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Evidence from Short Selling Activity**

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Are Stock Acquirers Overvalued?

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We use a novel identification approach to test whether stock acquirers are overvalued prior to merger announcements. We argue that the overvaluation of firms drives both high short-selling activity and a higher likelihood of stock mergers. We document that, as early as 12 months before a merger announcement, short interest is higher (lower) for firms that eventually make stock (cash) acquisitions. Short interest is negatively associated with acquirer long-term returns following the merger announcement. Finally, stock (but not cash) acquirers have higher short interest than their targets. We investigate alternative explanations for the relation between short interest and acquirer activity and show that these explanations do not appear to drive our results. We conclude that overvalued firms select stock as a means of payment in acquisitions and that short selling activity does not completely eliminate acquirer overvaluation in the short run.

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1. Introduction

Recent models of acquisition behavior propose that, on average, stock acquirers are overvalued (Shleifer and Vishny 2003, Rhodes-Kropf and Viswanathan 2004). According to these models, overvalued firms can transform their overvalued stock into real assets by using it to acquire other, less overvalued, firms. While this idea explains many of the stylized facts observed in merger activity, it is difficult to test empirically because overvaluation is unobservable. Previous empirical studies attempted to test this theory by employing valuation metrics that compare stock acquirers' market value to proxies for fundamental value. For example, Dong, Hirshleifer, Richardson, and Teoh (2006) investigate price-to-book and price-to-value measures, and find that stock acquirers have higher valuation measures than do non-stock acquirers.¹ Rhodes-Kropf, Robinson, and Viswanathan (2005) use regression models to break down the market-to-book ratio into firm and sector transitory mispricing components and a long-run fundamental market-to-book ratio. They find that stock acquisitions are associated with firm and sector mispricing components.

However, empirical tests based on valuation measures face the challenge of separating overvaluation explanations of mergers from the alternative Q-theory of mergers (Servaes 1991, Jovanovic and Rousseau 2002). Q-theory suggests that acquirers with a high Tobin's Q are more likely to purchase targets with a low Tobin's Q because they are better able than the targets to put the acquired assets to efficient use, i.e., they have better growth opportunities. Thus, studies that rely on firm-value measures must make implicit modeling assumptions about how investors impound information about future growth opportunities of the firm and industry into prices. Dong, Hirshleifer, Richardson, and Teoh (2006, p. 757) point to the problem in identifying overvaluation from growth-based motives for stock mergers:

A challenge for distinguishing between alternatives is that the misvaluation and Q hypotheses share several implications. Furthermore, each hypothesis is ambiguous with respect to some takeover characteristics... Further theoretical work will be

¹ Ang and Cheng (2006), Friedman (2006), Sinha (2004), and Bi and Gregory (2009) find similar evidence about the high valuation measures of stock acquirers.

valuable in developing further predictions that distinguish between alternative hypotheses more sharply.

In this study, we propose a novel empirical approach to identifying acquirer overvaluation. Our approach does not rely on a valuation model, but instead on the idea that overvaluation drives two independent phenomena: (1) higher short interest, and (2) (potentially) a higher likelihood of engaging in stock mergers. While both overvaluation theory and Q-theory predict that firms with high valuation metrics (e.g., market-to-book) have a higher likelihood of engaging in mergers, only overvaluation theory predicts that those same firms attract short selling activity (Q-theory does not predict negative expected returns for acquirers).² This distinction motivates our use of the level of short interest as a proxy for whether a stock is overvalued.

Our methodology assumes that short sellers are sophisticated investors who are able to identify overvalued firms. We conjecture that if short sellers suspect that a firm is sufficiently overvalued and will experience negative returns, they are likely to short it. For example, a common hedge fund trading strategy is the long/short strategy in which hedge funds exploit valuation differences across stocks (Fung and Hsieh 1997). A hedge fund would short stocks that appear to be overvalued, and hold long positions in stocks that appear undervalued. Empirical studies find supporting evidence for the relation between short interest variables and overvaluation. For example, Dechow, Hutton, Meulbroek, and Sloan (2001) and Hirshleifer, Teoh, and Yu (2009) report that short sellers target firms whose fundamentals imply overvaluation (e.g., low cash-to-price ratios or high accruals). More directly, Asquith and Meulbroek (1995), Dechow, Hutton, Meulbroek, and Sloan (2001), and Desai, Ramesh, Thiagarajan, and Balachandran (2002) find that portfolios of heavily shorted stocks underperform the market,³ and Boehmer, Huszar, and Jordan (2010) find that stocks with low short interest exhibit positive abnormal returns. Using short flow data, Boehmer, Jones, and Zhang (2008) find that heavily shorted stocks underperform lightly shorted stocks. Diether, Lee, and Werner (2009) use daily short-sale flow data and find that short sellers correctly predict negative

² In fact, Servaes (1991) finds that acquirer returns following a merger announcement are increasing in the acquirer's Tobin's Q.

³ However, Asquith, Pathak, and Ritter (2005) find that such underperformance is negligible when portfolio returns are value-weighted.

future returns. Drake, Rees, and Swanson (2011) find that short interest is informative about future returns beyond the information in analyst stock recommendations.

Our variable of interest is pre-merger announcement short interest (shares sold short scaled by shares outstanding). The prior literature has used either raw short interest (e.g., Asquith, Pathak, and Ritter 2005) or has estimated abnormal short interest as the residual from a short-interest model (e.g., Pownall and Simko 2005, Francis, Venkatachalam, and Zhang 2008). Our approach uses raw short interest adjusted in two ways. First, as short interest shows a strong positive trend during our sample period, we adjust raw short interest for the contemporaneous average level of short interest (*Adjusted Short Interest*). Second, we note that the level of short selling is affected by the costs of short selling, and not just by the degree of overvaluation. D'Avolio (2002) highlights the role of firm size and institutional ownership in explaining the costs of short selling (see also Diether and Werner 2009 and Nagel 2005). Therefore, we develop another measure of short interest (*Abnormal Short Interest*) based on deviations from the level of short interest in groups of stocks of similar size and institutional ownership as the firm in question.

Our main result is that current short interest predicts both future merger choices and post-merger long-run performance. When we examine the short interest of acquirers-to-be, we find a wide variation according to the type of future merger (see Figure 1). We show that stock acquirers have significantly higher pre-merger short interest than do cash acquirers (short interest in mixed acquirers falls between that of stock and cash acquirers). The relation between short interest and merger choices is also predictive. Specifically, stocks with high short interest are more likely to engage in a stock merger and less likely to engage in a cash merger in the following 12 months. To illustrate the magnitude of the effect, firms that are in the top quintile of the short interest distribution are 54% more likely to engage in a stock merger in the following month, and about 22% less likely to engage in a cash merger relative to firms in the bottom quintile of the short interest distribution.

One concern is that short interest could be correlated with acquirers' growth opportunities. If this were the case, then short interest would not differentiate between the

overvaluation and Q-theory explanations for mergers. We examine this issue by replicating the analysis in Rhodes-Kropf, Robinson, and Viswanathan (2005) which breaks down the market-to-book ratio into mispricing components (firm- and sector-levels) and a long-run “fundamental” market-to-book component. While we find that short interest is positively correlated with the firm-level mispricing component it is uncorrelated with the long-run market-to-book component. This suggests short interest is correlated with mispricing but not with growth opportunities based on firm fundamentals.

After establishing a link between short interest and merger activity, we analyze the relation between pre-merger short interest and subsequent abnormal acquirer returns. We find that pre-announcement short interest (either adjusted or abnormal) is not meaningfully correlated with merger announcement returns. However, long-term abnormal returns exhibit monotonic relations with respect to short interest. We use calendar time portfolios to measure abnormal returns following merger announcements relative to a three- or four-factor model. During the first six months following an announcement, stock acquirers in the two highest quintiles of short interest exhibit cumulative three-factor abnormal returns of -4.0% (-66.5 monthly basis points). The abnormal returns to highly shorted stock acquirers are weaker for a four-factor model and lose economic magnitude and statistical power when portfolio returns are value-weighted.⁴

Further evidence for the overvaluation hypothesis comes from the relative short interest of acquirers and their targets. Shleifer and Vishny (2003) propose that targets should be undervalued relative to their stock acquirers. Consistent with this hypothesis, we document that for the sub-population of public targets (where we can obtain data on the short interest of targets) short interest is significantly higher for stock acquirers than for their targets. In contrast, short interest does not significantly differ between cash acquirers and their targets.

We investigate alternative explanations for the link between short interest and merger choice. These explanations propose that short selling acquirers-to-be takes place

⁴ Mitchell and Stafford (2000) and Ben-David and Roulstone (2010) also find that when acquirer portfolio returns are value-weighted, factor model alphas become statistically insignificant.

for reasons other than overvaluation. The explanations that we test are: (1) short sellers are front running anticipated acquisition announcements as part of a merger arbitrage strategy, (2) short sellers anticipate negative announcement returns associated with merger announcements, (3) short sellers engage in “pairs trading” in which they buy undervalued firms and hedge themselves by shorting firms whose characteristics make them likely to become future acquirers, and (4) short interest is correlated with merger waves. We analyze these alternative explanations and find little support for them.

Our paper delivers two main contributions to the literature. First, we provide new evidence on the longstanding question of whether stock acquirers are overvalued. We believe that our overvaluation proxy can identify overvalued firms better than previous proxies. Our evidence is consistent with stock acquirers engaging in mergers because they are overvalued, and not because they have high growth opportunities. Second, we introduce two new measures of short interest: adjusted and abnormal short interest. These measures can be applied to valuation questions regarding other corporate events, such as seasoned equity offerings.

The paper continues as follows. In Section 2, we describe the data used in the study and provide summary statistics. Section 3 explains our tests and presents our empirical results. In Section 4, we test alternative explanations. Section 5 concludes.

2. Data

2.1. Mergers and Acquisitions and Firm Data

Our mergers dataset is drawn from the Thomson SDC database and contains mergers that were announced between 1989 and 2007.⁵ We restrict our data in a manner similar to that used in Moeller, Schlingemann, and Stulz (2004). To be included in our sample, acquirers must be domestic and publicly traded, while targets can be either public or private. In addition, the purchased equity stake must be larger than 50% and at the

⁵ The start date of the sample period is 1989 because our short interest data (discussed in detail below) is available from 1988 and we require 12 months of short selling data prior to mergers. The sample ends in 2008, but we require 12 months of short selling data following mergers. Hence we effectively use only mergers through the end of 2007.

completion of the transaction the acquirer should own 100% of the target's equity. We exclude from the sample any transactions with a deal value lower than \$1m and transactions for which the deal value was lower than 1% of the acquirer's firm value at the announcement month. As in Moeller, Schlingemann, and Stulz (2004), firm value is computed as the sum of market value of equity, long-term debt, debt in current liabilities, and the liquidation value of preferred shares. We limit our sample to acquirers with share codes 10 or 11 (common shares). We differ from Moeller, Schlingemann, and Stulz (2004) by not excluding mergers that were not completed or that took longer than 1,000 days to complete, in order to avoid look-ahead bias.

We also require acquirers to have the data needed to compute the three market-to-book components used in Rhodes-Kropf, Robinson, and Viswanathan (2005).⁶ These variables are: firm-specific error in market-to-book ($M/B (Firm)$), time-series sector error in market-to-book ($M/B (Sector)$), and long-run value to book ($M/B (Long-run)$). The construction of these variables follows the discussion in Rhodes-Kropf, Robinson, and Viswanathan (2005)'s Section 5.⁷ The first component ($M/B (Firm)$) equals the difference between a firm's market value of equity and the market value of equity implied by a current industry multiple; it represents misvaluation at the firm level. The second component ($M/B (Sector)$) equals the difference between market value implied by a current industry multiple and market value implied by a long-run industry multiple; it represents misvaluation at the industry level. The long-run component ($M/B (Long-run)$) represents the fairly valued market-to-book ratio based on fundamentals and is equal to the market value implied by a long-run industry multiple and the firm's actual book value of equity.⁸ (See Appendix A for variable definitions and Appendix B for a more detailed description of the market-to-book ratio components and their construction.)

We define *cash mergers* as mergers in which the acquirer pays with cash only and *stock mergers* as mergers in which the acquirer pays with stock only. All other mergers

⁶ This requirement reduces the sample by 30 acquisitions.

⁷ All inferences in the paper are robust to using the raw market-to-book ratio in place of its components.

⁸ Rhodes-Kropf, Robinson, and Viswanathan (2005) write: "This long-run value to book measure varies over time and across firms, but this variation is attributable solely to firm-specific variation in accounting fundamentals. Valuation effects that arise from hot industry effects or firm-specific misvaluation have been purged from this measure." (pp. 579-580).

are *mixed mergers*. Overall, our sample includes 8,406 merger announcements, of which 2,472 (29%) are all stock mergers, 2,886 (34%) are all cash mergers, and 3,048 (36%) are a mix of stock and cash. Table 1, Panel A presents the distribution of merger announcements through time for the various payment methods. The pattern is similar to the distributions in Dong, Hirshleifer, Richardson, and Teoh (2006) and Moeller, Schlingemann, and Stulz (2004). We note temporal waves in the distribution and type of transactions: in the 1990s there are generally more stock mergers than cash mergers; however, this pattern changes in the 2000s when there are generally more cash mergers.^{9,10}

We use several commonly-used databases for accounting and market information. Our accounting data comes from the Compustat Annual File. Our market data (such as returns and shares outstanding) is drawn from CRSP. Institutional holdings are from Thomson Financial, based on 13F filings. For some of our tests, we use the universe of firms in CRSP and Compustat. In order to be included in our dataset, a firm must exist for at least one year in both CRSP and Compustat (matching is done by 8-digit CUSIP).

