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Price Pressure around Mergers

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ABSTRACT

This paper examines the trading behavior of professional investors around 2,130 mergers announced between 1994 and 2000. We find considerable support for the existence of price pressure around mergers caused by uninformed shifts in excess demand, but that these effects are short-lived, consistent with the notion that short-run demand curves for stocks are not perfectly elastic. We estimate that nearly half of the negative announcement period stock price reaction for acquirers in stock-financed mergers reflects downward price pressure caused by merger arbitrage short selling, suggesting that previous estimates of merger wealth effects are biased downward.

TRADITIONAL EVENT STUDIES estimate wealth effects associated with corporate actions, such as mergers, by implicitly assuming that excess demand curves for stocks are perfectly elastic. As a result, measured abnormal returns are generally attributed to the underlying event. For example, it has been well documented that acquiring companies that use their stock as the merger consideration experience announcement period abnormal returns between −2 percent and −3 percent. Conversely, cash acquirers experience flat to slightly positive abnormal returns (see Travlos (1987) and Andrade, Mitchell, and Stafford (2001)). The negative stock price reaction to stock-financed mergers is often taken as support for information-based theories of financial policy (Myers and Majluf (1984)) and investment policy (Jensen (1986) and Shleifer and Vishny (2003)). Common interpretations of the negative stock price reactions are that acquirers use stock as the form of payment when their stock is overvalued or that the market perceives the merger to be a value-destroying investment project.

Evidence presented in this paper suggests that a substantial part of the negative reaction to stock merger announcements is due to downward price pressure caused by merger arbitrage short selling of acquirers' stocks around merger announcement dates. In particular, if excess demand curves for stocks are downward sloping in the short-run, then increases in the supply of stock

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will cause the equilibrium price to decrease. Although the common assumption that stocks' supply curves are vertical and fixed may be reasonable in many situations, it is unlikely to hold around merger announcements, when short sellers dramatically increase the effective supply of shares.

Researchers studying the market for securities have long been interested in the notion of price pressure and downward-sloping excess demand curves for stocks. In a perfect capital market, excess demand curves for stocks are perfectly elastic—investors can buy or sell unlimited amounts of stock at a market price that reflects all relevant information. As a result, shifts in excess demand caused by uninformed trading will have no impact on price. In real-world capital markets, market frictions will limit market forces from keeping excess demand curves perfectly elastic.

Scholes (1972) proposes two alternatives to the perfect capital market hypothesis. One is the price pressure hypothesis, which asserts that prices will temporarily diverge from their information-efficient values with uninformed shifts in excess demand to compensate those that provide liquidity. Mechanically, this occurs when prices return to their information-efficient values, presumably over a short horizon. The second alternative is the long-run downward-sloping demand curve hypothesis. If individual securities do not have perfect substitutes then arbitrage will be ineffective in keeping excess demand curves horizontal. Scholes is also one of the first to empirically test for price pressure effects by examining large block trades. However, it is difficult to hold the information effects associated with these trades constant, and therefore to distinguish between competing hypotheses. If new information is revealed, all hypotheses predict a price change.

The most convincing evidence of price pressure for stocks comes from studies suggesting that uninformed demand affects prices. Harris and Gurel (1986) and Shleifer (1986) estimate abnormal returns for firms added to the S&P 500 index to be 3 percent on the inclusion day. Both papers argue that inclusions to the S&P 500 index convey no new information about future return distributions, but cause outward shifts in excess demand by investment strategies that track the S&P 500. Harris and Gurel interpret their findings as supportive of the price pressure hypothesis because they find nearly complete price reversal over a 2-week interval. On the other hand, Shleifer views his results as evidence of downward-sloping long-run demand curves for securities because he finds little evidence of a price reversal.[1] Recently, Wurgler and Zhuravskaya (2002) tested the downward-sloping demand curve hypothesis by classifying firms added to the S&P index on the basis of whether they have close substitutes. Consistent with the hypothesis that excess demand curves slope downward, the inclusion effect is greater for firms that lack close substitutes, where it is riskier for arbitrageurs to keep demand curves elastic. Studies that examine samples other

[1] Subsequently, several other studies have examined S&P 500 inclusions and deletions, and have generally found a partial price reversal, but an essentially permanent component as well (see Dhillon and Johnson (1991), Beneish and Whaley (1996), Lynch and Mendenhall (1997), Chen, Noronha, and Singal (2002), and Blume and Edelen (2002)).

than S&P 500 additions and deletions also find evidence consistent with price pressure.[2]

To determine whether price pressure associated with downward-sloping demand curves for stocks contributes to negative acquirer announcement period returns, we construct a comprehensive sample of mergers announced between 1994 and 2000. There are several critical points throughout a merger transaction that stimulate trading activity, some of which is caused by new information about the future distribution of returns, but much of which is unrelated to new information. Merger pricing periods and closings are central dates for merger arbitrage and index-tracking investment strategies. Yet there is typically little information regarding the likelihood of merger completion revealed on these dates. We measure changes in stock prices and short interest around these critical points in the merger process. Our results provide considerable support for the existence of short-term price pressure around mergers caused by uninformed shifts in supply and demand curves.

Most stock mergers are fixed-exchange-ratio mergers, where the number of acquirer shares to be exchanged for each target share is revealed when the merger is announced. For these types of mergers, the announcement period stock price reaction coincides with both the release of new information and a shift in supply caused by merger arbitrage short selling. Less common, but important for our study, are floating-exchange-ratio stock mergers. In a floating-exchange-ratio stock merger, the number of acquirer shares to be exchanged for each target share is determined during a pricing period that is usually 3 months after the merger announcement. It is during the pricing period that merger arbitrageurs actively short sell acquirer shares in floating-exchange-ratio mergers. Typically, there is little new information about the probability of the merger going forward that is revealed during the pricing period, as the transaction terms are pre-specified and the pricing period generally begins after conditions upon which the merger is contingent have been satisfied. The reaction to floating-exchange-ratio mergers at announcement is positive, but there is a negative stock price drift averaging –3.2 percent during the pricing period, consistent with price pressure caused by merger arbitrage short selling. Over the subsequent month, acquirers' stock prices rebound 2.5 percent, on average.

We also find evidence of price pressure around merger closings. The consummation of a stock-financed merger triggers portfolio rebalancing for equity value-weighted investment strategies, such as those tracking the Standard and Poor's (S&P) Indices. To minimize tracking error, investment strategies linked to these indices must rebalance their portfolios as close to the merger closing date as possible. When a merger involving an S&P member firm is expected

[2] Madhavan (2001) examines rebalancing of the Russell indices. Bagwell (1992) studies a sample of 32 Dutch auction tender offers and documents that companies repurchasing shares face upward sloping supply curves. Studies of buyer-initiated large-block transactions (Holthausen, Leftwich, and Mayers (1990)) and seller-initiated large-block transactions (Scholes (1972) and Mikkelson and Partch (1985)) provide additional evidence consistent with price pressure effects, although the results are also consistent with the notion that large block transactions convey information.

to require portfolio rebalancing, we find a stock price run-up of nearly 3 percent in the days around the merger closing, followed by a 1-month reversal of roughly 1.5 percent. Interestingly, we find no evidence of price pressure effects around merger closings for transactions that are not expected to require portfolio rebalancing, such as for cash-financed mergers.

Finally, we document a link between the negative stock price reaction to stock-financed mergers and the amount of short selling that occurs over the month surrounding the merger announcement. The median increase in short interest for acquiring firms around fixed-exchange-ratio stock mergers is 40 percent. The level of short interest falls dramatically when the merger closes, consistent with the expected trading behavior of merger arbitrageurs. Moreover, the cross section of stock price reactions to stock-financed mergers is related to the change in short interest that occurs over the month surrounding the announcement. We estimate that nearly half of the negative reaction reflects downward price pressure caused by merger arbitrage short selling. In particular, after controlling for changes in short interest due to merger arbitrageur trading, the negative average announcement period stock price reaction to stock-financed mergers is only −1.44 percent, whereas, the average reaction is −2.65 percent without controlling for the effects of price pressure. This suggests that previous estimates of the wealth effects associated with stock-financed mergers are biased downward.

This paper is organized as follows. Section I explains the timing and motive for trade by various professional investor types around mergers. Section II describes the data. Section III discusses price pressure effects from merger arbitrage. Section IV provides evidence on price pressure effects due to index rebalancing. Section V interprets the results and discusses the relevance of price pressure for measuring value effects of mergers and event studies in general, and Section VI concludes.

I. The Trading Patterns of Various Professional Investor Types around Mergers

Professional investors are responsible for much of the trading in equity markets. Shleifer and Vishny (1997) emphasize that professional investors are often specialized, in that they focus on a single or limited number of investment strategies. In addition, the nature of professional money management "... is that brains and resources are separated by an agency relationship" (Shleifer (2000), p. 89). As a result, many professional investors are careful not to have their performance deviate too significantly from others that claim to follow similar investment strategies. For example, investment funds that track the S&P indices attempt to minimize their tracking error by purchasing new index additions as close to the closing price on the effective date as possible, despite having to pay a liquidity premium to do so. Another type of professional investor, the merger arbitrageur, specializes in buying targets after mergers are announced. The typical merger arbitrageur minimizes tracking error by waiting to invest until the merger is formally announced and by liquidating immediately upon

the closure of the merger. This type of behavior by professional investors, such as S&P index funds and merger arbitrageurs, induces interesting trading patterns around mergers, especially for stock-financed mergers.

A. The Trading Behavior of Merger Arbitrageurs around Mergers

The most obvious investment strategy that requires active trading around mergers is merger arbitrage (also called risk arbitrage). Merger arbitrage refers to a specialized investment strategy that essentially amounts to providing insurance to target firm shareholders against deal failures. As a result of a merger announcement, the future return distribution of the target firm is dramatically altered, as the target firm's stock trades at a small discount to the consideration offered by the acquiring company. If the merger is successful, this discount diminishes as the merger approaches consummation, generating a small positive holding period return. However, if the merger fails, the target firm's stock price usually falls dramatically, generating a large negative return. Merger arbitrageurs are compensated for bearing this transaction risk.[3]

The key to the merger arbitrage trade is the link between the target firm's shares and the consideration promised by the acquiring firm. This link is severed if the merger is not consummated, but otherwise guides the arbitrage trade. Since merger arbitrageurs specialize in isolating, evaluating, and bearing transaction risk, there is no reason for them to be exposed to overall market risk. Thus, merger arbitrageurs attempt to profit from the spread between the promised consideration and the current target firm stock price.

