides the detailed holdings necessary for this research. Nonetheless, it is interesting to check the overlap of our sample institutions derived from Spectrum (procedures described later) and those in either database. To do this, we use the TASS database which covers 2,400 hedge funds during the period of January 1994 to December 1999. We find that more than

[4]More detailed information can be found at http://www.sec.gov/divisions/investment/13ffaq.htm.

49% of our sample institutions are also covered in TASS. As will be described in the next section, we identify 112 institutions from Spectrum as merger arbitrageurs. Forty-seven of them are also in TASS. However, many of our sample institutions are easily be identified as arbitrageurs and yet are not in TASS. For example, we identify Long Term Capital Management (LTCM) as an arbitrageur based on our selection procedure but it is not covered in TASS. We will return to an extensive analysis of the robustness of our sample selection procedure just before the conclusion. In general, our results are not sensitive to this issue.

3.3. Filter rules to identify arbitrage holdings

To specifically identify those institutions actively involved in purchasing shares around acquisitions, we use the methodology illustrated in Fig. 1. First, the change of institutional ownership in a target firm is calculated from the quarter immediately before to the quarter immediately after a takeover announcement.[5] Seventy-two deals are deleted from our sample of 680 deals because they do not cross two quarters. Second, we require that a risk arbitrageur have a positive change in holdings for at least six deals and in more than 60% of all deals in which they have holdings. Institutions meeting these criteria are classified as arbitrageurs. These cutoff points are arbitrary. To ensure the results are insensitive to these choices, we report robustness checks later in the paper. Overall, these choices do not alter our main conclusions.

Third, changes in holdings in *all* of the sample deals are calculated for all of the identified arbitrageurs. Changes in holdings for each deal are measured from the quarter ending just before the announcement date to the quarter ending just before the deal resolution date. (In a later section we discuss the stability of these changes across multiple-quarter offers.) In practice, arbitrageurs typically tender their shares to the bidder at the completion of an acquisition. Even if this were not the case, we could not follow holdings through the quarter after an acquisition since most of the target firms disappear, eliminating the need for reporting by the institutions. Finally, the total change of holdings per deal is aggregated by summing all changes in holdings for that deal across all arbitrageurs. This aggregate change in holdings is normalized by total target shares outstanding. To illustrate: Suppose a target firm has 100,000 shares outstanding. If half (56) of our arbitrageurs increase their holdings by 100 shares each from the quarter before an acquisition announcement to the quarter before its resolution, the change in holdings by arbitrageurs would be 5,600 shares, or 5.6%.

There are more than 2,000 institutions reported in Spectrum during our sample period. Our procedure classifies 112 institutions as arbitrageurs. Spectrum divides institutional investors into five categories: banks, insurance companies, investment companies and their managers, independent investment advisors, and other institutions. In 1998, Spectrum re-assigned the types of institutions. We find that

[5]While we expect arbitrageurs to be net buyers in most cases, some arbitrageurs with established positions in a target could analyze the characteristics of a deal and decide to sell.

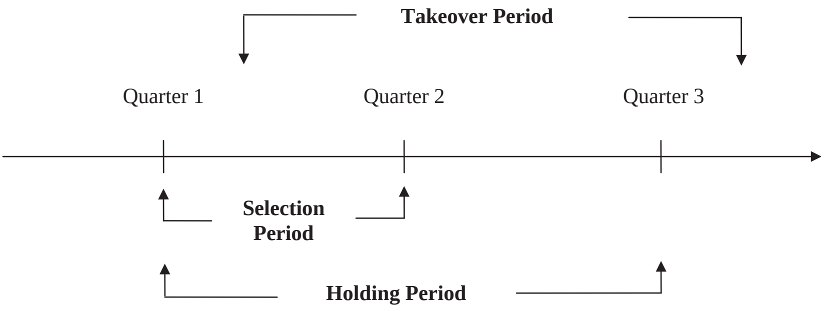

Fig. 1. An illustration of identifying arbitrageurs. Example: Suppose a takeover is announced between quarter one and quarter two, and the case is resolved (successful or withdrawn) after quarter three. To identify arbitrageurs, we compute the change of holdings in the target firm from quarter one to quarter two, which is the first reporting quarter after the announcement. We require that arbitrageurs are net buyers in six or more deals (i.e., the net change of holdings is positive), and that they are "frequent buyers" as well. Thus, for an institution in the Spectrum database to be an arbitrageur, it needs to have a positive change in holdings for at least six deals and in more than 60% of all deals in which they are involved. We then measure the change in arbitrage holdings from the quarter ending just before the announcement to the quarter ending just before the case is resolved. In this example, those quarters are quarter one quarter three, respectively.

many institutions are re-assigned from types 3 or 4 to type 5 ("others"). In order for the types to be consistent over time, we use the originally assigned types for existing institutions throughout the sample period.

Panel B of Table 1 reveals the number of selected arbitrageurs in each institutional category. As expected, independent investment advisors account for 66.1% of the sample. This group includes large investment banks and brokerage firms as well as hedge funds. Interestingly, 16.1% of the sample consists of "other" institutions; these include the largest pension funds, foundations, and university endowments. As discussed in Moore (1999), pension funds used to be net sellers of target companies' stocks once the transactions were announced. Since the late 1980s, pension funds have hired arbitrageurs to make investment decisions on securities subject to acquisitions.

Intuitively, we might expect that most arbitrageurs fall into the category of independent investment advisors. Our results, however, reveal that several types of institutions have started to show interest in the business of merger arbitrage. In fact, the growing nature of multi-business groups in many institutions has made it more difficult to classify them by just one type. For example, since the 1980s, banks (type 1) and investment companies (type 3) have begun to establish arbitrage departments which were generally managed in the capital markets area of the firms (Moore, 1999). Since regulation and the nature of business provide different incentives for each type of institution, we also examine whether our results vary across different types of institutions.

In Table 1, the right two columns of Panel B present the mean, median, and range in the number of deals for each type of arbitrageur. Summary statistics over all 112 arbitrageurs are shown in the last row of Panel B. A typical arbitrageur participates in 30 deals during our sample period, with the mean number of deals being 52. The least active arbitrageur invests in seven deals; the most active invests in 380 deals.[6] Considering the categories of asset managers, investment companies took part in the fewest acquisitions (mean of 24), while banks and independent investment advisors took part in the most (88 and 53, respectively). The range of the number of deals for banks shows the most variation, spanning the entire range from seven to 380 deals. The number of deals for insurance and investment companies is more concentrated—the range is only from 26 to 88 and 16 to 44, respectively.

3.4. Sample distribution of number of arbitrageurs and their change in holdings (Δholdings and ΔQ1hold)

Panel C of Table 1 displays the distribution of both levels and changes in arbitrage holdings per deal. On average, there are about ten arbitrageurs per deal with average arbitrage holdings increasing by 4.4% of shares outstanding. Although our average holdings are rather conservative due to the stringent screening procedure and the fact that the changes in holdings are an aggregate measure, subsequent analyses reveal that even a modest Δholdings impacts returns and premia. In addition, note that we measure the change of holdings until the last quarter before the deal is resolved. If arbitrageurs unload their stocks before the resolution date in deals spanning several quarters, the change could be negative even though their holdings are positive across the first two quarters. Thus, our measured change in holdings may be lower than the initial change in holdings. We explore this issue in our sensitivity tests. Although our calculated Δholdings may underestimate the actual figure, we do not expect our measure to be systematically biased. In fact, it may cause our results to be more conservative.

Of course, arbitrageurs can purchase fewer target shares at an early stage and then increase their holdings later if the probability of success increases. To examine this, we report the level of and change in holdings across the first quarter of the acquisition. Panel C reveals that the average level of holdings is higher when it is measured throughout the whole process, but the Δholdings is similar when it is estimated either across the first quarter or across the whole process. The mean (median) change in holdings across the entire acquisition period is 4.4% (2.4%); across only the first quarter, the mean (median) change in holdings is 4.2% (2.2%). In tests not shown of multiple-quarter deals, we find that the largest increase in holdings occurs over the first two quarters. Since many deals are initiated near the end of the quarter, continued purchasing in the second quarter is not surprising. The change in arbitrage holdings declines substantially afterward. In subsequent multivariate analysis, we test our model using both measures of change in holdings. Our results are not sensitive to these different measures of holdings.

[6]Note that the first selection rule we use to choose arbitrageurs requires a positive change in holdings in at least six deals. However, even if arbitrageurs pass this rule, they must still satisfy the second criteria. That is why the minimum number of deals an arbitrageur invested in is seven.

Other basic statistics reveal that both Δholdings and the number of arbitrageurs vary greatly across the sample. The maximum number of arbitrageurs per deal is 63. The maximum change in holdings is an increase of more than 51% of shares outstanding while the minimum is a reduction of 4.1%. In a subsequent section, we also reveal that Δholdings varies significantly with different deal characteristics.

The last four columns of Panel A of Table 1 reveal the time-series distribution of the number of arbitrageurs and the mean and median change in holdings. Note that the number of deals increases over our sample period. Interestingly, the average number of arbitrageurs per deal also increases, rising from 6.2 in 1992 to 12.6 in 1998 with a low of 8.7 in 1999. The average change of holdings ranges from 2.7% of shares outstanding in 1992 to a peak level of 6.9% in 1997, with a lower 4.3% in 1998 and 2.7% in 1999. The fact that the number of deals grows over time with a higher average increase in arbitrage holdings in each deal indicates that more arbitrageurs became active in accumulating a greater number of target shares as our sample period progressed.

We further examine the changes in holdings by year and by type of asset manager. The results (available upon request) indicate that independent investment advisors (type 4) have the highest Δholdings and the greatest number of arbitrageurs, and that those figures are generally stable over the years of our sample. On the other hand, there is an upward trend in banks (type 1) and pension fund management (type 5). Insurance companies (type 2) and investment companies (type 3) have the lowest holdings among the five different types of asset managers. Overall, independent investment advisors dominate the business of merger arbitrage; however, other financial institutions are showing increased interest in arbitrage.

3.5. Acquisition characteristics and the change in arbitrage holdings

Table 2 describes some of the salient characteristics of our sample and how they differ across deals associated with smaller and larger changes in arbitrage holdings. Panel A examines variables more closely aligned with theories of passive arbitrage, while Panel B examines variables more closely aligned with active arbitrage. Panel C contains other deal-specific variables. Note that the variables in Panels A and B are likely to be related. Moreover, some variables, such as offer success, are related to both passive and active theories of arbitrage. Passive arbitrageurs are expected to invest in deals with a higher probability of success; active arbitrageurs are expected to influence the probability of success. Our main purpose in this section is to present the characteristics of our sample. A multivariate analysis, controlling for any inherent endogeneity, is presented in a subsequent section.

Column 1 of Table 2 provides the mean and median values for sample characteristics while the remaining columns contrast these values across subsamples of deals associated with small and large changes in arbitrage holdings, respectively. The final column displays the level and significance of differences between the subsamples.