2.2. Short Interest Data

Short interest data comes from two sources. We download monthly short interest data from the COMPUSTAT Monthly Securities Database which contains monthly short interest levels for all firms listed on U.S. exchanges beginning in 2003. For earlier years, we obtained data directly from the NYSE, AMEX, and NASDAQ exchanges. The exchanges report open short positions using a settlement date of the 15th of each calendar month (or the last prior trading day). Following prior studies, we deflate short interest by the number of shares outstanding as reported by CRSP (e.g., Dechow, Hutton, Meulbroek, and Sloan 2001, Asquith, Pathak, and Ritter 2005).

⁹ Additionally, in untabulated analyses we note that the number of private target acquisitions is greater than the number of public target acquisitions in every year in our sample. See Table 2, Panel C for the number of private versus public target acquisitions in our sample.

¹⁰ We discuss possible effects of merger waves on short interest in section 4.4.

We note that aggregate short interest exhibits a secular trend over time (see Table 1, Panel B). To account for this trend we construct the *Adjusted Short Interest* variable which is the stocks' short interest minus the average monthly short interest across all stocks. As Table 1, Panel B shows, adjusting the short interest removes the time trend.

We are also concerned about heterogeneity in short selling constraints across stocks. Prior studies have shown that short selling costs can vary substantially across stocks (Diether and Werner 2009), and that two of the strongest covariates with these constraints are market capitalization and institutional ownership: in general, small-cap stocks with low institutional ownership are more expensive to sell short (see Dechow, Hutton, Meulbroek, and Sloan 2001, D'Avolio 2002, Asquith, Pathak, and Ritter 2005, Nagel 2005, and Diether and Werner 2009). Hence, short interest levels result from both the differential costs of short selling and from relative valuation; all else being equal, short interest signals more overvaluation at firms where shorting is more constrained. To control for the variation in short selling costs, we construct a measure of *Abnormal Short Interest*, which is the difference between a firm's short interest ratio and the average short interest ratio for its corresponding benchmark portfolio based on market capitalization and institutional ownership. Each year, we rank firms into quintiles based on beginning-of-the-year size (market-value of equity) and then, within each size quintile, we rank firms into quintiles based on institutional ownership (percent of total shares owned by institutions) to create 25 benchmark portfolios (5×5). Since a firm's short interest is adjusted for the benchmark short interest in the same month, our adjustment also controls for the positive time trend in raw short interest.

A caveat of the abnormal short interest variable is that we may be removing a portion of the overvaluation effect we are looking for (i.e., “throwing the baby out with the bathwater”). While short selling constraints are correlated with size and institutional ownership, misvaluation is also correlated with these variables. The stock prices of small firms and firms with low institutional ownership are more likely to deviate from fundamentals due to the high costs of arbitrage, which include liquidity and information costs (see Pontiff 2006 and Ali, Hwang, and Trombley 2003). Therefore, we view our abnormal short interest variable as a conservative measure of overvaluation.

2.3. Summary Statistics

Table 2, Panel A presents the distributions of variables measured one month prior to the merger announcement (month -1) for our sample of 8,406 acquiring firms. Acquirers in our sample have an average market capitalization of \$2.7bn (with a stock price of approximately \$27), a mean market-to-book ratio of 3.48, a mean institutional ownership of 46.8%, and a mean annual turnover of 1.70. Table 2, Panel B presents summary statistics for the universe of firms. In general, we find that, relative to the universe, acquiring firms are larger, have higher market-to-book ratios, higher institutional ownership, higher share turnover, and more positive past returns.

Table 2, Panel C presents summary statistics for acquiring firms (by type of transaction); acquirers of public and private targets are presented separately, as are the universe of firms. The sample's composition and characteristics are very similar to those in previous papers such as Dong, Hirshleifer, Richardson, and Teoh (2006) and Sinha (2004). Acquirers' average market capitalization for public targets ranges from \$5.3bn for stock deals to \$6.7bn for mixed deals, which are considerably larger than the average for the universe of firms of \$1.2bn. These averages are also much larger than the average market capitalization for acquirers of private targets, which range from \$1.2bn for mixed deals to \$1.9bn for cash deals. Across all three payment types, the average transaction size in our sample is also much larger for public acquisitions than it is for private acquisitions. For example, the average transaction value is \$1.3bn for stock acquisitions of public targets, while it is only \$99m for stock acquisitions of private targets. With respect to the control variables, we find that, relative to acquirers of private targets, acquirers of public targets have lower market-to-book ratios, higher firm-specific error in market-to-book, higher institutional ownership, higher stock prices, slightly lower turnover, and have lower past returns. In addition, we find that, relative to cash acquirers, stock acquirers have higher market-to-book ratios, higher firm-specific errors in market-to-book, lower institutional ownership, slightly higher stock prices, higher turnover, and have higher past returns.

Table 2, Panel C also presents descriptive statistics for raw, adjusted, and abnormal short interest at month -1. Focusing on the adjusted and abnormal short interest

statistics, we find that for both public and private targets, short interest in the acquirers' stock is greatest for stock, followed by mixed acquisitions and cash acquisitions. For example, we find that the average adjusted short interest for stock acquisitions of public (private) targets is 0.68% (0.70%); for cash acquisitions of public (private) targets, it is -0.07% (0.50%). We investigate these patterns further in Section 3.

3. Empirical Tests

3.1. Short Interest prior to Merger Announcements

We begin our empirical tests by investigating the pattern of short interest around merger announcements, splitting out the sample by method of payment. In Figures 1a and 1b, we plot mean adjusted short interest and mean abnormal short interest separately for stock, cash, or mixed payment from month -36 to month +36 relative to the merger announcement month.

In this section we focus on the pre-announcement period, months -36 to -1. The reason for this is that we are interested in whether stock acquirers are overvalued *before* the announcement. (The notable spike in short interest following the announcement is related to merger arbitrage and is discussed in Section 4.1.)¹¹ In both figures, we find that stock acquirers have positive adjusted and abnormal short interest throughout the pre-merger horizon. Until month -15, the magnitude is relatively stable (around 0.35% and 0.20% in Figures 1a and 1b, respectively); from month -15 until the announcement month, short interest increases steadily. In month -1, adjusted and abnormal short interest of stock acquirers are approximately 0.70% and 0.45%, respectively.

For cash acquirers, we find that adjusted short interest is positive, but lower in magnitude than the adjusted short interest of mixed and stock acquirers. The abnormal

¹¹ Merger arbitrage is a common trade in which traders bet on the likelihood of mergers being completed. In stock and mixed acquisitions of public targets, traders buy the target and short sell the acquirer using the exchange ratio of shares (as provided in the merger announcement). In the typical case, the value of the acquirer's shares will be more expensive than the target's shares that will be exchanged on the date of completion. At the merger completion the values will converge. Thus, the trade is profitable in cases where the completion is successful; a loss is incurred in cases in which the merger is withdrawn (Baker and Savaşoğlu 2002).

short interest of cash acquirers is negative throughout the horizon and we observe no marked increase in either adjusted or abnormal short interest at the merger announcement.

To verify that the Figure 1 plots of mean short interest by merger type are statistically different from each other, we explore these results in a regression framework. In Table 3, we regress adjusted and abnormal short interest on merger type, acquirer characteristics, and 48 industry (Fama-French 1997) fixed effects interacted with year fixed effects. In all regressions in the paper, we cluster the standard errors at the industry level. Columns (1), (2), and (3) present regressions where the dependent variables are, respectively, the adjusted short interest twelve months, six months, and one month before the announcement. We present similar analyses in Columns (4), (5), and (6) using abnormal short interest. Across all regressions, the coefficients on *Stock Merger* and *Mixed Merger* suggest that both short interest variables are significantly higher for stock acquirers than they are for cash mergers and that they are also higher for mixed mergers than for cash mergers (significant for the six months horizon). For both short interest variables, we also find that the coefficient on *Stock Merger* is significantly greater than the coefficient on *Mixed Merger* at Month -1 (result untabulated). On average, we find that stock acquirers have adjusted and abnormal short interest that is 0.24% to 0.39% higher than cash acquirers across the pre-merger period.

One concern is that short interest could be correlated with growth expectations; if so, short interest would not distinguish between overvaluation and Q-theory explanations for mergers. Table 3 allows us to assess this claim. The regressions in Table 3 show that while the short interest variables are strongly correlated with firm-specific error in the market-to-book ratio, they are negatively correlated with sector error, and have no significant relation with the fairly valued market-to-book ratio based on long-run fundamentals. This suggests that short interest is not higher for firms with high fundamental growth opportunities.

3.2. Predicting M&A Activity and Payment Type

In this section, we investigate whether the degree of short interest predicts future acquisition choices. If overvaluation drives both short selling and stock acquisition decisions, then we should see a correlation between the two. We use probit regression to estimate a model that predicts either future stock acquisitions or future cash acquisitions. For these analyses, we use the universe of firm-months with available data. As explanatory variables, we include adjusted short interest or abnormal short interest (the variables of interest) and nine control variables, including an indicator variable for past firm acquisitions, log of market capitalization, institutional holdings, components of market-to-book, log of price, turnover, and past returns (see Appendix A for definitions). These control variables should capture fundamental motives for merger activity. We recognize that the effects of short selling activity may not be monotonic and we therefore rank the short interest variables into quintiles and create a set of dummy variables indicating the quintile assignment of short interest within the universe of firms that same month. The quintile assignments enter the regressions in this section and in all remaining analyses.

In Table 4, Panel A, we present the estimation results (marginal effects and standard errors reported) for probit regressions predicting stock or cash acquisitions using adjusted short interest. We estimate the models separately using explanatory variables measured at months -12, -6, and -1 relative to the merger announcement month. We do this to investigate potential temporal changes in the observed relations. Columns (1) to (3) show the results predicting stock acquisitions. As predicted by the overvaluation theory, there is a monotonic positive association between the quintile assignments of short interest and the propensity to engage in a future stock merger.

The economic magnitude of the relation between short selling and the likelihood to engage in a stock merger is large. At Month -1 for example, the probit marginal effect of *Adjusted Short Interest Q5* suggests that the probability of a future stock merger for firms in the highest quintile of abnormal short interest is 54% higher: the marginal effect of Q5 is 0.21%, where the unconditional probability of engaging in a stock merger is

0.39% (Table 2, Panel B). We also find that many of the control variables are important in explaining future stock acquisitions. Specifically, we find that firms with an acquisition history, lower institutional ownership, higher share prices, higher turnover, and higher past returns have a greater incidence of future stock mergers.

In Columns (4) to (6), we present the results from predicting cash acquisitions. The overvaluation theory predicts that the relation between the likelihood to engage in cash acquisitions and short interest is non-positive. We find that high adjusted short interest ($Q4$ and $Q5$) is negatively associated with the propensity to engage in a future cash acquisition. At Month -6, the probit marginal effect of *Adjusted Short Interest Q5* suggests that the probability of a future cash merger for firms in the highest quintile of abnormal short interest is 22% lower: the marginal effect of $Q5$ is -0.09%, where the unconditional probability of engaging in a cash merger is 0.41% (Table 2, Panel B).

In Table 4, Panel B, we present the estimation results (marginal effects and standard errors reported) for probit regressions predicting stock or cash acquisitions using abnormal short interest. As discussed in Section 2.2., we consider the abnormal short interest variable as a conservative proxy for overvaluation due to the double sorting on size and institutional ownership. Panel B presents results that are qualitatively similar to those in Panel A, although the magnitude of the coefficients in Columns (1) to (3) is about a third of what they are in Panel A. We suspect that the double sorting procedure eliminates some of the mispriced stocks from the top quintile of short selling. The magnitude of the coefficients in Columns (4) to (6) of Panel B is comparable to that of Panel A.¹²

Table 4 also provides an interesting insight into the relation between the market-to-book components and the likelihood of engaging in mergers. Columns (1) to (3) in each panel show that the likelihood of engaging in a stock merger is positively correlated with the firm- and sector-specific error components of market-to-book; however, it is uncorrelated with the long-run component of market-to-book. Conversely, the likelihood

¹² Given that some firms are “serial” acquirers, one alternative explanation for our findings is that short interest is high in the pre-announcement period due to increases in short interest following prior acquisitions. We test this alternative explanation by only retaining the first acquisition of each acquirer in our sample; we find that our reported results hold.

of a cash acquisition (Columns (4) to (6)) is negatively correlated with the firm-specific error component of market-to-book and is positively correlated with the long-run component of market-to-book. Overall, these results are consistent with the evidence presented in Rhodes-Kropf, Robinson, and Viswanathan (2005) and resonate with the idea that stock acquisitions are driven by overvaluation while cash acquisitions are driven by fundamentals.