For cash mergers, the merger arbitrage trade is simple—buy shares of the target firm's stock and hold until the merger closes. The merger arbitrageur provides liquidity to the shareholders of the target firm that want to sell on the announcement day and on the days that follow. Trading activity is very high on the announcement day and remains high for several days as merger arbitrageurs enter their investment positions. When the merger transaction is consummated, merger arbitrageurs, and any other shareholders of the target firm, receive cash for their shares. The investment is complete with no additional trading.

Capturing the arbitrage spread in stock mergers is slightly more complicated, involving trades in both the target and acquiring firms' stocks. Again, the merger arbitrageur buys shares in the target firm. However, because the link between these shares and the promised consideration now involves shares in the acquiring firm rather than simply cash, isolating transaction risk requires the arbitrageur to also trade shares in the acquiring firm. The appropriate trade in the acquiring firm's stock depends on whether the stock offer is a fixed-exchange-ratio offer, a floating-exchange-ratio offer, or a collar offer.

Fixed-exchange-ratio stock mergers are the most straightforward of the stock-financed mergers. At announcement, the acquirer agrees to exchange a fixed

[3] Clearly, merger arbitrage is not risk free, and the name "merger arbitrage" is a misnomer. See Mitchell and Pulvino (2001) and Baker and Savasoglu (2002) for recent descriptions of the risks and returns from merger arbitrage.

number of acquirer shares for each target share. Consequently, for each target share purchased, the merger arbitrageur sells short the fixed number of acquirer shares per the merger agreement. In order to minimize market risk, these trades are typically placed simultaneously, and often in terms of a limit spread order. While merger arbitrageurs may provide some liquidity in the target firm's stock, they demand liquidity in the acquirer's stock because the arbitrage trade requires the immediate shorting of acquirer shares. When the merger closes, the short position in the acquirer's shares is cancelled when the shares owned in the target firm are exchanged for acquirer shares.

For example, in September 2001, Hewlett Packard agreed to acquire Compaq Computer and pay 0.6325 shares of Hewlett Packard for each share of Compaq. The merger arbitrageur attempting to capture the arbitrage spread would, soon after the announcement, short sell 0.6325 shares of Hewlett Packard for every share of Compaq purchased. Around the announcement of the merger, over 20 million Hewlett Packard shares were sold short, as short interest increased from 30 million to 51 million shares. This increase in short interest was equivalent to more than 4 days of typical daily trading volume for Hewlett Packard, estimated as the median daily trading volume over the previous 3 months.[4] When the merger closed in May 2002, each Compaq share was converted into 0.6325 shares of Hewlett Packard, exactly offsetting the initial short position in Hewlett Packard, such that no additional trading was necessary.

Unlike fixed-exchange-ratio offers that specify the number of acquirer shares to be exchanged for each target share, floating-exchange-ratio stock offers specify the *value* (V_{Offer}) of the acquirer's stock to be exchanged for each target share. The number of acquirer shares that will ultimately be exchanged for each target share is determined later, by dividing the offer value by the acquirer's average stock price ($P_{Average}$) measured during a pre-specified pricing period. The pricing period typically occurs just before merger closing, which is at least 2 months after the merger is announced. From the arbitrageur's perspective, floating-exchange-ratio mergers are similar to cash mergers before the pricing period begins, as the promised consideration is specified in units of dollars. However, after the pricing period ends, floating-exchange-ratio mergers are identical to fixed-exchange-ratio mergers, as the promised consideration is specified in units of acquirer shares. Therefore, the arbitrageur is not short any acquirer shares prior to the pricing period and is short $V_{Offer}/P_{Average}$ acquirer shares after the pricing period. The important point is that, to isolate transaction risk, arbitrageurs short sell the acquirer's stock during the pricing period. Merger agreements typically specify pricing periods such that almost all deal uncertainty is resolved before the pricing period begins. This is accomplished by specifying the pricing period, relative to a specific event. For example, the pricing period for the 1998 acquisition of Money Store by First Union was specified as "the average of the per share closing sales price of First Union common stock

[4] Interestingly, in December 2001, when it seemed as though Hewlett Packard shareholders would vote against the merger, many merger arbitrageurs sold their positions and short interest fell to 31 million shares. The merger was eventually completed in May 2002.

on the New York Stock Exchange Composite Transactions Tape for each of the five trading days immediately prior to the effective date of the merger."[5] First Union announced the acquisition of Money Store on March 4, 1998. On June 1, 1998, First Union and Money Store filed the necessary SEC forms to inform shareholders of the merger details (such as the pricing period) and the upcoming meeting on Friday, June 26, 1998 to vote on the merger. The merging parties revealed the merger would close soon after the shareholder meeting—the actual closing date was June 30, 1998, and the corresponding pricing period was June 23 to 29. In our sample, pricing periods for floating exchange ratio mergers ended an average of 5 days (median equals 3 days) before merger closing. The mean and median pricing period lengths are 13 and 10 days, respectively.

Merger closing dates are not always known with complete certainty before they occur, and therefore merger arbitrageurs must sometimes estimate pricing period start and end dates. Mergers are typically consummated shortly after the final condition specified in the merger agreement has been met, which is often an affirmative shareholder vote, as illustrated by the Money Store example. Since shareholder-voting dates are announced well in advance (approximately 30 days) of merger closing, inferring pricing period dates prior to merger closing is usually a straightforward task. Estimating pricing period dates can be somewhat more difficult when other events, such as regulatory approval, dictate the merger closing date. But, even in these less common cases, scheduled meetings by regulatory bodies can be used to obtain fairly accurate estimates of pricing period start and end dates in advance of the actual pricing period.

Because, the pricing period typically occurs just before merger closing, most deal uncertainty is resolved prior to commencement of the pricing period. While there may be news regarding future acquirer returns revealed during the pricing period, there is no reason to believe that news is systematically positive or systematically negative. However, unlike fixed-exchange-ratio mergers where arbitrage short selling spans the time between merger announcement and closing (typically 3 months), short selling is much more concentrated in floating-exchange-ratio mergers. Below, we argue that concentrated merger arbitrage short selling is the primary cause of the observed negative acquirer stock price drift during the pricing period.

Finally, in addition to fixed- and floating-exchange-ratio offers, there are more complicated types of stock mergers, typically referred to as collars.[6] For example, one common type of collar augments the floating-exchange ratio by providing both a maximum and a minimum number of acquirer shares that will be issued for each outstanding target share. Another type of collar augments a fixed-exchange-ratio merger by specifying both a minimum and maximum value of the acquirer stock that will be issued. The consideration offered in collar transactions can be viewed as a portfolio consisting of the acquirer's stock and options on the acquirer's stock. As with any portfolio of options, collar transactions can be "delta-hedged" with stock positions or by trading in the options

[5] First Union SEC form 424B3 filed on June 1, 1998.

[6] For a discussion of why firms use collars in mergers, see Fuller (2003) and Officer (2003).

market. For the analysis presented in this paper, the important feature of collar transactions is that isolating transaction risk requires more short selling at announcement than is required for floating-exchange-ratio stock mergers and less short selling at announcement than is required for fixed-exchange-ratio stock mergers. To the degree that arbitrageurs delta hedge and gamma hedge collar transactions, the short interest in the acquirer's stock will continuously change as the acquirer's stock price changes.

B. The Trading Behavior of S&P Index Funds around Mergers

The S&P 500 Composite Stock Price Index is the most common of the S&P equity indices, but there are numerous others, including the S&P MidCap 400 and the S&P SmallCap 600.[7] All of the S&P indices are market value-weighted indices, which are tracked explicitly and implicitly by numerous mutual funds, pension funds, and other professional investors. Today, more than one trillion dollars is indexed to the S&P 500, accounting for 8.5 percent of its total value. Professional investors who track the S&P indices try to minimize deviations between their performance and that of the target index. As a result, changes in the composition of an index—either the actual members of the index or the weights of the existing members—can stimulate substantial portfolio rebalancing. Mergers are a frequent cause of both types of these changes.

The first situation where a merger stimulates trading by S&P index funds is when the merger itself triggers an addition or deletion in the S&P index. An acquisition of an S&P member firm always leads to its deletion from the index, and often leads to the addition of the acquiring firm if the acquirer is not already an S&P member. However, S&P does not always replace a target company with its acquirer. For example, General Re disappeared from the S&P 500 index when Berkshire Hathaway acquired it in December 1998, but Berkshire, with its several thousand dollar share price, was not included because S&P felt that it was too illiquid. S&P instead added Carnival Corporation.

The second situation where a merger leads to rebalancing of an S&P index occurs when a stock-financed merger triggers an immediate rebalancing of an S&P index without a change in the names of the index members. This is the result of an S&P index rule that requires an immediate rebalancing whenever the number of shares outstanding of one of its members changes by more than 5 percent (not including stock splits and dividends). Absent a 5 percent change, the index rebalances quarterly. Stock mergers often trigger the 5 percent rule. When a stock-financed merger is consummated, the acquiring firm issues additional shares in exchange for the target shares outstanding. The target shares are cancelled, and the market value of the acquirer's equity increases. This increase in the acquirer's equity value affects value-weight investment strategies that have positions in the acquiring firm. Moreover, the magnitude of this rebalancing can be quite large. For example, in December 1996, WorldCom (member of S&P 500)

[7] We focus on the S&P 500 Composite Stock Price Index because it is the most tracked equity index in the world.

acquired MFS Communications (nonmember of S&P 500). Upon the close of this merger, WorldCom issued 462 million shares, more than doubling total shares outstanding from 409 million to 871 million. Correspondingly, S&P increased the weight of WorldCom in the S&P 500 index from 0.74 percent to 1.58 percent, effective at the close of trading on December 31, 1996. With roughly 8.5 percent of the S&P 500 held by index funds, these funds would be expected to purchase an additional 29 million shares in WorldCom near the merger closing date. This represents approximately 17 days of typical WorldCom trading volume, estimated as the median daily trading volume over the 3 months prior to the merger announcement. Situations such as this are sometimes referred to as "hidden additions."[8] Hidden additions around certain stock-financed merger closings are interesting because they stimulate large trades that are not motivated by new information.

C. Implications for Price Pressure

The trading behavior by professional investors described above has several implications for price pressure around mergers. The cleanest situations in which to look for uninformed demand affecting prices is during pricing periods for floating-exchange-ratio stock mergers and at closing dates for stock-financed mergers when the merger induces index rebalancing. At the same time, there should be no price pressure effect at merger closing when index rebalancing is unnecessary. This will be the case for cash-financed mergers, where cash is exchanged for other assets leaving the acquirer's equity value unchanged, and for stock-financed mergers between firms that are already members of the same S&P index.