As shown in Panel A, we find that most targets are successfully acquired (91%), most deals are friendly (97%), and the average toehold is quite small (0.9%). Most

Table 2
Summary statistics of deal characteristics for the full sample and by change in arbitrage holdings

Table 2 reports deal characteristics for the full sample and by change in holdings. Toehold is the percentage of target shares held by the bidder prior to the announcement. First-quarter spread is calculated as (offer price$-P^{\mathrm{T}}$)/P^{T}, where P^{T} is the target firm's stock price on the last day of the announcement quarter. Final-quarter spread is measured until the last day of the last quarter before the deal is consummated. Attitude, measured as the percentage of friendly deals in each group, is based on whether target management resisted or was faced with an unsolicited offer as determined by SDC. Success is a dummy variable equal to one if the target is successfully acquired. Runup is the cumulative abnormal return to the target firm's stock for trading days (−54, −1) before the first bid. Markup is calculated as (final offer price $-P^{\mathrm{T}}_{-1})/P^{\mathrm{T}}_{-1}$, where P^{T}_{-1} is the target firm's stock price one day before the announcement. Takeover premium is calculated as stock price runup plus markup. Annualized return is calculated as (unannualized returns)∗365/(deal duration). See the text for calculations of unannualized buy-and-hold returns. Thirty-day return is calculated by accumulating daily returns until the earliest of resolution date or the thirtieth business day after announcement, then normalizing by multiplying 30/(deal duration) if the deal duration is less than 30 days. Revision return is calculated as (final offer price − initial offer price)$/P^{\mathrm{T}}_{-1}$. Transaction value is the total market value of consideration in millions, excluding fees and expenses. Deal duration is measured as the length of time between the first formal announcement of the takeover and the announced resolution of the deal. We test the difference between the whole sample and the subgroups in means and medians using the two-sided *t*-test and the Wilcoxon rank sum test. (***), (**), and (*) indicate significance at the 1%, 5%, and 10% levels, respectively.

		Split of median of Δholdings			
	All (1)	<Median (2)	⩾Median (3)	Difference (2)−(3)	
	Mean [median]	Mean [median]	Mean [median]	Mean [median]	
Panel A. Variables associated with theories of passive arbitrage					
(1) Toehold	0.86%	0.93%	0.80%	0.12%	
	[0.00%]	[0.00%]	[0.00%]	[0.00%]	
(2a) First-quarter spread	10.49%	14.06%	6.91%	7.15%	***
	[7.27%]	[9.24%]	[5.38%]	[3.86%]	***
(2b) Final-quarter spread	9.28%	13.63%	4.93%	8.70%	***
	[4.56%]	[7.57%]	[2.60%]	[4.97%]	***
(3) Attitude (% Friendly)	97.37%	96.71%	98.03%	−1.30%	
(4) Deal status (success rate)	90.95%	88.49%	93.42%	−4.90%	**
Panel B. Variables associated with theories of active arbitrage					
(5) Runup	8.70%	7.14%	10.27%	−3.10%	
	[7.88%]	[6.99%]	[8.95%]	[−1.96%]	
(6) Markup	28.53%	29.16%	27.90%	1.26%	
	[23.20%]	[21.02%]	[25.18%]	[−4.16%]	
(7) Premium	37.23%	36.30%	38.17%	−1.90%	
	[33.25%]	[32.77%]	[34.26%]	[−1.49%]	
Panel C. Other deal-specific variables					
(8a) Annualized return	49.84%	39.83%	59.85%	−20.00%	
	[18.55%]	[17.46%]	[19.45%]	[−1.99%]	*
(8b) Thirty-day return	5.34%	2.89%	7.80%	−4.90%	***
	[1.57%]	[1.08%]	[1.97%]	[−0.89%]	***
(9) Revision return	0.23%	0.02%	0.44%	−0.40%	

Table 2 (*continued*)

	All (1)	Split of median of Δholdings: <Median (2)	≥Median (3)	Difference (2)−(3)	
	Mean [median]	Mean [median]	Mean [median]	Mean [median]	
	[0.00%]	[0.00%]	[0.00%]	[0.00%]	
(10) Value of transaction	886.17	770.78	1001.56	−230.80	
($MM)	[161.6]	[91.30]	[308.85]	[−217.55]	***
(11) Duration	154.16	152.23	156.10	−3.87	
	[129.0]	[125.5]	[130.0]	[−4.50]	

bidders do not own target shares before the acquisitions. These deal characteristics are typical of the literature for this period. We next calculate two different measures of arbitrage spread: First-quarter spread is calculated as (offer price $-$ $P^{\mathrm{T}})/P^{\mathrm{T}}$, where P^{T} is the target firm's stock price on the last day of the announcement quarter, and final-quarter spread is measured on the last day of the last quarter before the deal is consummated. The mean and median first-quarter spreads are 10.5% and 7.3%, respectively. Since the vast majority of offers are successful, it is not surprising to find that the mean and median final-quarter spreads have narrowed to 9.3% and 4.6%, respectively.[7]

Following Schwert (1996, 2000), we calculate price runup and markup; the sum of these two items is the bid premium. Price runup is the cumulative abnormal return to the target firm's stock from trading days −54 to −1 before the first bid. Price markup is calculated as (final offer price $-$ $P^{\mathrm{T}}_{-1})/P^{\mathrm{T}}_{-1}$, where P^{T}_{-1} is the target price one day before the announcement. Means and medians for these variables are shown in the first column of Panel B. Price runup averages 8.7%, just a bit higher than the median of 7.9%. The markup has a mean and median of 28.5% and 23.2%, respectively. The average premium is 37%, slightly higher than the median of 33%.

Panel C describes other deal-specific variables. These include measures of return, the value of the transaction, and deal duration. Baker and Savasoglu (2002) and Mitchell and Pulvino (2001) provide interesting analyses of returns in cash and stock portfolios. We follow their lead in modeling different arbitrage strategies with respect to the form of payment. In a cash deal i, an arbitrageur simply purchases the target stock and holds the position until deal consummation. For a stock swap or a collar transaction, arbitrageurs typically take a long position in the target stock and hedge their position by shorting δ shares of the acquirer's stock. Here δ is the exchange rate of the offer. (Appendix A provides a more detailed description of these

[7]We also calculate the spread on the day after the acquisition announcement as in Jindra and Walkling (2004). The magnitude of this spread is similar to the first-quarter spread defined in Table 2. However, we use first-quarter spread and final-quarter spread (as shown in Table 2) in our multivariate analysis since these variables are aligned chronologically with our estimates of change in arbitrage holdings. Our results are robust to different measurements of spread.

procedures.) We find that the mean and median annualized returns (from day one through offer resolution) are 50% and 19%, respectively. Thirty-day returns average 5% with a median of about 1.6%.[8] Revision returns are calculated as the change from the initial offer price to the final offer price normalized by the target price on day one. The mean revision return is 0.23% while the median is 0%. Fewer than 13% of sample deals are revised (79 out of 608). The mean value of the acquisition bid is $886 million. The median ($162 million) is substantially lower. The mean duration of an offer is 154 days, about five months; the median duration is nearly a month shorter (129 days).

The last three columns of Table 2 contrast variable characteristics across deals with high and low changes in arbitrage holdings. Passive arbitrageurs are expected to invest more heavily in deals associated with a higher probability of success. The results of Panel A are generally consistent with this. Deals with the greatest change in arbitrage holdings have lower spreads and are more likely to be successful. Smaller spreads indicate greater market adjustment towards the bid price and lower uncertainty surrounding the deal. Mean and median spreads are 6.9% and 5.4% in deals with the highest change in arbitrage holdings. These figures are significantly smaller than the 14.1% mean and 9.2% median noted in deals with the smallest change in arbitrage holdings. As mentioned above, spread and deal success are also associated with theories of active arbitrage. Thus, it is difficult to distinguish the passive versus active theories from the univariate results presented here. We discuss this issue in more detail in our multivariate analysis.

To the extent that the level of arbitrage activity is known at the end of the quarter, we would expect it to be reflected in the determination of the spread. However, this information is still uncertain at the end of the quarter. Cornelli and Li (2002) utilize this fact, noting that arbitrageurs have an informational advantage from knowledge of their own holdings. Also in Panel A, we find that while the deals with higher changes in holdings are more likely to be friendly, the difference across the groups is insignificant. We do not find a significant difference in toeholds between deals with high and low accumulations of arbitrage holdings.

In Panel B, we examine variables discussed in the theories of active arbitrage. Active arbitrageurs influence both offer outcome and the size of the bid premium. We have already examined the univariate relation between offer success and arbitrage holdings. While we find that runup is higher in the deals with greater arbitrage holdings, the differences in runup, markup, and premium are not significantly different from each other across categories of holdings.

[8]Deals differ in their duration. To put returns on a comparable basis across offers, we annualize arbitrage return. Three alternatives for annualization are actual duration, median-duration return, and thirty-day return. We are concerned that actual duration may distort annualized returns. A high return earned on short duration offers produce extreme values when annualized. These extreme annualized returns are not available to arbitrageurs unless they can repeatedly duplicate such offers. As two alternatives, we calculate median-duration return by accumulating daily return until day 129 (median duration in our sample) and the thirty-day return accumulating until the earliest of resolution date or the thirtieth business day after announcement. Multivariate results using these different definitions of returns are qualitatively similar.

Table 3

Sample distribution of arbitrage holdings by deal characteristics and method of payment

Panels A–C show the estimated number of arbitrageurs and their Δholdings categorized by deal characteristics. Panel D presents the estimated number of arbitrageurs and their change in holdings categorized by methods of payment: cash, stock, and collar. The data source is the Spectrum Database, which provides the quarterly holdings of financial institutions with more than $100 million in securities under management. The identification of arbitrageurs and the change of arbitrage holdings in each deal are derived as follows. First, we calculate the change of institutional ownership in the target firm from the quarter immediately before to the quarter immediately after a takeover announcement. Second, to be identified as a risk arbitrageur, the institution needs to have positive changes in holdings for more than 60% of the deals in which they are involved and participate in at least six deals in our sample. Finally, we calculate the change of holdings in all of our sample deals for the identified arbitrageurs. The change of holdings is calculated by summing all holdings in the quarter ending before the deal resolution and subtracting the reported holdings the quarter before the deal announcement. See Table 2 for variable definitions. The right four columns of all panels test the difference in means and medians between two groups. *P*-values under mean, as reported in parentheses, are associated with t-statistics using a two-sided *t*-test of no difference in mean between two groups. Figures under the median are *p*-values associated with the Wilcoxon rank sum test of no difference in medians between two groups