3.3. Short Interest and Acquirer Returns

To provide more evidence on whether the correlation between short interest and future merger choices is related to the overvaluation of acquirers, we examine the relation between pre-announcement short interest and announcement and post-announcement returns. If short selling activity is related to overvaluation, it should be associated with future negative returns.

First, we examine whether merger announcement returns are lower for acquirers that have high short interest. In Table 5 we regress market-adjusted merger announcement returns on short interest variables and the following control variables: logged market cap, institutional ownership, the components of market-to-book, logged price, turnover, 12-month past returns, stock and mixed payment indicators, transaction relative size, a diversifying merger indicator (equal to one if the acquirer and target are not in the same Fama-French 48 industry classification), a public target indicator, a withdrawn indicator, and industry \times year fixed effects. These control variables are commonly used in studies of merger announcement returns (e.g., Fuller, Netter, and Stegemoller 2002, Moeller, Schlingemann, and Stulz 2004, Masulis, Wang, and Xie 2007). The results show that there is no monotonic or meaningful relation between pre-merger, adjusted short interest merger announcement returns. There is a non-monotonic relation between abnormal short interest and announcement returns: acquirers in the top two quintiles of abnormal short interest experience positive announcement returns, although the effect is stronger for Q4 than for Q5. Overall, these results suggest that

pressure by short sellers is not enough to undo mispricing upon the announcement of the merger (if indeed short interest is higher for overvalued stocks).¹³

Second, we explore the relation between pre-announcement short interest (measured at month -1) and acquirer long-term returns using a monthly calendar-time portfolio approach. We assign acquirers to monthly equal- or value-weighted portfolios according to their quintile-rank of adjusted short interest. Acquirers remain in the portfolio for the horizon studied: 6, 12, or 24 months, starting one month after the merger announcement. For each portfolio, we create a time series of the monthly returns for months that have at least ten firms (consistent with Moeller, Schlingemann, and Stulz (2004)). We then regress the excess returns (portfolio return less the risk-free rate) of the monthly time series on a Fama and French (1993) 3-factor model (Panel A), or on a 4-factor model including the Carhart (1997) momentum factor (Panel B). The intercepts from the regressions reflect the average monthly abnormal returns that are not explained by the pricing factors.¹⁴

Table 6 presents the intercepts from the regressions in monthly basis points (bp). The left-side columns in each panel weight firms in the portfolio equally, while the right-side columns weight firms in the portfolio by market value. We focus on Panel A. The results show that abnormal returns following the announcement covary with short interest. Specifically, abnormal returns for the top two quintiles (Q4 and Q5) of short interest are abnormally negative. For stock acquirers, we find that portfolios with high short interest underperform following the acquisition. The magnitude of the average decline in value for the high short interest stock acquirers is 4.0% (-66.5bp x 6) over the six-month horizon. Cash acquirers with high short interest also underperform, however the average decline in value for these firms is only 2.3% (-38.4bp x 6) over the six-month horizon. We also note that low short interest cash acquirers outperform by about 5.3% (89.1bp x 6) in the first six months. This outperformance is consistent with the overvaluation theory, which suggests that undervalued acquirers prefer cash as the

¹³ We note that small firms have significantly higher announcement returns, as documented by Moeller, Schlingemann, and Stulz (2004) and that announcement returns are lower for stock acquirers in general.

¹⁴ For further details on this methodology, see Mitchell and Stafford (2000) and Andrade, Mitchell, and Stafford (2001).

medium of payment. The results are weaker for 4-factor model alphas (Panel B), but for stock acquirers with high short interest, we again find that these firms underperform in the six months following the acquisition, with an average decline in value of 3.9% (-65.1bp x 6). When the portfolios are value-weighted (right columns of Panels A and B), the abnormal return patterns disappear almost entirely. The fact that value-weighted returns are zero suggests that the results for the equally-weighted portfolios are primarily driven by small acquirers. This is consistent with Ben-David and Roulstone (2010) who find that the underperformance of stock acquirers is driven by the poor performance of small firms.

Overall, these results suggest that acquirers with high short interest (especially small acquirers) underperform after the merger announcement. This is consistent with these firms being overvalued at the time of the merger announcement and with short interest identifying this overvaluation.

3.4. Short Interest of Acquirers versus Targets

The theory of stock-market-driven acquisitions postulates that stock acquirers should be more overvalued than their targets (Shleifer and Vishny 2003, Rhodes-Kropf and Viswanathan 2004). The rationale is that stock acquirers engage in mergers in order to exchange their overvalued stock for the targets' less overvalued assets.

We examine this hypothesis in Table 7, where we restrict the sample to mergers in which the targets are public firms (short interest is observable only for these targets).¹⁵ The top panel reports mean short interest (adjusted and abnormal) along with the market-to-book ratio, and the Rhodes-Kropf, Robinson, and Viswanathan (2005) market-to-book components, for stock acquirers (Column (1)) and their targets (Column (2)). Column (3) presents the mean difference in these variables between acquirers and their targets (the standard error of the difference is in parentheses). As theory predicts, the panel shows that both adjusted and abnormal short interest are significantly higher for acquirers than

¹⁵ Our sample size is smaller than that of Rhodes-Kropf, Robinson, and Viswanathan (2005) because of the data restrictions we impose on our sample. Specifically, as described in Section 2.1, we apply the data restrictions in Moeller, Schlingemann, and Stulz (2004). We further require short interest for each target. Neither of these additional restrictions are imposed in Rhodes-Kropf, Robinson, and Viswanathan (2005).

for their targets. The market-to-book ratio (and its first two components) is also higher for acquirers than for targets, while the third market-to-book component is higher for targets than acquirers.¹⁶

The bottom panel examines cash mergers. For those mergers, short interest is not statistically different for acquirers and targets, consistent with the idea that cash acquirers are not overvalued. However, as with stock acquirers, the market-to-book ratio and its first two components are higher for cash acquirers relative to cash targets.

There is one additional implication of Q-theory that can be tested in this panel. Q-theory predicts that firms become acquirers (targets) because they have high (low) growth opportunities. Thus, targets should have lower market-to-book ratios than both the acquirer *and the average firm*. Panel A shows that stock acquirers choose targets with market-to-book ratios higher than that of the average firm in the universe of stocks (See Table 2 Panel B). In contrast, cash acquirers choose targets whose market-to-book ratio is much lower than that of the average firm.¹⁷ Thus, the evidence in Table 7 is consistent with stock acquirers being motivated by overvaluation while cash acquirers are motivated by fundamental growth opportunities.

4. Alternative Explanations

Our tests have shown that short interest is indicative of firms' merger choices and is associated with post-merger announcement returns. The overvaluation hypothesis suggests that overvaluation (which is unobservable) drives both high short interest and a higher likelihood of stock mergers. However, there are alternative explanations for the relation between short interest and mergers. In this section, we consider four intuitive explanations for our results and assess their viability.

¹⁶ Rhodes-Kropf, Robinson, and Viswanathan (2005) find similar results for the market-to-book components.

¹⁷ The contrast between stock and cash targets' market-to-book ratios is even higher for the firm-specific error in M/B: stock (cash) target's firm-specific error is well above (below) the firm-specific error of the average firm. The firm-specific overvaluation of stock targets may explain why they accept bids from overvalued acquirers (Rhodes-Kropf and Viswanathan 2004, Shleifer and Vishny 2003).

4.1. Merger Arbitrage ahead of the Announcement

As discussed earlier, merger announcements allow traders to engage in merger arbitrage: buying targets and short selling acquirers. Figure 1 shows strong evidence for merger arbitrage with adjusted short interest and abnormal short interest spiking at the announcement. The first alternative explanation for our results is that traders anticipate merger announcements and begin shorting potential acquirers ahead of such announcements. Thus, the buildup in short interest prior to the merger announcement reflects traders anticipating the opportunity for merger arbitrage, not necessarily traders' belief that these firms are overvalued.

One implication of this explanation is that we should see two empirical regularities at the announcement: (1) a sharp increase in the shorting of acquirers of public targets (for whom merger arbitrage can now begin in earnest), and (2) a drop in the short interest of acquirers of private targets (for whom merger arbitrage is impossible). Figure 2, which examines short interest around acquisitions of public targets, confirms the rise in short interest for stock and mixed acquirers. However, Figure 3, which examines the short interest of acquirers of private targets, fails to show the expected drop in short interest for the private acquirers' subset. In fact, the short interest of acquirers of private targets increases following the merger announcement.¹⁸ This suggests that short interest positions taken in advance of stock and mixed-payment acquisitions of private targets were not intended to anticipate opportunities for merger arbitrage.^{19,20}

¹⁸ The results in Figures 2 and 3 are consistent with Mitchell, Pulvino and Stafford (2004), who show that short interest spikes at the merger announcement of public targets and remains flat at the merger announcement of private targets.

¹⁹ We verify that the results in Figures 2 and 3 hold in a multivariate setting using a regression similar to that in Table 3 but which includes an interaction of the merger type with an indicator for whether the target is public. With this specification, abnormal short interest spikes after the announcement for stock and mixed acquirers of public targets; for stock acquirers of private targets, abnormal short interest is abnormally high prior to the announcement and remains steady afterwards (results untabulated).

²⁰ Consistent with the idea that short sellers do not short stocks in anticipation of pending merger announcements, Blau, Fuller, and Wade (2010), using daily short volume data from 2005 through 2006, find no evidence for abnormal short selling activity in the days prior to merger announcements.

4.2. Short Sellers Anticipate Negative Merger Announcement Returns

The second alternative explanation is that short sellers allocate capital towards stocks that they suspect will engage in value-destroying mergers. In turn, value-destroying mergers are stock mergers due to fundamental characteristics of the merger (e.g., due to asymmetric information à la Myers and Majluf 1984 and Hansen 1987). According to this explanation, future stock acquirers with heavy short selling are not overvalued prior to the merger. Consistent with this hypothesis, Doukas and Zhu (2010) find evidence in Taiwanese data that short selling activity a few days ahead of merger announcements is negatively correlated with announcement returns.

Given that maintaining short positions is costly, the only reason that would justify short selling *ahead* of merger announcements is that the announcement returns are expected to be negative, and that there is no way to capture these returns after the announcement. If, however, information about the quality of a merger disseminates slowly, short sellers are better off waiting for the announcement of the details of the merger and then choosing whether to engage in short selling.

To test this idea, we revisit our results in Table 3 (which document the level of pre-announcement short interest by merger type) and add merger announcement returns and their interaction with merger type to the regression. If short sellers are shorting a firm because they believe the firm is likely to engage in a value-destroying merger and that they will capture the benefits of the value destruction at the merger announcement, then short interest should be higher for mergers with more negative announcement returns. Further, this effect should be strongest for stock mergers.

The results of this new regression analysis are found in Table 8. As was seen before, the levels of short interest and abnormal short interest are higher for stock mergers relative to mixed and cash mergers. More importantly, we find no relation between announcement returns and the levels of short interest and abnormal short interest. The main effect of announcement returns (which quantifies the relation between short interest and announcement returns for cash mergers) is not significantly different from zero, and the interactions of announcement returns and the indicators for stock or mixed mergers, though negative, are also not significantly different from zero. We

conclude that there is little evidence that short interest is driven by short sellers anticipating a value-destroying merger event as opposed to short sellers targeting firms they believe to be overvalued.

4.3. The Pairs Trading Explanation for Short Selling

A third alternative explanation is that short sellers are engaged in long/short “pairs trading” in which “...investors hedge themselves by shorting a security whose return is highly correlated with the return of another security they have purchased (e.g., selling Dell short and purchasing Gateway)” (Dechow, Hutton, Meulbroek, and Sloan, 2001, p. 81). If the firms chosen for the short side of the strategy have characteristics associated with stock acquirers, we will observe a spurious correlation between short interest and the propensity to engage in stock acquisitions. For example, traders may believe that small value firms are undervalued. They purchase small value firms and short firms similar to the small value firms (e.g., in the same industry), but larger in size and with higher market-to-book ratios. Since large firms and firms with high market-to-book ratios tend to make stock acquisitions, this strategy results in a spurious correlation between short interest and stock acquisitions. Importantly, this correlation exists even if short sellers believe the firms they are shorting are fairly valued.

For pairs trading to explain our results, the high short interest firms in our sample must be firms whose returns are highly correlated with those of other firms, making them suitable for the hedging side of the strategy. We investigate this idea by revisiting our Table 4 results (on the ability of short interest to predict future mergers) and partitioning our firms by the level of idiosyncratic risk. Pontiff (2006) surveys the literature and concludes that idiosyncratic risk is the best measure of impediments to arbitrage activity; this is partially due to idiosyncratic firms being unsuited for hedging strategies. For our purposes, if the relation between short interest and future acquisitions is found among idiosyncratic stocks, it is evidence that short sellers are actively targeting specific firms and not just shorting as a hedge strategy. In addition, given that idiosyncratic firms are difficult to arbitrage, it is likely that these firms would be mispriced and would thus potentially be firms for traders to short.

We estimate idiosyncratic risk for each firm-month by regressing past monthly returns on the Fama and French (1993) factors along with the Carhart (1997) momentum factor. Idiosyncratic risk is measured as the standard deviation of the residuals from this regression using the past 48 firm-months (with a minimum requirement of 24 firm-months) of returns. We split our sample into firms above (below) the median value of idiosyncratic risk within each month. We then estimate a probit regression that predicts future stock acquisitions separately for each subsample.

