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Acquirer Valuation and Acquisition Decisions: Identifying Mispricing Using Short Interest

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Abstract

We use short interest as an investor-based measure of over- or undervaluation that distinguishes between the misvaluation and 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 acquisitions and 22% less likely to engage in cash acquisitions. Stock (but not cash) acquirers have higher short interest than their targets. Overall, our results suggest that the previously documented underperformance of stock acquirers and the overperformance of cash acquirers can be explained by misvaluation, as captured by short interest.

I. Introduction

An ongoing debate in the literature centers on the driving forces behind acquisitions. Some studies suggest that firms' misvaluation leads to the decision to acquire another firm (*misvaluation theory*; Shleifer and Vishny (2003) and Rhodes-Kropf and Viswanathan (2004)), but others argue that fundamental motives such as growth opportunities drive firms to engage in mergers (*the Q-theory of mergers*; Servaes (1991) and Rousseau (2009)). A key challenge in this debate, noted by Dong, Hirshleifer, Richardson, and Teoh (2006), is that it is empirically difficult to distinguish between the theories because they both predict that firms

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with high market values relative to fundamentals are more likely to engage in acquisitions, especially in stock acquisitions.[1]

In this study, we propose a novel empirical approach to identifying acquirer misvaluation that allows us to distinguish between the two potential motives for mergers. Specifically, we rely on the idea that short interest in a stock reflects sophisticated investors' beliefs about the degree of over- and undervaluation but is unlikely to reflect firm growth opportunities. Our key identifying assumption that short sellers take (avoid) short positions in overvalued (undervalued) stocks is supported by empirical evidence in prior studies.[2] Our findings add new evidence to the currently unsettled debate.

We argue that short interest is an attractive measure of misvaluation for two reasons. 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). For example, Maksimovic, Phillips, and Yang (2010) find that misvaluation proxies based on the market-to-book ratio (e.g., Rhodes-Kropf et al. (2005)) are correlated with future productivity. Second, short positions are costly. Short sellers do not have access to the sale proceeds until the short position is closed, and lending contracts include loan fees that have been estimated at 1.64% (annually) for New York Stock Exchange (NYSE) stocks and 3.74% (annually) for National Association of Securities Dealers Automated Quotations (NASDAQ) stocks (Diether and Werner (2011)). The cost of short selling is what links short interest to mispricing. Specifically, informed short sellers must earn higher expected returns to compensate for the cost of short selling; they will short a stock only when the marginal benefit of shorting equates to or exceeds the marginal cost. Thus, high short interest is indicative of mispricing, because it is mispricing that induces investors to initiate costly arbitrage.

We document that short interest predicts future merger choices on several dimensions. For the population of acquirers, short interest is substantially higher for stock acquirers than for cash acquirers. For the universe of firms, firms with higher short interest are more likely to engage in stock mergers and less likely to engage in cash mergers in the following 6 months. As an illustration of the magnitude of the effect, after controlling for previously identified determinants of acquisitions, we find that 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

[1]Numerous studies including Sinha (2003), Rhodes-Kropf, Robinson, and Viswanathan (2005), Ang and Cheng (2006), Friedman (2006), and Bi and Gregory (2011) find that acquirers have high market-to-book ratios and interpret such evidence as being consistent with misvaluation theory. Servaes (1991), Rousseau (2009), and Levine (2013) interpret similar evidence as being consistent with the Q-theory of mergers.

[2]See, for example, Dechow, Hutton, Meulbroek, and Sloan (2001), Desai, Ramesh, Thiagarajan, and Balachandran (2002), Boehmer, Huszar, and Jordan (2010), and Drake, Rees, and Swanson (2011).

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market-to-book–based proxies for misvaluation (i.e., the market-to-book decomposition in Rhodes-Kropf et al. (2005)). In other words, our results linking short interest with acquisition choices are not simply picking up previously documented relations between short interest and fundamental-based valuation measures and between fundamental-based valuation measures and acquisitions.

After establishing a link between short interest and merger activity, we conduct two sets of additional tests to provide further evidence of a misvaluation motive for mergers. In the first set, we analyze the relation between preannouncement short interest and subsequent abnormal returns for the acquirer. We find that preannouncement short interest is not meaningfully correlated with merger announcement returns. However, long-term abnormal returns exhibit a strong negative correlation with short interest. During the first 6 months following a merger announcement, stock acquirers in the two highest quintiles of short interest exhibit cumulative 3-factor abnormal returns of −4.0% (−67 monthly basis points (bps)). During the same horizon, cash acquirers from the two bottom quintiles of short interest exhibit abnormal returns of +5.3% (+89 monthly bps). These results lose economic magnitude and statistical power when portfolio returns are value-weighted, suggesting that the misvaluation signal embedded in short interest is noisier in large stocks than in small stocks (consistent with Asquith, Pathak, and Ritter (2005)). This result can be explained by the fact that shorting costs are smaller in large stocks than in small stocks and because short interest in large stocks may be contaminated by short positions that are part of index arbitrage.

We acknowledge that we are not the first to provide evidence that postannouncement returns of stock acquirers are lower than those of cash acquirers (see, e.g., Loughran and Vijh (1997) and Rau and Vermaelen (1998)). However, we are the first to condition these returns on levels of short interest. In a follow-up test, we examine whether postannouncement abnormal returns for stock and cash acquirers are similar to the abnormal returns of nonacquirers with the same level of short interest. Our results reveal that the returns for stock and cash acquirers with high short interest are statistically indistinguishable from the returns of nonacquirers with high short interest. This result shows that the previously documented underperformance of stock acquirers and the overperformance of cash acquirers can be explained by misvaluation, as captured by short interest.

In the second set of tests, we investigate the short interest of acquirers relative to the short interest of 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 to exchange overvalued equity for less overvalued assets. Consistent with this hypothesis, we document that for the subpopulation of public targets (for which 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 using 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,

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because cash acquirers, which do not experience negative long-run abnormal returns, are unlikely to be overvalued. Overall, these findings are consistent with the idea that short interest provides new insights into valuation relative to previously used measures.

Finally, we investigate two alternative explanations for the link between short interest and merger choice. These explanations propose that short positions in acquirers-to-be are motivated by factors unrelated to misvaluation. First, we examine whether short sellers are frontrunning anticipated acquisition announcements as part of a merger arbitrage strategy. Second, we examine whether 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. We investigate these alternative explanations and find little support for them.