		Below group median [< median]		Above group median [> = median]		Test of differences	
		Mean	Median	Mean	Median	Mean	Median
Panel A. Variables associated with theories of passive arbitrage							
(1) Toehold		No ($N = 575$)		Yes ($N = 33$)			
	N_{arbs}	9.60	6.00	10.30	7.00	−0.71	−1.00
	Δholdings	4.47%	2.44%	3.78%	2.32%	0.69%	0.12%
(2a) First-quarter spread		Negative ($N = 138$)		Non-negative ($N = 470$)			
	N_{arbs}	12.83	9.00	8.70	5.00	4.13 ***	4.00 ***
	Δholdings	5.56%	3.68%	4.10%	2.12%	1.46% **	1.56% ***
(2b) Final-quarter spread		Negative ($N = 169$)		Non-negative ($N = 439$)			
	N_{arbs}	13.25	9.00	8.24	5.00	5.01 ***	4.00 ***
	Δholdings	6.10%	3.72%	3.79%	1.89%	2.31% ***	1.83% ***
(3) Attitude		Hostile ($N = 16$)		Friendly ($N = 592$)			
	N_{arbs}	13.88	9.50	9.52	6.00	4.35	3.50 *
	Δholdings	5.21%	1.03%	4.41%	2.45%	0.80%	−1.42%
(4) Deal status		Withdrawn ($N = 55$)		Success ($N = 553$)			
	N_{arbs}	9.25	7.00	9.67	6.00	−0.42	1.00
	Δholdings	2.67%	1.16%	4.61%	2.61%	−1.94% ***	−1.46% **

Panel B. Variables associated with theories of active arbitrage									
(5) Runup	N_{arbs}	10.18	6.00	9.08	5.00	1.10		1.00	
	Δholdings	3.92%	2.12%	4.95%	2.79%	−1.02%	**	−0.68%	
(6) Markup	N_{arbs}	9.72	5.00	9.55	6.00	0.18		−1.00	
	Δholdings	3.77%	1.81%	5.11%	2.82%	−1.34%	***	−1.01%	**
(7) Premium	N_{arbs}	10.27	7.00	8.97	5.50	1.30		1.50	
	Δholdings	3.81%	2.27%	5.08%	2.63%	−1.27%	***	−0.36%	*
Panel C. Other deal-specific variables									
(8a) Annualized return	N_{arbs}	10.54	6.00	8.74	6.00	1.80	**	0.00	
	Δholdings	4.28%	2.28%	4.59%	2.72%	−0.31%		−0.44%	
(8b) Thirty-day return	N_{arbs}	9.22	5.00	10.05	7.00	−0.83		−2.00	**
	Δholdings	4.03%	1.92%	4.83%	2.82%	−0.80%	*	−0.90%	*
(9) Value of transaction	N_{arbs}	3.45	3.00	15.90	13.00	−12.46	***	−10.00	***
	Δholdings	2.64%	0.80%	6.25%	4.61%	−3.61%	***	−3.82%	***
(10) Duration	N_{arbs}	8.94	6.00	10.18	6.00	−1.24		0.00	
	Δholdings	4.10%	2.02%	4.69%	2.65%	−0.59%		−0.63%	

Panel D. Distribution of arbitrage holdings categorized by method of payment

				Test of difference between selected subsamples					
		Mean	Median			Mean		Median	
Cash ($N = 142$)				Cash/stock					
	N_{arbs}	7.58	5.00		N_{arbs}	−2.64	***	−1.00	**
	Holding	4.11%	1.75%		Holding	0.07%		−0.38%	
Stock ($N = 353$)				Cash/collar					
	N_{arbs}	10.23	6.00		N_{arbs}	−2.21	*	−1.00	
	Holding	4.04%	2.13%		Holding	−1.56%	**	−2.54%	***
Collar ($N = 113$)				Stock/collar					
	N_{arbs}	9.80	6.00		N_{arbs}	0.43		0.00	
	Holding	5.67%	4.29%		Holding	−1.63%	***	−2.16%	***

***, ** and * indicate significance at the 1%, 5%, and 10% levels, respectively.

In Panel C we note significant differences across small and large Δholdings in mean or median levels of annualized returns and thirty-day returns. For example, thirty-day returns average 7.8% in deals with the largest change in arbitrage holdings. This is significantly larger than the 2.9% for deals with the smallest change in arbitrage holdings. The returns earned here are available to any investor purchasing the day after the announcement of the acquisition. The fact that Δholdings is greater in deals with larger annualized and thirty-day returns is consistent with the returns reported here being lower bounds for returns to arbitrageurs. The positive relation between Δholdings and arbitrage returns is consistent with both the passive arbitrage hypothesis of Larcker and Lys (1987) and the active arbitrage theories modeled in Cornelli and Li (2002) and Gomes (2001). Panel C also reveals a univariate finding of a greater increase in arbitrage holdings in larger deals; this result will be reversed when we control for other deal characteristics in our multivariate analysis.

3.6. Deal characteristics categorized by number of arbitrageurs and their holdings

Table 2 illustrated the level of characteristics across deals with low and high changes in arbitrage holdings. Table 3 inverts this analysis, examining the number of arbitrageurs and the change in arbitrage holdings for deals categorized across the variables of our sample. Categorical variables are naturally split by their attributes; some continuous variables are also naturally split by their attributes (e.g., the existence or absence of toeholds and whether spreads are positive or negative). Other continuous variables are split into groups above and below the median. Our previous caution about endogeneity continues to apply throughout this table.

Panel A displays results for variables associated with passive arbitrage. We classify spreads into positive and negative groups. Although the spread is positive in most cases, Jindra and Walkling (2004) find that over 23% of the spreads are negative in their sample of cash tender offers. Our sample covers a later time period and also includes stock and collar offers. Overall, we find that 23% of first-quarter spreads are negative and 28% of final-quarter spreads are negative. A negative spread means that the post-announcement price exceeds the offered bid price; Jindra and Walkling (2004) associate this with a greater probability of deal revision. In the current sample, both the mean and median number of arbitrageurs and the mean and median change in the level of arbitrage holdings are significantly greater in the negative spread cases. This is true for both the first- and final-quarter spreads.

Successful deals are associated with a greater increase in holdings. In successful deals, the mean and median levels of holdings are 4.6% and 2.6%, respectively; comparable values for withdrawn deals are 2.7% and 1.1%. This result is consistent with both the passive and active arbitrage theories. The number of arbitrageurs, however, does not significantly differ across deal outcomes. The results also suggest that target management's reaction to the bid and the existence of bidder toeholds do not affect the number of arbitrageurs or the change of their holdings. An exception is that the number of arbitrageurs is significantly greater in hostile deals.

Panel B contains results for variables associated with theories of active arbitrage. The average change in arbitrage holdings is significantly smaller in deals with a lower level of price runup. Mean and median changes in holdings are also significantly smaller in deals with lower levels of markup and premium.

Panel C contains results for other deal-specific variables. Our univariate results do not indicate a significant relation between the change in holdings and annualized returns. However, unless a particular type of deal can be constantly replicated (an unlikely assumption), annualized returns will be unrepresentative of the returns available to arbitrageurs. We do note that the mean and median levels of Δholdings are significantly smaller in the deals earning lower than median thirty-day returns in comparison to deals above the median. The mean and median number of arbitrageurs for large transactions is 15.9 and 13.0, respectively. This is significantly greater than the corresponding numbers for the small firms (3.5 and 3.0). The mean and median increase in arbitrage holdings is also significantly greater for large deals in comparison to smaller deals. As we have noted, however, the univariate results with regard to Δholdings and deal size will be reversed in our multivariate analysis. Finally, the change in arbitrage holdings and the number of arbitrageurs are insignificantly different across samples of short and long deal durations. This is consistent with the notion (and results we will present later) that arbitrageurs tend to retain their positions until the deal is resolved.

Panel D of Table 3 displays the relation between Δholdings and the method of payment offered to target firms' shareholders. Analyzing these characteristics is important since arbitrage strategies are known to differ by form of payment. In addition, Travlos (1987) and Huang and Walkling (1987) show how form of payment affects bidder and target returns. The second and third columns show the means and medians of the number of arbitrageurs and Δholdings while the two columns at the far right test for significant differences in Δholdings among payment methods. Arbitrageurs have the highest mean and median Δholdings in collar deals (5.7%, 4.3%) and the lowest in stock or cash deals. Stock and cash deals have mean (median) Δholdings of 4.0% (2.1%) and 4.1% (1.8%), respectively. The difference between the change in holdings for cash and stock offers is insignificant. Collar offers, however, are associated with significantly greater Δholdings than either stock or cash offers. The average number of arbitrageurs shows a different ordering, being highest in stock offers (10.2 arbitrageurs per deal) and lowest in cash offers (7.6 arbitrageurs per deal). The median number of arbitrageurs per deal is six in stock and collar offers and five in cash offers.

4. Simultaneous estimation of premium, Δholdings, probability of success, and returns

4.1. Description of the empirical model

The main objective of this research is to examine arbitrage activity as it relates to the passive and active arbitrageur hypotheses suggested in the literature. The main implications of the active and passive theories are indicated in Eqs. (1)–(3). The first passive model implies that the change in arbitrage holdings will be unrelated to arbitrage returns and the probability of deal success; arbitrageurs earn the same returns as naïve investors without utilizing superior ability to predict deal success. The passive argument of Larcker and Lys (1987) suggests the opposite, with arbitrageurs adjusting their holdings accordingly. On the other hand, the active arbitrageur hypothesis of Cornelli and Li (2002) and Gomes (2001) suggests that deal attributes are materially affected by arbitrage activity. Thus, Δholdings would be significant in explaining the probability of bid success, arbitrage returns, and the level of bid premia.

As mentioned previously, the theoretical models indicate that many takeover variables are endogenously determined. These include Δholdings, bid premia, and arbitrage returns. For example, Gomes' (2001) model implies that bidders are willing to increase bid premia to mitigate the potential hold-out problem. At the same time, arbitrageurs are also more likely to increase their holdings when the premia are high. Cornelli and Li (2002) suggest that there is a positive relation between Δholdings and returns.[9] We recognize this potential endogeneity in our analysis, testing for its existence and controlling for its effects through the use of appropriate instruments with two-stage least squares (2SLS). At the same time, we note that our main conclusions are unaltered if we use a simpler technique (OLS) or a more elaborate one (three-stage least squares).[10]

However, rather than rely solely on the theory, we test for endogeneity empirically. Our results, shown in Appendix B, indicate that Δholdings, bid premia, and arbitrage returns are endogenous while toeholds are more likely to be exogenous. If variables are endogenous, estimates from ordinary least squares will be biased and inconsistent, in which case it is necessary to estimate coefficients within a system of simultaneous equations. Consequently, we estimate a system of equations by regressing these endogenous variables on each other as well as appropriate control variables suggested in the literature. In earlier versions of this paper, we include in each equation only control variables recognized in the literature as related to the dependent variable. Although this approach is legitimate for single-equation regressions, recent studies (e.g., Coles et al., 2003) suggest inclusion of all control variables in each equation. Our results are similar using either approach.

The regressions reported in our tables and in our text discussion use thirty-day returns. Our main conclusions remain if we use annualized returns or returns based on the median duration of offers, 129 days. Additional control variables not

[9]Several theoretical models related to toeholds indicate that premia and toeholds could be jointly determined (see e.g., Hirshleifer and Titman, 1990; Bulow et al., 1999). Our endogeneity test, however, indicates that toeholds are more likely to be exogenous. Nevertheless, including toeholds in our system of estimation does not change our conclusions.