The results are presented in Table 9, Panels A (adjusted short interest) and B (abnormal short interest). In Panel A, we find a nearly monotonic relation between the likelihood of a stock merger and the degree of pre-merger short interest for both high- and low-idiosyncratic-risk stocks. Contrary to the prediction of the pairs trading hypothesis, the relation is slightly stronger for the high-idiosyncratic group. In Panel B, the results are even more asymmetric, with the relation between abnormal short interest and future stock mergers being strongly driven by high-idiosyncratic-risk stocks. As high-idiosyncratic firms are more costly to arbitrage, it is unlikely that short sellers are taking short positions in these firms as part of a pairs trading strategy.^{21,22}

4.4. Merger Waves and Short Interest

As noted in Section 2.1 and as documented in several prior papers, mergers tend to occur in waves (Andrade, Mitchell, and Stafford 2001, Harford 2005, Rhodes-Kropf, Robinson, and Viswanathan 2005). The fourth explanation for our results is that short selling activity may be correlated with the same factors driving merger waves. We investigate this explanation in three ways. First, we rerun our tests without the peak merger years. As seen in Table 1, Panel A, mergers in our sample peak during the bubble

²¹ We also estimate the probit model predicting cash acquisitions for the high- and low-idiosyncratic-risk subsamples (untabulated). Consistent with the main results, we find a negative association between abnormal short interest quintiles and the propensity to engage in a future cash acquisition for both subsamples.

²² We note that, consistent with the literature on idiosyncratic risk and financial anomalies (e.g., Pontiff 2006), the fact that the relation between short interest and merger choice is stronger for high-idiosyncratic-risk firms may explain why predictable, long-term returns following mergers by highly shorted acquirers are not arbitraged away.

years of the late 1990's. Given the high relative volume of acquisitions and the high valuations of firms during these years we test whether our results are driven by acquisitions in this time period. We remove observations from 1996 to 2001 and find that our reported results hold.

Second, we examine whether short interest is correlated with sector overvaluation. Rhodes-Kropf, Robinson, and Viswanathan (2005) find that acquisitions cluster in industries with high time-series sector error in market-to-book. Similarly, Table 4 shows that stock (and, to a lesser extent, cash) acquisitions are positively correlated with sector error. However, Table 3 shows that short interest in our sample is negatively correlated with the time-series sector error. This suggests that short interest in our sample is not driven by "hot" sectors experiencing merger waves.

Third, we assess whether short interest is associated with high past returns. If merger waves are driving both acquisitions and short selling activity, short interest should be positively correlated with market returns. However, Lamont and Stein (2004) and Asquith, Pathak, and Ritter (2005) find that short interest is negatively correlated with past market returns. Similarly, our Table 3 provides no evidence that short interest in our acquirers is positively associated with past firm returns. Overall, our results suggest that merger waves are not mechanically driving the association between short interest and acquisitions.

The results of this section make it unlikely that the short selling of future acquirers is unrelated to overvaluation. Rather, they suggest that short sellers target firms that are likely to be overvalued and that these firms are likely to engage in stock acquisitions, consistent with theory of market-driven acquisitions.

5. Conclusion

In this paper, we use short interest to identify overvaluation of firms that engage in stock acquisitions. Instead of depending on measures of relative valuation, we rely on the notion that short sellers, who are sophisticated market players, allocate more capital to stocks that they anticipate will experience the greatest decline in value. Unlike other

proxies for overvaluation, our measure appears to be uncorrelated with firm growth opportunities and thus is able to distinguish the overvaluation theory of acquisitions from Q-theory.

The empirical evidence is consistent with the idea that overvalued firms become stock acquirers (Shleifer and Vishny 2003 and Rhodes-Kropf and Viswanathan 2004). We document that firms with high short interest are more likely to engage in stock mergers and are less likely to engage in cash mergers. Further, we document that acquirers with high short interest underperform acquirers with low short interest for up to three years following the merger announcement. Finally, also consistent with the overvaluation theory, we show that short interest is significantly higher for stock acquirers than for their targets; in contrast, short interest is not significantly different between cash acquirers and their targets.

We consider four alternative explanations for the relation between pre-merger short interest and merger choices: first, that short sellers are anticipating the opportunity for merger arbitrage; second, that short sellers are anticipating value-destroying mergers; third, that short sellers are engaging in pairs trading strategies where the short position consists of firms that are likely to make acquisitions; and fourth, that short interest is correlated with merger waves. We present evidence that these explanations are inconsistent with our results.

Beyond identifying overvaluation in the context of mergers, our paper makes a methodological contribution to the corporate finance literature. Our proposed methodology can be used in other cases where researchers attempt to detect overvaluation and wish to abstract from formal valuation models. For example, the same methodology could be applied to other corporate actions, such as seasoned equity offerings, or the issuance of convertible bonds.

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Appendix A: Variable Definitions

SDC Thomson

Transaction Value	The transaction value as reported in \$m.
Transaction Size	The transaction value scaled by acquirer market capitalization.
Cash Merger	Indicates a 100 percent cash merger.
Mixed Merger	Indicates a merger consisting of cash and stock.
Stock Merger	Indicates a 100 percent stock merger.
Withdrawn	Indicates whether a merger was withdrawn.
Past acquisition	Indicates whether the firm was an acquirer before.
Public target	Indicates whether the target is traded on the stock market.

Short Interest Data

Short Interest	Computed as the number of shares sold short at mid-month divided by the total shares outstanding (from CRSP).
Adjusted Short Interest	Computed as the difference between the short interest ratio and the average short interest ratio for the corresponding month.
Abnormal Short Interest	Computed as the difference between the short interest ratio and the average short interest ratio for a corresponding benchmark portfolio (5×5) based on quintiles of size (from CRSP) and institutional ownership (from 13F Thomson SDC), within the same month.

CRSP Annual File

Announcement Return	Announcement returns are computed as the cumulative market-adjusted returns over the three days (days -1, 0, +1) around the merger announcement.
Market Cap	Market cap (#shares outstanding \times price), measured in \$k.
Past Returns	Buy-and-hold raw return for the prior twelve months.
Price	Nominal share price, measured in \$.
Turnover	Computed as the annual split-adjusted trading volume divided by the average of number of split-adjusted shares outstanding over the year before the merger announcement.

Compustat

Market-to-book	Computed as the annual market value of equity (fiscal year end's share price multiplied by total shares outstanding) divided by the book value of equity (CEQ in Compustat).
Diversifying	Indicator variable equal to one if the acquirer and target are not in the same Fama-French 48 industry; zero otherwise.

13F Thomson SDC

Institutional Ownership	Fraction of shares outstanding owned by institutional investors.
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Rhodes-Kropf, Robinson, and Viswanathan (2005)

M/B (Firm)	Firm-specific error in market-to-book from Rhodes-Kropf, Robinson, and Viswanathan (2005). It equals the difference between a firm's market value and the market value implied by a current industry multiple. See Appendix B and Rhodes-Kropf, Robinson, and Viswanathan (2005) for further details.
M/B (Sector)	Sector (industry) error in market-to-book from Rhodes-Kropf, Robinson, and Viswanathan (2005). It equals the difference between market value implied by a current industry multiple and market value implied by a long-run industry multiple. See Appendix B and Rhodes-Kropf, Robinson, and Viswanathan (2005) for further details.
M/B (Long-run)	Long-run value to book from Rhodes-Kropf, Robinson, and Viswanathan (2005). It equal to the market value implied by a long-run industry multiple and the firm's actual book value of equity. See Appendix B and Rhodes-Kropf, Robinson, and Viswanathan (2005) for further details.

Appendix B: The Rhodes-Kropf, Robinson, and Viswanathan (2005) Breakdown of the Market-to-book ratio

In order to test overvaluation explanations for mergers, Rhodes-Kropf, Robinson, and Viswanathan (2005) decompose the market-to-book ratio into two components related to firm-level and sector-level mispricing, and a third component related to the long-run market-to-book ratio based on fundamentals. The key to the decomposition is the estimation of the following regression model relating the market value of equity to the book value of equity, net income, and leverage:²³

$$m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \alpha_{2jt} \ln(NI)_{it}^+ + \alpha_{3jt} I_{(<0)} \ln(NI)_{it}^+ + \alpha_{4jt} LEV_{it} + \varepsilon_{it} \quad (1)$$

where m_{it} is the log of the market value of equity, b_{it} is the log of the book value of equity, NI is net income, $I_{(<0)}$ is an indicator variable for whether net income is negative, and LEV is the leverage ratio. Equation (1) is estimated by industry-year for the Fama-French (12) industries. For each industry-year, α_{jt} represents the multiple applied to accounting information for that industry and year in determining the market value of equity; for each industry, α_j is the average of the yearly α_{jt} 's over the sample period.

The multiples estimated with equation (1) are used to express the (logged) market-to-book ratio as the difference between the market value of equity and the firm's intrinsic value and the difference between intrinsic value and the book value of equity. In addition, the difference between market value and intrinsic value is divided into a firm-specific and a sector-specific component. Specifically:

$$m_{it} - b_{it} = \underbrace{m_{it} - v(\theta_{it}; \alpha_{jt})}_{\text{firm error}} + \underbrace{v(\theta_{it}; \alpha_{jt}) - v(\theta_{it}; \alpha_j)}_{\text{sector error}} + \underbrace{v(\theta_{it}; \alpha_j) - b_{it}}_{\text{long-run component}} \quad (2)$$

²³ Equation (1) is Rhodes-Kropf, Robinson, and Viswanathan (2005)'s “Model III”. Model I uses only the book value of equity to explain the market value of equity, while Model II uses the book value of equity and net income. Rhodes-Kropf, Robinson, and Viswanathan (2005) reports that “...the breakdown of M/B across the three models is remarkably consistent”; as such, we report results using only components estimated with Model III.

where m_{it} is the log of the market value of equity; b_{it} is the log of the book value of equity; θ represents firm-level accounting information (the independent variables in equation (1)); α represents sector multiples on the individual items of accounting information; $v(\theta_{it}; \alpha_{jt})$ is a firm's intrinsic value based on time t accounting information and time t sector multiples; and $v(\theta_{it}; \alpha_j)$ is a firm's intrinsic value based on time t accounting information and long-run sector multiples.

The first RHS expression in equation (2) is the difference between the market value of equity and firm value implied by sector multiples at time t . This captures mispricing due to a firm's value differing from the value warranted by the firm's accounting fundamentals and the current multiples applied to those fundamentals for firms in the same industry. In the paper we refer to this term as M/B (Firm). The second RHS expression in equation (2) is the difference between the firm's value implied by current sector multiples and that implied by long-run sector multiples. This term captures mispricing due to sectors being mispriced relative to long-run multiples, i.e., sectors being "hot" at a particular point in time. In the paper we refer to this term as M/B (Sector). The third RHS expression in equation (2) captures the difference between firm value implied by long-run multiples and the current book value. This term "...is the portion of M/B that cannot be attributed to firm-specific deviations from industry average values or to industry-wide waves in valuation levels" (Rhodes-Kropf, Robinson, and Viswanathan 2005, p. 579). This long-run value to book captures the difference between market value and book value attributable to firm fundamentals, including growth opportunities. In the paper we refer to this term as M/B (Long-run).

Table 2 presents descriptive statistics on the market-to-book ratio, the log of the market-to-book ratio, and the three components of the logged market-to-book ratio. Consistent with Rhodes-Kropf, Robinson, and Viswanathan (2005), M/B (Long-run) is the dominant component of the market-to-book ratio and the two mispricing components are larger for acquirers than for firms in general.

Table 1. Time Series of Acquisitions and Short Interest

Panel A presents the distribution of acquisitions through time by target type and payment type. Panel B presents means for the short interest variables for the universe of firms and for acquirers over time. The sample period is from 1989 to 2007. Variable definitions are in Appendix A.