II. Data Description

The data set for this study includes all mergers and acquisitions of U.S. publicly traded firms (NYSE, Nasdaq, and AMEX) that are announced between 1994 and 2000. Critical transaction information such as announcement dates, agreement dates, termination dates, entry of a second bidder, and transaction terms is obtained by reading Dow Jones News Wires, Press Release Wires, Reuters Newswires, and *The Wall Street Journal* articles relating to each merger transaction. For complicated transactions involving floating-exchange ratios and collars, information is gathered from merger agreements and 8-Ks filed with the Securities and Exchange Commission (SEC). The 1994 starting point for the sample coincides with the online availability of SEC filings.

In addition to merger transaction and stock price information, we obtain short interest data directly from the NYSE, Nasdaq, and AMEX over the period 1994 to 2001. We modify the short interest data in the following ways. First, we correct errors caused by stock splits and stock dividends via comparisons with the

[8] We thank Diane Garnick at Dresdner, Kleinwort, Wasserstein for discussions on this issue.

CRSP stock split data. Second, we fill in missing short interest data when appropriate, using alternative sources, such as Bloomberg and Barron's. Third, we correct major outliers in the data, again using Bloomberg and Barron's. Fourth, we convert the monthly short interest data to a specific date in each month. For example, Nasdaq reported January 2002 short interest on January 28, 2002. Member firms were required to report their January short interest figures to Nasdaq as of settlement on January 15 (firms must report short positions as of settlement on the 15th of each month, or the preceding trading day if the market is not open on the 15th). In order to account for the 3-day Regulation-T delay in settlement, we calculate a trade date computed as 3 business days preceding the reporting date. For instance, in January 2002, the 15th occurred on a Tuesday, and thus the corresponding trade date was Thursday, January 10. We convert each short interest month to a specific trading date in that month in order to precisely match changes in short selling to specific merger event dates.

Table I presents a summary of the mergers used in this study, separated by announcement year and transaction type. The sample consists of 2,130 mergers including 736 cash mergers, 64 floating-exchange-ratio stock mergers, 244 collar mergers, and 1,086 fixed-exchange-ratio stock mergers. Based on market equity values, acquirers tend to be considerably larger than targets. The relative sizes of targets to acquirers vary according to the type of transaction. In the typical fixed-exchange-ratio merger, the target is about 25 percent as large as the acquirer, whereas targets are about 10 percent of the size of acquirers in cash mergers and tender offers. The size differential is greatest in floating-exchange-ratio mergers where the median relative size of target firms to acquirers is only 3 percent.

One possible reason for the large size differential in floating-exchange-ratio mergers is that the number of acquirer shares that must be issued can vary widely depending on the acquirer's stock price during the pricing period. A significant decrease in the acquirer's stock price between deal announcement and the pricing period can result in the issuance of many more shares than anticipated at the merger announcement. If the target and acquirer sizes were close enough, and if the price change were large enough, control of the combined firm could be transferred to target shareholders. As a result, acquirers are only likely to offer floating-exchange ratios when the target is relatively small. As relative size increases, one way to mitigate the possibility that target shareholders own too much of the combined entity is to use a collar. As previously noted, collars can be used to augment floating-exchange-ratio mergers by placing upper and lower bounds on the number of acquirer shares to be exchanged for each target share. They can also be used to augment fixed-exchange-ratio mergers to limit the value of acquirer shares to be issued to each target shareholder. Panel C of Table I shows that for collar mergers, the ratio of target market capitalization to acquirer market capitalization is 13 percent, approximately halfway between the ratios for floating-exchange-ratio mergers and fixed-exchange-ratio mergers.

Table I

Merger Sample Summary, 1994 to 2000

This table summarizes the mergers used in this paper, based on form of consideration paid. Cash transactions consist of mergers where the consideration is 100 percent cash. Floating-exchange-ratio stock transactions consist of mergers where the number of acquirer shares to be exchanged for each target share is specified as a dollar value per share divided by the average acquirer price over a pricing period that is specified at the merger announcement. Floating-exchange-ratio transactions that contain an additional cash component are included in the sample. Collar transactions consist of mergers where the floating exchange ratio is limited by upper and lower bounds, or where the dollar value of acquirer stock to be issued in the merger is limited by upper and lower bounds. Fixed-exchange-ratio stock transactions consist of mergers where the consideration is 100 percent stock and where the number of acquirer shares to be exchanged for each target share is fixed and specified at merger announcement. Acquirer equity market values are measured on the day after the merger announcement. The acquirer *CAAR* is measured over a 3-day window surrounding the merger announcement date (see Table II for further explanation).

		Acquirer Market Equity ($Millions)		Relative Size	Acquirer *CAAR* [−1, +1]	
Year	Number Announced	Median	Average	Median Target Equity Value/ Acquirer Equity Value	Average	*t*-statistic
Panel A: Cash Mergers and Tender Offers						
1994	74	1,770	3,660	0.17	1.35%	2.09
1995	94	1,068	5,936	0.17	0.87%	1.49
1996	79	1,746	11,100	0.07	1.44%	2.43
1997	107	1,854	11,700	0.11	1.48%	2.45
1998	91	1,655	11,700	0.12	0.49%	0.84
1999	149	2,411	26,700	0.10	2.56%	2.66
2000	142	2,116	16,100	0.10	−1.23%	−2.39
Total	736	1,869	14,000	0.10	0.96%	3.48
Panel B: Floating-exchange-ratio Stock Mergers						
1994	5	1,730	2,484	0.02	−1.20%	−1.73
1995	4	6,197	13,900	0.02	3.13%	1.22
1996	9	3,607	9,100	0.03	−0.10%	−0.11
1997	19	5,163	39,100	0.07	−0.12%	−0.12
1998	14	6,137	30,400	0.01	0.50%	0.50
1999	8	11,500	58,100	0.05	1.78%	2.10
2000	5	28,700	39,100	0.01	2.47%	1.70
Total	64	5,099	30,600	0.03	0.58%	1.28
Panel C: Collar Stock Mergers						
1994	17	1,381	2,271	0.06	−1.07%	−1.36
1995	29	1,016	2,860	0.10	−2.06%	−2.08
1996	44	1,396	2,981	0.15	0.72%	0.84
1997	50	816	3,051	0.24	−0.06%	−0.06
1998	39	4,621	10,500	0.10	−1.50%	−1.25
1999	49	2,401	12,800	0.10	−1.97%	−2.15
2000	16	1,945	3,864	0.09	−0.67%	−0.20
Total	244	1,579	6,165	0.13	−0.88%	1.97
Panel D: Fixed-exchange-ratio Stock Mergers						
1994	107	496	2,257	0.24	−1.82%	−2.50
1995	128	1,030	2,413	0.26	−1.84%	−2.75
1996	141	1,199	3,575	0.28	−2.12%	−3.53
1997	168	1,267	4,932	0.28	−2.21%	−4.23
1998	154	1,645	9,174	0.40	−3.26%	−5.13
1999	209	1,825	21,200	0.24	−3.23%	−4.85
2000	179	2,799	28,000	0.20	−3.86%	−4.72
Total	1,086	1,408	11,800	0.25	−2.73%	−10.57

The last two columns of Table I describe acquirer stock price reactions to merger announcements by year. For cash mergers and tender offers, the acquirer abnormal returns tend to be positive, averaging 0.96 percent (t-statistic = 3.48). In contrast, the acquirer abnormal return in fixed-exchange-ratio stock offers tend to be significantly negative, averaging −2.73 percent (t-statistic = −10.57), becoming more negative later in the sample period. Interestingly, acquirer abnormal returns in floating-exchange-ratio stock mergers are positive whereas acquirer abnormal returns are negative for fixed-exchange ratio and collar transactions. Previous studies that have noted the difference in returns between cash and stock mergers conclude that stock mergers convey negative information regarding the acquirer's stock price. In later sections of this paper, we provide empirical evidence that nearly half of the negative acquirer reaction observed in fixed-exchange-ratio stock mergers is caused by price pressure associated with merger arbitrage short selling around merger announcements.

III. Price Pressure Effects from Merger Arbitrage

In general, detecting price pressure effects around announcements of corporate events is problematic because of the simultaneous effects of price pressure and information revelation. To disentangle the price pressure and information effects, we examine acquiring firms' stock price changes around mergers. Merger arbitrage investment strategies require short sales in the acquiring firms' stock soon after the announcement for fixed-exchange-ratio stock mergers and during the pricing period for floating-exchange-ratio stock mergers. Clearly, the potential effects of price pressure at merger announcement are clouded by the new information released by the announcement itself. However, floating-exchange-ratio stock mergers represent a unique sample because of the separation between the short selling by merger arbitrageurs and the information released in the announcement. On average, the pricing period is 3 months after the announcement.

Table II displays abnormal returns for various types of mergers around announcement, closing, pricing period, and the entire transaction window. Daily abnormal returns (*AR*s) are calculated using the market model. Market model parameters are estimated over a 150-day window beginning 21 days after the merger closing or failure date, where the value-weighted CRSP index proxies for the market portfolio.[9] Post-merger acquirer betas are used to control for changes in underlying assets and capital structure of the acquiring firm associated with the merger.

Consistent with the notion that short selling by merger arbitrageurs exerts downward pressure on the acquirers' stock, the announcement period abnormal returns are negative for fixed-exchange-ratio and collar stock mergers.

[9] Market model regressions are estimated using an intercept, but the daily *AR* is calculated assuming that the intercept is zero. We require at least 50 valid observations for the estimation. Cumulative average abnormal returns (*CAAR*s) are the sum of daily *AR*s. Test statistics for average *AR*s and *CAAR*s are calculated by dividing the mean by the standard error of the mean.

Table II

Announcement Period, Closing Period, and Pricing Period Cumulative Average Abnormal Stock Returns for Acquirers

Cumulative average abnormal returns (*CAAR*s) are measured using a one-factor market model. Market model parameters are estimated over a 150-day window beginning 21 days after the merger close or fail date using the value-weighted CRSP index as a proxy for market returns. Event day 0 corresponds to the first day that merger effects can be incorporated into securities prices. Closing date returns are calculated for successful deals only. Mergers are classified as "Cash," "Floating-exchange-ratio Stock," "Collar," and "Fixed-exchange-ratio Stock," based on the form of payment to target shareholders. In fixed-exchange-ratio stock mergers, the number of acquirer shares to be given to each target shareholder is determined on the announcement date. In floating-exchange-ratio stock mergers, the *value* of acquirer shares per target share is fixed on the announcement date. The actual number of acquirer shares issued per target share is obtained by dividing value by the average acquirer price during a later pricing period defined in the merger agreement. Test statistics are calculated using the standard error of the mean.