[10]Greene (1997) documents that the choice between 2SLS and 3SLS is unclear. More efficient estimates could be provided by 3SLS, but it is prone to any specification error in the structure of the model (3SLS results are available upon request). With one minor exception, OLS results are similar to those with simultaneous equations. The exception occurs in the regression explaining arbitrage return: The coefficient for premium becomes insignificant in the OLS regression (p-value $= 0.12$). Otherwise, results are similar. Because the theory emphasizes endogeneity, we focus on 2SLS results in our discussions.

previously discussed include a measure of abnormal volume following the offer and three binary variables to recognize the existence of multiple bids, defensive strategies and tender offers, respectively. Abnormal post-announcement volume is defined as $\mathrm{AV}_i = (1/T)\Sigma_{t=+1}^{\min[50,\text{delisting}-1]} V_{it} - (1/73)\Sigma_{t=-126}^{t=-54} V_{it}$, normalized by total shares outstanding. The latter two variables are known ex ante. The system is estimated using 2SLS with at least one instrument in each equation. The requirement for the instrument is that it should be closely correlated with the corresponding dependent variable but not with other dependent variables. We use price runup as the instrument for bid premium, number of arbitrageurs and deal size for change in holdings, and lockup for returns.[11]

One of our important control variables is the spread. At each point at which it is measured, it captures the prevailing market wisdom about the outcome of the offer. We wish to test whether the change in arbitrage holdings contains additional information about offer outcomes while controlling for the spread. In order for spread to function as a control, however, it must be measured contemporaneously or simultaneously with the change in arbitrage holdings. Otherwise, the change in holdings will adjust to information not contained in the spread, imparting a "look ahead" bias in our analysis.

4.2. Multivariate analysis

Table 4 shows the results from the estimated equations. In Panel A, the change in arbitrage holdings is measured from the quarter before deal announcement to the quarter after announcement ($\Delta Q1$hold). In Panel B, the change in arbitrage holdings is estimated until the quarter before deal consummation (Δholdings). In each Panel we use a measure of spread estimated contemporaneously with the change in holdings. Thus, in Panel A, spread is measured at the end of the first quarter, the same time at which the change in holdings is measured. In Panel B, spread and the change in holdings are measured at the end of the last quarter before the deal concludes. Overall, the results in Table 4 support the case that arbitrageurs establish their positions early; results are similar across both measurements.

We divide our discussion of Table 4 into three parts: Results concerning control variables previously analyzed in the literature, results for our endogenous variables of interest, and results related to determinants of arbitrage holdings and returns. Endogenous variables are shown in the shaded areas; instrumental and other control variables are shown in non-shaded areas.

In general, results for the control variables are consistent with the literature. For example, deals with a higher runup also provide higher premia. Moreover, neither toeholds nor target management attitude show a strong correlation with premia. We

[11]Although we have used the instrumental approach to mitigate the potential causal effects, we are careful not to assert strong causality. Even the best efforts to find appropriate instruments will be imperfect. For instance, an (expected) successful deal could attract both larger positions and a greater number of arbitrageurs. If this is the case, then the number of arbitrageurs becomes less suitable as an instrument.

Table 4
Simultaneous-equation estimation of cross-sectional models for the takeover premium, arbitrage holdings, and returns

Table 4 presents the results from the simultaneous-equation estimation of the relations among the takeover premium, arbitrage holdings, and annualized returns. The systems are estimated using two-stage least squares (2SLS). The variable "$\Delta Q1$Hold" refers to the aggregate change of arbitrage holdings from the quarter before deal announcement to the quarter after the announcement while "Δholdings" is the aggregate change of arbitrage holdings from the quarter-end before the announcement to the quarter-end preceding its resolution. $N_{\rm arb}$ is the number of arbitrageurs in each deal. Return is calculated by accumulating daily returns until the earliest of resolution date or the thirtieth business day after announcement, normalizing by multiplying 30/(deal duration). See the text for calculations of daily returns. First-quarter spread is calculated as (offer price $-$ $P^{\rm T})/P^{\rm T}$, where $P^{\rm T}$ is the target firm's stock price on the last day of the announcement quarter. Final-quarter spread is similarly measured on the last day of the last quarter before the deal is consummated. We match the initial spread with $\Delta Q1$Hold and the final spread with Δholdings in our regressions. Revision return is calculated as (Final offer price $-$ Initial offer price)$/P^{\rm T}_{-1}$. Friendly is a dummy variable with a value of one for friendly deals and zero otherwise based on whether the target firm resisted or faced an unsolicited offer as determined by SDC. Toehold is the percentage of target shares held by the bidder prior to the announcement. Runup is the cumulative abnormal returns to the target firm's stock for trading days (-54, -1) before the first bid. Markup is calculated as (final offer price $-$ $P^{\rm T}_{-1})/P^{\rm T}_{-1}$, where $P^{\rm T}_{-1}$ is the target firm's stock price one day before the announcement. Premium is the target's price runup plus markup. Deal duration is measured as the length of time between the first formal announcement of the takeover and the announced resolution of the deal. Success is a dummy variable with a value of one for successful deals. Collar (Stock) is a dummy variable with a value of one for the collar (stock) deals. Multiple bidders is a dummy variable with a value of one if multiple-bid contest. Defense is a dummy variable with a value of one for deals in which the target firm has adopted defensive tactics as reported in SDC. Tender is a dummy variable with a value of one if the bid is a tender offer. Abnormal volume is defined as

$$\mathrm{AV}_i = (1/T)\sum_{t=+1}^{\min[50,\mathrm{delisting}-1]} V_{it} - (1/73)\sum_{t=-126}^{t=-54} V_{it}.$$

Deal value, in millions, is the total market value of consideration, excluding fees and expenses. The variable "days" is measured as the length of time between the last reporting date in Spectrum before deal announcement and the first formal announcement of the takeover. Arbitrage capital is estimated by aggregating the values of all deals for the institutions identified as arbitrageurs for each quarter in the sample. Heteroskedasticity-consistent covariance is applied in the estimation procedure. P-values are reported in parentheses. Endogeneity tests for the regressors in this table are shown in the appendix, Table 9.

	(Panel A). 2SLS – $\Delta Q1$Hold			(Panel B). 2SLS – Δholdings		
	Premium	$\Delta Q1$Hold	Return	Premium	Δholdings	Return
Constant	0.438	0.057	0.253	0.415	0.031	0.027
	(0.059)	(0.078)	(0.112)	(0.082)	(0.374)	(0.093)
Premium		0.018	0.045		0.018	0.046
		(0.000)	(0.044)		(0.000)	(0.037)
$\Delta Q1$Hold or Δholdings	0.375		0.600	0.318		0.726
	(0.120)		(0.086)	(0.168)		(0.010)
$\Delta Q1$Hold)^2 or (Δholdings)^2			-0.728			-1.214
			(0.637)			(0.226)

Table 4 (*continued*)

	(Panel A). 2SLS – $\Delta Q1$Hold			(Panel B). 2SLS – Δholdings		
	Premium	$\Delta Q1$Hold	Return	Premium	Δholdings	Return
Return	0.318	0.015		0.324	0.018	
	(0.000)	(0.060)		(0.000)	(0.044)	
Runup	0.903			0.896		
	(0.000)			(0.000)		
$\text{Log}(1+N_{\text{arb}})$		0.043			0.045	
		(0.000)			(0.000)	
Log(deal value)		−0.012			−0.012	
		(0.000)			(0.000)	
Lockup			0.033			0.032
			(0.101)			(0.103)
Toehold	−0.003	0.000	−0.002	−0.003	0.000	−0.002
	(0.224)	(0.678)	(0.277)	(0.289)	(0.472)	(0.291)
Collar	0.019	0.020	−0.060	0.032	0.018	−0.061
	(0.702)	(0.004)	(0.081)	(0.528)	(0.013)	(0.075)
Stock	−0.036	0.006	−0.025	−0.025	0.004	−0.025
	(0.416)	(0.367)	(0.409)	(0.583)	(0.521)	(0.418)
Revision returns	0.671	0.019	0.101	1.066	0.004	0.097
	(0.000)	(0.428)	(0.398)	(0.000)	(0.873)	(0.416)
First- or final-quarter spread	0.652	−0.024	0.001	0.506	−0.031	0.002
	(0.000)	(0.011)	(0.976)	(0.000)	(0.001)	(0.965)
Success	0.077	0.011	0.009	0.085	0.014	0.006
	(0.118)	(0.106)	(0.802)	(0.095)	(0.050)	(0.867)
Multi. Bidders	−0.057	0.002	0.014	−0.061	−0.004	0.014
	(0.422)	(0.799)	(0.783)	(0.403)	(0.705)	(0.774)
Friendly	−0.122	−0.004	0.002	−0.136	−0.005	0.002
	(0.174)	(0.748)	(0.972)	(0.141)	(0.711)	(0.970)
Defense	0.038	0.034	0.149	−0.028	0.036	0.149
	(0.794)	(0.082)	(0.134)	(0.853)	(0.093)	(0.133)
Tender	0.034	0.005	−0.008	0.048	0.002	−0.008
	(0.568)	(0.523)	(0.841)	(0.431)	(0.814)	(0.845)
Log(duration)	−0.012	−0.006	−0.024	0.000	−0.004	−0.025
	(0.638)	(0.093)	(0.161)	(0.990)	(0.306)	(0.135)
Abnormal volume	0.020	0.003	0.010	0.018	0.003	0.009
	(0.001)	(0.002)	(0.022)	(0.004)	(0.003)	(0.025)
Log(days)	0.001	−0.006	−0.003	0.003	−0.004	−0.004
	(0.925)	(0.007)	(0.764)	(0.856)	(0.074)	(0.729)
Log(Arb capital)	−0.012	−0.001	−0.010	−0.014	0.000	−0.011
	(0.436)	(0.634)	(0.327)	(0.363)	(0.938)	(0.303)
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted R^2	0.475	0.464	0.039	0.475	0.445	0.042

also find that offers with higher spreads and revision returns are associated with higher premia.

More importantly, the results of Table 4 provide support for both the passive and active explanations for positive abnormal returns to arbitrageurs. Three variables in the regression explaining Δholdings can be considered proxies for the probability of success: spread, friendly, and success itself. Spread and friendly are pure ex ante proxies for success that are readily observable by all investors, not just those with superior ability. The significance of these variables in the equations is consistent with both passive-arbitrageur arguments. The major difference between the purely passive role of arbitrageurs and the passive arbitrage theory of Larcker and Lys (1987) is that in Larcker and Lys, arbitrageurs are superior at forecasting offer success and increase their holdings correspondingly. Success can be considered a "perfect foresight" proxy for success. Both $\Delta Q1$Hold and Δholdings are significantly smaller in high spread offers (i.e., those in which the market anticipates a smaller probability of success). This is consistent with the passive role of arbitrageurs. $\Delta Q1$Hold and Δholdings are significantly larger in successful offers. This is consistent with the Larker and Lys assertion that arbitrageurs have superior predictive ability. Our results indicate that Δholdings is insignificantly related to target managerial attitude. Overall, the evidence from Table 4 is consistent with arbitrageurs having superior ability to predict deal outcomes. The results of the regressions are also consistent with the active arbitrage theories of Cornelli and Li (2002) and Gomes (2001) since they reveal significant endogenous relations among Δholdings, bid premia, and returns.