Panel A: Time Series of Acquisitions

Year	Acquisition Count		
	Stock	Mixed	Cash
1989	54	44	56
1990	42	45	43
1991	65	66	47
1992	83	72	49
1993	143	104	97
1994	167	136	127
1995	228	133	135
1996	263	185	164
1997	278	251	185
1998	306	285	242
1999	226	234	195
2000	217	176	153
2001	108	166	153
2002	62	200	161
2003	63	171	175
2004	60	202	235
2005	48	243	261
2006	43	226	300
2007	16	109	108
Total	2,472	3,048	2,886
% of Sample	29.4%	36.3%	34.3%

Table 1. Time Series of Acquisitions and Short Interest (Cont.)**Panel B: Time Series of Short Interest**

Year	Universe			Acquirers		
	Short Interest	Adjusted Short Interest	Abnormal Short Interest	Short Interest	Adjusted Short Interest	Abnormal Short Interest
1989	0.006	0.000	-0.001	0.008	0.002	0.001
1990	0.008	-0.001	-0.001	0.010	0.001	0.000
1991	0.009	-0.001	-0.001	0.012	0.003	0.001
1992	0.009	-0.001	-0.001	0.011	0.002	0.000
1993	0.010	-0.001	-0.001	0.013	0.003	0.000
1994	0.012	-0.001	-0.001	0.017	0.005	0.002
1995	0.011	-0.001	-0.001	0.018	0.006	0.003
1996	0.012	-0.001	-0.001	0.017	0.005	0.002
1997	0.014	-0.001	-0.001	0.022	0.007	0.004
1998	0.015	-0.001	-0.001	0.023	0.008	0.004
1999	0.013	-0.001	-0.001	0.017	0.003	0.001
2000	0.014	-0.002	-0.001	0.018	0.003	0.001
2001	0.017	-0.002	-0.001	0.023	0.004	0.000
2002	0.021	-0.001	-0.001	0.031	0.009	0.002
2003	0.026	-0.001	0.000	0.035	0.008	0.000
2004	0.029	-0.001	0.000	0.034	0.004	0.001
2005	0.033	-0.001	-0.001	0.039	0.007	0.001
2006	0.040	-0.001	-0.001	0.044	0.004	-0.003
2007	0.051	-0.001	-0.001	0.052	0.006	-0.001
Average	0.018	-0.001	-0.001	0.023	0.005	0.001

Table 2. Summary Statistics

This table presents descriptive statistics for acquiring firms and for the universe. The sample period is from 1989 to 2007. Variable definitions are in Appendix A. In Panel C, Row 1 presents the mean, Row 2 presents the median, and Row 3 presents the standard deviation.

Panel A: Descriptive Statistics for Acquiring Firms at Month -1

Variable	Mean	Std	5%	Q1	Median	Q3	95%
Short Interest (t-1)	0.025	0.036	0.000	0.002	0.010	0.032	0.102
Adjusted Short Interest (t-1)	0.005	0.034	-0.025	-0.013	-0.006	0.010	0.079
Abnormal Short Interest (t-1)	0.001	0.032	-0.029	-0.014	-0.006	0.005	0.067
Market Cap (\$k)	2,670,898	7,818,140	26,790	142,362	499,721	1,601,279	11,533,028
Log of Market Cap (\$k)	13.13	1.83	10.20	11.87	13.12	14.29	16.26
Market-to-Book	3.48	3.88	0.88	1.56	2.31	3.76	10.13
Log of Market-to-Book	0.92	0.75	-0.13	0.44	0.84	1.32	2.32
M/B (Firm)	0.21	0.58	-0.74	-0.13	0.21	0.52	1.16
M/B (Sector)	0.13	0.21	-0.19	0.03	0.13	0.23	0.44
M/B (Long-run)	0.59	0.58	-0.28	0.15	0.57	1.04	1.49
Institutional Ownership	0.468	0.300	0.000	0.211	0.476	0.706	0.929
Price	26.95	24.01	3.15	12.13	22.80	35.25	63.75
Log of Price	2.95	0.93	1.15	2.50	3.13	3.56	4.15
Turnover	1.70	1.94	0.18	0.54	1.07	2.13	5.25
Past Returns (12 Months)	0.38	1.01	-0.44	-0.04	0.19	0.50	1.72
Transaction Value (\$m)	468	2,773	3	15	47	172	1,599
Transaction Size	0.26	0.60	0.02	0.04	0.10	0.26	0.96
Announcement Returns	0.009	0.085	-0.100	-0.026	0.003	0.036	0.134
Withdrawn	0.09	0.29	0.00	0.00	0.00	0.00	1.00
Stock Merger	0.29	0.46	0.00	0.00	0.00	1.00	1.00
Mixed Merger	0.36	0.48	0.00	0.00	0.00	1.00	1.00
Cash Merger	0.34	0.47	0.00	0.00	0.00	1.00	1.00
N	8,406						

Panel B: Descriptive Statistics for the Universe of Firm-Months

Variable	Mean	Std	5%	Q1	Median	Q3	95%
Short Interest (t-1)	0.018	0.034	0.000	0.000	0.004	0.020	0.087
Adjusted Short Interest (t-1)	-0.001	0.031	-0.029	-0.014	-0.009	0.001	0.060
Abnormal Short Interest (t-1)	-0.001	0.028	-0.027	-0.012	-0.007	-0.001	0.051
Market Cap (\$k)	1,233,208	3,190,712	7,723	43,120	167,341	742,850	6,668,732
Log of Market Cap (\$k)	12.14	2.04	8.95	10.67	12.03	13.52	15.71
Market-to-Book	3.03	3.94	0.57	1.18	1.86	3.20	9.18
Log of Market-to-Book	0.70	0.84	-0.56	0.17	6.20	1.16	2.22
M/B (Firm)	0.08	0.64	-0.93	-0.29	0.07	0.43	1.13
M/B (Sector)	0.09	0.22	-0.27	-0.01	0.09	0.20	0.43
M/B (Long-run)	0.54	0.67	-0.53	0.08	0.51	1.02	1.59
Institutional Ownership	0.339	0.304	0.000	0.049	0.276	0.579	0.884
Price	19.22	17.67	1.28	5.89	14.50	27.01	54.25
Log of Price	2.45	1.16	0.25	1.77	2.67	3.30	3.99
Turnover	1.29	1.73	0.12	0.38	0.78	1.55	4.12
Past Returns (12 Months)	0.18	0.79	-0.61	-0.19	0.08	0.36	1.22
Merger	0.012	0.111	0.000	0.000	0.000	0.000	0.000
Stock Merger	0.0039	0.0627	0.00	0.00	0.00	0.00	0.00
Mixed Merger	0.0044	0.0663	0.00	0.00	0.00	0.00	0.00
Cash Merger	0.0041	0.0638	0.00	0.00	0.00	0.00	0.00
N	971,662						

Table 2. Summary Statistics (Cont.)

Panel C: Descriptive Statistics by Acquisition Type at Month -1

Variable	Acquirers of Public Targets			Acquirers of Private Targets			Universe
	Stock	Mixed	Cash	Stock	Mixed	Cash	
Short Interest (t-1)	0.0230	0.0262	0.0202	0.0218	0.0253	0.0271	0.0183
	0.0114	0.0133	0.0105	0.0068	0.0091	0.0126	0.0042
	0.0315	0.0331	0.0267	0.0340	0.0382	0.0380	0.0336
Adjusted Short Interest (t-1)	0.0068	0.0051	-0.0007	0.0070	0.0048	0.0050	-0.0008
	-0.0036	-0.0049	-0.0066	-0.0062	-0.0077	-0.0068	-0.0090
	0.0307	0.0313	0.0265	0.0335	0.0361	0.0359	0.0313
Abnormal Short Interest (t-1)	0.0040	0.0009	-0.0035	0.0052	0.0016	-0.0014	-0.0011
	-0.0040	-0.0057	-0.0072	-0.0052	-0.0065	-0.0081	-0.0066
	0.0285	0.0280	0.0246	0.0316	0.0328	0.0331	0.0276
Market Cap (\$m)	5,339	6,672	6,603	1,621	1,249	1,937	1,233
	1,137	1,645	1,646	386	262	527	167
	11,933	13,008	13,045	5,224	4,377	5,595	3,191
Market-to-Book	2.69	1.88	2.01	3.39	2.29	1.97	1.99
	1.27	1.40	1.54	1.56	1.51	1.48	1.30
	4.42	1.83	1.81	8.21	7.49	2.79	2.12
M/B (Firm)	0.38	0.31	0.22	0.32	0.12	0.13	0.08
	0.35	0.33	0.20	0.30	0.13	0.10	0.07
	0.54	0.54	0.52	0.60	0.59	0.57	0.64
M/B (Sector)	0.15	0.14	0.14	0.14	0.12	0.13	0.09
	0.15	0.14	0.13	0.13	0.12	0.13	0.09
	0.22	0.20	0.16	0.24	0.21	0.19	0.22
M/B (Long-run)	0.50	0.44	0.54	0.67	0.64	0.56	0.54
	0.32	0.37	0.59	0.63	0.65	0.57	0.51
	0.57	0.52	0.52	0.62	0.58	0.56	0.67
Institutional Ownership	0.45	0.57	0.57	0.36	0.43	0.53	0.34
	0.44	0.60	0.61	0.33	0.41	0.56	0.28
	0.27	0.28	0.27	0.29	0.30	0.30	0.30
Price	34.39	37.70	33.88	28.19	20.05	26.09	19.22
	30.38	31.05	28.92	24.00	16.13	22.63	14.50
	25.31	34.96	22.93	27.87	17.05	21.04	17.67
Turnover	1.63	1.53	1.49	1.91	1.75	1.61	1.29
	0.91	1.01	0.96	1.05	1.18	1.08	0.78
	2.06	1.58	1.56	2.42	1.96	1.65	1.73
Past Returns (12 Months)	0.45	0.25	0.17	0.60	0.38	0.27	0.18
	0.27	0.19	0.15	0.28	0.17	0.16	0.08
	0.94	0.55	0.37	1.58	1.01	0.63	0.79
Transaction Value (\$m)	1,282	2,399	670	99	166	156	
	181	424	163	25	31	35	
	5,512	6,780	2,027	388	590	677	
Transaction Size	0.35	0.63	0.25	0.19	0.27	0.16	
	0.20	0.32	0.10	0.06	0.12	0.07	
	0.47	1.31	0.42	0.57	0.57	0.30	
Announcement Return	-0.030	-0.020	0.010	0.020	0.020	0.010	
	-0.020	-0.020	0.000	0.000	0.010	0.010	
	0.080	0.070	0.070	0.100	0.100	0.070	
Withdrawn	0.12	0.12	0.16	0.11	0.06	0.07	
	0.00	0.00	0.00	0.00	0.00	0.00	
	0.33	0.33	0.37	0.31	0.25	0.26	
N	925	627	473	1,547	2,421	2,413	971,662
% of Sample	11%	7%	6%	18%	29%	29%	

Table 3. Correlation between Short Interest and Future Merger Type

This table presents OLS regression results (coefficients and standard errors reported in parenthesis) of short interest on future merger type. This table tests in a multivariate fashion whether the time-series in Figure 1 are statistically different. The sample covers acquisitions from 1989 to 2007. Variable definitions are in Appendix A. The variables in each column are measured in the month specified by the column heading (i.e., month -12, -6, or -1) relative to the month of the merger announcement. The regressions include industry fixed effects (Fama-French (1997) 48 industries) interacted with year fixed effects (not reported for parsimony). Standard errors are robust to industry clustering using the Fama-French (1997) 48 classification scheme. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively.

SI measured at:	Dependent variable: Adjusted Short Interest			Abnormal Short Interest		
	Month -12	Month -6	Month -1	Month -12	Month -6	Month -1
	(1)	(2)	(3)	(4)	(5)	(6)
Stock Merger	0.213** (0.086)	0.320*** (0.106)	0.283*** (0.076)	0.263** (0.099)	0.359*** (0.108)	0.334*** (0.082)
Mixed Merger	0.140 (0.106)	0.258** (0.119)	0.129 (0.111)	0.184 (0.126)	0.297** (0.137)	0.153 (0.117)
Public Target	-0.040 (0.084)	-0.136 (0.117)	-0.154 (0.110)	0.048 (0.078)	-0.002 (0.115)	-0.006 (0.109)
Log of Market Cap	-0.073 (0.073)	-0.093 (0.071)	-0.201*** (0.074)	0.048 (0.056)	0.056 (0.056)	-0.007 (0.062)
Institutional Ownership	1.786*** (0.255)	2.543*** (0.313)	3.195*** (0.234)	-0.767*** (0.233)	-0.375 (0.283)	-0.023 (0.224)
M/B (Firm)	0.348*** (0.110)	0.314*** (0.075)	0.473*** (0.067)	0.274** (0.105)	0.197** (0.079)	0.361*** (0.067)
M/B (Sector)	-0.238 (0.323)	-0.646*** (0.225)	-0.561** (0.248)	-0.319 (0.274)	-0.637** (0.265)	-0.636** (0.244)
M/B (Long-run)	0.085 (0.110)	0.100 (0.090)	0.007 (0.088)	0.090 (0.102)	0.095 (0.076)	0.016 (0.084)
Log of Price	0.308*** (0.093)	0.265*** (0.091)	0.274** (0.116)	0.110 (0.071)	0.076 (0.075)	0.076 (0.093)
Turnover	0.803*** (0.117)	0.761*** (0.116)	0.805*** (0.095)	0.723*** (0.106)	0.697*** (0.107)	0.734*** (0.089)
Past Returns (12 months)	-0.098 (0.059)	-0.105** (0.051)	-0.197*** (0.071)	-0.003 (0.049)	-0.008 (0.053)	-0.109 (0.069)
Industry × Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes
N	7,757	8,378	8,406	7,757	8,378	8,406
Adj R ²	0.323	0.314	0.341	0.232	0.218	0.232

Table 4. Can Short Interest Predict Which Firms Become Acquirers?