Our proxy for misvaluation and the results it produces make several contributions to the mergers and acquisitions 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- or undervaluation (the market-to-book breakdown created by Rhodes-Kropf et al. (2005)) requires a long time series of data (which includes future observations) and calculates over- or undervaluation ex post. Second, our finding regarding the relative short interest of acquirers and targets provides support for overvaluation explanations for mergers that do not arise when using the market-to-book ratio or its components. 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 postannouncement abnormal returns (+5.3% within 6 months). We view this evidence as consistent with Q-theory: Undervalued firms expand through acquisitions due to their high growth potential. Fourth, we find that short interest predicts acquisition choices after controlling for fundamental-based measures of valuation such as the market-to-book ratio or its components, as in Rhodes-Kropf et al. (2005). Thus, the predictive power of short interest is not coming from its previously known relation with valuation measures, which are also correlated with acquisition choices. Finally, our paper helps to explain factors that influence 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.

Our work also contributes to studies that use short interest as a proxy for arbitrage activity related to misvaluation. Hanson and Sunderam (2014) use short interest to proxy for the amount of arbitrage activity and document its growth over time as well as changes in the use of value and momentum arbitrage strategies. Henry and Koski (2013) document short interest patterns around seasoned equity offerings (SEOs), while Autore, Gehy, and Jiang (2014) find that short interest predicts SEOs and argue that managers use equity offerings as an overvaluation signal. Furthermore, Karpoff and Lou (2010), Desai, Krishnamurthy, and Venkataraman (2006), and Efendi, Kinney, and Swanson (2006) indirectly link

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short selling and misvaluation by examining firms that are targeted by the U.S. Securities and Exchange Commission (SEC) for misrepresenting their financial statements or that restate earnings.

II. Data

A. Mergers and Acquisitions and Firm Data

Our mergers and acquisitions data set[3] is drawn from the Thomson Securities Data Company (SDC) database and contains mergers and acquisitions that were announced between 1989 and 2007. The start date of the sample period is 1989, because our short interest data are available from 1988 and we require 12 months of short selling data prior to mergers. The sample ends in 2008, but because we require 12 months of short selling data following mergers, we use mergers only through the end of 2007.

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 $1 million (m) and transactions for which the deal value was lower than 1% of the acquirer's firm value at the announcement month. As in Moeller et al., firm value is computed as the sum of market value of equity, long-term debt, debt in current liabilities, and liquidation value of preferred shares. We limit our sample to acquirers with share code 10 or 11 (common shares). We differ from Moeller et al. 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 stock mergers, 2,886 (34%) are cash mergers, and 3,048 (36%) are a mix of stock and cash. Panel A of Table 1 presents the distribution of merger announcements through time for the various payment methods. The pattern is similar to the distributions in Dong et al. (2006) and Moeller et al. (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. 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 Panel C of Table 2 for the number of private vs. public target acquisitions in our sample).

We use several databases for accounting and market information. Our accounting data come from the Compustat Annual File. Our market data (e.g., returns and shares outstanding) are drawn from the Center for Research in

[3]For brevity, we call the announcement events "merger" events, although they include both mergers and acquisitions.

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TABLE 1

Time Series of Acquisitions and Short Interest

Panel A of Table 1 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

	Acquisition Count		
Year	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%

Panel B. Time Series of Short Interest

	Universe		Acquirers	
Year	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

Security Prices (CRSP). Institutional holdings are from Thomson Financial, based on 13F filings. For some of our tests, we use the universe of firms in the CRSP and Compustat. To be included in our data set, a firm must exist for at least 1 year in both the CRSP and Compustat.

Our sample is further reduced by 30 acquisitions, because we require acquirers to have the data needed to compute the three market-to-book components used in Rhodes-Kropf et al. (2005): firm-specific error in market-to-book (*MB (Firm)*), time-series sector error in market-to-book (*MB (Sector)*), and long-run value to book (*MB (Long-run)*).[4] 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. The first component, *MB (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, *MB (Sector)*, equals the difference between the market value of equity implied by a current industry multiple and the market value of equity implied by a long-run industry multiple; it represents misvaluation at the industry level. The long-run component, *MB (Long-run)*, represents the fairly valued market-to-book ratio based on fundamentals and is equal to the market value of equity implied by a long-run industry multiple and the firm's actual book value of equity.[5] Appendix A provides variable definitions,

[4]We construct these variables following the discussion in Section 5 of Rhodes-Kropf et al. (2005).

[5]Rhodes-Kropf et al. ((2005), pp. 579–580) 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

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and Appendix B gives a more detailed description of the market-to-book ratio components and their construction.

B. Short Interest Data

Short interest data come from two sources. We download monthly short interest data for firms traded on the NYSE, American Stock Exchange (AMEX), and NASDAQ exchanges from the Compustat Monthly Securities Database, which contains monthly short interest levels beginning in 2003.[6] For earlier years, we obtain data directly from the NYSE, AMEX, and NASDAQ exchanges. The exchanges report open short positions using a settlement date of the 15th of each month (or the last prior trading day). Following prior studies, we calculate the *Short Interest Ratio* by deflating short interest by the number of shares outstanding, as reported by the CRSP (Dechow et al. (2001), Asquith et al. (2005)).

One concern with the short interest data is that they exhibit a trend over time. 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* for all firms traded on the three major U.S. exchanges. In Panel B of Table 1, we present mean short interest and adjusted short interest by year. In addition to adjusting short interest, 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.[7] Finally, given that prior research finds that short selling increases around ex-dividend days (Christoffersen, Geczy, Musto, and Reed (2005), Thornock (2013)) and that dividend policy may be associated with acquisition decisions, we also control for ex-dividend dates in the regressions.

C. Summary Statistics

Panel A of Table 2 presents the distributions of variables measured 1 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 $2.7 billion (bn) (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. Panel B presents summary statistics for the universe of firms. In general, we find that, relative to the universe, acquiring firms are larger and have higher market-to-book ratios, higher institutional ownership, higher share turnover, and more positive past returns.

Panel C of Table 2 presents summary statistics (means in the first row, medians in the second, and standard deviations in the third) for acquiring firms by

accounting fundamentals. Valuation effects that arise from hot industry effects or firm-specific misvaluation have been purged from this measure."

[6] A nice feature of using short interest as a proxy for mispricing is that it can be obtained easily from various data providers and, therefore, is not history or sample dependent, as are the market-to-book misvaluation measures in Rhodes-Kropf et al. (2005).

[7] See Dechow et al. (2001), D'Avolio (2002), Asquith et al. (2005), Nagel (2005), and Diether and Werner (2011).

