

Acquirer Valuation and Acquisition Decisions: Identifying Mispricing Using Short Interest

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We use short interest as a new investor-based measure of over/undervaluation that sharply distinguishes misvaluation- vs. Q-theories of mergers. Using this measure, we find that misvaluation is a strong determinant of merger-decision making. Firms in the top quintile of short interest are 54% more likely to engage in stock mergers and 22% less likely to engage in cash acquisitions. Post-merger return is strongly correlated with pre-merger short interest. Stock (but not cash) acquirers have higher short interest than their targets. We conclude that overvalued firms self-select to become stock acquirers, while undervalued firms engage in cash acquisitions.

1. Introduction

There is an ongoing debate about the driving forces behind merger initiation. While some studies suggest that firms' misvaluation leads to the decision to acquire another firm (misvaluation theory) others argue that fundamental motives drive firms to engage in mergers (the Q theory of mergers). In this study, we propose a novel empirical approach to identifying acquirer over- and undervaluation, which allows us to distinguish between these two potential motives for mergers. Specifically, we rely on the idea that short interest reflects revealed beliefs of sophisticated investors about the degree of over- and undervaluation of stocks. Our findings add new evidence to the currently unsettled debate.

A key issue in the debate is that it is empirically difficult to distinguish between the theories because they both predict that firms with high market value, relative to fundamentals, are more likely to engage in acquisitions and especially in stock acquisitions.¹ Studies supporting the misvaluation theory argue that firms engage in acquisitions because they are overvalued and engage in stock acquisitions in order to exchange their overvalued equity with real assets (see theory by Shleifer and Vishny 2003 and Rhodes-Kropf and Viswanathan 2004²). The empirical evidence for this theory is based on comparing the market-to-book ratio of acquirers, stratified by the method of payment (cash or stock). While stock acquirers generally have high market-to-book ratios, cash acquirers tend to have a low ratios (Dong, Hirshleifer, Richardson, and Teoh 2006, among others).³ Rhodes-Kropf, Robinson, and Viswanathan (2005) use a filtering algorithm based on regressions of historical corporate information to break the market-to-book ratio into components capturing misvaluation and firm fundamentals and find that the mispricing element is correlated with the decision to pay with stock. The mispricing theory suggests that targets in stock acquisitions can be also overvalued, as long they are less overvalued than the overvalued stock acquirer (see evidence in Rhodes-Kropf, Robinson, and Viswanathan 2005, Dong, Hirshleifer, Richardson, and Teoh 2006, and Rhodes-Kropf and Robinson 2008). As further evidence for mispricing, Mitchell and Stafford (2000) find that stock acquirers underperform following merger announcements.

¹ Dong, Hirshleifer, Richardson, and Teoh (2006, p. 757) point to the problem in identifying overvaluation motives from growth-based motives: "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."

² While the theory by Shleifer and Vishny (2003) explicitly models a market inefficiency, Rhodes-Kropf and Viswanathan (2004) focus on misvaluation due to private information.

³ For example, Dong, Hirshleifer, Richardson, and Teoh (2006) use price-to-book and price-to-value measures to explain merger motives. Other studies with similar valuation measures include Ang and Cheng (2006), Friedman (2006), Sinha (2004), and Bi and Gregory (2011). 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.

Other studies claim that the neoclassical Q theory can explain the same empirical regularities without deviating from market efficiency (see theory by Jovanovic and Rousseau 2002). Servaes (1991), Rousseau (2009), and Levine (2011) argue that acquirers have above-average market-to-book ratios because the growth opportunities of these firms are maximized by expanding through mergers. Rousseau (2009) and Levine (2011) present evidence that targets have above-average market-to-book ratios and above-average investment rates. Chang (2011) reports that the poor post-merger performance of stock acquirers can be explained by their higher investment rates. Finally, Di Giuli (2011) finds that post-merger investment rates are higher for acquirers that use stock as a method of payment, suggesting that their growth opportunities are correlated with their decision to use stock as a method of payment.

We introduce short interest into the debate because it has three distinct qualities which are important for tests of mispricing in the corporate context. First, short interest can be viewed as “polling” investors about misvaluation; thus, our measure is less likely to be confounded with growth opportunities because it does not rely on the ratio of a firm’s market price to firm fundamentals (as does the market-to-book measure). Second, our measure can easily be computed out of sample, and therefore it is not history and sample dependent (as are the measures in Rhodes-Kropf, Robinson, and Viswanathan 2005). Third, our misvaluation measure is based on the cross-section of stocks rather on the time-series. Therefore, it is less likely to be influenced by a changing economic environment.⁴

The methodology we propose assumes that short sellers are sophisticated investors who are able to identify over/undervalued firms. In our empirical tests, our main variable of interest is pre-merger announcement adjusted short interest (shares sold short scaled by shares outstanding, adjusted for the overall contemporaneous level of short interest). We assume that if short sellers suspect that a firm is sufficiently overvalued and will experience negative returns, they are likely to short it.⁵ In contrast, if a firm is perceived as undervalued, meaning that its expected returns are abnormally high, investors will avoid short selling it. The prior literature provides support for these conjectures. For example, Dechow, Hutton, Meulbroek, and Sloan (2001) and Hirshleifer, Teoh, and Yu (2011) report that short sellers target firms whose fundamentals imply overvaluation (e.g.,

⁴ To illustrate this point, consider the misvaluation measure of Rhodes-Kropf, Robinson, and Viswanathan (2005), which is based on regression estimates of the relation between market values, book values, and income across a long history, imposing the same coefficients across all periods. The misvaluation proxies are residuals from these regressions and potentially capture time-series variation due to misspecification of the regression model.

⁵ 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, Hanson and Sunderam 2012). A hedge fund would short stocks that appear to be overvalued, and hold long positions in stocks that appear to be undervalued.

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, while Boehmer, Huszar, and Jordan (2010) find that stocks with *low* short interest exhibit *positive* abnormal returns. Drake, Rees, and Swanson (2011) find that short interest is informative about future returns beyond the information in analyst stock recommendations. Asquith, Pathak, and Ritter (2005) show that the underperformance of highly shorted stocks is negligible when portfolio returns are value-weighted suggesting that the performance implications of short interest are strongest for small firms.

Previous work also employs short interest to identify the opinions of investors about over/undervaluation. Karpoff and Lou (2010) use short interest to examine whether short sellers detect firms that are subsequently targeted by the SEC for misrepresenting their financial statements. Henry and Koski (2010) document short interest patterns around seasoned equity offerings (SEOs). Autore, Gehy, and Jiang (2012) find that short interest predicts SEOs and argue that managers use them as an overvaluation signal. Desai, Krishnamurthy, and Venkataraman (2006) and Efendi, Kinney, and Swanson (2006) explore short selling activity around accounting restatements. Hanson and Sunderam (2012) use short interest as a proxy for arbitrage activity and document its growth over time as well as changes in the use of momentum and value arbitrage strategies.

Our main result is that short interest predicts future merger choices up to six months in advance, as well as long-run performance following the merger announcement. When we examine the short interest of acquirers-to-be, we find a strong correlation between pre-announcement short interest and the method of payment (see Figure 1a). We show that stock acquirers have significantly higher pre-announcement short interest, up to six months prior to the merger, than do cash acquirers (short interest in mixed acquirers falls between that of stock and cash acquirers). We also report that post-merger performance can be predicted using pre-merger short interest, supporting the view that post-merger performance is a result of overvaluation around the merger announcement.