	Cash (No Hedge)	Floating-exchange-ratio Stock (Late Hedge)	Collar Stock Mergers (Dynamic Hedge)	Fixed-exchange-ratio Stock (Early Hedge)
Announcement Date [−1, +1]				
CAAR	0.96%	0.58%	−0.88%	−2.73%
t-statistic	3.48	1.28	−1.97	−10.57
N	736	64	244	1,086
Closing Date [−1,+1]				
CAAR	0.07%	0.73%	0.47%	1.18%
t-statistic	0.38	1.63	1.27	5.61
N	621	58	219	880
Pricing Period (Variable Length)				
CAAR	n.a.	−3.18%	−0.97%	n.a.
t-statistic		−2.79	−1.43	
N		59	221	
Psuedo Pricing Period[a]				
CAAR	−0.05%	n.a.	n.a.	0.43%
t-statistic	0.16			1.33
N	628			894
Entire Event Window [Announcement − 20, Close + 20]				
CAAR	5.58%	−0.38%	−0.92%	0.41%
t-statistic	4.92	0.14	−0.45	0.38
N	563	55	202	876

[a]Psuedo pricing periods for cash and fixed-exchange-ratio stock deals are computed using acquirer stock prices over the 10 days ending 3 days before merger closing.

Cash mergers and floating-exchange-ratio stock mergers are associated with positive announcement period abnormal returns on average. More interesting, however, are the average abnormal returns during the pricing period for floating-exchange-ratio stock mergers, which are significantly negative. In particular, the cumulative average abnormal return (*CAAR*) is −3.18 percent (*t*-statistic = −2.79) for floating-exchange-ratio mergers.

Arguably, there is little new information revealed about the likelihood of merger completion during the pricing period. The merger consideration had

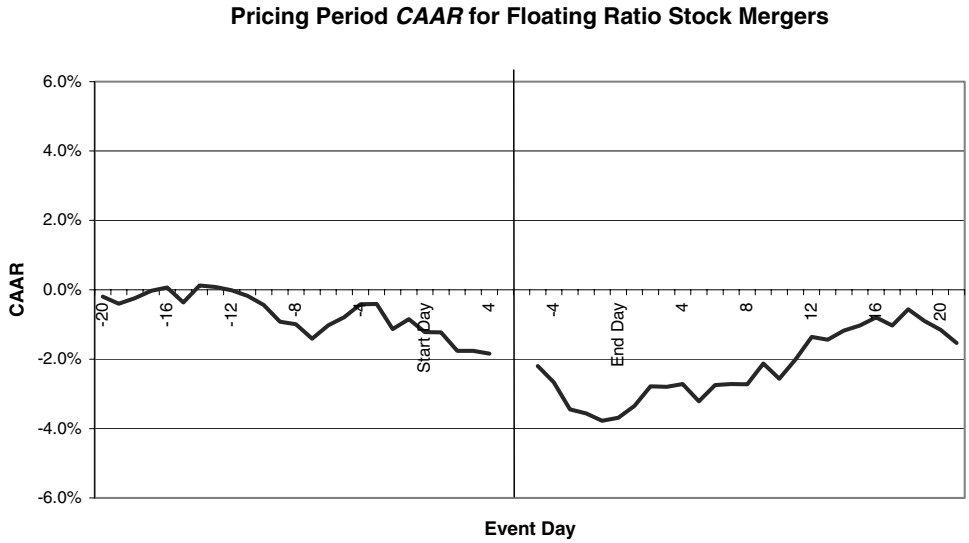

Figure 1. Acquirer cumulative average abnormal return during floating-exchange-ratio pricing periods. This figure displays average acquirer abnormal returns over the pricing period for successful floating-exchange-ratio stock mergers during 1994 to 2000. The gap between the beginning of the pricing period and the end of the pricing period is caused by cross-sectional differences in pricing period lengths. Vertical locations of the beginning and ending segments are determined such that the correct average *CAAR* from 20 days prior to the beginning of the pricing period to 20 days after the end of the pricing period is maintained.

been previously determined at the merger announcement, and pricing periods are typically designed to begin after nearly all of the conditions required to consummate the merger have been satisfied. The unique aspect of this situation is that merger arbitrageurs are actively short selling the stocks of the acquirers over this period, roughly the same amount each day. Figure 1 displays the event-time *CAAR* around the pricing period. As previously discussed, the typical pricing period lasts 10 trading days, ending 5 days prior to the merger closing date, although the actual length can be different across merger transactions. Therefore, the figure incorporates a break after the fifth day into the pricing period, and then starts with the fifth day prior to the pricing period ending date. The *CAAR* is relatively flat prior to the beginning of the pricing period. Once the pricing period begins, the *CAAR* starts to drift down, and then immediately reverses direction at the end of the pricing period. The pricing period drift of -3.18 percent is almost completely offset by a subsequent 1-month reversal of 2.53 percent (t-statistic $= 2.09$). This pattern is consistent with temporary price pressure caused by merger arbitrageurs short selling the stock of these acquirers.

Further support for the hypothesis that price pressure is responsible for this negative return is provided by returns for other types of mergers over similar time periods. For collar transactions, where short selling during the pricing period by arbitrageurs is expected to exist but with less intensity, the *CAAR*

is −0.97 percent (t-statistic = −1.43). To check whether negative returns observed during pricing periods for floating-exchange ratio and collar mergers are an artifact of mergers in general, returns for cash and fixed-exchange-ratio mergers are measured over a "pseudo pricing period," defined to be the 10 days ending 3 days before merger closing. The *CAAR* is actually positive 0.43 percent (t-statistic = 1.33) for fixed-exchange-ratio mergers and is effectively zero for cash mergers, suggesting that the pricing period is not a time over which information is typically revealed to investors.

To establish a link more directly between short selling of acquirers' stocks and the downward stock price drift throughout the pricing period, we examine changes in short interest over this interval. Table III and Figure 2 report the median percentage change in monthly short interest in event-time around merger announcements, closings, and pricing periods, by deal type. The last column of Panel A in Table III shows that for floating-exchange-ratio stock mergers, the median change in short interest is small in the months before and after the pricing period, but a statistically significant 12.1 percent during the pricing period. This estimate probably understates the true increase in short interest because of the nature of the short interest data. As described in Section II, short interest is measured by the exchanges only once a month, and therefore, will coincide with the end date of the pricing period only by chance. Typically, the effective date on which short interest is measured occurs at some point within the pricing period, before merger arbitrageurs have completed their short selling of the acquirer's stock. Occasionally, the pricing period begins and ends between short interest measurements. In these cases, our estimate of short interest during the pricing period completely misses short selling by arbitrageurs.

Figure 2 and Table III also show changes in short interest around merger announcements and closings for other types of mergers. For cash mergers and floating-exchange-ratio mergers, where we have no reason to believe that merger arbitrageurs short sell the acquirer's stock at or near the announcement, changes in short interest are essentially zero around merger announcements. On the other hand, for fixed-exchange-ratio stock mergers, where we expect merger arbitrageurs to short sell the acquirer's stock soon after the announcement and then maintain this short position until the merger closes, we find a large increase in short interest in the month of the announcement. The median change in short interest in the announcement month for fixed-exchange-ratio stock mergers is 40 percent, and short interest continues to increase in the months between the merger announcement and close. In the month the merger is consummated, the median decrease in short interest is 31 percent, as merger arbitrageurs have their short positions in the acquirers' stocks cancelled when their long positions in the targets' stocks are exchanged.[10] For collar transactions, where dynamic hedging strategies are common, the level of merger

[10] Note that the percentage decline in short interest at the merger closing is less than the percentage cumulative increase during the merger period in fixed-exchange-ratio stock mergers. Much of this is simply because short interest increases during the merger process. Therefore, for a given change in *number* of shares short, the *percentage* change in short interest decreases.

Table III

Acquirer Short Interest around Merger Events

This table presents short interest of acquirers around merger event dates. Panel A displays the median monthly percentage change in short interest around announcement, closing, and pricing period dates. Panel B displays short interest normalized by three different variables. The first measure normalizes short interest by acquirer shares outstanding; the second measure normalizes short interest by the median, over the 63 trading days ending 5 days before merger announcement, of acquirer volume (measured in number of shares); the third measure normalizes short interest in a given event month by the maximum short interest over the period beginning 3 months before merger announcement and ending 2 months after merger closing. Mergers are classified as "Cash," "Floating-exchange-ratio Stock," "Collar," and "Fixed-exchange-ratio Stock," based on the form of payment to target shareholders. In fixed-exchange-ratio stock mergers, the number of acquirer shares to be given to each target shareholder is determined on the announcement date. In floating-exchange-ratio stock mergers, the *value* of acquirer shares per target share is fixed on the announcement date. The actual number of acquirer shares issued per target share is obtained by dividing value by the average acquirer price during a later pricing period defined in the merger agreement.