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transaction payment type; acquirers of public and private targets are presented separately, as is the universe of firms. The sample's composition and characteristics are very similar to those in previous papers such as Dong et al. (2006) and Sinha (2003). Acquirers' average market capitalization for public targets ranges from \$5.3bn for stock deals to \$6.7bn for mixed deals, which is considerably larger than the average of \$1.2bn for the universe of firms. These averages are also much larger than the average market capitalization for acquirers of private targets, which ranges 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, but it

TABLE 2

Summary Statistics

Table 2 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.

Variable	Mean	Std Dev	5%	Q1	Median	Q3	95%
Panel A. Descriptive Statistics for Acquiring Firms at Month $t-1$							
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 (\$bn)	2.671	7.818	0.027	0.142	0.500	1.601	11.533
log(Market Cap) (\$k)	13.131	1.833	10.196	11.866	13.122	14.286	16.261
Market-to-Book	3.479	3.885	0.882	1.559	2.309	3.757	10.130
log(Market-to-Book)	0.922	0.746	−0.126	0.444	0.837	1.324	2.315
MB (Firm)	0.205	0.581	−0.737	−0.132	0.213	0.519	1.156
MB (Sector)	0.133	0.207	−0.187	0.034	0.131	0.230	0.441
MB (Long-run)	0.588	0.575	−0.281	0.151	0.568	1.037	1.485
Institutional Ownership	0.468	0.300	0.000	0.211	0.476	0.706	0.929
Price	26.954	24.005	3.150	12.125	22.800	35.250	63.750
log(Price)	2.948	0.933	1.147	2.495	3.127	3.562	4.155
Turnover	1.697	1.941	0.181	0.543	1.067	2.132	5.247
Past Returns (12 month)	0.376	1.007	−0.438	−0.045	0.193	0.500	1.724
Dividends	0.138	0.345	0.000	0.000	0.000	0.000	1.000
Transaction Value (\$m)	468.469	2,772.620	3.204	14.850	47.435	172.204	1,598.790
Transaction Size	0.258	0.596	0.015	0.041	0.099	0.256	0.959
Announcement Returns	0.009	0.085	−0.100	−0.026	0.003	0.036	0.134
Withdrawn	0.091	0.288	0.000	0.000	0.000	0.000	1.000
Stock Merger	0.294	0.456	0.000	0.000	0.000	1.000	1.000
Mixed Merger	0.363	0.481	0.000	0.000	0.000	1.000	1.000
Cash Merger	0.343	0.475	0.000	0.000	0.000	1.000	1.000
N	8,406						
Panel B. Descriptive Statistics for the Universe of Firm-Months							
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 (\$bn)	1.233	3.191	0.008	0.043	0.167	0.743	6.669
log(Market Cap) (\$k)	12.135	2.036	8.952	10.672	12.028	13.518	15.713
Market-to-Book	3.030	3.942	0.571	1.184	1.860	3.197	9.178
log(Market-to-Book)	0.696	0.844	−0.560	0.169	0.621	1.162	2.217
MB (Firm)	0.078	0.638	−0.932	−0.293	0.070	0.427	1.127
MB (Sector)	0.088	0.216	−0.267	−0.015	0.095	0.200	0.429
MB (Long-run)	0.537	0.670	−0.528	0.075	0.505	1.025	1.594
Institutional Ownership	0.339	0.304	0.000	0.049	0.276	0.579	0.884
Price	19.219	17.675	1.281	5.890	14.500	27.010	54.250
log(Price)	2.455	1.157	0.248	1.773	2.674	3.296	3.994
Turnover	1.287	1.725	0.121	0.381	0.777	1.552	4.123
Past Returns (12 month)	0.178	0.789	−0.610	−0.190	0.076	0.364	1.218
Dividends	0.127	0.333	0.000	0.000	0.000	0.000	1.000
Merger	0.012	0.111	0.000	0.000	0.000	0.000	0.000
Stock Merger	0.004	0.063	0.000	0.000	0.000	0.000	0.000
Mixed Merger	0.004	0.066	0.000	0.000	0.000	0.000	0.000
Cash Merger	0.004	0.064	0.000	0.000	0.000	0.000	0.000
N	971,662						

(continued on next page)

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TABLE 2 (continued)
Summary Statistics

Variable	Acquirers of Public Targets			Acquirers of Private Targets			Universe
	Stock	Mix	Cash	Stock	Mix	Cash	
Panel C. Descriptive Statistics by Acquisition Type at Month t − 1							
Adjusted Short Interest ($t-1$)	0.007	0.005	−0.001	0.007	0.005	0.005	−0.001
	−0.004	−0.005	−0.007	−0.006	−0.008	−0.007	−0.009
	0.031	0.031	0.027	0.034	0.036	0.036	0.031
Market Cap ($bn)	5.339	6.672	6.603	1.621	1.249	1.937	1.233
	1.137	1.645	1.646	0.386	0.262	0.527	0.167
	11.933	13.008	13.045	5.223	4.377	5.595	3.191
Market-to-Book	3.940	3.170	3.150	4.630	3.250	2.930	3.030
	2.470	2.230	2.370	2.570	2.280	2.170	1.860
	4.320	3.300	2.890	5.460	3.480	2.900	3.940
MB (Firm)	0.380	0.310	0.220	0.320	0.120	0.130	0.078
	0.350	0.330	0.200	0.300	0.130	0.100	0.070
	0.540	0.540	0.520	0.600	0.590	0.570	0.638
MB (Sector)	0.150	0.140	0.140	0.140	0.120	0.130	0.088
	0.150	0.140	0.130	0.130	0.120	0.130	0.095
	0.220	0.200	0.160	0.240	0.210	0.190	0.216
MB (Long-run)	0.500	0.440	0.540	0.670	0.640	0.560	0.537
	0.320	0.370	0.590	0.630	0.650	0.570	0.505
	0.570	0.520	0.520	0.620	0.580	0.560	0.670
Institutional Ownership	0.450	0.570	0.570	0.360	0.430	0.530	0.339
	0.440	0.600	0.610	0.330	0.410	0.560	0.276
	0.270	0.280	0.270	0.290	0.300	0.300	0.304
Price	34.390	37.700	33.880	28.190	20.050	26.090	19.219
	30.380	31.050	28.920	24.000	16.130	22.630	14.500
	25.310	34.960	22.930	27.870	17.050	21.040	17.675
Turnover	1.630	1.530	1.490	1.910	1.750	1.610	1.287
	0.910	1.010	0.960	1.050	1.180	1.080	0.777
	2.060	1.580	1.560	2.420	1.960	1.650	1.725
Past Returns (12 month)	0.450	0.250	0.170	0.600	0.380	0.270	0.178
	0.270	0.190	0.150	0.280	0.170	0.160	0.076
	0.940	0.550	0.370	1.580	1.010	0.630	0.789
Dividends	0.194	0.212	0.180	0.128	0.096	0.140	0.127
	0.000	0.000	0.000	0.000	0.000	0.000	0.000
	0.395	0.409	0.384	0.334	0.294	0.348	0.333
Transaction Value ($m)	1,281.790	2,398.560	670.400	99.060	165.540	156.350	
	180.540	423.680	162.980	25.300	31.000	35.000	
	5,512.490	6,780.300	2,027.410	388.070	589.680	677.220	
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%	