The relation between short interest and merger choices is also predictive for the entire universe of firms. 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 six months. To illustrate the magnitude of the effect, after controlling for previously-identified determinants of acquisitions, firms in the top quintile of the short interest distribution are 54% more likely to announce a stock merger in the following month, and 22% less likely to engage in a cash merger in the following month, relative to firms in the bottom quintile of the short interest distribution. Importantly, our short interest variable remains statistically and economically significant after controlling for

market-to-book-based proxies of over/undervaluation (e.g., the market-to-book decomposition in Rhodes-Kropf, Robinson, and Viswanathan 2005). In other words, our results linking short interest with acquisition choices are not simply picking up previously documented relations between 1) short interest and fundamental-based valuations measures and 2) fundamental-based valuation measures and acquisitions.

After establishing a link between short interest and merger activity, we analyze the relation between pre-announcement short interest and subsequent abnormal returns for the acquirer. We find that pre-announcement short interest is not meaningfully correlated with merger announcement returns. However, long-term abnormal returns exhibit a strong correlation with short interest. During the first six months following a merger announcement, stock acquirers in the two highest quintiles of short interest exhibit cumulative three-factor abnormal returns of -4.0% (-67 monthly basis points). During the same horizon, cash acquirers from the two bottom quintiles of short interest exhibit abnormal returns of +5.3% (+89 monthly basis points). These returns weaken for a four-factor model and lose economic magnitude and statistical power when portfolio returns are value-weighted.⁶

Further evidence for a valuation motive for mergers comes from the relative short interest of acquirers and their targets. Shleifer and Vishny (2003) propose that acquirers are more overvalued than their targets. This prediction is at the heart of the overvaluation theory, as it demonstrates the economic mechanism behind stock acquisitions: overvalued firms engage in stock acquisitions in order to exchange overvalued equity for less overvalued assets. 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 it is for their targets. In contrast, short interest does not significantly differ between cash acquirers and their targets. This finding stands in contrast to results with market-to-book ratios, where cash acquirers appear more overvalued than their targets. The difference in these findings suggests that previously used measures of overvaluation may be confounded with growth opportunities as cash acquirers, which do not experience negative, long-run abnormal returns, are unlikely to be overvalued.

⁶ 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. This evidence is consistent with Asquith, Pathak, and Ritter (2005) who find that the relation between short interest and returns is sensitive to value-weighting. That is, short interest appears to be a better proxy for overvaluation for smaller stocks. One explanation is that institutions, which tend to hold large stocks, are a lending source for short sellers. This leads to short-selling costs being lower for large stocks reducing mispricing of these stocks. Further, short selling is also associated with index arbitrage which focuses on large stocks. As such, short selling as a signal of overvaluation will be stronger for small stocks. We thank the referee for highlighting these explanations.

Overall, these facts are consistent with the idea that short interest provides new insights into valuation relative to previously used measures.

We investigate alternative explanations for the link between short interest and merger choice. These explanations propose that short selling acquirers-to-be takes place 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 fairly-valued firms whose characteristics make them likely to become future acquirers, (4) short interest is correlated with merger waves, (5) firms react to high short interest by engaging in an acquisition, and (6) short interest and the choice of the method of payment are both driven by uncertainty about the acquirer’s fundamentals. We analyze these alternative explanations and find little support.

Our proxy for over/undervaluation and the results it produces make several contributions to the literature. First, our proxy is an observable state variable and can be used in real-time. This is important because one of the common alternative proxies of over/undervaluation, the market-to-book breakdown by Rhodes-Kropf, Robinson, and Viswanathan (2005), requires using a long time-series (which includes future observations) and calculates over/undervaluation ex post. Second, our measure produces an important result supporting overvaluation explanations for mergers that neither market-to-book nor its components are able to generate. Specifically, as just discussed, we find that stock acquirers have higher short interest than their targets, and that this relation does not hold for cash acquirers and their targets. We speculate that previously-used proxies of over/undervaluation are not producing this result because of imprecision in those proxies. Third, our proxy sheds light not only on the overvaluation theories of Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004), but also on Q-theory (Servaes 1991, Jovanovic and Rousseau 2002). Specifically, we find that firms in the lowest quintiles of short interest engaging in cash acquisitions experience strong positive post-announcement abnormal returns (+5.3% within six months). We view this evidence as consistent with Q-theory: undervalued firms expand through acquisitions due to their high growth potential. Fourth, we show that short interest predicts acquisition choices after controlling for fundamental-based measures of valuation such as the market-to-book ratio (and its components as in Rhodes-Kropf, Robinson, and Viswanathan 2005). Thus, short interest’s predictive power is not coming from its previously-known relation with valuation measures which are also correlated with acquisition choices. Fifth, we show that short interest is not only associated with acquisition choices but is associated with post-merger performance. Finally, our paper contributes to studies of an economically significant portion of the

economy: the combined value of mergers in our sample is almost \$4 trillion. If short interest can be used to help predict which mergers will increase, rather than decrease, firm value, it can have a significant effect on investors.

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 2007.⁷ 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 completion of the transaction the acquirer must 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 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 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.^{8,9}

⁷ 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 and thus, we use mergers only through the end of 2007.

⁸ 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.

⁹ We discuss possible effects of merger waves on short interest in section 4.4.

We use several 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. Analyst forecasts are from the I/B/E/S database. 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.

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).¹⁰ We compute these variables to test whether the information contained in our short interest variable is incremental to what can be achieved using the market-to-book breakdown variables. 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 5.¹¹ 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.¹² See Appendix A for variable definitions and Appendix B for a more detailed description of the market-to-book ratio components and their construction.

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

¹⁰ This requirement reduces the sample by 30 acquisitions.

¹¹ All inferences in the paper are robust to using the raw market-to-book ratio in place of its components.

¹² 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).

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).

One concern with the short interest data is that it exhibits a secular trend over time (see Table 1, Panel B). To account for this issue, we construct a measure of *Adjusted Short Interest*, which is the difference between a firm's short interest ratio and the average short interest ratio across all firms. In addition, in our regressions we account for variation in short selling constraints that vary across firms by directly controlling for the main explanatory variables of the supply of shortable stocks: market capitalization, share price, past returns, and institutional ownership (see Dechow, Hutton, Meulbroek, and Sloan 2001, D'Avolio 2002, Asquith, Pathak, and Ritter 2005, Nagel 2005, and Diether and Werner 2009). Finally, given that prior research finds that short selling increases around ex dividend days (Christoffersen, Geczy, Musto, and Reed 2005, Thornock 2012) and that dividend policy may be associated with acquisition decisions, we also control for ex dividend dates in the regressions.

2.3. Summary Statistics

Table 2, Panel A presents the distributions of variables measured one month prior to the merger announcement (month $t - 1$) 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 (means in the first row, medians in the second, and standard deviations in the third) for acquiring firms by transaction payment; 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 adjusted short interest at month $t - 1$. We find that for both public and private targets, adjusted short interest in the acquirers' stock is greatest for stock acquisitions, 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 by the method of payment. In Figure 1a, we plot mean adjusted short interest separately for stock, cash, or mixed payment from month $t - 36$ to month $t + 36$ relative to the merger announcement month.