We also explore the dynamic tension between the degree of arbitrage activity and the level of arbitrage returns: A higher level of holdings can facilitate the takeover and provide greater arbitrage returns. Alternatively, increased competition among arbitrageurs could reduce their returns. We test whether there is a curvilinear relation between Δholdings and returns by adding the square of Δholdings to the return equation. This variable is motivated by Cornelli and Li's model in which increased arbitrage presence is associated with decreased marginal returns caused by competition. While the sign of the coefficient of $(\Delta holdings)^2$ is consistent with the Cornelli and Li conjecture, the effect is statistically insignificant.

Apart from the primary variables of interest, the coefficients of several control factors also shed light on the determinants of Δholdings and returns. Interestingly, we find that arbitrageurs do not increase holdings in multiple-bidder deals. One plausible explanation is in line with the argument of limited arbitrage by Shleifer and Vishny (1997). Arbitrageurs desire to hedge their long positions in target shares but face increased capital constraints in the case of multiple bidders. That is, capital constraints are exacerbated by the quick arrival of competition. Betton and Eckbo (2000), for example, document that rival bids on average arrive within 15 days. We also find that after controlling for other deal characteristics, the changes in holdings are lower in larger deals. This might be because of the capital constraints as mentioned above. Another possibility is that arbitrageurs restrict the maximum amount of capital they invest in each deal.

Changes in arbitrage holdings are significantly higher in collar offers while the changes in stock deals are comparable to those in cash offers. Target management attitude, on the other hand, is not associated with $\Delta Q1$Hold or Δholdings. This is consistent with arbitrageurs believing that target management resistance at the beginning of the process is simply a bargaining strategy (Schwert, 2000). The insignificant result from target management attitude does not support the pure passive arbitrage theory that arbitrageurs are simply naïve investors without predictive abilities. We also find that there is no significant relation between Δholdings and deal duration. Since we measure Δholdings from the quarter end before the acquisition announcement until the first quarter after announcement ($\Delta Q1$Hold) or through the quarter before the resolution (Δholdings), this result implies that arbitrageurs do not try to unload their positions at an early stage of the takeover process. All results are also robust to the inclusion of year dummies to control for time effects.

The third equation of Table 4 estimates the relation between arbitrage returns and deal characteristics. We find that collar offers are associated with lower arbitrage returns. Interestingly, arbitrage returns are not affected by target managerial attitude or competition among bidders. Finally, there exists a positive contemporaneous relation between arbitrage returns and abnormal post-announcement volume in the stock of target companies. To the extent that this measure is correlated with stock liquidity, the results are consistent with higher returns earned in more liquid stocks in which it is easier for arbitrageurs to disguise their trading.

4.3. Is the probability of offer success correlated with the change in arbitrage holdings?

Larcker and Lys (1987), Cornelli and Li (2002), and Gomes (2001) all suggest a positive relation between the involvement of arbitrageurs and the probability of offer success. The implied alternative hypothesis to these three studies is that arbitrageurs are noise traders whose participation does not affect the market for corporate control. Under this scenario, bidders can ignore the presence of arbitrageurs when they determine deal characteristics.

A direct way to test these hypotheses is to include an equation relating Δholdings to bid success in the system estimated in Table 4. Indeed, Table 9 in the appendix reveals that the probability of deal success is endogenously determined with other variables of interest, especially in conjunction with Δholdings. It is important to recognize this endogeneity. To check for robustness, we actually use two different econometric models to test whether the change in holdings is related to deal success: The systems approach and a separate logistic analysis.

Our first approach treats deal success as a fourth linear equation in the system that we have previously estimated. Again, we include at least one instrument in each equation and other control variables in all equations. In particular, we use the target managerial attitude as an instrument for deal success. Note that although the target managerial attitude is exogenous with our main variables of interest, it still has potential limitations as an instrument.Specifically, a perfect instrument for deal success is a variable correlated with success but unknown at the time of the change in holdings.

Ideally, the probability of success should be estimated as a nonlinear probability model (e.g., probit or logit). However, it is technically infeasible to incorporate logit or probit into the system of equations because the probability of deal success is a discrete variable while the other four dependent variables in the system are continuous. Although the applied linear system has some shortcomings, the obtained

Table 5
Simultaneous-equation estimation of cross-sectional models for the takeover premium, the arbitrage holdings, probability of deal success, and returns, 01/1992 to 12/1999

Table 5 presents the results from the simultaneous-equations estimation of the relations among bidder's toehold, takeover premium, probability of deal success, arbitrage holdings, and annualized returns. The systems are estimated using two-stage least squares (2SLS) and two-stage logistic regressions. To facilitate estimation and obtain more consistent results, 2SLS estimates the probability of deal success as a linear model. The variable "Δholdings" is used in model I of the logistic regressions. Following the suggestion in Maddala (1983, p. 244) to correct for the endogeneity problem, models II, III, and IV include the fitted holdings as a regressor. The fitted holding is estimated by regressing holdings against other explanatory variables, except the probability of deal success, and then calculating the expected holding for each deal. Lockup is a dummy variable with a value of one if the bidder obtains a lockup option from the target. See Table 4 for other variable definitions. Heteroskedasticity-consistent covariance is used in the estimation procedure. *P*-values are reported in parentheses. Endogeneity tests for the regressors in this table are shown in the appendix, Table 9

	(Panel A). 2SLS				(Panel B). Logistic regressions (dependent variable: success = 1; 0, else)			
	Premium	Success	Δholdings	Return	(I)	(II)	(III)	(IV)
Constant	0.318	0.003	0.031	0.267	−4.809	−3.984	−4.855	−9.622
	(0.166)	(0.983)	(0.361)	(0.081)	(0.220)	(0.002)	(0.136)	(0.019)
Premium			0.017	0.046				
			(0.000)	(0.036)				
Success	0.057		0.014	0.006				
	(0.228)		(0.043)	(0.851)				
Δholdings	0.317	0.421		0.743	14.630			
	(0.170)	(0.020)		(0.009)	(0.001)			
$(\Delta \text{holdings})^2$				−1.261				
				(0.209)				
Return	0.324		0.018					
	(0.000)		(0.041)					
(*fitted*)Δholdings						28.378	31.170	88.395
						(0.007)	(0.007)	(0.000)
Runup	0.894							
	(0.000)							
Friendly		0.679			6.423	5.193	4.993	7.982
		(0.000)			(0.040)	(0.000)	(0.001)	(0.006)
$\text{Log}(1+N_{\text{arb}})$			0.045					
			(0.000)					

Log(deal value)			−0.012					
			(0.000)					
Lockup		0.038		0.033	0.654	0.792	0.569	0.502
		(0.105)		(0.098)	(0.202)	(0.084)	(0.238)	(0.306)
Toehold	−0.003	0.004	0.000	−0.002	0.151	0.160	0.153	0.201
	(0.355)	(0.049)	(0.733)	(0.268)	(0.058)	(0.001)	(0.012)	(0.024)
Collar	0.023	−0.019	0.018	−0.061	−0.605			−2.492
	(0.637)	(0.638)	(0.013)	(0.070)	(0.540)			(0.018)
Stock	−0.033	−0.032	0.004	−0.025	−1.023			-1.749
	(0.459)	(0.384)	(0.585)	(0.414)	(0.269)			(0.041)
Revision returns	1.096	0.134	−0.003	0.101	2.205			−0.210
	(0.000)	(0.336)	(0.904)	(0.396)	(0.129)			(0.893)
First- or final-spread	0.505	−0.136	−0.031	0.003	−1.819		−1.487	1.807
	(0.000)	(0.009)	(0.001)	(0.952)	(0.111)		(0.206)	(0.275)
Multi. bidders	−0.058	−0.378	−0.005	0.015	−3.492		−3.140	−3.976
	(0.424)	(0.000)	(0.623)	(0.762)	(0.000)		(0.000)	(0.000)
Defense	0.041	0.093	0.039	0.148	−0.089			2.397
	(0.775)	(0.435)	(0.057)	(0.118)	(0.973)			(0.444)
Tender	0.043	0.062	0.001	−0.008	0.915			0.040
	(0.473)	(0.202)	(0.865)	(0.848)	(0.351)			(0.964)
Log(duration)	0.000	0.058	−0.004	−0.025	0.764		0.665	0.578
	(0.985)	(0.004)	(0.234)	(0.141)	(0.117)		(0.149)	(0.260)
Abnormal volume	0.018	−0.005	0.003	0.009	−0.088			−0.447
	(0.005)	(0.328)	(0.002)	(0.026)	(0.157)			(0.001)
Log(days)	0.003	−0.027	−0.004	−0.004	−0.694		−0.459	−0.308
	(0.850)	(0.028)	(0.073)	(0.734)	(0.073)		(0.165)	(0.432)
Log(Arb capital)	−0.015	0.008	0.000	−0.011	0.071			0.138
	(0.357)	(0.300)	(0.891)	(0.303)	(0.580)			(0.305)
Year dummies	Yes		Yes	Yes				
Adjusted R^2	0.444	0.267	0.454	0.045	0.325	0.188	0.289	0.343

estimates are consistent. The system of equations estimated in Panel A of Table 5 produces results suggested by the active arbitrageur hypothesis: The probability of success is positively related to Δholdings. In addition, our previous results still hold after including the probability of bid success into our system of estimation.

The second approach to test whether the change in holdings is related to deal success follows the procedure in Maddala (1983, p. 244). We first estimate a model to predict "expected" changes in holdings by regressing Δholdings against other explanatory variables excluding 'Success,' which is the perfect foresight proxy for the probability of success. One requirement for those independent variables is that they should be highly correlated with Δholdings but not with offer success. Specifically, we include the following variables to estimate the expected Δholdings: $\log(1 + N_{\text{arb}})$, log(deal value), abnormal volume, premium, collar, stock, tender, and return. The first two are instrumental variables while the others are controls. All these variables have significant correlations with Δholdings but have low correlations with the probability of success.

This first-stage procedure yields "fitted" and "error" components of Δholdings in each deal. If the probability of success has a significant effect on Δholdings, it will exist in the error component of the first equation. Since we would like to isolate the effect of the probability of success away from Δholdings in the second-stage regression, we include the fitted value as a regressor in logistic models explaining the probability of deal success. The coefficient of Δholdings directly tests its impact on the probability of deal success.