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 errors in market-to-book ratios, higher institutional ownership, higher stock prices, slightly lower turnover, and 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 ratios, lower institutional ownership, slightly higher stock prices, higher turnover, and higher past returns.

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Panel C of Table 2 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 acquirers of public (private) targets is 0.70% (0.70%); for cash acquirers of public (private) targets, it is −0.10% (0.50%). We investigate these patterns further in Section III.

III. Empirical Tests

A. Short Interest Prior to Merger Announcements

We begin our empirical tests by investigating the pattern of adjusted short interest around merger announcements by the method of payment. In Graph A of Figure 1, we plot mean adjusted short interest separately for stock, cash, and mixed payments from month $t - 36$ to month $t + 36$ relative to the merger announcement month.

We focus on the preannouncement period, months $t - 36$ to $t - 1$, because we are interested in whether acquirers display over- or undervaluation patterns *before* the merger is announced. As a precursory comment, we note that the spike in adjusted short interest following the announcement is related to merger arbitrage. 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 if the merger is withdrawn (Baker and Savaşoglu (2002)).

Graph A of Figure 1 shows that stock acquirers have positive adjusted short interest throughout the premerger horizon. Until month $t - 15$, the magnitude is relatively stable (around 0.40%); from month $t - 15$ until the announcement month, adjusted short interest increases steadily. In month $t - 1$, adjusted short interest of stock acquirers is approximately 0.70%. For cash acquirers, adjusted short interest is also positive but generally lower in magnitude than the adjusted short interest of mixed and stock acquirers. For cash acquirers, we also observe no marked increase in adjusted short interest at the merger announcement. In an untabulated test, we verify that the adjusted short interest levels are statistically distinct for months −12 to −1, per method of payment.

B. Predicting Mergers and Acquisitions Activity and Payment Type

In this section, we investigate whether valuation considerations (proxied by the degree of current adjusted short interest) determine future acquisition choices. We use probit regressions 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 use adjusted

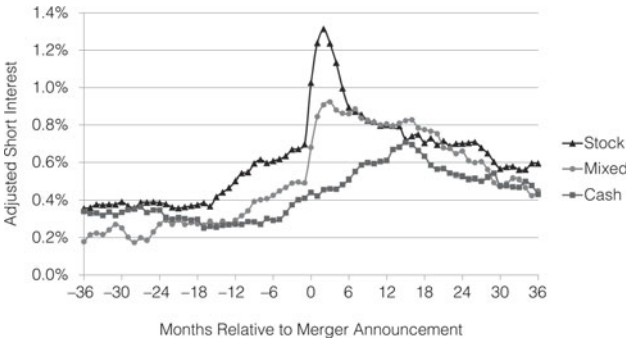
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FIGURE 1

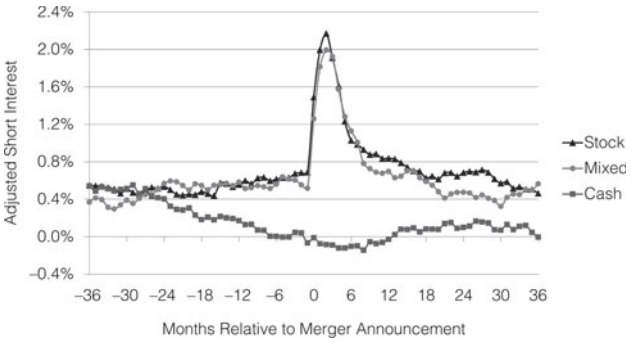
Adjusted Short Interest around Acquisitions

The graphs in Figure 1 plot mean adjusted short interest for acquirers over a 73-month window centered on the merger announcement. The sample includes firms that engaged in an acquisition between 1989 and 2007. The sample in Graph A includes all acquisitions. The sample in Graph B includes acquisitions in which the target is publicly traded. The sample in Graph C includes acquisitions in which the target is privately held.

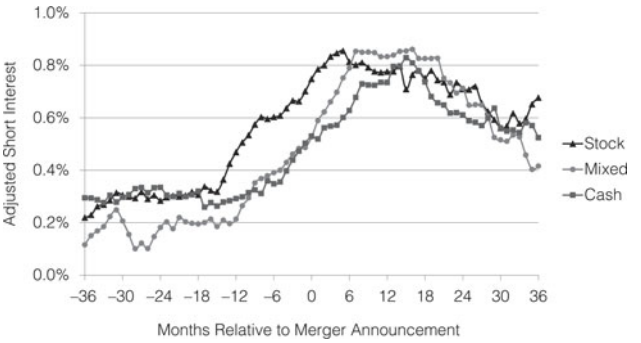
Graph A. Adjusted Short Interest around All Acquisitions



Graph B. Adjusted Short Interest around Acquisitions of Public Targets



Graph C. Adjusted Short Interest around Acquisitions of Private Targets



short interest and control variables, including an indicator variable for past firm acquisitions, the log of market capitalization, institutional holdings, components of the market-to-book ratio, the log of price, turnover, an indicator variable for dividends, and past returns (see Appendix A for definitions). These control

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variables 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 adjusted short interest variable into quintiles and create a set of indicator variables to distinguish the quintile assignment of adjusted 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 Panel A of Table 3, we present the estimation results (marginal effects $\times$ 1,000 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 1–5) and $t-1$ (columns 6–10) relative to the merger announcement month. As in all our tests, standard errors are clustered at the industry level (clustering errors by industry $\times$ year leads to tighter standard errors). As predicted by overvaluation theory, we find, across all model specifications, a monotonic positive association between the quintile assignments of adjusted 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.