We focus on the pre-announcement period, months $t - 36$ to $t - 1$, as we are interested in whether acquirers display over/undervaluation patterns *before* the merger is announced. As a precursory comment, we note that the spike in short interest following the announcement is related to merger arbitrage and is discussed in Section 4.1.¹³ In the figure, we find that stock acquirers have positive adjusted short interest throughout the pre-merger horizon. Until month $t - 15$, the magnitude is relatively stable (around 0.40%); from month $t - 15$ until the announcement month, short interest increases steadily. In month $t - 1$, adjusted short interest of stock acquirers is approximately 0.70%. For cash acquirers, we find that adjusted short interest is also positive, but generally lower in magnitude than the adjusted short interest of mixed and stock acquirers. For cash

¹³ 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 Savaşoglu 2002).

acquirers, we also observe no marked increase in adjusted short interest at the merger announcement.¹⁴

3.2. Predicting M&A Activity and Payment Type

In this section, we investigate whether valuation considerations (proxied by the degree of current short interest) determine future acquisition choices. 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 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 as well as variation in constraints on short selling. We recognize that the effects of short selling activity may not be monotonic. Therefore we rank the short interest variables into quintiles and create a set of indicator 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 3, Panel A, we present the estimation results (marginal effects and standard errors reported) for probit regressions predicting stock acquisitions using adjusted short interest. We estimate the models separately using explanatory variables measured at months $t - 6$ (Columns (1) to (5)) and $t - 1$ (Columns (6) to (10)) relative to the merger announcement month. As in all our tests, standard errors are clustered at the industry level.¹⁵ As predicted by 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 difference between the first quintile (the omitted category) and the fifth quintile is statistically significant at the 1% level.¹⁶

¹⁴ In an untabulated test, we verify that the short interest levels are statistically distinct for months -12 to -1, per method of payment. The results are available upon request.

¹⁵ The results have generally stronger statistical significance with clustering at the industry * year level.

¹⁶ We observe that there is overlap in the information captured by the short interest variables and the Rhodes-Kropf, Robinson, and Viswanathan (2005) variables. When comparing Column (4), which includes the RKR variables but not the short interest quintile indicators, to Column (5), which includes the short interest quintile indicators, we observe that the magnitude of the coefficients on the RKR variables decline by 10% to 14%. When the short interest quintile indicators are added, the pseudo- R^2 increases by 0.002, a relatively substantial increase given that the base level of pseudo- R^2 is around 0.03. The significance on both the short interest indicators and the RKR variables when included together provides evidence that these variables are incrementally important to acquisition decisions and suggests that these variables capture unique aspects of misvaluation.

The economic magnitude of the relation between short selling and the likelihood of engaging in a stock merger is large.¹⁷ At month $t - 1$ for example, the probit marginal effect of *Adjusted Short Interest Q5* estimates that the probability of a future stock merger for firms in the highest quintile of adjusted short interest is 54% higher than for a firm in the lowest quintile of adjusted short interest.¹⁸ 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. With regard to previously used measures of valuation, the market-to-book ratio and its two misvaluation components are all positively associated with stock acquisitions.

In Panel B, we present results from predicting cash acquisitions. The results show a monotonic decrease in the likelihood of cash acquisitions as short interest increases. To illustrate the magnitude, at month $t - 1$, the probit marginal effect of *Adjusted Short Interest Q5* estimates that the probability of a future cash merger for firms in the highest quintile of adjusted short interest is 22% lower than for firms in the lowest quintile of adjusted short interest.¹⁹ Past acquisitions, institutional ownership, and price are positively associated with making cash acquisitions. In addition, the market-to-book ratio is negatively associated with cash acquisitions while its long-run component is positively associated with cash acquisitions.

Overall, our results suggest that overvaluation (as proxied by short interest and the market-to-book ratio) is positively (negatively) associated with stock acquisitions (cash acquisitions). Note that for both Panels A and B the coefficients on adjusted short interest are not subsumed or materially weakened by the inclusion of either the market-to-book ratio or its decomposition as in Rhodes-Kropf, Robinson, and Viswanathan (2005). This suggests that the short interest variable contains information that is not impounded in previously used measures of valuation.

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 valuation of acquirers, we examine the relation between pre-announcement short interest and acquirer returns around the announcement or in the period

¹⁷ 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.

¹⁸ The marginal effect of Q5 is 0.21% (Column (10)) beyond the probability for a stock merger in the lowest quintile, while the unconditional probability of engaging in a stock merger is 0.39% (Table 2, Panel B).

¹⁹ The marginal effect of Q5 is -0.09% (Column (10)), while the unconditional probability of engaging in a cash merger is 0.41% (Table 2, Panel B).

following the announcement. If short selling activity is related to over- or undervaluation, it should be associated with future negative or positive returns, respectively.

First, we examine whether merger announcement returns are lower for acquirers that have high short interest. In Table 4 we regress market-adjusted merger announcement returns on short interest variables and the following control variables: log of market capitalization, institutional ownership, the components of market-to-book, log of price, turnover, 12-month past returns, stock and mixed payment indicators, transaction 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 in Columns (1) and (2) show that there is no monotonic or meaningful relation between pre-merger adjusted short interest and merger announcement returns. We note that small firms have higher announcement returns as documented by Moeller, Schlingemann, and Stulz (2004) and that announcement returns are lower for stock acquirers in general.

Second, we explore the relation between pre-announcement short interest (measured at month $t - 1$) and acquirer long-term returns using a monthly calendar-time portfolio approach. First, we replicate results from previous studies (Mitchell and Stafford (2000) and Ben-David and Roulstone (2010)) to show that in our sample stock acquirers significantly underperform their pricing benchmarks (3- or 4-factor models) following the merger announcement, and that the performance of cash acquirers is essentially zero. These results are presented in Appendix C.

Next, 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.²⁰

²⁰ For further details on this methodology, see Mitchell and Stafford (2000) and Andrade, Mitchell, and Stafford (2001).

Table 5 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.²¹

The results polarize once we split the sample by payment type. 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% ($-66.5\text{bp} \times 6$) 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% ($-38.4\text{bp} \times 6$) over the six-month horizon. We also note that low short interest cash acquirers outperform by about 5.3% ($89.1\text{bp} \times 6$) in the first six months. This outperformance is consistent with overvaluation theories which suggest that undervalued acquirers prefer cash as the 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% ($-65.1\text{bp} \times 6$). 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. As discussed in footnote 6, index arbitrage and the preference of institutions to hold large stocks (which lowers short-selling costs for large firms relative to small firms) both suggest that short selling should identify misvaluation more clearly among small stocks, consistent with our equal-weighted versus value-weighted results.

Overall, these results suggest that stock acquirers with high short interest (especially small acquirers) underperform after the merger announcement, and that cash acquirers with low short interest outperform following the announcement.²² This evidence is consistent with the idea that

²¹ We combined Q1+Q2 and Q4+Q5 due to the small number of observations.

²² Prior research provides evidence that firms with high short interest underperform in the future (see, Asquith and Meulbroek, 1995 and Asquith, Pathak, and Ritter, 2005). As an additional test, we estimate the 3- and 4-factor models for the universe of firms and find that the alphas to short interest portfolios for acquiring firms are not significantly different than the alphas to short interest portfolios for the universe of firms. We emphasize that we have no reason to expect the performance of overvalued acquirers included in our sample to be different from the performance of overvalued non-acquirers in the universe of firms. This evidence supports our hypothesis that firms self-select based on their degree of overvaluation to engage in stock or cash mergers.

some stock (cash) acquirers are overvalued (undervalued) and that short interest is capable of identifying such misvaluations.

3.4. Short Interest of Acquirers versus Targets

Theories of market-driven acquisitions postulate 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. In contrast, Q-theory suggests that acquirers should have higher valuation than their targets because their growth opportunities are higher.

We examine these hypotheses in Table 6, where we restrict the sample to mergers in which the targets are public firms (short interest is observable only for these targets).²³ Panels A and B report means for adjusted short interest along with the market-to-book ratio, and the Rhodes-Kropf, Robinson, and Viswanathan (2005) market-to-book components. Panel A shows the statistics for stock acquisitions and Panel B presents the statistics for cash acquisitions. In both panels, Column (1) presents statistics for acquirers, Column (2) statistics for targets, and Column (3) shows the difference (the standard error of the difference is in parentheses).