Panel A: Median Percentage Change in Short Interest around Merger Announcements

Event Month	Cash Mergers (No Hedge)	Floating-exchange-ratio Stock Mergers (Late Hedge)	Collar Stock Mergers (Dynamic Hedge)	Fixed-exchange-ratio Stock Mergers (Early Hedge)
−3	1.91%	−1.28%	4.54%	1.63%
−2	0.55%	−0.24%	3.32%	1.59%
−1	1.22%	9.88%	0.51%	2.63%
0	0.25%	0.09%	20.21%	40.37%
+1	0.40%	1.90%	12.17%	18.32%
+2	2.85%	4.27%	12.41%	6.63%
+3	0.87%	−0.85%	−0.13%	2.54%

Panel B: Median Percentage Change in Short Interest around Merger Closings and Pricing Periods

	Closing Period				Pricing Period	
Event Month	Cash Mergers (No Hedge)	Floating-exchange-ratio Stock Mergers (Late Hedge)	Collar Stock Mergers (Dynamic Hedge)	Fixed-exchange-ratio Stock Mergers (Early Hedge)	Floating-exchange-ratio Stock Mergers (Late Hedge)	Collar Stock Mergers (Dynamic Hedge)
−3	–	–	–	–	−2.94%	7.39%
−2	−0.01%	−0.68%	12.82%	14.05%	6.82%	9.73%
−1	0.34%	13.97%	21.38%	9.21%	0.22%	14.20%
0	−0.34%	−0.34%	−23.68%	−30.90%	12.11%	20.21%
+1	4.39%	−2.54%	−0.71%	−4.59%	−2.43%	−14.11%
+2	1.22%	1.02%	0.04%	−0.30%	−2.06%	−2.49%
+3	1.61%	4.80%	0.47%	0.75%	−1.70%	0.04%

Panel C: Short Interest Measures for Fixed-exchange-ratio Stock Mergers (Medians)

	Announcement Period			Closing Period		
Event Day	Short Interest/ Shares Outstanding	Short Interest/Median Daily Volume	Short Interest/ Shares Issued	Short Interest/ Shares Outstanding	Short Interest/Median Daily Volume	Short Interest/ Shares Issued
−3	1.12%	3.7	3.97%	–	–	–
−2	1.13%	3.7	3.74%	3.19%	11.6	17.58%
−1	1.16%	3.9	3.83%	3.79%	12.6	20.19%
0	2.14%	7.3	8.31%	2.25%	7.3	10.27%
+1	2.59%	9.2	10.22%	1.95%	6.1	6.80%
+2	2.80%	9.8	11.22%	1.92%	6.3	6.84%
+3	2.58%	9.1	10.64%	2.02%	6.7	7.82%

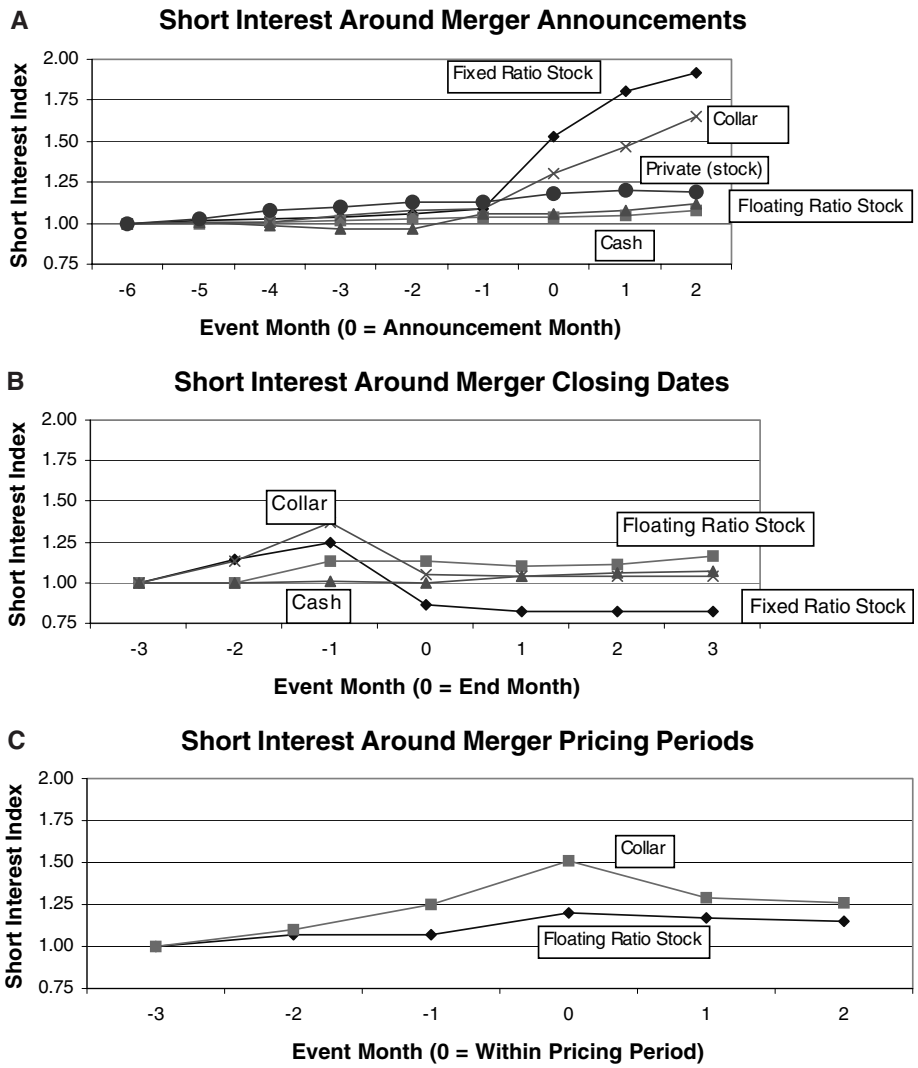

Figure 2. Acquirer short interest. This figure displays acquirer short interest as a fraction of short interest measured 6 months prior to merger announcement in Panel A, 3 months prior to closing in Panel B, and 3 months prior to the pricing period in Panel C. Panel A shows short interest around merger announcements for cash mergers, fixed-exchange-ratio stock mergers, floating-exchange-ratio stock mergers, collar mergers, and stock mergers of privately held targets by publicly traded acquirers during 1994 to 2000. Panel B shows the short interest fraction around merger closing dates and Panel C shows the short interest fraction around the pricing period for floating-exchange ratio and collar mergers.

arbitrage short selling around merger announcements is expected to be greater than the level observed for cash and floating-exchange-ratio mergers and lower than the level observed for fixed-exchange-ratio mergers. Figure 2 and Table III confirm that not only is this the case, but as with fixed-exchange-ratio

mergers, the observed increase in short interest reverses after merger closing. This evidence, combined with the pricing period abnormal returns for floating-exchange-ratio stock mergers, suggests that short selling by merger arbitrageurs exerts significant downward price pressure on acquirers' stocks. Additional evidence establishing a direct link between merger arbitrage short selling and announcement period returns for fixed-exchange-ratio and collar mergers is provided in Section V.

IV. Price Pressure Effects from Index Trading

As described in Section I, funds that attempt to track the S&P indices are active buyers of acquiring firms around the closing of certain stock-financed mergers. These purchases represent outward shifts in excess demand for the stocks of acquiring firms. Because these demand shifts are not driven by new information about future return distributions, they provide another setting to detect the presence of price pressure effects.

Figure 3 shows acquirer abnormal returns around merger announcement dates and closing dates. In the few days that precede the merger closing, acquiring firms in fixed-exchange-ratio stock mergers (Panel C) experience a stock price run-up of about 2 percent, which is immediately reversed over the next several days. The run-up and subsequent reversal is not observed for cash and floating-ratio stock mergers (Panels A and B). As we argue below, much of this abnormal return is caused by an increase in index fund demand for these acquirer stocks.

A clear example where a merger completion leads to index rebalancing, requiring substantial purchases of the acquirer's stock, is when an S&P index member acquires a non-S&P member with stock. This type of acquisition increases the market value of the acquiring firm's equity as additional shares are issued in exchange for the target shares outstanding. If the acquisition increases the number of acquirer shares by more than 5 percent, S&P increases the acquirer's weight in the index when the merger closes, inducing purchases by index funds. Similar increases in demand for the acquirer's stock occur when an S&P index member acquires a target that is a member of another S&P index. For example, the acquisition of an S&P 400 target by an S&P 500 acquirer will induce buying of the acquirer's stock by S&P 500 index funds.

There are also clear examples where a merger closing does not alter index weights, and therefore will not induce buying by index funds. In cash mergers where one asset (cash) is exchanged for another asset (target company), the acquirer's equity account is unaffected. Thus, in a cash merger, index weights are not altered and index fund trading around the merger closing would not be expected. Similarly, stock mergers where both the acquirer and the target are members of the same S&P index will not induce index fund trading. While it is true that index weights change at the closing (acquirer weight increases, target weight goes to zero), an index fund that holds both the acquirer and target will be naturally rebalanced, as the fund's target shares are relinquished in exchange for acquirer shares.

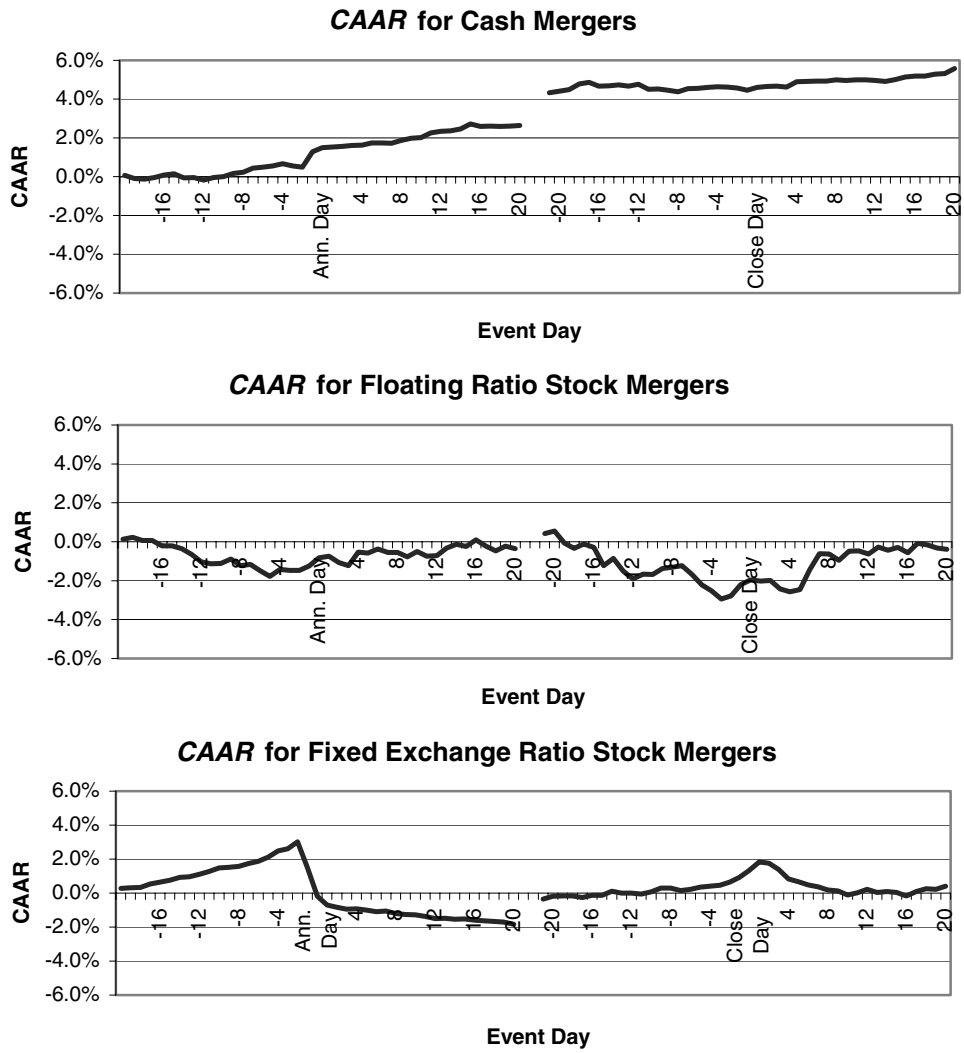

Figure 3. Acquirer cumulative average abnormal returns around merger announcements and closings. This figure displays average acquirer announcement period and closing period abnormal returns for cash mergers, fixed-exchange-ratio stock mergers, and floating-exchange-ratio stock mergers from 1994 to 2000. Gaps between announcement period segments and closing period segments are caused by differences in time-to-completion across mergers. Vertical locations of the announcement period and closing period segments are determined such that the correct average *CAAR* from 20 days prior to announcement to 20 days after closing is maintained.