The four columns in Panel B present the results from the logistic regressions. Regression (I) uses Δholdings itself as an explanatory variable while the fitted value is used in regressions (II) to (IV). The results still hold and most importantly, the relation between the probability of deal success and Δholdings remains significant. This result is robust to a different estimate of holdings ($\Delta Q1$Hold) measured across only the first quarter of deal announcement.

Consistent with Schwert (2000) and Walkling (1985), managerial resistance is significantly related to the probability of success with either the analysis of Panels A or B. In addition, both techniques of estimation indicate that higher toeholds increase the probability of deal success, a result consistent with Betton and Eckbo (2000).

In general, the results of Tables 4 and 5 provide strong empirical support for both the passive arbitrage model of Larcker and Lys (1987) and the active arbitrage models of Cornelli and Li (2002) and Gomes (2001). The change in holdings is significantly related to offer success as implied by Larcker and Lys. The change in holdings is also significantly related to the spread between offered bid price and the market price. However, the probability of success, arbitrage returns, and bid premia are all significantly related to Δholdings as implied by Cornelli and Li and Gomes.

4.4. Regression analysis of the change in arbitrage holdings and revision returns

Is arbitrage activity related to deal revision? If a deal is terminated, can arbitrageurs predict or influence the possibility that the target firm receives subsequent bid(s) in the near future? If the answers to these questions are affirmative, it strengthens the argument that arbitrageurs have a significant active impact on takeovers.

Table 6 presents a multivariate analysis by regressing revision returns against changes in arbitrage holdings and associated control variables. To minimize the causality issue between the changes in holdings and revision returns, our tests are performed by only using the initial change in holdings ($\Delta Q1$Hold) from the quarter immediately before to the quarter immediately after the announcement. We also modify our second measure of the change in holdings (Δholdings) for deals lasting more than two quarters by deleting arbitrage holdings accumulated after the deal is revised. The results indicate that both measures of the change in holdings are strongly related to revision returns. When arbitrageurs increase their initial holdings, deals are more likely to be revised. The relation is statistically and economically significant. For example, the first regression indicates that when arbitrage holdings increase one standard deviation (5.9%), revision returns increase about 0.77%.

It is also possible however, that arbitrageurs tend to choose deals with characteristics associated with the revision returns. (For example, recall that the average number of arbitrageurs was greater in deals with negative spreads.) To recognize this type of effect, we include spread, target management attitude, and bidder's initial toehold as control variables in regressions III–V. In regressions VI and VII, we also include control variables for multiple bidders, tender offers, existence of defensive tactics, and form of payment. The only significant control variable is the dummy variable for multiple bidders. As expected, offers with multiple bidders are more likely to have further positive revisions.

As shown in regression III, the positive relation between $\Delta Q1$Hold and revision returns remains significant with a p-value of 0.02. Similar results are obtained using fitted values of $\Delta Q1$Hold (as in regression V). Similar results (available upon request) are also obtained in sensitivity tests using: (a) a logistic regression with the dependent variable set equal to one for revised-up offers; and, (b) the simultaneous estimation of revision returns and $\Delta Q1$Hold in a 2SLS estimation. In specification (b) we use toehold as the instrument for the equation of revision returns and both the number of arbitrageurs and deal size as instruments for $\Delta Q1$Hold. As before, revision returns are significantly, positively related to $\Delta Q1$Hold.

4.5. The relation between the change in arbitrage holdings in withdrawn offers and subsequent bids

In the previous section we find that the magnitude of revision returns is significantly related to the change in arbitrage holdings. Nevertheless, some acquisition bids inevitably fail. In this section we examine whether Δholdings in failed offers is linked to the probability of subsequent offers.

For 55 failed deals during the period of 1992 to 1999, we first exclude seven multiple-bidder cases in which the target firms are acquired by other bidders during the initial takeover period. For the remaining 48 deals we search the SDC database and Lexis–Nexis to determine whether there are new bids by the end of 2001.

Table 6
Regressions explaining revision returns

The dependent variable is the revision return calculated as (final offer price − initial offer price)/P^{T}_{+1}, where P^{T}_{+1} is the target firm's stock price one day after the announcement. First-quarter spread is calculated as (offer price − P^{T})/P^{T}, where P^{T} is the target firm's stock price on the last day of the announcement quarter. Final-quarter spread is similarly measured on the last day of the last quarter before the deal is consummated. We match the initial spread with ΔQ1Hold and the final spread with Δholdings in our regressions. "ΔQ1Hold" is the aggregate change of arbitrage holdings in each deal from the quarter before announcement to the quarter after announcement. The change is then normalized by the target firm's share outstanding. Δholdings is the aggregate change of arbitrage holdings in each deal from the quarter before announcement until the quarter end before the deal is revised. Following the suggestion in Maddala (1983, p. 244) to correct for the endogeneity problem, we also include the fitted ΔQ1Hold as a regressor. The fitted change in holdings is estimated by regressing ΔQ1Hold against other explanatory variables, except the revision return, and then calculating the expected ΔQ1Hold for each deal. Friendly is a dummy variable with a value of one for friendly deals and zero otherwise, it is based on whether the target firm resisted or faced an unsolicited offer as determined by SDC. Toehold is the percentage of target shares held by the bidder prior to the announcement. Runup is the cumulative abnormal returns to the target firm's stock for trading days (−54, −1) before the first bid. Collar (Stock) is a dummy variable with a value of one for the collar (stock) deals. Multiple bidders is a dummy variable with a value of one if it is a multiple-bid contest. Defense is a dummy variable with a value of one for deals in which the target firm has adopted defensive tactics as reported in SDC. Tender is a dummy variable with a value of one if the bid is a tender offer. Heteroskedasticity-consistent covariance is used in the estimation procedure. P-values are reported in parentheses.

	(I)	(II)	(III)	(IV)	(V)	(VI)	(VII)	(VIII)
Constant	−0.003	−0.002	−0.003	−0.002	−0.006	0.037	0.038	0.037
	(0.366)	(0.541)	(0.507)	(0.659)	(0.226)	(0.283)	(0.277)	(0.283)
ΔQ1Hold	0.139		0.130			0.098		
	(0.013)		(0.018)			(0.064)		
Δholdings (*before revision*)		0.105		0.097			0.078	
		(0.044)		(0.048)			(0.092)	
ΔQ1Hold (*fitted*)					0.180			0.098
					(0.013)			(0.149)
Toehold			0.003	0.003	0.003	0.002	0.002	0.002
			(0.135)	(0.135)	(0.140)	(0.142)	(0.142)	(0.147)
Runup			0.011	0.012	0.014	0.018	0.018	0.020
			(0.355)	(0.332)	(0.252)	(0.128)	(0.124)	(0.096)
First- or final-quarter spread			−0.030	−0.031	−0.030	−0.032	−0.033	−0.033
			(0.282)	(0.262)	(0.270)	(0.227)	(0.216)	(0.205)
Friendly						−0.049	−0.049	−0.049
						(0.123)	(0.121)	(0.119)
Multi. bidders						0.090	0.092	0.090
						(0.008)	(0.007)	(0.008)
Tender						0.003	0.003	0.004
						(0.764)	(0.719)	(0.694)
Defense						−0.007	−0.007	−0.007
						(0.758)	(0.782)	(0.769)
Collar						0.006	0.007	0.007
						(0.491)	(0.459)	(0.469)
Stock						0.006	0.006	0.007
						(0.487)	(0.462)	(0.446)
Adjusted R^2	0.008	0.005	0.036	0.034	0.033	0.094	0.091	0.093

Panel A of Table 7 shows that 14 firms receive new takeover attempts within one year, six firms after one year but within two years, and eight firms after two years. We do not find information in SDC or Lexis–Nexis related to the remaining 20 firms.

Table 7
The relation between subsequent bids for failed tender offers and arbitrage holdings

This table reports the incidence of target firms that receive subsequent bids after the announcement of deal failure. Panel A presents the distribution of failed deals according to the date at which they received new takeover attempts. Panel B compares arbitrage holdings in deals in which the target firms receive subsequent bids by the end of 2001 and deals without any subsequent attempts during the same period. Panel C compares arbitrage holdings in cases in which the target does and does not receive subsequent bids within one year after the announcement of deal failure. Δholdings is the aggregate change of holdings in each deal normalized by target firm's shares outstanding. N_{arb} is the number of arbitrageurs in each deal. The procedure of selecting arbitrageurs is described in the text and Table 2. (***), (**), and (*) indicate significance at the 1%, 5%, and 10% levels, respectively.

Panel A. The distribution of failed deals

	Number of firms	Percentage (%)
Firms receiving multiple bids and acquired	7	12.7
Firms receiving subsequent bids		
<1 *year*	14	25.5
1 *year*~ 2 *years*	6	10.9
>2 *years*	8	14.5
Other firms	20	36.4
Total	55	100.0

Panel B. Comparison of Δholdings in deals receiving subsequent bids by the end of 2001 ($N = 28$) *versus holdings in other deals* ($N = 20$)

	Min	Q1	Mean		Std. Dev.	Median		Q3	Max
Number of arbitrageurs									
Deals with new bids	0.0	3.0	10.0		12.2	7.0		13.5	61.0
Deals have no new bids	0.0	2.0	7.9		6.2	5.5		12.5	20.0
Difference	0.0	1.0	2.1		5.9	1.5		1.0	41.0
Δholdings in each deal									
Deals with new bids	−0.79%	0.19%	3.25%		4.18%	1.79%		4.82%	12.97%
Deals have no new bids	−0.68%	0.11%	1.31%		2.00%	0.44%		1.53%	7.16%
Difference	−0.11%	0.08%	1.94%	**	2.18%	1.35%	*	3.29%	5.82%

Panel C. Comparison of Δholdings in deals receiving subsequent bids within one year ($N = 14$) *versus holdings in other deals* ($N = 34$)

	Min	Q1	Mean		Std. Dev.	Median		Q3	Max
Number of arbitrageurs									
Deals with new bids	2.0	5.0	15.1		15.2	13.0		18.0	61.0
Deals have no new bids	0.0	2.0	6.7		5.7	5.0		10.0	20.0
Difference	2.0	3.0	8.4	*	9.5	8.0	**	8.0	41.0
Δholdings in each deal									
Deals with new bids	−0.79%	0.49%	4.83%		5.18%	2.37%		9.80%	12.97%
Deals have no new bids	−0.68%	0.13%	1.46%		1.99%	0.70%		2.66%	7.16%
Difference	−0.11%	0.36%	3.37%	**	3.18%	1.67%	**	7.15%	5.82%

Panel B of Table 7 compares Δholdings and the number of arbitrageurs in deals receiving subsequent bids with those in other deals. Target firms are more likely to receive new bids when the increase of arbitrage holdings remains high. On average, Δholdings are a significant 1.9% higher in firms receiving new bids than those in other firms. The cumulative frequency distribution of Δholdings (summarized by the minimum through the maximum holdings) is consistently higher in deals that attract new bids.

Panel C provides a similar analysis comparing firms receiving new bids within one year to the rest of the sample. The results are even stronger. The average (median) difference in Δholdings between firms with new bids and those without is 3.4% (1.7%). Both differences are significant at the 5% level.