As theory predicts, the panel shows that adjusted short interest is significantly higher for acquirers than 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 insignificantly higher for targets than acquirers.

For cash mergers, however, short interest is not statistically different for acquirers and targets, consistent with the idea that cash acquirers are not overvalued. However, the market-to-book ratio is higher for cash acquirers than for their targets supporting Q-theory's prediction that cash acquirers have higher growth opportunities than their targets.

Panel B also presents evidence supporting our conjecture that short interest is a cleaner proxy for over/undervaluation. Specifically, Panel B shows that the firm- and industry-level components of the market-to-book ratio indicate cash acquirers are more "overvalued" than their targets; yet the long-term component is not statistically distinct between cash acquirers and their

²³ Our sample size is smaller than that of Rhodes-Kropf, Robinson, and Viswanathan (2005) because of the data restrictions we impose on our sample. 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 is imposed in Rhodes-Kropf, Robinson, and Viswanathan (2005).

targets. We suspect that these unexpected results are a symptom of the firm- and industry-level market-to-book components being potentially contaminated with firm growth opportunities.²⁴

There is one additional implication of Q-theory that can be tested in this panel. Q-theory predicts that firms become acquirers because of their high growth opportunities and that firms become targets because of their 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.²⁵ Thus, this piece of evidence supports the idea that stock acquirers are motivated by overvaluation while cash acquirers are motivated by fundamental growth opportunities.

4. Alternative Explanations

Our tests have shown that short interest is predictive 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 merger choices. 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.

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 1a shows strong evidence for merger arbitrage with adjusted 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. Boone and Mulherin (2007) show that in the pre-merger period investment banks court various targets, hence, short sellers may know that a merger is on its way. Cai, Song, and Walking (2011) find that information about future mergers tend to leak to the market. 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.

²⁴ In their analysis, Rhodes-Kropf, Robinson, and Viswanathan (2005) also find that both stock and cash acquirers are overvalued relative to their targets.

²⁵ 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).

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 1b, which examines short interest around acquisitions of public targets, confirms the rise in short interest for stock and mixed acquirers. However, Figure 1c, which examines the short interest of acquirers of private targets, fails to show the expected drop in short interest for these acquirers. In fact, the short interest of acquirers of private targets increases following the merger announcement.²⁶ 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.^{27,28}

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.

Given that maintaining short positions is costly, the only reason for short selling *ahead* of merger announcements is that the announcement returns are expected to be negative and there is no way to capture these returns after the announcement.²⁹ If, however, information about the quality of a merger disseminates slowly, short sellers would be 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 return to Table 4, Column (3), which explores the determinants of announcement returns for stock acquisitions. 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

²⁶ The results in Figures 1b and 1c 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.

²⁷ We use a multivariate regression framework to verify that the levels of adjusted short interest in Figures 1b and 1c are statistically distinct. With this specification, adjusted short interest spikes after the announcement for stock and mixed acquirers of public targets; for stock acquirers of private targets, adjusted short interest is abnormally high prior to the announcement and remains steady afterwards (results untabulated).

²⁸ Consistent with this finding, Blau, Fuller, and Wade (2010) find no evidence for abnormal short selling activity in the days prior to merger announcements.

²⁹ 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.

the value destruction at the merger announcement,³⁰ then announcement returns should be negatively correlated with short interest for stock acquisitions. Column (3) shows the opposite: announcement returns for stock acquisitions with high short interest are weakly higher than announcement returns for stock acquisitions with low short interest. We conclude that there is no 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. Hedging Explanation for Short Selling

A third alternative explanation is that short interest reflects hedging activity rather than a consensus that a firm is overvalued. For example, investors engage in “pairs trading” by going long in undervalued firms and hedging themselves by shorting fairly-valued firms (Dechow, Hutton, Meulbroek, and Sloan 2001). Another example is hedging by call options writers. If the firms chosen for the short side of the strategy have characteristics associated with stock acquirers (e.g., growth firms), 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.³¹ 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.

We offer two solutions. First, we follow Hirshleifer, Teoh, and Yu (2011) and control directly for market-to-book as well as for past returns in our regressions.

Second, we conduct a robustness test. For hedging trades 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 3 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

³⁰ E.g., Barger, Schlingemann, Stulz, and Zutter (2008) find that merger announcement returns of public targets are lower when the acquiring firm is private rather than public. This result suggests that public acquirers could overpay. Also, Moeller, Schlingemann, and Stulz (2004) find that announcement returns are lower for acquirers which acquire public, rather than private, firms.

³¹ Hanson and Sunderam (2012) use the level of short interest as a proxy for the amount of arbitrage activity aimed at exploiting momentum and value strategies.

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 7, Panels A (stock acquisitions) and B (cash acquisitions). 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. Similarly, we find that the relation between the likelihood to engage in cash acquisitions and the adjusted short interest is not moderated by the level of idiosyncratic risk. Thus, our results show that it is unlikely that short sellers are taking material short positions in acquirers-to-be as part of a pairs trading strategy.³²

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 alternative explanation for our results is that short selling activity is 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 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 over/undervaluation. Rhodes-Kropf, Robinson, and Viswanathan (2005) find that acquisitions cluster in industries with high time-series sector error in market-to-book. Similarly, Table 3 shows that stock (and, to a lesser

³² 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 arbitrated away.

extent, cash) acquisitions are positively correlated with sector error. However, in untabulated correlation and regression analyses, we find that short interest in our sample is negatively correlated with 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, in an untabulated analysis we find 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.

4.5. Firms React to Short Interest

Another possibility is that firms react to the negative signal in high short interest by acquiring another firm (as in the theory of Edmans, Goldstein, and Jiang (2011)). Such behavior would be consistent with the “eat or be eaten” theory of mergers (Gorton, Kahl, and Rosen, 2009) in which mid-size firms are encouraged to engage in acquisitions in order not to become targets themselves. High short interest may be an indicator to managers that the market views them as vulnerable to takeovers and that they should take action by acquiring another firm.

In the context of our study, the hypothesis derived from this model is that short interest should be a stronger predictor of acquisitions for mid-size firms. To test this prediction we follow Gorton, Kahl, and Rosen (2009) and construct an indicator for firms which are more likely to be sensitive to this consideration (firms in size percentile 5 to 30 within their industry). Our tests (unreported) show that the propensity to engage in either a stock or cash merger is not significantly higher for mid-size firms with high short interest. Hence, our results are inconsistent the idea that short interest induces firms to initiate acquisitions as a response to pressure from the market.

4.6. Uncertainty about Fundamentals

Finally, uncertainty about the acquirer’s fundamentals could be responsible for both high short interest and the choice of method of payment, leading to correlation between the two variables, but not causation. Specifically, high uncertainty (i.e., high degree of disagreement) about the acquirer’s fundamentals could lead short-sellers to short the acquirer’s stock. In addition, high

uncertainty (measured as dispersion of analyst estimates of earnings or idiosyncratic risk) has been shown to be associated with equity offerings (Moeller, Schlingemann, and Stulz 2007).

To test whether uncertainty about fundamentals creates spurious correlation between high short interest and the choice of method of payment, we perform two tests. First, we use the standard deviation of analysts' one-year-ahead earnings per share estimates (obtained from I/B/E/S) as a proxy for uncertainty. We add it as a control to the main tables (Table 3, Panels A and B). In untabulated results we find no material change in the economic or statistical significance of the short interest variable. Similarly, when we interact short interest quintile indicators with analyst dispersion, the main effect of short interest quintile indicators remains as strong as before.

Second, we refer again to the tests in Table 7. In this table we split the sample by acquirers' idiosyncratic risk and rerun the main specification of method of payment choice. We do not find material differences between these sub-samples in the correlation of payment choice with short interest.