This table presents probit regression results (marginal effects and standard errors reported in parenthesis) predicting stock or cash acquisitions. The sample includes the universe of firms with available data from 1989 to 2007. Variable definitions are in Appendix A. The variables in each column are measured in the month specified by the column heading (i.e., month -12, -6, or -1) relative to the month in which the dependent variable is measured. Adj. Short Interest Q2-Q5 are indicators for the second through fifth quintiles of the adjusted short interest distribution; Q1, the omitted group, represents the lowest quintile of adjusted short interest. Quintiles of short interest are assigned on each calendar month. Standard errors are robust to industry clustering using the Fama-French (1997) 48 classification scheme. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Adjusted Short Interest

Dependent variable: Adj SI measured at:	Stock Acquirer (0/1)			Cash Acquirer (0/1)		
	Month -12	Month -6	Month -1	Month -12	Month -6	Month -1
	(1)	(2)	(3)	(4)	(5)	(6)
Adjusted Short Interest Q2	0.0005*** (0.0002)	0.0007*** (0.0002)	0.0007*** (0.0002)	-0.0001 (0.0003)	0.0003 (0.0002)	-0.0001 (0.0002)
Adjusted Short Interest Q3	0.0006** (0.0003)	0.0011*** (0.0004)	0.0007** (0.0003)	-0.0002 (0.0002)	-0.0001 (0.0002)	-0.0004 (0.0002)
Adjusted Short Interest Q4	0.0010*** (0.0003)	0.0014*** (0.0004)	0.0012*** (0.0004)	-0.0003 (0.0002)	-0.0003 (0.0002)	-0.0006*** (0.0002)
Adjusted Short Interest Q5	0.0018*** (0.0004)	0.0022*** (0.0005)	0.0021*** (0.0006)	-0.0010*** (0.0002)	-0.0008*** (0.0002)	-0.0009*** (0.0002)
Past Acquisition	0.0035*** (0.0009)	0.0038*** (0.0009)	0.0039*** (0.0009)	0.0028*** (0.0002)	0.0029*** (0.0001)	0.0030*** (0.0002)
Log of Market Cap	-0.0003* (0.0002)	-0.0003** (0.0001)	-0.0002* (0.0001)	0.0000 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)
Institutional Ownership	-0.0034** (0.0014)	-0.0033** (0.0014)	-0.0032** (0.0014)	0.0042*** (0.0005)	0.0045*** (0.0005)	0.0044*** (0.0004)
M/B (Firm)	0.0009*** (0.0002)	0.0010*** (0.0002)	0.0010*** (0.0002)	-0.0002 (0.0001)	-0.0002** (0.0001)	-0.0004*** (0.0001)
M/B (Sector)	0.0007* (0.0004)	0.0018*** (0.0004)	0.0020*** (0.0003)	0.0006 (0.0004)	0.0009** (0.0004)	0.0009** (0.0004)
M/B (Long-run)	0.0005 (0.0005)	0.0006 (0.0005)	0.0007 (0.0004)	0.0003** (0.0002)	0.0004** (0.0002)	0.0004** (0.0002)
Log of Price	0.0012** (0.0004)	0.0011** (0.0004)	0.0011** (0.0005)	0.0004* (0.0002)	0.0005** (0.0002)	0.0007*** (0.0002)
Turnover	0.0001** (0.0000)	0.0001** (0.0000)	0.0001** (0.0000)	0.0001** (0.0000)	0.0001 (0.0000)	0.0000 (0.0000)
Past Returns (12 months)	0.0001** (0.0001)	0.0002*** (0.0000)	0.0003*** (0.0000)	0.0001* (0.0001)	0.0002* (0.0001)	0.0001 (0.0001)
N	902,281	940,207	971,662	902,281	940,207	971,662
Pseudo R ²	0.028	0.035	0.041	0.035	0.040	0.044

Table 4. Can Short Interest Predict Which Firms Become Acquirers? (Cont.)

Panel B: Abnormal Short Interest

Dependent variable: Abn SI measured at:	Stock Acquirer (0/1)			Cash Acquirer (0/1)		
	Month -12	Month -6	Month -1	Month -12	Month -6	Month -1
	(1)	(2)	(3)	(4)	(5)	(6)
Abnormal Short Interest Q2	0.0002 (0.0002)	-0.0002 (0.0002)	-0.0003 (0.0003)	-0.0003* (0.0002)	0.0000 (0.0002)	0.0003* (0.0002)
Abnormal Short Interest Q3	-0.0002 (0.0003)	-0.0004 (0.0003)	-0.0002 (0.0004)	-0.0002 (0.0002)	0.0003* (0.0002)	0.0002 (0.0001)
Abnormal Short Interest Q4	-0.0000 (0.0003)	-0.0000 (0.0002)	0.0002 (0.0004)	-0.0008*** (0.0001)	-0.0005** (0.0002)	-0.0003* (0.0002)
Abnormal Short Interest Q5	0.0007** (0.0003)	0.0006* (0.0003)	0.0008* (0.0004)	-0.0010*** (0.0002)	-0.0008*** (0.0002)	-0.0006*** (0.0002)
Past Acquisition	0.0035*** (0.0009)	0.0038*** (0.0009)	0.0039*** (0.0009)	0.0028*** (0.0002)	0.0029*** (0.0001)	0.0030*** (0.0002)
Log of Market Cap	-0.0003 (0.0002)	-0.0002 (0.0001)	-0.0002 (0.0001)	0.0001 (0.0001)	-0.0000 (0.0001)	-0.0000 (0.0001)
Institutional Ownership	-0.0031** (0.0015)	-0.0031** (0.0015)	-0.0029** (0.0014)	0.0038*** (0.0004)	0.0042*** (0.0004)	0.0041*** (0.0004)
M/B (Firm)	0.0010*** (0.0002)	0.0011*** (0.0002)	0.0011*** (0.0002)	-0.0002 (0.0001)	-0.0002** (0.0001)	-0.0004*** (0.0001)
M/B (Sector)	0.0006 (0.0004)	0.0017*** (0.0004)	0.0019*** (0.0003)	0.0006 (0.0004)	0.0009** (0.0004)	0.0009** (0.0004)
M/B (Long-run)	0.0006 (0.0005)	0.0007 (0.0005)	0.0007 (0.0005)	0.0004** (0.0002)	0.0004** (0.0002)	0.0004** (0.0002)
Log of Price	0.0011*** (0.0004)	0.0011*** (0.0004)	0.0011*** (0.0004)	0.0003 (0.0002)	0.0005** (0.0002)	0.0006*** (0.0002)
Turnover	0.0001*** (0.0000)	0.0001*** (0.0000)	0.0001** (0.0001)	0.0001** (0.0000)	0.0001* (0.0000)	0.0000 (0.0000)
Past Returns (12 months)	0.0001** (0.0001)	0.0002*** (0.0001)	0.0003*** (0.0000)	0.0001* (0.0001)	0.0002** (0.0001)	0.0001 (0.0001)
N	902,281	940,207	971,662	902,281	940,207	971,662
Pseudo R ²	0.027	0.034	0.040	0.035	0.040	0.044

Table 5. Pre-Announcement Short Interest and Announcement Returns

This table presents regression results (coefficients and standard errors reported) explaining merger announcement returns. The sample includes firms that engaged in an acquisition from 1989 to 2007. Variable definitions are in Appendix A. The independent variables are all measured in month -1 relative to the month of the merger announcement. Quintiles of short interest are assigned on each calendar month. The regressions include industry (Fama-French (1997) 48 industries) fixed effects interacted with year fixed effects (not reported for parsimony). Standard errors are robust to industry clustering using the Fama-French 48 classification scheme. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively.

	Market-Adjusted Announcement Returns (-1,+1)			
	X = Adjusted		X = Abnormal	
	(1)	(2)	(3)	(4)
X Short Interest Q2 (t-1)	-0.001 (0.003)	-0.001 (0.003)	0.003 (0.003)	0.003 (0.003)
X Short Interest Q3 (t-1)	0.001 (0.004)	0.001 (0.004)	0.002 (0.003)	0.002 (0.003)
X Short Interest Q4 (t-1)	-0.000 (0.005)	0.000 (0.005)	0.006** (0.003)	0.006** (0.003)
X Short Interest Q5 (t-1)	-0.002 (0.004)	-0.002 (0.004)	0.004 (0.002)	0.004* (0.002)
Stock Merger		-0.008*** (0.003)		-0.009*** (0.003)
Mixed Merger		-0.004* (0.002)		-0.004* (0.002)
Log of Market Cap	-0.003** (0.001)	-0.003** (0.001)	-0.003** (0.001)	-0.003** (0.001)
Institutional Ownership	0.005 (0.003)	0.004 (0.003)	0.006* (0.004)	0.005 (0.004)
M/B (Firm)	0.002 (0.003)	0.002 (0.003)	0.001 (0.003)	0.002 (0.003)
M/B (Sector)	-0.011 (0.008)	-0.011 (0.008)	-0.011 (0.007)	-0.011 (0.008)
M/B (Long-run)	0.003 (0.002)	0.004 (0.002)	0.003 (0.002)	0.003 (0.002)
Log of Price	-0.010*** (0.003)	-0.010*** (0.003)	-0.010*** (0.003)	-0.010*** (0.003)
Turnover	0.001 (0.001)	0.001 (0.001)	0.000 (0.001)	0.000 (0.001)
Past Returns	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)	0.002 (0.002)
Transaction Size	-0.004 (0.004)	-0.004 (0.004)	-0.004 (0.004)	-0.004 (0.004)
Diversifying	0.004 (0.003)	0.004 (0.003)	0.004 (0.003)	0.004 (0.003)
Public Target	-0.024*** (0.004)	-0.022*** (0.004)	-0.024*** (0.004)	-0.022*** (0.004)
Withdrawn	-0.004 (0.004)	-0.004 (0.004)	-0.004 (0.004)	-0.004 (0.004)
Industry × Year Fixed Effects	Yes	Yes	Yes	Yes
N	8,246	8,246	8,246	8,246
Adj R ²	0.076	0.077	0.076	0.077

Table 6. Pre-Announcement Adj. Short Interest and Post-Announcement Returns

This table presents calendar-time portfolio regression results (intercepts and standard errors reported) explaining post-merger announcement returns. The sample includes firms that engaged in an acquisition from 1989 to 2007. Adjusted short interest is measured in month -1 relative to the month of the merger announcement. Quintiles of short interest are assigned on each calendar month. Acquirers enter a portfolio one month after the merger announcement and stay for the number of months specified in the columns (horizon). A portfolio-month must have 10 stocks or more to be included in the analysis. Monthly portfolio returns are regressed on 3-Factor (Panel A) or 4-Factor (Panel B) models. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Intercepts from Calendar Time Portfolios (3 Factors)

Payment	Adjusted Short Interest of Acquirers (t-1)	# acquirers	3-Factor alphas over...					
			Equal-Weighting			Value-Weighting		
			6 mth	12 mth	24 mth	6 mth	12 mth	24 mth
All	Q1	477	63.2*	58.5**	34.3	27.8	2.6	-19.1
			(36.3)	(26.3)	(23.0)	(39.0)	(31.3)	(26.8)
	Q2	807	27.8	12.9	9.9	35.0	-8.5	-4.6
			(22.5)	(17.7)	(14.5)	(21.2)	(18.5)	(15.1)
	Q3	1091	-15.5	-0.2	3.4	-9.6	-9.4	-10.2
			(15.8)	(17.3)	(14.7)	(23.9)	(19.2)	(16.9)
	Q4	1306	-40.8***	-47.9***	-31.0**	-24.2	-12.9	-9.6
			(15.7)	(13.0)	(12.7)	(22.7)	(16.6)	(13.5)
	Q5	1462	-49.0***	-25.8	-16.2	8.8	0.3	-7.9
			(18.4)	(16.2)	(16.6)	(22.6)	(19.7)	(16.5)
	Avg # months:		190.7	222.7	228.7	190.7	222.7	228.7
	Avg # firms in portfolio:		32.1	53.8	90.7	32.1	53.8	90.7
Stock	Q1+Q2	396	-3.4	-10.0	4.4	-20.4	-17.2	-20.9
			(43.1)	(30.3)	(24.2)	(42.6)	(32.1)	(24.0)
	Q3	279	-44.1	-24.7	0.1	-29.6	0.6	2.6
			(44.8)	(32.0)	(25.7)	(59.3)	(39.8)	(28.2)
	Q4+Q5	873	-66.5**	-40.5*	-24.5	-23.0	-13.4	-13.3
			(27.9)	(22.6)	(21.3)	(30.0)	(27.0)	(20.6)
	Avg # months:		110.5	166.0	209.8	110.5	166.0	209.8
	Avg # firms in portfolio:		22.9	32.5	47.0	22.9	32.5	47.0
Cash	Q1+Q2	423	89.1***	45.8**	45.2**	50.2	-8.2	14.5
			(30.6)	(23.2)	(19.7)	(33.0)	(27.9)	(21.3)
	Q3	391	-37.8	24.0	17.0	-35.7	12.8	16.0
			(27.2)	(18.9)	(15.9)	(39.3)	(27.2)	(20.4)
	Q4+Q5	915	-38.4**	-29.1*	-13.7	-54.8**	-18.1	3.9
			(19.1)	(15.6)	(14.8)	(26.5)	(19.9)	(16.1)
	Avg # months:		151.0	193.8	220.0	151.0	193.8	220.0
	Avg # firms in portfolio:		22.2	36.6	58.4	22.2	36.6	58.4

Panel B: Intercepts from Calendar Time Portfolios (4 Factors)