We next perform a logistic analysis of the same issue, setting the dependent variable equal to one if the target receives another bid within one year, and zero if it does not. Table 8 reports logistic results using five different specifications. The first and second regressions show that the probability of receiving another bid increases significantly with the number of arbitrageurs or with Δholdings. The coefficient of the number of arbitrageurs becomes insignificant after both variables are included. Regressions (IV) and (V) include several control variables related to the original bids. The coefficient of Δholdings remains significant in both regressions. Further, we find that if the original deals had multiple bidders or if target management was friendly, the target firms are more likely to receive another bid in the future. The results in this section suggest that both the number of arbitrageurs and Δholdings are associated with higher revision returns. After initial acquisitions are terminated, their holdings are positively correlated with the possibility that new bids will eventually emerge in those deals.

5. Additional robustness checks and extensions

We have already reported several robustness checks in the preceding text. These include the use of different econometric specifications (OLS, 2SLS, and 3SLS), and the use of thirty-day arbitrage returns, 129-day returns (the median duration), and annualized returns. In this section we report robustness checks with regard to the identification of arbitrageurs, financial firms, momentum traders, and the various types of institutions identified as arbitrageurs.

5.1. *Identification of arbitrageurs*

The series of tests presented in previous sections are contingent upon the empirical procedure for selecting arbitrageurs. In this section, we perform four sensitivity checks with regard to the identification of arbitrageurs; all four tests produce conclusions similar to our original results.

Recall that to be identified as a merger arbitrageur, an institution needs to have a positive change in holdings in at least six deals and in more than 60% of all deals in which they are involved. Our first robustness check is to verify whether our main

Table 8
Logistic regressions of the probability of target firms receiving subsequent bids within one year of failed takeovers

This table shows logistic estimations of the probability of target firms receiving subsequent bids within one year after the initial deals failed. The dependent variable equals one if the target firm receives a new takeover attempt and zero if the firm does not receive a subsequent bid within a year. Δholdings is the aggregate change of arbitrage holdings in each deal normalized by target firm's shares outstanding. N_{arb} is the number of arbitrageurs in each deal. The procedure of selecting arbitrageurs is described in the text and Table 2. Friendly is a dummy variable with a value of one for friendly deals and zero otherwise based on whether the target firm resisted or received an unsolicited offer as determined by SDC. Collar (Stock) is a dummy variable with a value of one for collar (stock) deals. Runup is the cumulative abnormal returns to the target firm's stock for trading days (−54, −1) before the first bid. Markup is calculated as (final offer price − P^{T}_{-1})P^{T}_{-1}, where P^{T}_{-1} is the target firm's stock price one day before the announcement. Premium is target's price runup plus markup. Multiple bidders is a dummy variable with a value of one if the original deal was a multiple-bid contest. Heteroskedasticity-consistent covariance is used in the estimation procedure. *P*-values are reported in parentheses.

	(I)	(II)	(III)	(IV)	(V)
Constant	−2.886	−1.647	−2.710	−4.243	−4.000
	(0.005)	(0.001)	(0.013)	(0.006)	(0.009)
Log(1 + N_{arb})	0.961		0.587	0.479	0.502
	(0.023)		(0.205)	(0.368)	(0.355)
Δholdings		27.344	21.260	24.826	23.624
		(0.002)	(0.022)	(0.034)	(0.044)
Premium				0.344	0.149
				(0.775)	(0.906)
Collar				0.314	
				(0.762)	
Stock					−0.569
					(0.535)
Multi. bidders				2.611	2.746
				(0.006)	(0.002)
Friendly				1.505	1.778
				(0.080)	(0.048)
Log likelihood	−25.94	−24.64	−23.83	−20.59	−20.49
P-value for the model	0.014	0.003	0.006	0.010	0.009
McFadden R^2	0.105	0.150	0.178	0.289	0.293

results are sensitive to these two cutoff points. To be specific, we modify the first cutoff so as to be a positive change in holdings in eleven deals or sixteen deals. The increment of ten (from our original six to sixteen) is about one standard deviation of the number of deals involved in our sample. In our second test we alter the criteria for the number of deals in which institutions have a positive change in holdings, increasing it to 70% and 80% of the deals in which they are involved. These first two screening rules produce four new sets of arbitrageurs with more stringent selection criteria. We then re-estimate our results. While several coefficients become less significant, the relation among the four endogenous variables of interest (premia, success, Δholdings and returns) remains significant beyond the 5% level. We conclude that adopting more stringent filter rules does not materially affect our main results.[12]

Third, we re-estimate our results using the change in holdings from the top six arbitrageurs and the top ten arbitrageurs only, rather than all of our identified arbitrageurs. Six is the median number of arbitrageurs in each deal and ten is the average number. Arguably, these top arbitrageurs are more active and purchase more shares during acquisitions. Thus, this re-estimation also serves as a further test of the active arbitrageur hypothesis. The models of Cornelli and Li and Gomes imply that sizable changes in holdings will drive the results. Arbitrageurs accumulating smaller positions after the announcement would not be as influential as those accumulating larger positions. Nevertheless, correlations between our original measure of Δholdings and these two variations all exceed 0.95. Our multivariate results are robust to these alternate definitions.

Fourth, we re-estimate our results using only those arbitrageurs from our sample that are found in the TASS Hedge Fund Database. The correlation of Δholdings between this database and our original measure is very high (0.99). Correspondingly, our results are similar.

5.2. *Are our results driven by financial firms?*

Financial firms account for about thirty percent of our sample (183 out of 608). Several studies (see e.g., Officer, 2002) have also documented the popularity of mergers and acquisitions in the financial industry during the 1990s. However, financial mergers exhibit systematically different motivations and characteristics from nonfinancial counterparts. Arbitrageurs may use different decision criteria to determine whether to participate in financial mergers. To investigate if this is the case, we separate the sample into financial and nonfinancial mergers, classifying the deal as a financial merger if either the bidder's or the target's two-digit CRSP SIC code is between 60 and 69.

In general, there seems to be little systematic difference between the two subsamples with regard to our analysis—the interrelations among endogenous variables are quite similar. One exception is the weak relation between Δholdings and takeover premia in the financial sample. Also, several control variables are insignificant as determinants of Δholdings in financial firms. For example, while the method of payment and target management attitude explain holdings in the subsample of nonfinancial firms, they are insignificant for financial companies. This is probably due to the lack of variation in these variables in the subsample of financial mergers. We find that financial mergers tend to use either stock or collars as the method of payment. They also tend to be friendly. In our sample of 183 financial mergers, only 26 deals use cash as the method of payment and only two deals are classified as hostile takeovers.

[12]Results of any of these tests are available upon request.

5.3. Are our results driven by momentum trading?

It is well documented that some institutions, especially mutual funds, are "momentum investors," buying past-winning stocks (see, for example, Lakonishok et al., 1992; Grinblatt et al., 1995). In contrast, Gompers and Metrick (2001) provide evidence that "large" institutions are not momentum investors. Wermers (1999) and Nofsinger and Sias (1999) show that stock price momentum is positively correlated with institutional herding behavior. Badrinath and Wahal (2002) show that institutions act as momentum investors when they initiate the purchase of stocks but act as contrarian investors when they unload their positions.

Momentum traders purchase shares when the price is increasing regardless of any corporate news about acquisitions. Arbitrageurs, on the other hand, usually do not accumulate the target company's stock before the deal is announced; by this definition, they are not momentum investors. However, due to the fact that the target stock could experience price runups, we may simply be choosing institutions that are also momentum or positive-feedback investors. Although we cannot completely rule out this possibility, it seems unlikely that the institutional investors we identify have acted independent of important news about corporate acquisitions. Further tests confirm this conjecture.

First, we analyze our group of arbitrageurs versus the remainder of the institutions identified in Spectrum. It has been suggested that arbitrageurs in general do not purchase target shares before the deal is formally announced. We find some support for this argument. Fewer than 45% of identified arbitrageurs in our sample report holdings of target shares before announcements. The corresponding percentage for non-arbitrageurs (the remaining institutions) is more than 63%. The difference is significant at the 1% level. Thus, it is consistent with the notion that arbitrageurs usually do not hold target shares beforehand.

Second, we compare the trading activities between arbitrageurs and non-arbitrageurs during the takeover process. In particular, we are interested in the question: How long would arbitrageurs maintain their positions after they purchase target shares? If non-arbitrageurs own target shares after a deal is announced, we expect many of them to reduce their holdings before the deal is resolved. In contrast, we expect arbitrageurs to hold on to their positions for a longer period to realize the return. To test this possibility, we calculate the percentage of arbitrageurs and non-arbitrageurs who have positive holdings in the announcement quarter and who do not sell their shares until the quarter just before the resolution date. The results show that more than 33% of non-arbitrageurs lower their positions, compared to only 6% of our arbitrageurs: once our arbitrageurs decide to take part in mergers, they retain most of their holdings over the whole process.

Finally, even though the above tests do not suggest that our identified arbitrageurs are simply momentum investors, we control for the momentum effect in the regressions presented in Tables 5 and 6 by including two variables, the target price runups and the logarithm of the number of days between the last reporting quarter before the takeovers and the deal announcement date (Log(Days)). If the momentum effect exists in our sample, we should observe a positive relation between price runup and holdings as well as log(Days) and holdings. The coefficient of runup is insignificant while the coefficient of Log(Days) is negative and significant. Taken together, the evidence suggests that the institutions we select do exhibit the merger-arbitrage behavior we desire and that they are distinct from other regular institutions.

5.4. Do the results vary across different types of institutions?

Our results suggest that independent investment advisors are the dominant category of arbitrageurs. Two other facts support this finding. If hedge fund companies file their holdings, they mostly fall into this category. Also, merger arbitrage accounts for a large portion of the business these firms conduct. Thus, independent investment advisors tend to be more active in accumulating target shares, thereby pushing deals to completion, and they have a greater incentive to function as active blockholders.

On the other hand, other types of institutions might be more passive with regard to active participation in acquisitions, functioning, in effect, as free-riders. There are several reasons to suspect this. One possibility is that the capital they invest is not as large as that of other institutions and thus their potential influence on deals is not strong enough for them to actively participate. It is also possible that some institutions are constrained by prudent-man laws and regulations. Various types of institutions have different levels of exposure to fiduciary liability. As a result, some institutions might try to avoid a huge loss on one deal by trading less. They could also tend to act passively to avoid adverse publicity. Del Guercio (1996) asserts that bank managers are the most likely to be constrained by prudent-man laws while mutual fund managers are the least likely to be constrained. Using data derived from the CDA Spectrum database, she focuses her analysis on three types of institutions: banks, mutual funds, and pension funds.

From a regulatory point of view, we might expect individual investment advisers (type 4) to be the least constrained by regulatory burdens followed by mutual fund companies and their managers (type 3) (although they are not allowed to short-sell securities). These two types of institutions are only regulated by the SEC. Banks (type 1) and pension funds (in type 5) are explicitly governed by the prudent-man laws. Pension funds, in particular, are regulated by the Employees Retirement Income Security Act (ERISA). Similarly, insurance companies have a maximum equity limitation of 15% in their portfolios. Given different levels of regulatory constraints across institutional investors, we examine whether different types of institutions behave differently during the takeover process.