We conclude from these tests that uncertainty about fundamentals is not a major driver of the correlation between the choice of the method of payment and short interest.

5. Conclusion

In this paper, we use short interest to identify over/undervaluation and the effects of valuation on acquisition decisions. Instead of depending on measures of relative valuation such as the market-to-book ratio, we rely on the notion that short sellers, who are sophisticated market players, allocate more capital to stocks they believe are overvalued. Unlike other proxies for valuation, our measure is unlikely to be correlated with firm growth opportunities and thus, is able to distinguish overvaluation theories of acquisitions from Q-theory.

Our empirical evidence is consistent with the idea that overvalued firms become stock acquirers (consistent with the overvaluation theory of Shleifer and Vishny 2003 and Rhodes-Kropf and Viswanathan 2004) and that undervalued firms are more likely to become cash acquirers (in accordance with Q-theory). 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. Furthermore, we document that stock acquirers with high short interest underperform following the merger announcement while cash acquirers with low short interest outperform following the merger announcement. We also 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. The latter result is important because analysis using market-to-book ratios comes to a different conclusion, possibly because market-to-book is confounded by the firm's growth opportunities.

We consider several alternative explanations for the relation between short interest and acquisitions; however, we fail to find evidence supporting these alternative stories. We conclude that short interest does provide useful information about firm valuation. Further, our analyses support both overvaluation and Q-theory explanations for mergers. Consistent with overvaluation explanations, stock acquirers have high short interest and, the higher the level of short interest, the greater they underperform following the merger. Consistent with Q-theory, cash acquirers have low short interest and, the lower the level of short interest, the more they outperform following the merger.

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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.

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) Decomposition 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:³³

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

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:

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

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;

³³ 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.

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 right-hand-side (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.

Appendix C: Calendar-Time Portfolios, by Method of Payment

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 $t - 1$ 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	3-Factor alphas over...					
	Equal-Weighting			Value-Weighting		
	6 mth	12 mth	24 mth	6 mth	12 mth	24 mth
All	-27.3*** (9.1)	-28.7*** (9.2)	-33.9*** (9.8)	7.2 (9.5)	-4.0 (7.3)	-5.4 (5.3)
Stock	-97.3*** (18.7)	-76.0*** (16.6)	-58.1*** (16.7)	-44.3** (20.3)	-37.7** (16.2)	-31.7** (12.3)
Mixed	-37.0*** (13.5)	-40.7*** (12.7)	-53.1*** (12.4)	-11.8 (13.4)	-25.9** (11.2)	-31.7*** (8.9)
Cash	5.9 (12.0)	0.8 (9.4)	-6.7 (8.7)	1.5 (14.4)	-4.0 (11.3)	4.4 (8.9)
Stock-Cash	-103.8*** (22.5)	-77.2*** (18.2)	-51.8*** (16.0)	-47.8* (25.1)	-34.8* (20.6)	-37.0** (16.3)
Avg # months:	299.3	299.3	299.3	299.3	299.3	299.3
Avg # firms in portfolio:	137.3	246.0	406.5	137.3	246.0	406.5

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

Payment	4-Factor alphas over...					
	Equal-Weighting			Value-Weighting		
	6 mth	12 mth	24 mth	6 mth	12 mth	24 mth
All	-13.1 (8.8)	-9.2 (8.4)	-8.3 (8.2)	-7.1 (9.3)	-11.5 (7.3)	-7.6 (5.5)
Stock	-78.4*** (18.6)	-46.8*** (15.4)	-19.2 (14.1)	-57.4*** (20.7)	-42.4** (16.6)	-31.0** (12.6)
Mixed	-16.9 (13.1)	-17.2 (11.9)	-24.4** (10.9)	-16.3 (13.8)	-28.8** (11.6)	-30.9*** (9.2)
Cash	15.9 (12.0)	10.9 (9.3)	7.4 (8.2)	-5.1 (14.7)	-9.2 (11.6)	2.4 (9.2)
Stock-Cash	-95.4*** (23.1)	-58.7*** (18.1)	-27.7* (15.3)	-55.0** (25.8)	-34.5 (21.2)	-34.6** (16.8)
Avg # months:	299.3	299.3	299.3	299.3	299.3	299.3
Avg # firms in portfolio:	137.3	246.0	406.5	137.3	246.0	406.5

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

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 $t - 1$

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
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	1.48
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 Month)	0.38	1.01	-0.44	-0.04	0.19	0.50	1.72
Dividends	0.14	0.35	0.00	0.00	0.00	0.00	1.00
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
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	0.62	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 Month)	0.18	0.79	-0.61	-0.19	0.08	0.36	1.22
Dividends	0.13	0.33	0.00	0.00	0.00	0.00	1.00
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 $t - 1$**

Variable	Acquirers of Public Targets			Acquirers of Private Targets			Universe
	Stock	Mix	Cash	Stock	Mix	Cash	
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
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	3.94	3.17	3.15	4.63	3.25	2.93	3.03
	2.47	2.23	2.37	2.57	2.28	2.17	1.86
	4.32	3.30	2.89	5.46	3.48	2.90	3.94
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 Month)	0.450	0.250	0.170	0.600	0.380	0.270	0.178
	0.270	0.190	0.150	0.280	0.170	0.160	0.076
	0.940	0.550	0.370	1.580	1.010	0.630	0.789
Dividends	0.194	0.212	0.180	0.128	0.096	0.140	0.127
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.395	0.409	0.384	0.334	0.294	0.348	0.333
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	0.350	0.630	0.250	0.190	0.270	0.160	
	0.200	0.320	0.100	0.060	0.120	0.070	
	0.470	1.310	0.420	0.570	0.570	0.300	
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	0.120	0.120	0.160	0.110	0.060	0.070	
	0.000	0.000	0.000	0.000	0.000	0.000	
	0.330	0.330	0.370	0.310	0.250	0.260	
N	925	627	473	1,547	2,421	2,413	971,662
% of Sample	11%	7%	6%	18%	29%	29%	

Table 3. 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 $t - 6$, or $t - 1$) relative to the month in which the dependent variable is measured. Adjusted 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: Stock Acquirers