We observe that there is overlap in the information captured by the adjusted short interest variables and the Rhodes-Kropf, Robinson, and Viswanathan (RKRV) (2005) variables. When comparing column 4 of Table 3, which includes the RKRV components but not the adjusted short interest quintile indicators, to column 5, which includes the adjusted short interest quintile indicators, we observe that the magnitudes of the coefficients on the RKRV variables decline by 8% to 15%. When the adjusted 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 adjusted short interest indicators and the RKRV 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. 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%[8] higher than for firms in the lowest quintile of adjusted short interest. 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.

One alternative explanation for our findings relates to the fact that some firms are "serial" acquirers. For these firms, short interest could be high in the

[8]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 0.40% (Panel B of Table 2).

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TABLE 3

Can Short Interest Predict Which Firms Become Acquirers?

Table 3 presents probit regression results (marginal effects × 1,000 and standard errors reported in parentheses) 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. *, **, and *** indicate two-tailed significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Stock Acquirers

	Dependent Variable: Stock Acquirer (0/1)									
	Adj. Short Interest: Month $t-6$					Adj. Short Interest: Month $t-1$				
Variables	1	2	3	4	5	6	7	8	9	10
Adj. Short Interest Q2	0.657***		0.655***		0.672***	0.688***		0.672***		0.675***
	(0.231)		(0.231)		(0.228)	(0.219)		(0.217)		(0.216)
Adj. Short Interest Q3	1.143***		1.139***		1.084***	0.769***		0.716***		0.730***
	(0.258)		(0.258)		(0.252)	(0.230)		(0.226)		(0.224)
Adj. Short Interest Q4	1.528***		1.518***		1.388***	1.323***		1.191***		1.205***
	(0.270)		(0.270)		(0.261)	(0.254)		(0.247)		(0.246)
Adj. Short Interest Q5	2.495***		2.469***		2.211***	2.357***		2.055***		2.065***
	(0.310)		(0.309)		(0.295)	(0.286)		(0.271)		(0.27)
Market-to-Book		0.009***	0.008***				0.225***	0.202***		
		(0.001)	(0.001)				(0.019)	(0.019)		
MB (Firm)				1.119***	1.028***				1.116***	1.028***
				(0.088)	(0.089)				(0.088)	(0.088)
MB (Sector)				1.596***	1.770***				1.819***	1.980***
				(0.348)	(0.342)				(0.359)	(0.353)
MB (Long-run)				0.743***	0.632***				0.767***	0.665***
				(0.097)	(0.094)				(0.097)	(0.094)

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TABLE 3 (continued)

Can Short Interest Predict Which Firms Become Acquirers?

Panel A. Stock Acquirers (continued)

	Dependent Variable: Stock Acquirer (0/1)									
	Adj. Short Interest: Month $t-6$					Adj. Short Interest: Month $t-1$				
Variables	1	2	3	4	5	6	7	8	9	10
Past Acquisition	3.763***	3.744***	3.767***	3.766***	3.767***	3.900***	3.955***	3.968***	3.908***	3.913***
	(0.190)	(0.190)	(0.190)	(0.184)	(0.184)	(0.189)	(0.189)	(0.189)	(0.184)	(0.184)
log(Market Cap)	−0.123**	0.004	−0.126***	−0.183***	−0.283***	−0.068	−0.027	−0.122**	−0.135**	−0.222***
	(0.050)	(0.047)	(0.050)	(0.050)	(0.052)	(0.052)	(0.050)	(0.052)	(0.053)	(0.055)
Institutional Ownership	−3.671***	−3.302***	−3.654***	−3.002***	−3.330***	−3.575***	−3.080***	−3.373***	−2.929***	−3.227***
	(0.271)	(0.280)	(0.272)	(0.275)	(0.269)	(0.269)	(0.284)	(0.277)	(0.273)	(0.267)
log(Price)	1.109***	1.070***	1.112***	1.062***	1.080***	1.213***	1.212***	1.234***	1.123***	1.131***
	(0.102)	(0.101)	(0.102)	(0.098)	(0.100)	(0.117)	(0.115)	(0.116)	(0.109)	(0.111)
Turnover	0.142***	0.205***	0.140***	0.162***	0.104***	0.158***	0.174***	0.120***	0.168***	0.112***
	(0.020)	(0.020)	(0.020)	(0.019)	(0.020)	(0.019)	(0.019)	(0.019)	(0.019)	(0.019)
Past Returns (12 month)	0.350***	0.354***	0.348***	0.221***	0.228***	0.412***	0.363***	0.363***	0.308***	0.312***
	(0.040)	(0.043)	(0.040)	(0.046)	(0.043)	(0.040)	(0.041)	(0.040)	(0.041)	(0.040)
Dividends	−0.044	−0.170	−0.037	0.019	0.121	−0.416**	−0.385***	−0.284*	−0.346***	−0.245
	(0.171)	(0.171)	(0.171)	(0.171)	(0.172)	(0.162)	(0.163)	(0.164)	(0.162)	(0.163)
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

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TABLE 3 (continued)

Can Short Interest Predict Which Firms Become Acquirers?

Panel B. Cash Acquirers

	Dependent Variable: Cash Acquirer (0/1)									
	Adj. Short Interest: Month $t-6$					Adj. Short Interest: Month $t-1$				
Variables	1	2	3	4	5	6	7	8	9	10
Adj. Short Interest Q2	0.312		0.314		0.324	−0.127		−0.122		−0.153
	(0.214)		(0.213)		(0.214)	(0.181)		(0.181)		(0.181)
Adj. Short Interest Q3	−0.124		−0.115		−0.090	−0.360**		−0.341*		−0.376**
	(0.206)		(0.206)		(0.207)	(0.181)		(0.182)		(0.183)
Adj. Short Interest Q4	−0.349*		−0.330		−0.328	−0.639***		−0.602***		−0.605***
	(0.205)		(0.206)		(0.206)	(0.173)		(0.174)		(0.176)
Adj. Short Interest Q5	−0.816***		−0.784***		−0.760***	−0.966***		−0.901***		−0.874***
	(0.196)		(0.198)		(0.199)	(0.172)		(0.174)		(0.177)
Market-to-Book		−0.054	−0.044				−0.143***	−0.125***		
		(0.040)	(0.036)				(0.032)	(0.031)		
MB (Firm)				−0.310***	−0.245***				−0.475***	−0.423***
				(0.108)	(0.107)				(0.102)	(0.102)
MB (Sector)				0.985***	0.918***				0.999***	0.899***
				(0.289)	(0.288)				(0.275)	(0.275)
MB (Long-run)				0.326***	0.356***				0.346***	0.377***
				(0.091)	(0.091)				(0.087)	(0.088)
Past Acquisition	2.858***	2.858***	2.835***	2.920***	2.896***	2.940***	2.906***	2.894***	2.984***	2.973***
	(0.144)	(0.146)	(0.144)	(0.146)	(0.145)	(0.141)	(0.141)	(0.140)	(0.142)	(0.142)

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TABLE 3 (continued)

Can Short Interest Predict Which Firms Become Acquirers?