Finally, there are examples of mergers where the effect of the merger closing on index fund trading is ambiguous. Mergers involving two firms, neither of which is a member of an S&P index will not induce trading by S&P index fund managers. However, they may (or may not) induce trading by fund managers that track other indices like Wilshire 5000, where index weights are sometimes

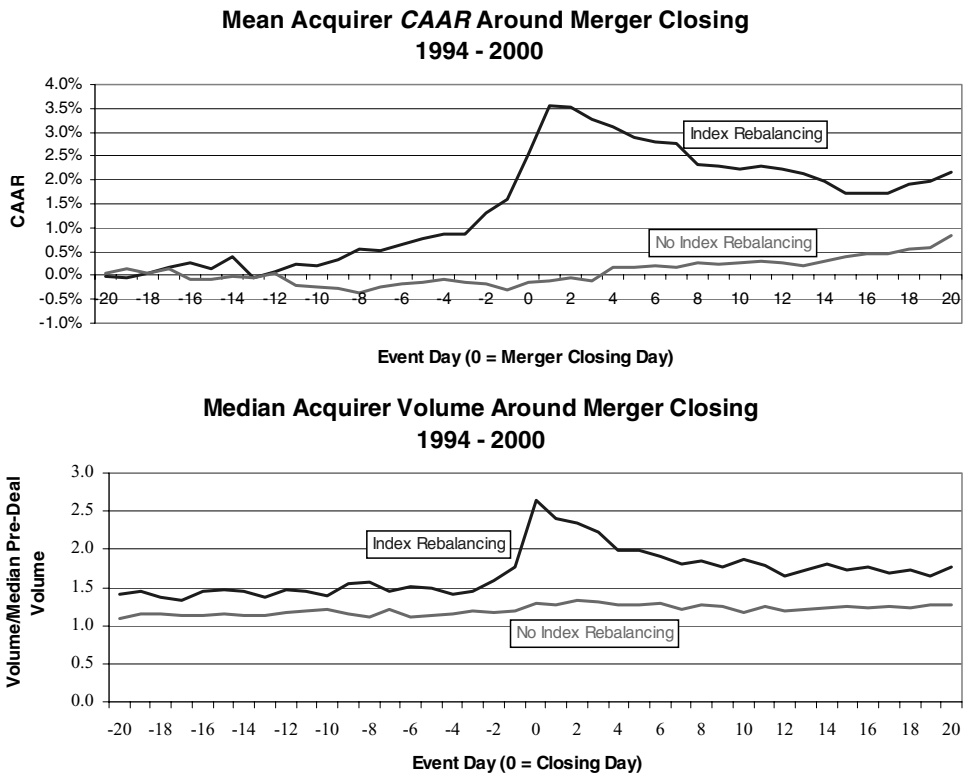

Figure 4. Effect of index trading on acquirer closing period returns and share volume. This figure displays average acquirer abnormal returns (top panel) and acquirer share volume (bottom panel) around merger closings for mergers during 1994 to 2000. For each sample firm, daily share volume is normalized by the median share volume measured over a 63-trading-day period (1 quarter), beginning 5 trading days before the merger announcement and ending 67 trading days before the merger announcement. The "index rebalancing" sample consists of those acquirers that index funds must purchase around merger closing to match changes in index weights. The "no index rebalancing" sample consists of those acquirers for which no index-based trading around merger closing is expected.

modified around closings for large stock mergers. We refer to the sample of mergers that fall into this ambiguous category as the "unclassified" sample.

Figure 4 presents returns (top panel) and trading volume (bottom panel) around merger closings for two different samples. In the sample where index rebalancing around merger closing is expected, *CAAR*s drift up significantly in the days preceding the merger closing, peak at 3.6 percent, and then partially reverse after the merger closing. Where no rebalancing is expected, *CAAR*s remain close to zero over the entire 40-day period surrounding merger closing. The difference between the index-rebalancing *CAAR* and the non-index-rebalancing *CAAR*, measured over the period beginning 3 days prior to closing and ending 1 day after closing, is 2.7 percent with a *t*-statistic of 5.8.

The bottom panel of Figure 4 presents median trading volume around merger closings. For each merger in our sample, daily trading volume is normalized by the median trading volume measured in the quarter prior to the merger announcement. During each day around the merger closing, the sample median of normalized volume is computed. As reflected by the level of the graphs in Figure 4, trading volume after the merger announcement is up to 50 percent greater than trading volume prior to the merger announcement. More interesting is the effect of merger closing on trading volume for index-rebalancing mergers and non-index-rebalancing mergers. In the sample for which we would expect index rebalancing, share volume spikes at closing, reaching a level that is more than 2.5 times greater than pre-announcement trading volume, and then partially reverses. In the sample where no index rebalancing is expected, share volume is essentially flat over the entire 40-day period surrounding merger closing. The dramatic and simultaneous increases in excess return and volume for the sample of index-rebalancing mergers, and the absence of increases for the non-index-rebalancing mergers, is strong evidence of price pressure associated with index trading around merger closings.

In conjunction with Figure 4, Table IV reports stock price run-ups and reversals around merger closings, again separated on the basis of whether the merger triggers index rebalancing. In particular, stock price run-ups are calculated as short-window *CAAR*s beginning 3 days prior to merger closing and ending on the peak day, where the peak day is identified as the day between closing and 2 days after closing that maximizes the *CAAR*. Stock price reversals are calculated as *CAAR*s measured from 1 day after the peak day to 20 days after the merger closing.

Panel A of Table IV reports *CAARs* around merger closings when index rebalancing is expected. The first sub-sample displayed in Panel A consists of mergers where an S&P acquirer buys a non-S&P target in a stock acquisition that increases the acquirer's shares outstanding by more than 5 percent. For this sample of mergers, the stock price run-up from 3 days before the merger closing through 1 day after the close is 3.36 percent, with a t-statistic of 5.20. Over the next month, there is a partial stock price reversal of -1.32 percent (t-statistic $= -1.44$). Index rebalancing due to a stock-financed merger completion can also trigger additional purchases of the acquirer's stock when both the acquirer and target are S&P members, but of different indices. Based on aggregate assets tracking specific indices, price pressure is likely to be greatest when (1) an S&P 500 firm acquires an S&P MidCap 400 firm or an S&P 600 SmallCap firm, or (2) an S&P MidCap 400 firm acquires an S&P SmallCap 600 firm. Results for these mergers are reported in the middle of Panel A. In these situations, the average stock price run-up is 1.63 percent (t-statistic $= 2.31$), followed by a complete stock price reversal over the subsequent 20 trading days of -2.51 percent (t-statistic $= -1.75$).

The cases above are sometimes referred to as the hidden additions, as there is infrequent attention paid to index rebalancing caused by these mergers. The third type of index rebalancing mergers are the more familiar additions to a S&P index as a consequence of a nonmember S&P index firm acquiring

Table IV

Effects of Indexing on Acquirers' Closing Returns

This table reports stock price run-ups and reversals around merger closings. Cumulative average abnormal returns (*CAAR*s) are presented for the period beginning 3 days prior to the closing day and ending on the peak day, as well as for the period beginning 1 day after the peak day and ending 20 days after the closing day. The peak day is defined as the day from the closing day to 2 days after the closing that maximizes the stock price run-up. Test statistics are calculated using the standard error of the mean. Panel A presents results for the "Index-Rebalancing" sample consisting of those acquirers that index funds must purchase around merger closing to match changes in index weights; Panel B presents results for the "Non-index-rebalancing" sample consisting of those acquirers for which no index-based trading around merger closing is expected; Panel C present results for the "Unclassified" sample consisting of acquirers that cannot be clearly placed in the Index Rebalancing or Non-index-rebalancing categories.

	CAAR	
	[Closing Day −3, Peak Day] (Stock Price Run-up)	[Peak Day +1, Closing Day + 20] (Stock Price Reversal)
Panel A: Index-rebalancing Mergers		
Stock Merger with S&P Acquirer of Non-S&P Target (Hidden Addition)		
CAAR	3.36%	−1.32%
t-statistic	5.20	−1.44
N	166	166
Peak day	Closing day +1	Closing day +1
Stock Merger with S&P Acquirer of S&P Target from Different Index (Hidden Addition)		
CAAR	1.63%	−2.51%
t-statistic	2.31	−1.75
N	52	52
Peak day	Closing day	Closing day
Stock Merger with Non-S&P Acquirer of S&P Target		
CAAR	2.33%	−1.16%
t-statistic	1.20	−1.12
N	50	50
Peak day	Closing day +2	Closing day +2
Panel B: Non-index-rebalancing Mergers		
Stock Merger with S&P Acquirer of S&P Target from Same Index		
CAAR	0.26%	−0.73%
t-statistic	0.27	−0.68
N	78	78
Peak day	Closing day +1	Closing day +1
Cash Merger		
CAAR	0.03%	0.88%
t-statistic	0.10	2.06
N	620	620
Peak day	Closing day +2	Closing day +2
Panel C: Unclassified Mergers		
Stock Merger with Non-S&P Acquirer of Non-S&P Target		
CAAR	1.00%	−1.84%
t-statistic	1.94	−2.63
N	420	412
Peak day	Closing day +1	Closing day +1

an S&P index firm. Results, reported in the third section of Panel A, show a stock run-up of 2.33 percent (t-statistic = 1.20) with a reversal of −1.16 percent (t-statistic = −1.12).