Dependent variable: Adjusted SI measured at:	Stock Acquirer (0/1)									
	Month t-6					Month t-1				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Adj. Short Interest Q2	0.0007*** (0.0002)		0.0007*** (0.0002)		0.0007*** (0.0002)	0.0007*** (0.0002)		0.0007*** (0.0002)		0.0007*** (0.0002)
Adj. Short Interest Q3	0.0011*** (0.0003)		0.0011*** (0.0003)		0.0011*** (0.0003)	0.0008*** (0.0002)		0.0007*** (0.0002)		0.0007*** (0.0002)
Adj. Short Interest Q4	0.0015*** (0.0003)		0.0015*** (0.0003)		0.0014*** (0.0003)	0.0013*** (0.0003)		0.0012*** (0.0002)		0.0012*** (0.0002)
Adj. Short Interest Q5	0.0025*** (0.0003)		0.0025*** (0.0003)		0.0022*** (0.0003)	0.0024*** (0.0003)		0.0021*** (0.0003)		0.0021*** (0.0003)
Market-to-Book		0.0000*** (0.0000)	0.0000*** (0.0000)				0.0002*** (0.0000)	0.0002*** (0.0000)		
M/B (Firm)				0.0011*** (0.0001)	0.0010*** (0.0001)				0.0011*** (0.0001)	0.0010*** (0.0001)
M/B (Sector)				0.0016*** (0.0003)	0.0018*** (0.0003)				0.0018*** (0.0004)	0.0020*** (0.0004)
M/B (Long-run)				0.0007*** (0.0001)	0.0006*** (0.0001)				0.0008*** (0.0001)	0.0007*** (0.0001)
Past Acquisition	0.0038*** (0.0002)	0.0037*** (0.0002)	0.0038*** (0.0002)	0.0038*** (0.0002)	0.0038*** (0.0002)	0.0039*** (0.0002)	0.0040*** (0.0002)	0.0040*** (0.0002)	0.0039*** (0.0002)	0.0039*** (0.0002)
Log of Market Cap	-0.0001** (0.0000)	0.0000 (0.0000)	-0.0001** (0.0000)	-0.0002*** (0.0000)	-0.0003*** (0.0001)	-0.0001 (0.0001)	-0.0000 (0.0001)	-0.0001** (0.0001)	-0.0001** (0.0001)	-0.0002*** (0.0001)
Institutional Ownership	-0.0037*** (0.0003)	-0.0033*** (0.0003)	-0.0037*** (0.0003)	-0.0030*** (0.0003)	-0.0033*** (0.0003)	-0.0036*** (0.0003)	-0.0031*** (0.0003)	-0.0034*** (0.0003)	-0.0029*** (0.0003)	-0.0032*** (0.0003)
Log of Price	0.0011*** (0.0001)	0.0011*** (0.0001)	0.0011*** (0.0001)	0.0011*** (0.0001)	0.0011*** (0.0001)	0.0012*** (0.0001)	0.0012*** (0.0001)	0.0012*** (0.0001)	0.0011*** (0.0001)	0.0011*** (0.0001)
Turnover	0.0001*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0000)	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0000)	0.0002*** (0.0000)	0.0001*** (0.0000)
Past Returns (12 mo)	0.0003*** (0.0000)	0.0004*** (0.0000)	0.0003*** (0.0000)	0.0002*** (0.0000)	0.0002*** (0.0000)	0.0004*** (0.0000)	0.0004*** (0.0000)	0.0004*** (0.0000)	0.0003*** (0.0000)	0.0003*** (0.0000)
Dividends	-0.0000 (0.0002)	-0.0002 (0.0002)	-0.0000 (0.0002)	0.0000 (0.0002)	0.0001 (0.0002)	-0.0004** (0.0002)	-0.0004** (0.0002)	-0.0003* (0.0002)	-0.0003** (0.0002)	-0.0002 (0.0002)
N	947,062	947,062	947,062	940,207	940,207	983,082	983,082	983,082	971,662	971,662
Pseudo R ²	0.031	0.029	0.031	0.033	0.035	0.036	0.037	0.039	0.039	0.041

Table 3. Can Short Interest Predict Which Firms Become Acquirers? (Cont.)

Panel B: Cash Acquirers

Dependent variable: Adjusted SI measured at:	Cash Acquirer (0/1)									
	Month -6					Month -1				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Adj. Short Interest Q2	0.0003 (0.0002)		0.0003 (0.0002)		0.0003 (0.0002)	-0.0001 (0.0002)		-0.0001 (0.0002)		-0.0002 (0.0002)
Adj. Short Interest Q3	-0.0001 (0.0002)		-0.0001 (0.0002)		-0.0001 (0.0002)	-0.0004** (0.0002)		-0.0003* (0.0002)		-0.0004** (0.0002)
Adj. Short Interest Q4	-0.0003* (0.0002)		-0.0003 (0.0002)		-0.0003 (0.0002)	-0.0006*** (0.0002)		-0.0006*** (0.0002)		-0.0006*** (0.0002)
Adj. Short Interest Q5	-0.0008*** (0.0002)		-0.0008*** (0.0002)		-0.0008*** (0.0002)	-0.0010*** (0.0002)		-0.0009*** (0.0002)		-0.0009*** (0.0002)
Market-to-Book		-0.0001 (0.0000)	-0.0000 (0.0000)					-0.0001*** (0.0000)	-0.0001*** (0.0000)	
M/B (Firm)				-0.0003*** (0.0001)	-0.0002** (0.0001)					-0.0005*** (0.0001)
M/B (Sector)				0.0010*** (0.0003)	0.0009*** (0.0003)					0.0010*** (0.0003)
M/B (Long-run)				0.0003*** (0.0001)	0.0004*** (0.0001)					0.0003*** (0.0001)
Past Acquisition	0.0029*** (0.0001)	0.0029*** (0.0001)	0.0028*** (0.0001)	0.0029*** (0.0001)	0.0029*** (0.0001)	0.0029*** (0.0001)	0.0029*** (0.0001)	0.0029*** (0.0001)	0.0030*** (0.0001)	0.0030*** (0.0001)
Log of Market Cap	-0.0000 (0.0000)	-0.0001 (0.0000)	-0.0000 (0.0000)	-0.0000 (0.0000)	-0.0000 (0.0001)	-0.0001* (0.0000)	-0.0001** (0.0000)	-0.0001 (0.0000)	-0.0001 (0.0000)	-0.0000 (0.0001)
Institutional Ownership	0.0045*** (0.0002)	0.0042*** (0.0002)	0.0044*** (0.0002)	0.0042*** (0.0002)	0.0045*** (0.0002)	0.0044*** (0.0002)	0.0041*** (0.0002)	0.0043*** (0.0002)	0.0042*** (0.0002)	0.0044*** (0.0002)
Log of Price	0.0006*** (0.0001)	0.0006*** (0.0001)	0.0006*** (0.0001)	0.0005*** (0.0001)	0.0005*** (0.0001)	0.0008*** (0.0001)	0.0008*** (0.0001)	0.0008*** (0.0001)	0.0007*** (0.0001)	0.0007*** (0.0001)
Turnover	0.0001*** (0.0000)	0.0000 (0.0000)	0.0001*** (0.0000)	-0.0000 (0.0000)	0.0001** (0.0000)	0.0001*** (0.0000)	0.0000* (0.0000)	0.0001*** (0.0000)	-0.0000 (0.0000)	0.0000 (0.0000)
Past Returns (12 months)	0.0002*** (0.0001)	0.0002*** (0.0001)	0.0002*** (0.0001)	0.0002*** (0.0001)	0.0002** (0.0001)	0.0001 (0.0001)	0.0001* (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)
Dividends	-0.0002 (0.0002)	-0.0001 (0.0002)	-0.0002 (0.0002)	-0.0001 (0.0002)	-0.0001 (0.0002)	-0.0005*** (0.0001)	-0.0005*** (0.0001)	-0.0006*** (0.0001)	-0.0005*** (0.0001)	-0.0005*** (0.0001)
N	947,062	947,062	947,062	940,207	940,207	983,082	983,082	983,082	971,662	971,662
Pseudo R ²	0.039	0.038	0.039	0.039	0.040	0.043	0.042	0.043	0.044	0.044

Table 4. Announcement Returns and Pre-Announcement Short Interest

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 $t - 1$ 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.