Panel B. Cash Acquirers (continued)

	Dependent Variable: Cash Acquirer (0/1)									
	Adj. Short Interest: Month $t-6$					Adj. Short Interest: Month $t-1$				
Variables	1	2	3	4	5	6	7	8	9	10
log(Market Cap)	−0.047	−0.060	−0.037	−0.043	−0.029	−0.087*	−0.103**	−0.063	−0.063	−0.029
	(0.048)	(0.047)	(0.049)	(0.050)	(0.051)	(0.048)	(0.046)	(0.047)	(0.049)	(0.050)
Institutional Ownership	4.473***	4.183***	4.418***	4.249***	4.470***	4.401***	4.075***	4.301***	4.156***	4.354***
	(0.227)	(0.224)	(0.229)	(0.226)	(0.230)	(0.216)	(0.211)	(0.215)	(0.216)	(0.219)
log(Price)	0.574***	0.564***	0.569***	0.521***	0.534***	0.775***	0.773***	0.766***	0.694***	0.696***
	(0.086)	(0.087)	(0.086)	(0.089)	(0.087)	(0.086)	(0.087)	(0.086)	(0.090)	(0.089)
Turnover	0.091***	0.043	0.100***	−0.005	0.060**	0.071***	0.045*	0.095***	−0.029	0.031
	(0.024)	(0.027)	(0.023)	(0.030)	(0.026)	(0.024)	(0.026)	(0.022)	(0.030)	(0.028)
Past Returns (12 month)	0.170***	0.197***	0.181***	0.170***	0.150**	0.070	0.103*	0.091	0.074	0.061
	(0.055)	(0.054)	(0.055)	(0.058)	(0.059)	(0.057)	(0.056)	(0.057)	(0.059)	(0.060)
Dividends	−0.155	−0.132	−0.175	−0.064	−0.101	−0.524***	−0.538***	−0.567***	−0.465***	−0.489***
	(0.158)	(0.160)	(0.158)	(0.162)	(0.160)	(0.145)	(0.145)	(0.143)	(0.147)	(0.146)
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

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preannouncement period due to increases in short interest following prior acquisitions. We test this alternative explanation (results untabulated) by retaining only the first acquisition of each acquirer in our sample; we find that our reported results hold.

In Panel B of Table 3, we present results from predicting cash acquisitions. The results reveal a monotonic decrease in the likelihood of cash acquisitions as adjusted short interest increases. As an illustration of the magnitude, at month $t-1$, we find that 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 22.5%[9] lower than for firms in the lowest quintile of adjusted short interest. 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 adjusted short interest) is positively (negatively) associated with stock acquisitions (cash acquisitions). Note that for both Panels A and B of Table 3, 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 et al. (2005). This suggests that the adjusted short interest variable contains information that is not impounded in previously used measures of valuation.

C. 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 preannouncement adjusted short interest and acquirer returns around the announcement or in the period 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 preannouncement adjusted short interest. In Table 4, we regress market-adjusted merger announcement returns on the quintiles of adjusted short interest (measured at month $t-1$) and the following control variables: the log of market capitalization, institutional ownership, the components of the market-to-book ratio, the log of price, turnover, 12-month past returns, stock and mixed payment indicators, transaction size, a diversifying merger indicator (equal to 1 if the acquirer and target are not in the same Fama–French (1997) 48 industry classification), a public target indicator, a withdrawn indicator, an ex-dividend date indicator, and industry-fixed effects $\times$ year-fixed effects. These control variables are commonly used in studies of merger announcement returns.[10] In columns 1 and 2, we find no evidence of a monotonic or meaningful relation between premerger adjusted short interest and merger announcement returns.

[9]The marginal effect of Q5 is -0.09% (column 10), while the unconditional probability of engaging in a cash merger is 0.40% (Panel B of Table 2).

[10]For example, see Fuller, Netter, and Stegemoller (2002), Moeller et al. (2004), and Masulis, Wang, and Xie (2007).

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TABLE 4

Announcement Returns and Preannouncement Short Interest

Table 4 presents regression results (coefficients and standard errors reported) explaining merger announcement returns. The sample includes firms that engaged in an acquisition between 1989 and 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-fixed effects (Fama–French (1997) 48 industries) interacted with year-fixed effects (not reported for parsimony). Standard errors are robust to industry clustering using the Fama–French 48 classification scheme. *, **, and *** indicate two-tailed significance at the 10%, 5%, and 1% levels, respectively.

	Market-Adjusted Announcement Returns (−1, +1)			
	Sample			
	All	All	Stock Only	Cash Only
Variables	1	2	3	4
Adjusted Short Interest ($t-1$) Q2	−0.001	−0.000	−0.000	−0.003
	(0.003)	(0.003)	(0.004)	(0.004)
Adjusted Short Interest ($t-1$) Q3	0.001	0.001	0.010	−0.002
	(0.004)	(0.004)	(0.008)	(0.004)
Adjusted Short Interest ($t-1$) Q4	0.000	0.000	0.018**	−0.006
	(0.005)	(0.005)	(0.008)	(0.004)
Adjusted Short Interest ($t-1$) Q5	−0.002	−0.001	0.006	−0.003
	(0.004)	(0.004)	(0.007)	(0.005)
Stock Merger		−0.008**		
		(0.003)		
Mixed Merger		−0.004*		
		(0.002)		
log(Market Cap)	−0.003**	−0.003**	−0.004	−0.000
	(0.001)	(0.001)	(0.003)	(0.001)
Institutional Ownership	0.005*	0.004	−0.003	0.005
	(0.003)	(0.003)	(0.008)	(0.008)
MB (Firm)	0.002	0.002	0.002	0.000
	(0.003)	(0.003)	(0.009)	(0.007)
MB (Sector)	−0.011	−0.011	−0.008	0.002
	(0.008)	(0.008)	(0.025)	(0.011)
MB (Long-run)	0.003	0.004	0.005	0.003
	(0.002)	(0.002)	(0.005)	(0.005)
log(Price)	−0.010***	−0.010***	−0.012**	−0.009**
	(0.003)	(0.003)	(0.005)	(0.004)
Turnover	0.001	0.001	0.003	0.001
	(0.001)	(0.001)	(0.002)	(0.001)
Past Returns	0.002	0.002	0.001	−0.001
	(0.002)	(0.002)	(0.002)	(0.003)
Transaction Size	−0.004	−0.004	−0.011	0.024**
	(0.004)	(0.004)	(0.014)	(0.010)
Diversifying	0.004	0.004	0.015**	0.001
	(0.003)	(0.003)	(0.006)	(0.002)
Public Target	−0.023***	−0.022***	−0.031***	−0.004
	(0.004)	(0.004)	(0.010)	(0.003)
Withdrawn	−0.004	−0.004	−0.002	−0.008
	(0.004)	(0.004)	(0.010)	(0.005)
Dividends	0.002	0.001	0.011*	−0.005
	(0.004)	(0.004)	(0.006)	(0.004)
Industry-Fixed Effects × 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