Interestingly, when merger completions do not lead to index rebalancing, which is the case for stock-financed mergers between acquirers and targets from the same S&P index and for cash mergers, there is virtually no evidence of a stock price run-up or reversal. These cases are displayed in Panel B of Table IV. For stock mergers involving members of the same index, the run-up is only 0.26 percent (t-statistic = 0.27) with a reversal of −0.73 percent (t-statistic = −0.68). For cash mergers, there is no run-up at all.

Finally, the remaining cases, where we have neither an explicit reason to expect index trading, nor an explicit reason to expect the absence of index trading, are reported in Panel C of Table IV. In these cases, neither the acquirer nor the target is a member of an S&P index. However, merger closings for this sample may be influenced by index funds that track the Wilshire 5000, a value-weight index of all publicly traded firms. Funds tracking this index will have to rebalance around certain merger closings, but we are unable to effectively identify these situations. As shown in Panel C, there is a marginally significant stock price run-up of 1.00 percent (t-statistic = 1.94), followed by a complete reversal of −1.84 percent (t-statistic = −2.63) over the next month. Although the economic magnitude of the run-up and reversal is much smaller for this residual sample than for the index-rebalancing sample, the statistical significance suggests that merger closings induce trading in these unclassified stocks. We cannot reliably determine whether this is caused by Wilshire 5000 index funds or by some other group of event-based traders.

Overall, it appears that outward shifts in demand linked to index rebalancing around merger closings lead to significant stock price increases, which at least partially reverse in the weeks that follow. This implies that excess demand curves for stocks are downward sloping in the short-run. There are two especially important aspects to these findings. First, for the results presented in Panel A of Table IV, the increases in demand are not motivated by new information about the distribution of future returns for the acquirers, but simply the rebalancing of the index caused by the merger completion. Second, this is not a general phenomenon that occurs around all merger closings, but predominantly those where index funds are expected to make substantial purchases of the acquirers' stocks.

V. Reinterpreting Announcement Period Stock Price Reactions to Mergers

The negative stock price reaction to stock-financed mergers is often interpreted either as (1) a signal that the acquirer's stock was previously overvalued or (2) an indication that the market perceives the merger to be a value-destroying investment project. These interpretations generally rely on an implicit assumption that excess demand curves for stocks are perfectly elastic. If excess demand curves for stocks are downward sloping in the short-run, then increases

in the supply of stock will cause the equilibrium price to decrease. Although the common assumption that stocks' supply curves are vertical and fixed may be reasonable in many situations, it is unlikely to hold during mergers, where short sellers dramatically increase the effective supply of shares soon after the merger announcement. Merger arbitrage short selling around mergers is likely to explain some of the negative announcement period stock price reaction for acquirers in stock-financed mergers.

In addition to our findings, there is other evidence that is consistent with the notion that short selling by merger arbitrageurs is at least partially responsible for the negative stock price reaction for acquirers at announcement of certain types of mergers. For example, Houston and Ryngaert (1997) examine announcement-period returns for 209 acquisitions in the banking industry. Unlike previous studies that focus on cash and fixed-exchange-ratio stock mergers, Houston and Ryngaert also examine collar transactions. By modeling the collar offer as a portfolio of options, they estimate the sensitivity of the target shareholder's payoff to changes in the bidder's stock price. Results from their study indicate that when the target payoff sensitivity is zero (e.g., pure cash mergers), the acquirer stock price reaction is flat. Conversely, when the target payoff sensitivity is one (e.g., fixed-exchange-ratio stock mergers), the acquirer stock price reaction is negative. For intermediate sensitivities, the acquirer stock price reaction is moderately negative and is directly related to the target's payoff sensitivity. Houston and Ryngaert interpret their results as supporting the adverse selection model of Myers and Majluf (1984) and the model of Hansen (1987), who argues that acquirers that are relatively undervalued will make cash mergers and acquirers that are relatively overvalued will make stock mergers.[11] However, this interpretation is inconsistent with evidence provided by Fuller, Netter, and Stegemoller (2002) who examine announcement period abnormal returns for frequent acquirers. In their sub-sample of private targets, the average acquirer announcement period abnormal return is positive, independent of whether stock or cash is used as consideration.

Unlike the information-based adverse selection hypothesis, evidence related both to private transactions and collar transactions is consistent with price pressure caused by the trading behavior of merger arbitrageurs. Clearly, merger arbitrageurs are unable to buy equity in private targets, and therefore have no interest in shorting the acquirers' stocks. As shown in Figure 2, acquirers' short interest around the announcement of stock mergers of private targets remains virtually unchanged.[12] This is consistent with the positive acquirer returns observed for stock acquisitions of private targets. Furthermore, evidence related to collar transactions is consistent with merger arbitrageurs attempting to isolate transaction risk by hedging against changes in the acquirer's stock price. As the sensitivity of the target's payoff to the bidder's price increases, merger

[11] Fishman (1989) offers an alternative explanation for the medium of exchange in acquisitions. In his model, cash offers are used to signal an acquirer's high valuation of a target firm, thereby pre-empting competitive bidding by other potential acquirers.

[12] We are grateful to Jeff Netter for providing the sample of acquirers of private targets.

arbitrageurs will more aggressively short sell the acquirer's stock. Price pressure caused by this short selling can produce negative announcement period returns.

A summary of acquirer announcement period returns from previous studies is provided in Table V. With one exception (cash mergers in the banking sector analyzed by Houston and Ryngaert (1997)), average abnormal returns are negative when short selling of acquirers' stocks is expected soon after announcement, and positive when no short selling is expected. The negative acquirer stock price drift during pricing periods (see Figure 1) for floating-exchange-ratio stock mergers reinforces the price pressure interpretation. In fact, the average abnormal return for floating-exchange-ratio stock acquirers during pricing periods (−3.2 percent) is more negative than the average reaction to other stock mergers at announcement.

Table VI reports one additional link between acquirers' announcement period stock price movements and short selling by merger arbitrageurs. In particular, we examine the relation between acquirer announcement period *CAAR*s and changes in days of short interest.[13] Panel A shows that on average, there is virtually no change in short interest around cash and floating-exchange-ratio merger announcements, but there is a significant increase around fixed-exchange-ratio stock merger and collar merger announcements. For fixed-exchange-ratio mergers, the median increase in short interest is equal to 1.7 days worth of the acquirer's trading volume, and the average increase exceeds 5 days of acquirer volume.

To determine how much of the announcement period return can be attributed to price pressure from merger arbitrage short selling, we examine average *CAAR*s for different types of mergers after controlling for expected arbitrage activity. These estimates can be compared to those that do not control for merger arbitrage short selling to determine whether price pressure effects are significant.

As a proxy for merger arbitrage activity, we estimate the portion of the change in days of short interest around the merger announcement that can be attributed to merger arbitrage trading. Note that our focus is only on the change in days of short interest attributable to merger arbitrageurs, not that which may come from fundamental traders. Therefore, we model the change in days of short interest as a function of deal attributes that guide arbitrage trading:

$$\Delta DSI = \begin{cases} b_0 + b_1 \cdot \ln(RELSIZE) + b_2 HOSTILE & \text{if fixed-exchange ratio} \\ c_0 + c_1 \cdot \ln(RELSIZE) + c_2 HOSTILE & \text{if collar} \\ 0 & \text{otherwise .} \end{cases} \quad (1)$$

Equation (1) is motivated by the observation that at announcement, merger arbitrageurs do not short sell the stocks of acquirers in cash mergers or in

[13] The change in days of short interest, ΔDSI is measured as the change in short interest from pre-merger announcement to post-merger announcement, divided by the acquirer's median daily share volume. Median daily share volume is measured over the 63 trading days (one quarter) beginning 67 days before announcement and ending 5 days before announcement.

Table V

Results from Previous Studies of Acquirer Announcement Period Returns

This table reports acquirer announcement period abnormal returns from recent studies.

Sample	Study	Acquirers Announcement Period Abnormal Return
Short Selling of Acquirers' Stocks Expected at Merger Announcement		
Stock-financed (1973–1998)	Andrade et al. (2001)	−1.5%
Fixed-exchange-ratio stock (1994–2000)	This paper	−2.7%
Stock-financed publicly traded acquirer and target (1990–2000)	Fuller et al. (2002)	−1.9%
Fixed-exchange-ratio stock (banks, 1985–1992)	Houston and Ryngaert (1997)	−3.3%
Stock collars (banks, 1985–1992)	Houston and Ryngaert (1997)	−1.3%
Fixed-exchange-ratio stock (1992–1997)	Fuller (2003)	−2.2%
No Short Selling of Acquirers' Stocks Expected at Merger Announcement		
No stock-financing (1973–1998)	Andrade et al. (2001)	0.4%
Floating-exchange-ratio stock (1994–2000)	This paper	0.6%
Floating-exchange-ratio stock (1992–1997)	Fuller (2003)	1.0%
Cash, debt, preferred stock (banks, 1985–1992)	Houston and Ryngaert (1997)	−0.6%
Stock-financed publicly traded acquirer/private target (1990–2000)	Fuller et al. (2002)	2.5%
Cash-financed publicly traded acquirer/private target (1990–2000)	Fuller et al. (2002)	1.5%
Cash-financed publicly traded acquirer and target (1990–2000)	Fuller et al. (2002)	0.4%

Table VI

Effect of Changes in Short Interest on Announcement Period Abnormal Returns

This table describes the effects of changes in short interest on acquirers' *CAAR*s measured from day −1 to day +1 around merger announcements. Panel A describes the independent variable, change in days short interest (ΔDSI), which is defined as the change in short interest from pre-merger announcement to post-merger announcement, divided by the acquirer's median daily share volume. Median daily share volume is measured over the 63 trading days (one quarter) beginning 67 days before announcement and ending 5 days before announcement. Mergers are classified as "Cash," "Floating-exchange-ratio Stock," "Collar," and "Fixed-exchange-ratio Stock," based on the form of payment to target shareholders. In fixed-exchange-ratio stock mergers, the number of acquirer shares to be given to each target shareholder is determined on the announcement date. In floating ratio stock mergers, the *value* of acquirer shares per target share is fixed on the announcement date. The actual number of acquirer shares issued per target share is obtained by dividing value by the average acquirer price during a pricing period defined in the merger agreement. Panel B reports results for the first-stage regression of ΔDSI on a constant, the natural logarithm of target-to-acquirer market capitalizations, and a dummy variable reflecting whether the transaction was hostile for fixed-exchange ratio and collar mergers. Panel C reports the results from the second-stage regression of *CAAR*s on the fitted values from the first-stage regression, $E(\Delta DSI)$, and dummy variables reflecting the terms of the merger transaction. Panel D reports regression results from a baseline regression of *CAAR*s on the financing term dummy variables.