Payment	Adjusted Short Interest of Acquirers (t-1)	# acquirers	4-Factor alphas over...					
			Equal-Weighting			Value-Weighting		
			6 mth	12 mth	24 mth	6 mth	12 mth	24 mth
All	Q1	477	74.2** (37.1)	79.2*** (26.4)	58.8** (22.7)	17.6 (39.9)	-1.3 (32.2)	-8.3 (27.5)
	Q2	807	40.7* (22.8)	23.8 (18.1)	21.8 (14.6)	32.5 (21.8)	-12.8 (19.1)	-7.6 (15.6)
	Q3	1091	-0.9 (15.8)	24.5 (16.5)	28.5** (13.4)	-3.7 (24.7)	-1.6 (19.7)	-5.5 (17.4)
	Q4	1306	-35.2** (16.1)	-34.7*** (13.0)	-5.6 (11.1)	-44.0* (22.6)	-22.1 (16.9)	-11.9 (13.9)
	Q5	1462	-35.6* (18.6)	-1.8 (15.4)	20.0 (14.1)	-3.8 (23.0)	-8.4 (20.2)	-5.9 (17.0)
	Avg # months:		190.7	222.7	228.7	190.7	222.7	228.7
	Avg # firms in portfolio:		32.1	53.8	90.7	32.1	53.8	90.7
Stock	Q1+Q2	396	17.5 (44.0)	12.3 (30.6)	28.6 (23.8)	-21.9 (44.2)	-19.8 (33.3)	-20.1 (24.7)
	Q3	279	-21.0 (45.4)	-9.5 (32.1)	22.1 (25.2)	-52.4 (60.7)	-1.2 (40.8)	7.7 (28.9)
	Q4+Q5	873	-65.1** (28.8)	-18.6 (22.4)	10.7 (19.4)	-48.6 (29.7)	-24.9 (27.6)	-16.6 (21.2)
	Avg # months:		110.5	166.0	209.8	110.5	166.0	209.8
	Avg # firms in portfolio:		22.9	32.5	47.0	22.9	32.5	47.0
Cash	Q1+Q2	423	92.9*** (31.0)	57.0** (23.4)	55.7*** (19.9)	50.1 (33.5)	-6.8 (28.6)	19.4 (21.8)
	Q3	391	-26.2 (27.4)	34.3* (19.1)	28.0* (16.1)	-34.9 (40.4)	18.9 (27.8)	20.0 (21.0)
	Q4+Q5	915	-23.9 (19.0)	-11.2 (15.3)	14.4 (13.1)	-52.5* (27.2)	-13.6 (20.5)	10.5 (16.5)
	Avg # months:		151.0	193.8	220.0	151.0	193.8	220.0
	Avg # firms in portfolio:		22.2	36.6	58.4	22.2	36.6	58.4

Table 7. Descriptive Statistics for Public Acquirers versus Targets

This table presents the mean statistics for acquiring firms and their public targets. The sample period is from 1989 to 2007 and includes only acquirers of public targets. Standard deviations (Columns (1) and (2)) and standard errors (Column (3)) are presented within parentheses. For variable definitions, see Appendix A. The variables in each column are measured at month -1. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively, using *t*-tests.

	Stock Mergers		
	Acquirers	Targets	Difference
			(1)
Adjusted Short Interest (t-1)	0.007 (0.030)	-0.002 (0.027)	0.008 *** (0.002)
Abnormal Short Interest (t-1)	0.004 (0.028)	-0.002 (0.024)	0.006 *** (0.001)
Market-to-Book (t-1)	3.948 (3.979)	3.227 (4.125)	0.721 *** (0.214)
M/B (Firm) (t-1)	0.373 (0.538)	0.125 (0.588)	0.248 *** (0.030)
M/B (Sector) (t-1)	0.155 (0.214)	0.128 (0.218)	0.027 ** (0.011)
M/B (Long-run) (t-1)	0.528 (0.568)	0.540 (0.603)	-0.011 (0.031)
N	715		

	Cash Mergers		
	Acquirers	Targets	Difference
			(1)
Adjusted Short Interest (t-1)	-0.002 (0.026)	0.000 (0.036)	-0.002 (0.002)
Abnormal Short Interest (t-1)	-0.005 (0.023)	-0.003 (0.031)	-0.001 (0.002)
Market-to-Book (t-1)	3.292 (3.058)	2.640 (3.116)	0.652 *** (0.229)
M/B (Firm) (t-1)	0.212 (0.543)	-0.049 (0.594)	0.261 *** (0.042)
M/B (Sector) (t-1)	0.153 (0.162)	0.113 (0.204)	0.039 *** (0.014)
M/B (Long-run) (t-1)	0.575 (0.532)	0.595 (0.609)	-0.020 (0.042)
N	364		

Table 8. Does the Correlation of Short Interest and Merger Type Occur Because Short Sellers Anticipate Negative Announcement Returns?

This table presents OLS regression results (coefficients and standard errors reported) of short interest on future merger type. The sample covers acquisitions from 1989 to 2007. Variable definitions are in Appendix A. The variables in each column are measured in the month prior to the merger announcement. The regressions include industry fixed effects (Fama-French (1997) 48 industries) interacted with year fixed effects (not reported for parsimony). Standard errors are robust to industry clustering using the Fama-French (1997) 48 classification scheme. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively.

	Dependent variable: <u>Adjusted Short Interest (t-1)</u>	<u>Abnormal Short Interest (t-1)</u>
	(1)	(2)
Stock Merger	0.272*** (0.088)	0.313*** (0.091)
Mixed Merger	0.147 (0.110)	0.160 (0.121)
Announcement Return	0.800 (0.912)	0.304 (0.921)
Stock Merger × Announcement Return	-1.407 (1.318)	-0.548 (1.160)
Mixed Merger × Announcement Return	-1.093 (1.105)	-0.249 (1.031)
Public Target	-0.144 (0.119)	-0.144 (0.119)
Log of Market Cap	-0.196** (0.076)	-0.008 (0.063)
Institutional Ownership	3.136*** (0.235)	-0.055 (0.225)
M/B (Firm)	0.477*** (0.069)	0.362*** (0.069)
M/B (Sector)	-0.596** (0.263)	-0.658** (0.250)
M/B (Long-run)	0.019 (0.088)	0.023 (0.084)
Log of Price	0.274** (0.116)	0.081 (0.092)
Turnover	0.811*** (0.097)	0.740*** (0.090)
Past Returns (12 months)	-0.212*** (0.071)	-0.119* (0.070)
Industry × Year Fixed Effects	Yes	Yes
N	8,266	8,266
Adj R ²	0.343	0.235

Table 9. Short Interest and Future Stock Mergers, by Level of Idiosyncratic Risk

This table presents probit regression results (marginal effects and standard errors reported) predicting stock acquisitions. The sample includes the universe of firms with available data from 1989 to 2007. Variable definitions are in Appendix A. The variables in each column are measured in the month specified by the column heading (i.e., month -12, -6 or -1) relative to the month in which the dependent variable is measured. Quintiles of short interest are assigned on each calendar month. Standard errors are robust to industry clustering using the Fama-French (1997) 48 classification scheme. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Adjusted Short Interest

Adj SI measured at:	Dependent variable: Stock Acquirer (0/1)					
	High Idiosyncratic Risk			Low Idiosyncratic Risk		
	Month -12 (1)	Month -6 (2)	Month -1 (3)	Month -12 (4)	Month -6 (5)	Month -1 (6)
Adjusted Short Interest Q2	0.0005* (0.0003)	0.0006** (0.0003)	0.0006** (0.0002)	0.0005* (0.0003)	0.0005 (0.0003)	0.0004 (0.0004)
Adjusted Short Interest Q3	0.0007** (0.0003)	0.0009** (0.0004)	0.0004 (0.0003)	0.0005 (0.0004)	0.0008* (0.0004)	0.0005 (0.0004)
Adjusted Short Interest Q4	0.0013*** (0.0004)	0.0014*** (0.0004)	0.0009** (0.0004)	0.0008* (0.0004)	0.0009** (0.0004)	0.0009* (0.0006)
Adjusted Short Interest Q5	0.0016*** (0.0004)	0.0017*** (0.0004)	0.0014*** (0.0005)	0.0017*** (0.0007)	0.0017** (0.0007)	0.0016** (0.0007)
Past Acquisition	0.0021*** (0.0002)	0.0023*** (0.0002)	0.0025*** (0.0002)	0.0044*** (0.0012)	0.0046*** (0.0012)	0.0046*** (0.0011)
Log of Market Cap	-0.0001 (0.0001)	0.0000 (0.0001)	0.0001 (0.0001)	-0.0002 (0.0002)	-0.0002 (0.0002)	-0.0002 (0.0002)
Institutional Ownership	-0.0014*** (0.0005)	-0.0012*** (0.0005)	-0.0013*** (0.0005)	-0.0045*** (0.0015)	-0.0046*** (0.0015)	-0.0044*** (0.0014)
M/B (Firm)	0.0003 (0.0002)	0.0005** (0.0002)	0.0005*** (0.0002)	0.0013*** (0.0003)	0.0013*** (0.0003)	0.0014*** (0.0003)
M/B (Sector)	-0.0004 (0.0007)	0.0009 (0.0006)	0.0010 (0.0006)	0.0018** (0.0008)	0.0023*** (0.0007)	0.0029*** (0.0005)
M/B (Long-run)	0.0010*** (0.0003)	0.0010*** (0.0002)	0.0010*** (0.0002)	-0.0006 (0.0006)	-0.0005 (0.0006)	-0.0004 (0.0005)
Log of Price	0.0007*** (0.0002)	0.0006*** (0.0002)	0.0006*** (0.0002)	0.0010* (0.0005)	0.0010** (0.0005)	0.0014** (0.0006)
Turnover	0.0001* (0.0000)	0.0000 (0.0000)	0.0000 (0.0000)	-0.0002 (0.0004)	-0.0002 (0.0004)	-0.0003 (0.0004)
Past Returns (12 months)	0.0000 (0.0000)	0.0002*** (0.0000)	0.0003*** (0.0000)	0.0018*** (0.0005)	0.0017*** (0.0005)	0.0013*** (0.0003)
N	410,433	407,375	404,253	405,706	407,924	409,000
Pseudo R ²	0.024	0.031	0.0393	0.050	0.055	0.0618

**Table 9. Short Interest and Future Stock Mergers by Level of Idiosyncratic Risk
(Cont.)**

Panel B: Abnormal Short Interest

Abn SI measured at:	Dependent variable: Stock Acquirer (0/1)					
	High Idiosyncratic Risk			Low Idiosyncratic Risk		
	Month -12	Month -6	Month -1	Month -12	Month -6	Month -1
	(1)	(2)	(3)	(4)	(5)	(6)
Abnormal Short Interest Q2	0.0005*	-0.0001	-0.0003	-0.0001	-0.0003	-0.0004
	(0.0003)	(0.0003)	(0.0003)	(0.0002)	(0.0003)	(0.0003)
Abnormal Short Interest Q3	0.0003	-0.0001	0.0001	-0.0005	-0.0006	-0.0005
	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0005)	(0.0005)
Abnormal Short Interest Q4	0.0004*	0.0002	0.0006*	-0.0003	-0.0005	-0.0004
	(0.0002)	(0.0002)	(0.0003)	(0.0004)	(0.0004)	(0.0004)
Abnormal Short Interest Q5	0.0008***	0.0004*	0.0004	0.0005	0.0002	0.0002
	(0.0003)	(0.0002)	(0.0003)	(0.0003)	(0.0003)	(0.0002)
Past Acquisition	0.0021***	0.0023***	0.0025***	0.0044***	0.0046***	0.0046***
	(0.0002)	(0.0002)	(0.0002)	(0.0012)	(0.0012)	(0.0011)
Log of Market Cap	0.0000	0.0001	0.0001	-0.0002	-0.0001	-0.0001
	(0.0001)	(0.0001)	(0.0001)	(0.0002)	(0.0002)	(0.0002)
Institutional Ownership	-0.0011**	-0.0010**	-0.0011**	-0.0045***	-0.0046***	-0.0044***
	(0.0005)	(0.0005)	(0.0005)	(0.0015)	(0.0015)	(0.0015)
M/B (Firm)	0.0004	0.0005**	0.0005***	0.0013***	0.0014***	0.0014***
	(0.0002)	(0.0002)	(0.0002)	(0.0003)	(0.0003)	(0.0003)
M/B (Sector)	-0.0006	0.0008	0.0009	0.0017**	0.0022***	0.0028***
	(0.0007)	(0.0006)	(0.0006)	(0.0008)	(0.0007)	(0.0005)
M/B (Long-run)	0.0011***	0.0011***	0.0010***	-0.0006	-0.0005	-0.0005
	(0.0003)	(0.0002)	(0.0002)	(0.0007)	(0.0006)	(0.0005)
Log of Price	0.0008***	0.0007***	0.0007***	0.0010*	0.0010*	0.0014**
	(0.0002)	(0.0002)	(0.0002)	(0.0005)	(0.0005)	(0.0006)
Turnover	0.0001**	0.0001	0.0001	-0.0001	-0.0001	-0.0002
	(0.0000)	(0.0000)	(0.0000)	(0.0003)	(0.0003)	(0.0004)
Past Returns (12 months)	0.0000	0.0002***	0.0003***	0.0018***	0.0017***	0.0013***
	(0.0000)	(0.0000)	(0.0000)	(0.0005)	(0.0005)	(0.0003)
N	410,433	407,375	404,253	405,706	407,924	409,000
Pseudo R ²	0.023	0.030	0.039	0.049	0.054	0.061

Figure 1. Adjusted and Abnormal Short Interest around Acquisitions

These figures plot mean adjusted short interest or abnormal short interest for acquirers over a seventy-three month window centered on the merger announcement. The sample includes firms that engaged in an acquisition from 1989 to 2007.