Second, we explore the relation between preannouncement adjusted short interest (measured at month $t-1$) and acquirer long-term returns using a monthly calendar-time portfolio approach. We first replicate results from previous studies (Mitchell and Stafford (2000), Ben-David and Roulstone (2010)) and then

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verify 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 0. These results are presented in Panel A (3-factor model) and Panel B (4-factor model) of Table 5.

TABLE 5

Calendar-Time Portfolios, by Method of Payment

Table 5 presents calendar-time portfolio regression results (intercepts and standard errors reported) explaining postmerger announcement returns. The sample includes firms that engaged in an acquisition between 1989 and 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 1 month after the merger announcement and stay for the number of months specified in the columns (the horizon). A portfolio-month must have 10 or more stocks to be included in the analysis. Monthly portfolio returns are regressed on 3-factor (Panel A) or 4-factor (Panel B) models. *, **, and *** indicate two-tailed significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Intercepts from Calendar-Time Portfolios (3 factors)

	3-Factor Alphas over . . .					
	Equal-Weighting			Value-Weighting		
	Months					
Payment	6	12	24	6	12	24
All	−27.3***	−28.7***	−33.9***	7.2	−4.0	−5.4
	(9.1)	(9.2)	(9.8)	(9.5)	(7.3)	(5.3)
Stock	−97.3***	−76.0***	−58.1***	−44.3**	−37.7**	−31.7**
	(18.7)	(16.6)	(16.7)	(20.3)	(16.2)	(12.3)
Mixed	−37.0***	−40.7***	−53.1***	−11.8	−25.9**	−31.7***
	(13.5)	(12.7)	(12.4)	(13.4)	(11.2)	(8.9)
Cash	5.9	0.8	−6.7	1.5	−4.0	4.4
	(12.0)	(9.4)	(8.7)	(14.4)	(11.3)	(8.9)
Stock − Cash	−103.8***	−77.2***	−51.8***	−47.8*	−34.8*	−37.0**
	(22.5)	(18.2)	(16.0)	(25.1)	(20.6)	(16.3)
Avg. no. of months	299.3	299.3	299.3	299.3	299.3	299.3
Avg. no. of firms in portfolio	137.3	246.0	406.5	137.3	246.0	406.5

Panel B. Intercepts from Calendar-Time Portfolios (4 factors)

	4-Factor Alphas over . . .					
	Equal-Weighting			Value-Weighting		
	Months					
Payment	6	12	24	6	12	24
All	−13.1	−9.2	−8.3	−7.1	−11.5	−7.6
	(8.8)	(8.4)	(8.2)	(9.3)	(7.3)	(5.5)
Stock	−78.4***	−46.8***	−19.2	−57.4***	−42.4**	−31.0**
	(18.6)	(15.4)	(14.1)	(20.7)	(16.6)	(12.6)
Mixed	−16.9	−17.2	−24.4**	−16.3	−28.8**	−30.9***
	(13.1)	(11.9)	(10.9)	(13.8)	(11.6)	(9.2)
Cash	15.9	10.9	7.4	−5.1	−9.2	2.4
	(12.0)	(9.3)	(8.2)	(14.7)	(11.6)	(9.2)
Stock − Cash	−95.4***	−58.7***	−27.7*	−55.0**	−34.5	−34.6**
	(23.1)	(18.1)	(15.3)	(25.8)	(21.2)	(16.8)
Avg. no. of months	299.3	299.3	299.3	299.3	299.3	299.3
Avg. no. of firms in portfolio	137.3	246.0	406.5	137.3	246.0	406.5

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 horizons of 6, 12, or 24 months, starting 1 month after the merger announcement. For each portfolio, we create a time series of the monthly returns for months that have at least 10 firms (consistent with Moeller et al. (2004)).

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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 or on a 4-factor model including the Carhart (1997) momentum factor. The intercepts from the regressions reflect the average monthly abnormal returns that are not explained by the pricing factors. For further information on this methodology, see Mitchell and Stafford (2000) and Andrade, Mitchell, and Stafford (2001).

Table 6 presents the intercepts from the regressions in monthly basis points. We present the 3-factor model results in Panel A and the 4-factor model results in Panel B. The left-side columns in each panel weight firms in the portfolio equally, and 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 adjusted short interest. (We combine quintiles due to the small

TABLE 6

Preannouncement Adjusted Short Interest and Postannouncement Returns

Table 6 presents calendar-time portfolio regression results (intercepts and standard errors reported) explaining postmerger announcement returns. The sample includes firms that engaged in an acquisition between 1989 and 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 1 month after the merger announcement and stay for the number of months specified in the columns (the horizon). A portfolio-month must have 10 or more stocks to be included in the analysis. Monthly portfolio returns are regressed on 3-factor (Panel A) or 4-factor (Panel B) models. *, **, and *** indicate two-tailed significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Intercepts from Calendar-Time Portfolios (3 factors)