Sample:	Market-Adjusted Announcement Returns (-1,+1)			
	All	All	Stock only	Cash only
	(1)	(2)	(3)	(4)
Adjusted Short Interest (t-1) Q2	-0.001 (0.003)	-0.000 (0.003)	-0.000 (0.004)	-0.003 (0.004)
Adjusted Short Interest (t-1) Q3	0.001 (0.004)	0.001 (0.004)	0.010 (0.008)	-0.002 (0.004)
Adjusted Short Interest (t-1) Q4	0.000 (0.005)	0.000 (0.005)	0.018** (0.008)	-0.006 (0.004)
Adjusted Short Interest (t-1) Q5	-0.002 (0.004)	-0.001 (0.004)	0.006 (0.007)	-0.003 (0.005)
Stock Merger		-0.008** (0.003)		
Mixed Merger		-0.004* (0.002)		
Log of Market Cap	-0.003** (0.001)	-0.003** (0.001)	-0.004 (0.003)	-0.000 (0.001)
Institutional Ownership	0.005* (0.003)	0.004 (0.003)	-0.003 (0.008)	0.005 (0.008)
M/B (Firm)	0.002 (0.003)	0.002 (0.003)	0.002 (0.009)	0.000 (0.007)
M/B (Sector)	-0.011 (0.008)	-0.011 (0.008)	-0.008 (0.025)	0.002 (0.011)
M/B (Long-run)	0.003 (0.002)	0.004 (0.002)	0.005 (0.005)	0.003 (0.005)
Log of Price	-0.010*** (0.003)	-0.010*** (0.003)	-0.012** (0.005)	-0.009** (0.004)
Turnover	0.001 (0.001)	0.001 (0.001)	0.003 (0.002)	0.001 (0.001)
Past Returns	0.002 (0.002)	0.002 (0.002)	0.001 (0.002)	-0.001 (0.003)
Transaction Size	-0.004 (0.004)	-0.004 (0.004)	-0.011 (0.014)	0.024** (0.010)
Diversifying	0.004 (0.003)	0.004 (0.003)	0.015** (0.006)	0.001 (0.002)
Public Target	-0.023*** (0.004)	-0.022*** (0.004)	-0.031*** (0.010)	-0.004 (0.003)
Withdrawn	-0.004 (0.004)	-0.004 (0.004)	-0.002 (0.010)	-0.008 (0.005)
Dividends	0.002 (0.004)	0.001 (0.004)	0.011* (0.006)	-0.005 (0.004)
Industry \times Year Fixed Effects	Yes	Yes	Yes	Yes
N	8,246	8,246	2,437	2,822
Adj R ²	0.076	0.077	0.168	0.082

Table 5. 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 $t - 1$ 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		3-Factor alphas over...					
	Acquirers (t-1)	# acquirers	Equal-Weighting			Value-Weighting		
			6 mth	12 mth	24 mth	6 mth	12 mth	24 mth
All	Q1	477	63.2* (36.3)	58.5** (26.3)	34.3 (23.0)	27.8 (39.0)	2.6 (31.3)	-19.1 (26.8)
	Q2	807	27.8 (22.5)	12.9 (17.7)	9.9 (14.5)	35.0 (21.2)	-8.5 (18.5)	-4.6 (15.1)
	Q3	1091	-15.5 (15.8)	-0.2 (17.3)	3.4 (14.7)	-9.6 (23.9)	-9.4 (19.2)	-10.2 (16.9)
	Q4	1306	-40.8*** (15.7)	-47.9*** (13.0)	-31.0** (12.7)	-24.2 (22.7)	-12.9 (16.6)	-9.6 (13.5)
	Q5	1462	-49.0*** (18.4)	-25.8 (16.2)	-16.2 (16.6)	8.8 (22.6)	0.3 (19.7)	-7.9 (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 (43.1)	-10.0 (30.3)	4.4 (24.2)	-20.4 (42.6)	-17.2 (32.1)	-20.9 (24.0)
	Q3	279	-44.1 (44.8)	-24.7 (32.0)	0.1 (25.7)	-29.6 (59.3)	0.6 (39.8)	2.6 (28.2)
	Q4+Q5	873	-66.5** (27.9)	-40.5* (22.6)	-24.5 (21.3)	-23.0 (30.0)	-13.4 (27.0)	-13.3 (20.6)
	Avg # months:			110.5	166.0	209.8	110.5	166.0
Avg # firms in portfolio:			22.9	32.5	47.0	22.9	32.5	47.0
Cash	Q1+Q2	423	89.1*** (30.6)	45.8** (23.2)	45.2** (19.7)	50.2 (33.0)	-8.2 (27.9)	14.5 (21.3)
	Q3	391	-37.8 (27.2)	24.0 (18.9)	17.0 (15.9)	-35.7 (39.3)	12.8 (27.2)	16.0 (20.4)
	Q4+Q5	915	-38.4** (19.1)	-29.1* (15.6)	-13.7 (14.8)	-54.8** (26.5)	-18.1 (19.9)	3.9 (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
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
Avg # firms in portfolio:			22.2	36.6	58.4	22.2	36.6	58.4

Table 6. 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 errors are presented within parentheses. For variable definitions, see Appendix A. The variables in each column are measured at month $t - 1$. *, **, *** denote two-tailed significance at the 10%, 5%, and 1% levels, respectively, using t -tests.

Panel A: Means and Standard Errors of Overvaluation Proxies for Stock Mergers

	Stock Mergers			
	Acquirers	Targets	Difference	
	(1)	(2)	(3)	
Adjusted Short Interest (t-1)	0.007 (0.001)	-0.002 (0.001)	0.008 (0.002)	***
Market-to-Book (t-1)	3.948 (0.149)	3.227 (0.154)	0.721 (0.214)	***
M/B (Firm) (t-1)	0.373 (0.020)	0.125 (0.022)	0.248 (0.030)	***
M/B (Sector) (t-1)	0.155 (0.008)	0.128 (0.008)	0.027 (0.011)	**
M/B (Long-run) (t-1)	0.528 (0.021)	0.540 (0.023)	-0.011 (0.031)	
N	715			

Panel B: Means and Standard Errors of Overvaluation Proxies for Cash Mergers

	Cash Mergers			
	Acquirers	Targets	Difference	
	(1)	(2)	(3)	
Adjusted Short Interest (t-1)	-0.002 (0.001)	0.000 (0.001)	-0.002 (0.002)	
Market-to-Book (t-1)	3.292 (0.114)	2.640 (0.117)	0.652 (0.229)	***
M/B (Firm) (t-1)	0.212 (0.020)	-0.049 (0.022)	0.261 (0.042)	***
M/B (Sector) (t-1)	0.153 (0.006)	0.113 (0.008)	0.039 (0.014)	***
M/B (Long-run) (t-1)	0.575 (0.020)	0.595 (0.023)	-0.020 (0.042)	
N	364			

Table 7. 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 or cash acquisitions. The sample includes the universe of firms with available data from 1989 to 2007. Variable definitions are in Appendix A. All variables in each column are measured at month $t - 6$ relative to the month in which the dependent variable is measured. Quintiles of adjusted 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: Stock Acquisitions