Figure 1a: Adjusted Short Interest around Acquisitions

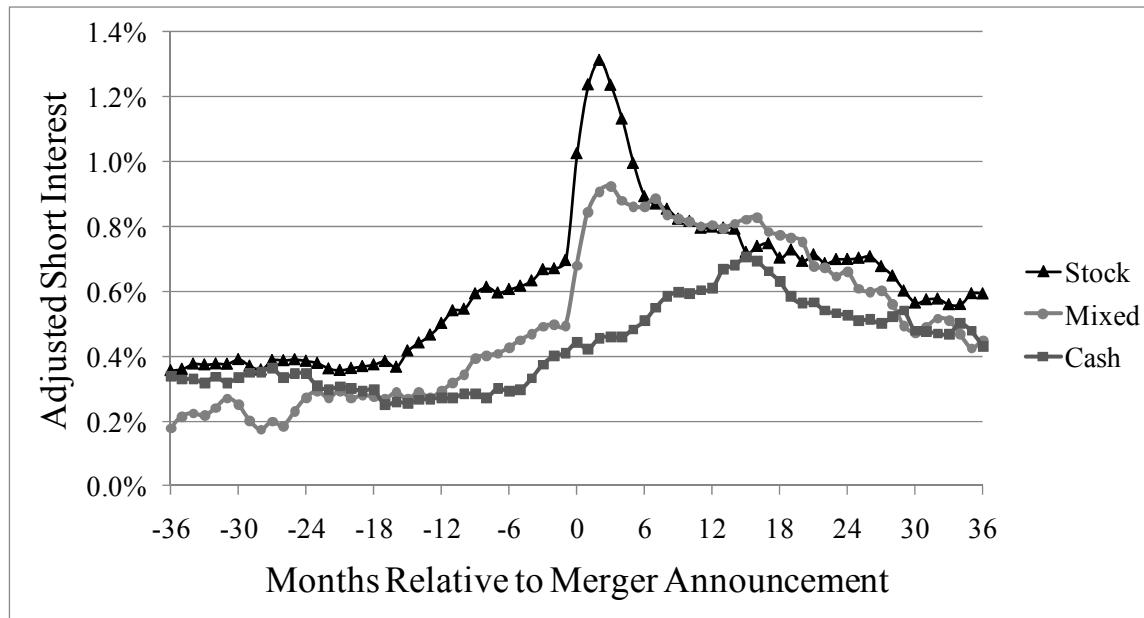


Figure 1b: Abnormal Short Interest around Acquisitions

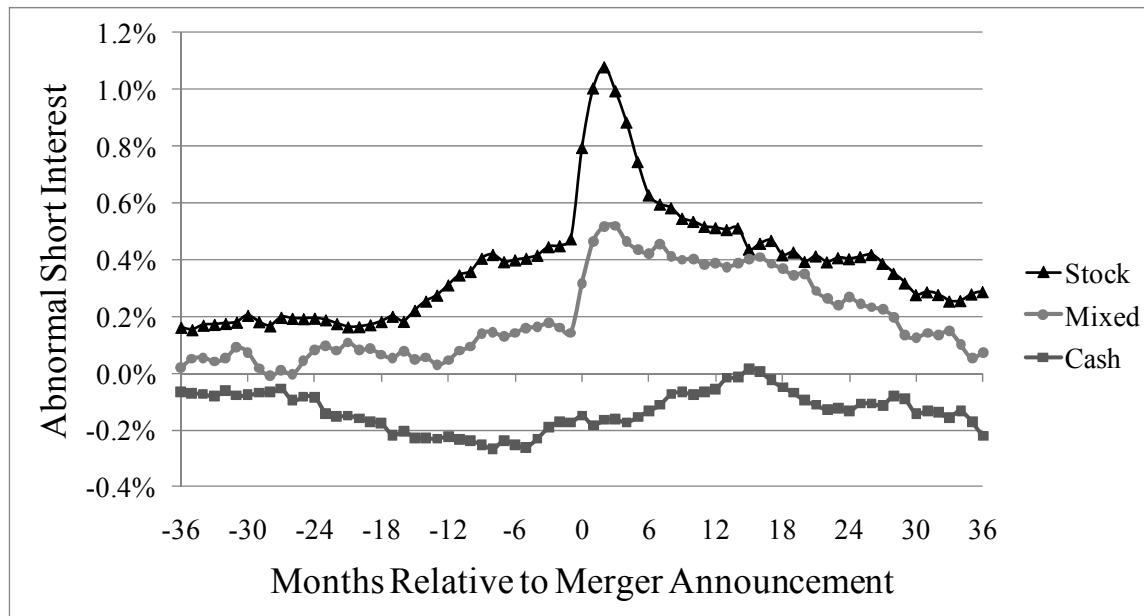


Figure 2. Adjusted and Abnormal Short Interest When the Target is Public

These figures plot mean adjusted short interest or abnormal short interest for acquirers of public targets over a seventy-three month window centered on the merger announcement. The sample includes firms that engaged in the acquisition of a public target from 1989 to 2007.

Figure 2a: Adjusted Short Interest around Acquisitions of Public Targets

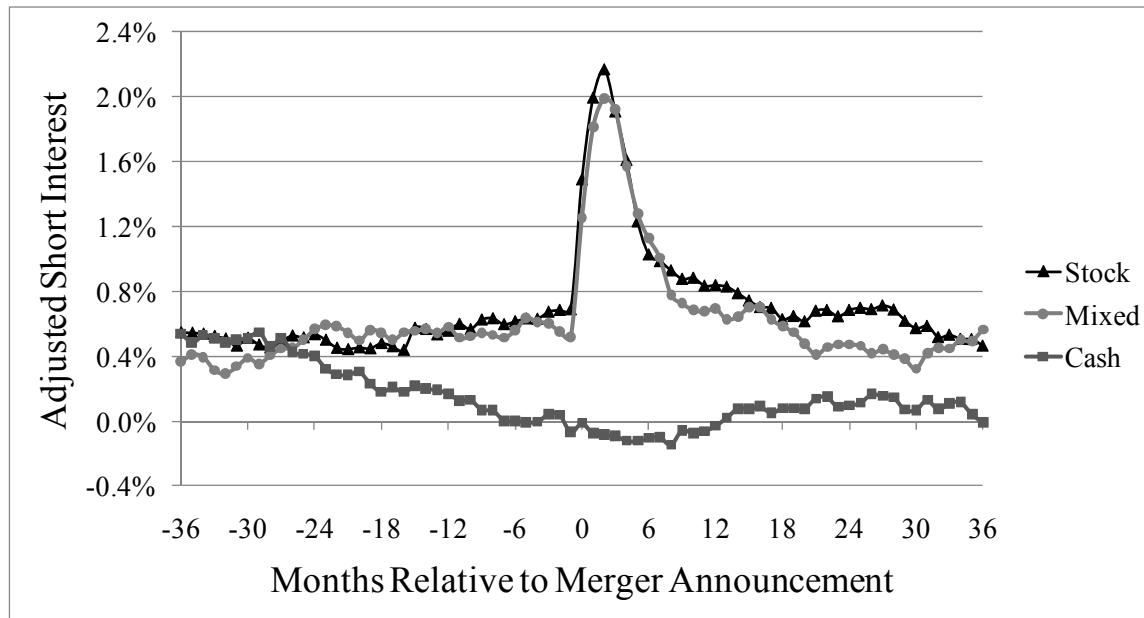


Figure 2b: Abnormal Short Interest around Acquisitions of Public Targets

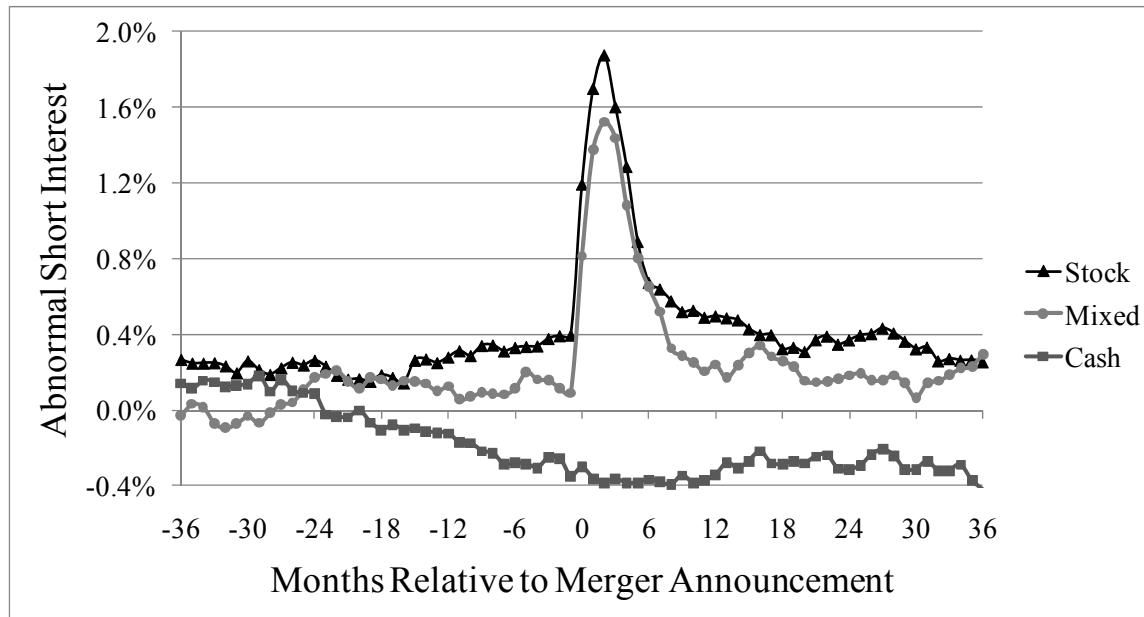


Figure 3. Adjusted and Abnormal Short Interest When the Target is Private

These figures plot mean adjusted short interest or abnormal short interest for acquirers of private targets over a seventy-three month window centered on the merger announcement. The sample includes firms that engaged in the acquisition of a private target from 1989 to 2007.

Figure 3a: Adjusted Short Interest around Acquisitions of Private Targets

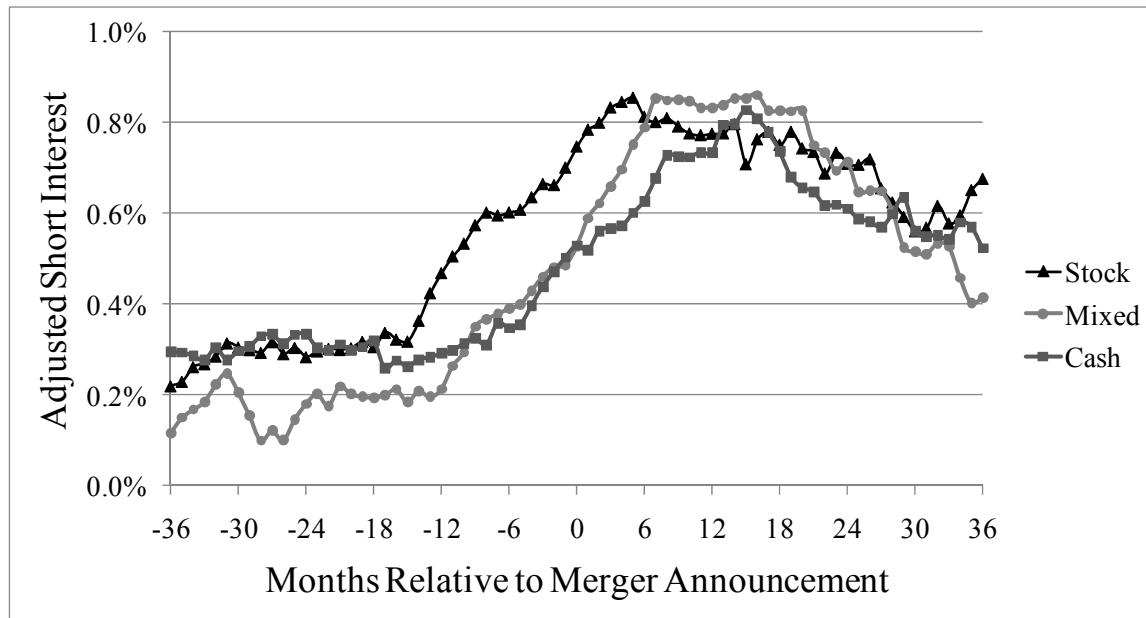


Figure 3b: Abnormal Short Interest around Acquisitions of Private Targets