When we re-estimate our results for each of the five different types of institutions identified in Table 1, we find that independent investment advisors (type 4) are the active players in mergers and acquisitions. Their holdings of target stocks are positively associated with deal success rates and bid premia. Banks and others (mostly pension funds) are the next-most active. Although our main results hold in these two subsamples, the relation between Δholdings and premia is not significant in either subsample. The subsamples of insurance and investment companies (type 2 and 3) have the weakest relations among five endogenous variables, perhaps because of their differential exposure to legal liability.

6. Conclusions

Despite the increased prominence of merger arbitrage activity since the 1980s, much remains unknown about the process and impact of an arbitrageurs' decision to participate in the takeover market. The empirical literature documents positive abnormal returns in takeover portfolios. This study provides the first test of the active theory of arbitrage activity and updates earlier research relating to the passive theory of arbitrage returns. The purely passive argument asserts that arbitrageurs act as naïve investors with no ability to predict deal outcomes; arbitrageurs do not influence deal attributes or outcomes. Under this argument, the change in arbitrage holdings will be significantly related to ex ante measures of deal success observable in the market (such as target management attitude), but insignificantly related to a perfect foresight model of success (actual deal outcome) and arbitrage returns. On the other hand, Larcker and Lys (1987) suggest another passive arbitrage explanation: Arbitrageurs have superior ability to predict takeover outcomes. Here, the change in holdings is indicative of superior skill in predicting offer outcomes. Implications of this superior skill include a significant relation among arbitrage holdings, returns, and the probability of deal success while controlling for the contemporaneously measured spread.

More recently, Cornelli and Li (2002) and Gomes (2001) develop active arbitrageur models, suggesting that the involvement of arbitrageurs effectively influences bid premia, arbitrage returns, and the probability of bid success. The results of our research provide support for both the passive and active arbitrage hypotheses. Our evidence is consistent with arbitrageurs possessing superior ability to predict offer success; moreover, the presence of arbitrageurs is strongly associated with different terms and outcomes of the offer. To the best of our knowledge, this is the first evidence testing the active influence of arbitrageurs and contrasting the passive versus active arbitrage models.

We control for the endogeneity of arbitrage holdings by explicitly accounting for the joint impact of four key acquisition variables (offer premium, probability of success, arbitrage returns, and the change in arbitrage holdings) as well as other control variables recognized in the literature. Using a sample of 608 offers over the 1992–1999 period, we find that in addition to the ability to anticipate deal success rates, the probability of deal success and takeover premia are also positively related to the increase in arbitrage holdings. In addition, the change in arbitrage holdings is also shown to be an important determinant of deal success, bid premia, and arbitrage returns. These results are consistent with both passive and active arbitrage theories.

We also investigate the factors driving arbitrageurs to get involved in acquisitions. Arbitrageurs purchase more target shares in collar offers than in cash or stock offers. In our multivariate analysis, the change in holdings is lower in larger deals. Interestingly, the decision of arbitrageurs to participate in acquisitions does not appear to be affected by target management hostility or the existence of multiple bidders.

Finally, we find that the changes in holdings during the announcement quarters are positively associated with revision returns. In cases in which the initial acquisitions fail, changes in arbitrage holdings are also positively correlated with target firms receiving subsequent bids within the next year. These last two findings are consistent with an active role of arbitrageurs in the takeover process.

Appendix A:. estimation of arbitrage returns

In a cash deal i, an arbitrageur simply purchases the target stock and holds the position until deal consummation. The first source of arbitrage profit is the difference between the price at which the target company trades after the deal announcement and the cash price finally offered by an acquirer or the stock price prevailing in the market immediately after failed offers. The second source of profit comes from any dividend received on the target stock before the deal was completed. Besides these two sources of profit, the transaction also requires arbitrageurs to pay a financing cost known as the broker call rate. We assume that arbitrageurs borrow at the risk-free rate. Therefore, the return for a cash deal i on day t has the form:

$$r_{it} = \frac{P_{it}^{\mathrm{T}} + D_{it}^{\mathrm{T}}}{P_{it-1}^{\mathrm{T}}} - 1 - r_{ft}, \tag{A.1}$$

where P_t^{T} and D_t^{T} are the target firm's price and dividend payment at time t, respectively, and r_{ft} is the risk-free rate at time t.

For a stock-swap or a collar transaction, arbitrageurs typically take a long position in the target stock and hedge their position by shorting δ shares of the acquirer's stock, where δ is the exchange rate of the offer. Thus, in comparison to the cash offer above, a stock/collar offer return also includes the proceeds from a short position in the acquirer's stock. We also assume arbitrageurs earn the risk-free rate from the proceeds of their short position. The associated costs are the borrowing cost (the risk-free rate by assumption) and the return and payment of the dividend from the short position. Therefore, the return for a stock/collar deal i on day t has the form:

$$r_{it} = \frac{P_{it}^{\mathrm{T}} + D_{it}^{\mathrm{T}}}{P_{it-1}^{\mathrm{T}}} - 1 - r_{ft} - \left(\frac{P_{it}^{\mathrm{A}} + D_{it}^{\mathrm{A}}}{P_{it-1}^{\mathrm{A}}} - 1 - r_{ft} \right) \delta \, \frac{P_{it-1}^{\mathrm{A}}}{P_{it-1}^{\mathrm{T}}}, \tag{A.2}$$

where P_t^{A} and D_t^{A} are the acquiring firm's price and dividend payment at time t, respectively. (In the case of unsuccessful offers, P_t^{A} is the price prevailing in the market immediately after its termination.) For a fixed-exchange-rate (FX) stock/collar deal, arbitrageurs' short positions are determined immediately after the takeover announcement. For a fixed-value (FV) stock/collar deal, the exchange rate δ varies across time until the end of the valuation period. Ideally, an arbitrageur's short position also varies with δ such that a perfectly hedged net position is reached.

In reality, it is generally not possible to reach this goal due to transaction costs. Thus, it is assumed that the arbitrageur determines the exchange ratio by the formula: $\delta =$ (acquirer's offer price)/(acquirer's stock price one day after announcement), and that their position is held until deal resolution (defined below). If the deal is revised, we assume arbitrageurs rebalance their positions, and the new exchange ratio is applied in the return formula.

Daily returns are calculated from the day after the announcement to the resolution day. The return is not calculated on any shares arbitrageurs accumulate prior to the deal announcement. This assumption is not unreasonable. Larcker and Lys (1987) report in their sample that in only three cases did arbitrageurs take positions prior to the takeover announcement. In fact, arbitrageurs usually start to assemble as much information as possible about the deal after a transaction is announced. They do not try to predict the occurrence of the events before the announcement (Moore, 1999). For successful deals, the resolution day is the day on which the target company's stock is delisted from CRSP. For unsuccessful deals, the resolution day is the day after deal failure is publicly announced. To be conservative, we use the return on the day after the deal cancellation is publicly announced as the last date to calculate holding-period returns. Thus, we assume that arbitrageurs clear their positions one day after the deal is cancelled.

Arbitrage returns are calculated as follows. First, daily returns are compounded from the day after announcement to the resolution day. The computed deal return serves as a proxy for arbitrageurs' buy-and-hold return in that deal. One potential problem in buy-and-hold returns is that offers have different periods of time. Thirty-day returns are calculated from the day after the announcement until thirty business days later. To calculate annualized returns, we multiply the buy-and-hold returns by 365/(offer duration).

Appendix B:. endogeneity Tests

Table 9 shows the results from the exogeneity tests regarding toeholds, bid premia, the change in arbitrage holdings, and arbitrage returns. An exogeneity test checks whether a regressor assumed to be exogenous in the system is in fact endogenous. Greene (1997, p. 763) and Spencer and Berk (1981) provide detailed descriptions of the procedure. As one example, we are interested in whether arbitrage return is exogenous in the equation in which the premium is the dependent variable. This corresponds to the second equation in our system. The null hypothesis is that the arbitrage return (the regressor in this equation) is exogenous. The F-statistic (60.317) in Table 9 indicates the rejection of the null hypothesis at the 1% level. Therefore, arbitrage return is more likely to be endogenous in the equation for the premium.

Overall, the tests in the top section of Table 9 indicate that toehold is more likely to be an exogenous variable. The other three variables, on the other hand, appear to be endogenous. Several coefficients indicate the rejection of the null hypothesis that those three variables are exogenous at the 1% level. For example, when we estimate the takeover premia and the returns, the endogeneity issue arises. When we estimate

Table 9
Endogeneity tests of bidder's toehold, takeover premium, arbitrage holdings, and returns

Panel A reports the F-statistic from the exogeneity tests of three endogenous variables in the system of simultaneous equations. Panel B reports the F-statistic from the exogeneity tests of four endogenous variables. Under the null hypothesis, each variable is exogenously determined. The systems in Tables 4 and 5 are estimated using two-stage least squares and three-stage least squares (not reported). Δholdings is the aggregate change of holdings in each deal normalized by target firm's shares outstanding. N_{arb} is the number of arbitrageurs in each deal. Return is annualized buy-and-hold returns, calculated as (unannualized returns)∗365/(deal duration). Toehold is the percentage of target shares held by the bidder prior to the announcement. Premium is target's price runup plus markup. Runup is the cumulative abnormal return to the target firm's stock for trading days (−54, −1) before the first bid. Markup is calculated as (final offer price $- P^T_{-1})/P^T_{-1}$, where P^T_{-1} is the target firm's stock price one day before the announcement. Success is dummy variable with a value of one for successful deals. P-values are reported in parentheses.

Panel A. F-Statistic (p-value) from the exogeneity test of four regressors

Endogenous variables as regressors	Dependent variables in simultaneous equations (in Table 4)		
	Premium	Δholdings	Return
Toehold	2.396 (0.122)	0.925 (0.337)	1.228 (0.268)
Premium		9.633 (0.002)	4.170 (0.041)
Δholdings	6.420 (0.013)		7.761 (0.005)
Return	60.317 (0.000)	6.990 (0.008)	

Panel B. F-Statistic (p-value) from the exogeneity test of five regressors

Endogenous variables as regressors	Dependent variables in simultaneous equations (in Table 5)			
	Premium	Success	Δholdings	Return
Toehold		5.362 (0.021)		
Premium				
Success			9.508 (0.002)	0.134 (0.714)
Δholdings		4.733 (0.030)		
Return				

Δholdings, both the premium and the return are very likely to be endogenous as well. Since these variables are continuous, simultaneous-equations models provide a convenient and effective approach to control for the endogeneity bias.

In Table 9, we add another important variable, probability of deal success, into the system and repeat the exogeneity test. In this table, we only report the F-statistic and its p-value related to the probability of success. The top panel shows that the probability of success is more likely to be determined endogenously with three other variables of interest.

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