Dependent variable: Sample:	Stock Acquirer (t) (0/1)					
	High Idiosyncratic Risk			Low Idiosyncratic Risk		
	(1)	(2)	(3)	(4)	(5)	(6)
Adjusted Short Interest (t-6) Q2	0.0007** (0.0003)	0.0007** (0.0003)	0.0006** (0.0003)	0.0003 (0.0004)	0.0004 (0.0003)	0.0005 (0.0003)
Adjusted Short Interest (t-6) Q3	0.0010*** (0.0004)	0.0010*** (0.0004)	0.0009** (0.0004)	0.0007 (0.0005)	0.0007 (0.0004)	0.0008* (0.0004)
Adjusted Short Interest (t-6) Q4	0.0016*** (0.0004)	0.0016*** (0.0004)	0.0014*** (0.0004)	0.0008* (0.0005)	0.0009* (0.0005)	0.0009** (0.0004)
Adjusted Short Interest (t-6) Q5	0.0020*** (0.0004)	0.0020*** (0.0004)	0.0017*** (0.0004)	0.0017** (0.0008)	0.0017** (0.0008)	0.0017** (0.0007)
Market-to-Book		0.0000*** (0.0000)			-0.0001 (0.0002)	
M/B (Firm)			0.0004** (0.0002)			0.0013*** (0.0003)
M/B (Sector)			0.0009 (0.0006)			0.0023*** (0.0007)
M/B (Long-run)			0.0010*** (0.0002)			-0.0005 (0.0006)
Past Acquisition	0.0022*** (0.0002)	0.0022*** (0.0002)	0.0023*** (0.0002)	0.0050*** (0.0014)	0.0050*** (0.0013)	0.0045*** (0.0012)
Log of Market Cap	0.0001 (0.0001)	0.0001 (0.0001)	0.0000 (0.0001)	-0.0000 (0.0002)	-0.0000 (0.0002)	-0.0002 (0.0002)
Institutional Ownership	-0.0017*** (0.0004)	-0.0016*** (0.0004)	-0.0012*** (0.0005)	-0.0051*** (0.0018)	-0.0051*** (0.0018)	-0.0046*** (0.0015)
Log of Price	0.0007*** (0.0002)	0.0007*** (0.0002)	0.0006*** (0.0002)	0.0010* (0.0005)	0.0010* (0.0005)	0.0010** (0.0005)
Turnover	0.0001* (0.0000)	0.0001 (0.0000)	0.0000 (0.0000)	-0.0002 (0.0004)	-0.0002 (0.0003)	-0.0002 (0.0004)
Past Returns (12 months)	0.0002*** (0.0000)	0.0002*** (0.0001)	0.0002*** (0.0000)	0.0019*** (0.0005)	0.0019*** (0.0005)	0.0017*** (0.0005)
Dividends	-0.0010** (0.0005)	-0.0010** (0.0005)	-0.0008* (0.0005)	0.0004 (0.0003)	0.0004 (0.0003)	0.0004 (0.0003)
N	413,592	412,316	407,375	410,031	409,245	407,924
Pseudo R ²	0.027	0.028	0.032	0.049	0.049	0.055

**Table 7. Short Interest and Future Stock Mergers by Level of Idiosyncratic Risk
(Cont.)**

Panel B: Cash Acquisitions

Dependent variable: Sample:	Cash Acquirer (t) (0/1)					
	High Idiosyncratic Risk			Low Idiosyncratic Risk		
	(1)	(2)	(3)	(4)	(5)	(6)
Adjusted Short Interest (t-6) Q2	-0.0002 (0.0003)	-0.0002 (0.0003)	-0.0002 (0.0003)	0.0005 (0.0003)	0.0005 (0.0003)	0.0006* (0.0003)
Adjusted Short Interest (t-6) Q3	-0.0005* (0.0003)	-0.0005* (0.0003)	-0.0005* (0.0003)	-0.0001 (0.0004)	-0.0001 (0.0004)	0.0000 (0.0004)
Adjusted Short Interest (t-6) Q4	-0.0006** (0.0003)	-0.0005** (0.0003)	-0.0006** (0.0003)	-0.0004 (0.0004)	-0.0004 (0.0004)	-0.0002 (0.0004)
Adjusted Short Interest (t-6) Q5	-0.0010*** (0.0003)	-0.0009*** (0.0003)	-0.0009*** (0.0003)	-0.0010*** (0.0003)	-0.0010*** (0.0003)	-0.0008*** (0.0003)
Market-to-Book		-0.0001*** (0.0000)			-0.0001 (0.0001)	
M/B (Firm)			-0.0002 (0.0002)			-0.0004* (0.0002)
M/B (Sector)			0.0001 (0.0003)			0.0017*** (0.0006)
M/B (Long-run)			0.0001 (0.0002)			0.0005** (0.0002)
Past Acquisition	0.0023*** (0.0002)	0.0022*** (0.0002)	0.0023*** (0.0002)	0.0035*** (0.0002)	0.0035*** (0.0002)	0.0035*** (0.0002)
Log of Market Cap	0.0002 (0.0002)	0.0002 (0.0002)	0.0002 (0.0002)	-0.0001 (0.0001)	-0.0001 (0.0001)	-0.0001 (0.0001)
Institutional Ownership	0.0031*** (0.0005)	0.0029*** (0.0005)	0.0031*** (0.0005)	0.0045*** (0.0005)	0.0045*** (0.0005)	0.0044*** (0.0005)
Log of Price	0.0007*** (0.0003)	0.0007*** (0.0003)	0.0007** (0.0003)	0.0004** (0.0002)	0.0004** (0.0002)	0.0003* (0.0002)
Turnover	0.0000 (0.0000)	0.0000 (0.0000)	-0.0000 (0.0000)	0.0005*** (0.0001)	0.0005*** (0.0002)	0.0004*** (0.0001)
Past Returns (12 months)	0.0001 (0.0001)	0.0001 (0.0001)	0.0001 (0.0001)	0.0008*** (0.0002)	0.0008*** (0.0002)	0.0007*** (0.0002)
Dividends	0.0002 (0.0005)	0.0002 (0.0005)	0.0002 (0.0005)	0.0001 (0.0002)	0.0001 (0.0002)	0.0001 (0.0002)
N	413,592	412,316	407,375	410,031	409,245	407,924
Pseudo R ²	0.044	0.045	0.045	0.038	0.038	0.039

Figure 1. Adjusted Short Interest around Acquisitions

These figures plot mean adjusted 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. In Figure 1a, the sample includes all acquisitions. In Figure 1b, the sample includes acquisitions in which the target is publicly traded. In Figure 1c, the sample includes acquisitions in which the target is privately held.

Figure 1a. Adjusted Short Interest around All Acquisitions

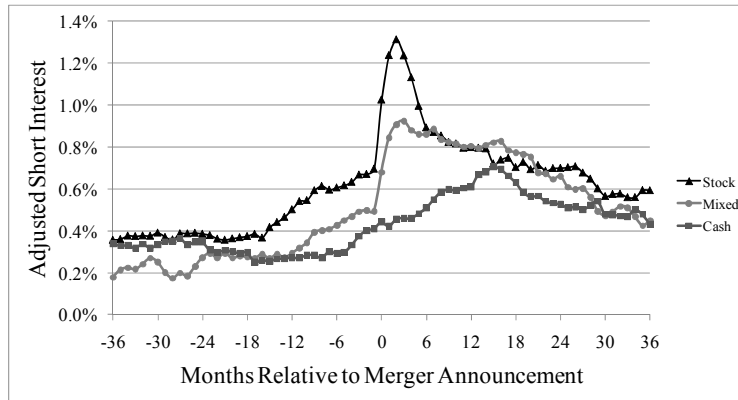


Figure 1b. Adjusted Short Interest around Acquisitions of Public Targets

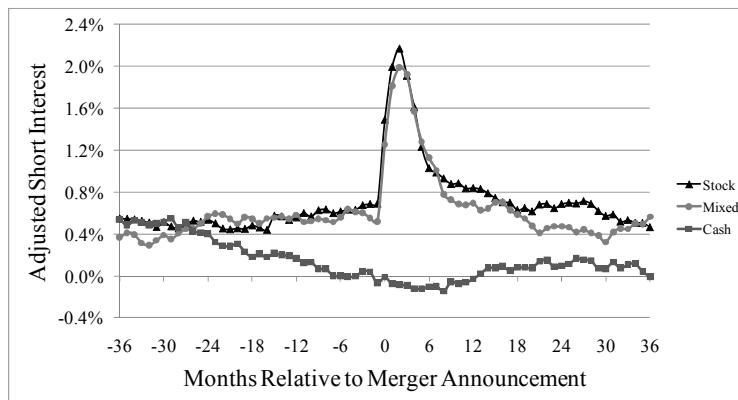


Figure 1c. Adjusted Short Interest around Acquisitions of Private Targets