Panel A: Summary Statistics for ΔDSI

	Cash Mergers (No Hedge)	Floating-exchange-ratio (Late Hedge)	Collar Stock Mergers (Dynamic Hedge)	Fixed-exchange Ratio (Early Hedge)
Median	0.00	−0.01	0.92	1.70
Mean	0.15	−0.26	3.48	5.15
t-statistic (mean)	(0.57)	(0.85)	(4.90)	(12.87)

Panel B: First-stage Regression Explaining ΔDSI due to Merger Arbitrage

Fixed-exchange Ratio			Collar			
Intercept	ln(*RelSize*)	Hostile	Intercept	ln(*RelSize*)	Hostile	R^2/N
8.31	1.78	−5.43	8.51	2.25	−6.90	0.1949
(17.13)	(8.30)	(−2.04)	(7.03)	(4.99)	(−1.05)	1,554

Panel C: Second-stage Regression Explaining *CAAR*[−1, +1]

Cash	Float	Collar	Fixed	Predicted ΔDSI	R^2/N
0.0062	0.0052	0.0026	−0.0144	−0.0023	0.0723
(2.07)	(0.57)	(0.44)	(−2.98)	(−2.29)	1,554

Panel D: Base-line Regression Explaining *CAAR* [−1, +1]

Cash	Float	Collar	Fixed	R^2/N
0.0062	0.0052	−0.0054	−0.0265	0.0677
(2.07)	(0.57)	(−1.05)	(−10.54)	1,554

floating-exchange-ratio stock mergers, as described in Section III. For fixed-exchange-ratio stock mergers, merger arbitrageurs short sell the acquirers' stocks roughly in proportion to the relative size of the target and acquirers' market capitalizations. In a fixed-exchange-ratio stock merger, where the exchange ratio is R, merger arbitrageurs short sell R shares of the acquirer for each share of the target that they buy. If merger arbitrageurs were to purchase all of the target shares outstanding, then the number of acquirer shares to be sold short is $R \times$ target shares outstanding. To make this measure of merger arbitrage short selling comparable across acquirers, we scale it by acquirer shares outstanding. As shown in equation (2), at merger completion, this measure is equivalent to the ratio of target to acquirer market capitalization:

$$\begin{aligned} RELSIZE &= \frac{Price_{Target} \cdot Shares_{Target}}{Price_{Acquirer} \cdot Shares_{Acquirer}} \\ &= \frac{R \cdot Shares_{Target} \cdot Price_{Acquirer}}{Price_{Acquirer} \cdot Shares_{Acquirer}} = \frac{R \cdot Shares_{Target}}{Shares_{Acquirer}}. \end{aligned} \tag{2}$$

Additionally, merger arbitrageurs tend to reduce their exposure to deals that are viewed as "hostile." The dummy variable, *HOSTILE*, is included to capture this effect. To allow for differences in arbitrage trading strategies for fixed-exchange ratio and collar mergers, the *RELSIZE* and *HOSTILE* coefficient estimates are allowed to take different values for fixed-exchange ratio and collar mergers.

Panel B of Table VI reports results from estimation of equation (1). Consistent with the predicted trading behavior of merger arbitrageurs, the coefficient of *RELSIZE* is positive and highly statistically significant for both fixed-exchange ratio and collar mergers, while the coefficient on the *HOSTILE* dummy variable is reliably negative for fixed-exchange-ratio deals. The fitted values from the first-stage estimation, representing the change in days of short interest due to merger arbitrage, ΔDSI, are used as an independent variable in the second-stage regression:

$$CAAR = c_1 \cdot CASH + c_2 \cdot FLOAT + c_3 \cdot COLLAR + c_4 \cdot FIXED + c_5 \cdot \Delta DSI, \tag{3}$$

where *CASH*, *FLOAT*, *COLLAR*, and *FIXED* are dummy variables reflecting the terms of the merger transaction.[14] There is no common intercept in this regression, as each transaction type has a separate intercept measuring the average *CAAR* for that deal type after controlling for the expected short selling behavior of merger arbitrageurs.

Panel C reports the results from the second-stage regression. Controlling for merger arbitrage short selling has a very significant impact. The coefficient on ΔDSI of -0.0023 (t-statistic $= -2.88$) implies that the average increase in

[14] Standard errors in the second stage regression are adjusted to reflect the estimation error in the ΔDSI variable.

short interest around a fixed-exchange-ratio merger announcement of 5.15 days would lead to a −1.18 percent incremental abnormal return for the acquirer. After controlling for the increase in short interest expected because of merger arbitrage trading, the reaction to fixed-exchange-ratio stock mergers is only −1.44 percent and the *t*-statistic is −2.91. This can be compared to the coefficient estimate of −2.65 percent and *t*-statistic of −10.54 (Panel D) obtained without controlling for arbitrage short selling. Based on this comparison, we conclude that merger arbitrage short selling explains nearly half of the negative announcement period return observed for fixed-exchange-ratio stock mergers. For collar transactions, controlling for the increase in short interest associated with merger arbitrage again has a noticeable impact. The announcement period reaction is negative (−0.54 percent) when there is no control for merger arbitrage short selling and positive (0.26 percent) when the control for merger arbitrage short selling is included in the regression.

An alternative explanation for the observed relation between changes in short interest and announcement period returns is that the announcement of a stock-financed merger signals that the acquirer's stock is overvalued. To correct this mispricing, traders may short the acquirer's stock resulting in an increase in short interest. According to this explanation, the increase in short interest is not caused by arbitrageurs, but rather by fundamental investors reacting to new information. However, unlike short selling by arbitrageurs, this alternative explanation cannot explain the pattern of short interest exhibited in the middle panel of Figure 2 and the "closing period" column in Panel B of Table III. Both the figure and the table show a significant drop in short interest in the month when the merger closes. Fundamental short sellers would be expected to close their short positions when prices revert to fundamental values, not necessarily when mergers close. Moreover, we find no relation between changes in days of short interest and announcement period abnormal returns for cash mergers, even conditioning on those with negative *CAAR*s where the market interprets the merger as bad news relative to expectations (results not reported). Fundamental traders seem to play virtually no role in explaining the results presented in Table VI.

There are two important implications of these findings. First, and most important, wealth effects estimated from announcement period event studies are biased down for certain types of mergers. This is not to say that price pressure effects dominate information effects. Rather, price pressure effects can be significant and should be accounted for before attempting to quantify the information content of merger announcement period returns. This applies to results from event studies of other corporate actions as well. Correctly interpreting event study findings around corporate announcements requires an understanding of the traders that are likely to be active in the market, and the price pressure that they generate (see also, Maloney and Mulherin (1992), Frank and Jagannathan (1998), and Ederington and Goh (2001)). Second, these results have implications for the interpretation of short interest levels. In addition to reflecting the sentiment of investors with negative opinions, short interest levels reflect hedging activity by arbitrageurs around major corporate

events.[15] In the case of merger arbitrage and convertible bond arbitrage, short selling by arbitrageurs is likely to dominate overall short interest levels.

VI. Conclusion

This paper studies price pressure effects in equity markets by examining the trading behavior of professional investors around mergers. We find support for the notion that short selling by merger arbitrageurs and index fund rebalancing lead to temporary price changes, which suggests that (1) traditional short-window event studies can produce poor estimates of shareholder wealth effects and (2) short-run demand curves for stocks are not perfectly elastic. However, the effects of price pressure appear to be fairly short lived, such that assuming demand curves for stocks are horizontal in most situations is probably still appropriate.

A common view of merger transactions is that acquirers tend to overpay for target firms, especially when paying with stock. On average, the abnormal stock price reaction to a merger announcement is -1.20 percent (t-statistic $= -3.34$) for the full sample of acquirers over the 1994 to 2000 time period. When stock is used as the merger consideration, the abnormal stock price reaction is -2.65 percent. From the perspective of the acquiring firms' shareholders, these mergers represent value-destroying decisions by management. However, for the sample of mergers studied in this paper, we find that about half of the negative announcement period stock price reaction to fixed-exchange-ratio stock mergers is due to downward price pressure caused by merger arbitrage short selling of acquirers' stocks. After controlling for the estimated price pressure effects due to merger arbitrage short selling around the merger announcement, the full sample announcement period stock price reaction increases to -0.47 percent with a t-statistic less than 1.0. The common conclusion that mergers destroy value is not convincing after considering the behavior of professional investors around the announcements of these events. Price pressure effects are likely to pose a problem for interpreting a variety of other event study findings, as well, where the nature of the event triggers trading by uninformed investors.

In addition, the evidence presented in this paper strengthens previous findings of price pressure effects, which for the most part all come from the same small sample of S&P 500 index additions. While some of our evidence is index related, the pricing period results from floating-exchange-ratio stock mergers are distinct, as is the direct link between downward stock price pressure and increases in short interest.

Existence of price pressure raises the question of why arbitrageurs are unable or unwilling to eliminate temporary price changes by buying shares of acquirers in stock-financed mergers at announcement, during pricing periods,

[15] We observe similar patterns in short interest around convertible debt offerings, where convertible debt arbitrageurs actively short sell the stock of issuing firms (results not reported). In addition, Bechman (2001) finds substantial changes in short interest around convertible bond call dates.

and around index rebalancing. The answer to this question is likely to be based on the institutional frictions that are prevalent in the money management business (Shleifer and Vishny (1997) and Mitchell, Pulvino, and Stafford (2002)). In the case of S&P index rebalancing around hidden additions, the underlying source of the profit opportunity stems from index fund managers' reluctance to incur tracking error, even if doing so would, on average, provide superior returns for investors. This reluctance stems from the principal-agent problem that exists between providers of capital and index fund managers. The same principal-agent problem exists between providers of capital and arbitrageurs. In the case of mergers studied in this paper, profit opportunities stemming from price pressure effects are probably too infrequent to justify a dedicated arbitrage fund. Investments in price pressure events could, however, enhance returns from other well-defined investment strategies such as merger arbitrage. The problem is that even though returns will be enhanced on average, there are almost certainly times when returns will be adversely affected. Given the inability of providers of capital to perfectly monitor arbitrage fund managers, reduced returns might be viewed as "style drift," possibly resulting in the redemption of capital. This implicit threat of capital redemption resulting from the principal-agent problem between capital providers and arbitrageurs prevents arbitrageurs from aggressively investing in auxiliary opportunities and limits arbitrage activity.

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