			3-Factor Alphas over . . .					
			Equal-Weighting			Value-Weighting		
			Months					
Payment	Adjusted Short Interest of Acquirers ($t - 1$)	No. of Acquirers	6	12	24	6	12	24
All	Q1	477	63.2*	58.5**	34.3	27.8	2.6	−19.1
			(36.3)	(26.3)	(23.0)	(39.0)	(31.3)	(26.8)
	Q2	807	27.8	12.9	9.9	35.0	−8.5	−4.6
			(22.5)	(17.7)	(14.5)	(21.2)	(18.5)	(15.1)
	Q3	1,091	−15.5	−0.2	3.4	−9.6	−9.4	−10.2
			(15.8)	(17.3)	(14.7)	(23.9)	(19.2)	(16.9)
	Q4	1,306	−40.8***	−47.9***	−31.0**	−24.2	−12.9	−9.6
			(15.7)	(13.0)	(12.7)	(22.7)	(16.6)	(13.5)
	Q5	1,462	−49.0***	−25.8	−16.2	8.8	0.3	−7.9
			(18.4)	(16.2)	(16.6)	(22.6)	(19.7)	(16.5)
Avg. no. of months			190.7	222.7	228.7	190.7	222.7	228.7
Avg. no. of firms in portfolio			32.1	53.8	90.7	32.1	53.8	90.7
Stock	Q1 + Q2	396	−3.4	−10.0	4.4	−20.4	−17.2	−20.9
			(43.1)	(30.3)	(24.2)	(42.6)	(32.1)	(24.0)
	Q3	279	−44.1	−24.7	0.1	−29.6	0.6	2.6
			(44.8)	(32.0)	(25.7)	(59.3)	(39.8)	(28.2)
	Q4 + Q5	873	−66.5**	−40.5*	−24.5	−23.0	−13.4	−13.3
			(27.9)	(22.6)	(21.3)	(30.0)	(27.0)	(20.6)
Avg. no. of months			110.5	166.0	209.8	110.5	166.0	209.8
Avg. no. of firms in portfolio			22.9	32.5	47.0	22.9	32.5	47.0
Cash	Q1 + Q2	423	89.1***	45.8**	45.2**	50.2	−8.2	14.5
			(30.6)	(23.2)	(19.7)	(33.0)	(27.9)	(21.3)
	Q3	391	−37.8	24.0	17.0	−35.7	12.8	16.0
			(27.2)	(18.9)	(15.9)	(39.3)	(27.2)	(20.4)
	Q4 + Q5	915	−38.4**	−29.1*	−13.7	−54.8**	−18.1	3.9
			(19.1)	(15.6)	(14.8)	(26.5)	(19.9)	(16.1)
Avg. no. of months			151.0	193.8	220.0	151.0	193.8	220.0
Avg. no. of firms in portfolio			22.2	36.6	58.4	22.2	36.6	58.4

(continued on next page)

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TABLE 6 (continued)

Preannouncement Adjusted Short Interest and Postannouncement Returns

Panel B. Intercepts from Calendar-Time Portfolios (4 factors)

			4-Factor Alphas over . . .					
			Equal-Weighting			Value-Weighting		
			Months					
Payment	Adjusted Short Interest of Acquirers ($t-1$)	No. of Acquirers	6	12	24	6	12	24
All	Q1	477	74.2**	79.2***	58.8**	17.6	−1.3	−8.3
			(37.1)	(26.4)	(22.7)	(39.9)	(32.2)	(27.5)
	Q2	807	40.7*	23.8	21.8	32.5	−12.8	−7.6
			(22.8)	(18.1)	(14.6)	(21.8)	(19.1)	(15.6)
	Q3	1,091	−0.9	24.5	28.5**	−3.7	−1.6	−5.5
			(15.8)	(16.5)	(13.4)	(24.7)	(19.7)	(17.4)
	Q4	1,306	−35.2**	−34.7***	−5.6	−44.0*	−22.1	−11.9
			(16.1)	(13.0)	(11.1)	(22.6)	(16.9)	(13.9)
	Q5	1,462	−35.6*	−1.8	20.0	−3.8	−8.4	−5.9
			(18.6)	(15.4)	(14.1)	(23.0)	(20.2)	(17.0)
Avg. no. of months			190.7	222.7	228.7	190.7	222.7	228.7
Avg. no. of firms in portfolio			32.1	53.8	90.7	32.1	53.8	90.7
Stock	Q1 + Q2	396	17.5	12.3	28.6	−21.9	−19.8	−20.1
			(44.0)	(30.6)	(23.8)	(44.2)	(33.3)	(24.7)
	Q3	279	−21.0	−9.5	22.1	−52.4	−1.2	7.7
			(45.4)	(32.1)	(25.2)	(60.7)	(40.8)	(28.9)
	Q4 + Q5	873	−65.1**	−18.6	10.7	−48.6	−24.9	−16.6
			(28.8)	(22.4)	(19.4)	(29.7)	(27.6)	(21.2)
Avg. no. of months			110.5	166.0	209.8	110.5	166.0	209.8
Avg. no. of firms in portfolio			22.9	32.5	47.0	22.9	32.5	47.0
Cash	Q1 + Q2	423	92.9***	57.0**	55.7***	50.1	−6.8	19.4
			(31.0)	(23.4)	(19.9)	(33.5)	(28.6)	(21.8)
	Q3	391	−26.2	34.3*	28.0*	−34.9	18.9	20.0
			(27.4)	(19.1)	(16.1)	(40.4)	(27.8)	(21.0)
	Q4 + Q5	915	−23.9	−11.2	14.4	−52.5*	−13.6	10.5
			(19.0)	(15.3)	(13.1)	(27.2)	(20.5)	(16.5)
Avg. no. of months			151.0	193.8	220.0	151.0	193.8	220.0
Avg. no. of firms in portfolio			22.2	36.6	58.4	22.2	36.6	58.4

number of observations.) Specifically, abnormal returns for the top two quintiles (Q4 and Q5) of adjusted short interest are abnormally negative.

The results polarize once we split the sample by payment type. For stock acquirers, we find that portfolios with high adjusted short interest underperform following the acquisition. The magnitude of the average decline in value for the high adjusted short interest stock acquirers is −4.0% (−66.5 bps × 6) over the 6-month horizon. Cash acquirers with high adjusted short interest also underperform; however, the average decline in value for these firms is only −2.3% (−38.4 bps × 6) over the 6-month horizon. We also note that low adjusted short interest cash acquirers outperform by about 5.3% (89.1 bps × 6) in the first 6 months. This outperformance is consistent with theories suggesting that undervalued acquirers prefer cash as the medium of payment.

The results are weaker for the 4-factor model alphas (Panel B of Table 6), but for stock acquirers with high adjusted short interest, we again find that these firms underperform in the 6 months following the acquisition, with an average decline in value of −3.9% (−65.1 bps × 6). When the portfolios are value weighted (right columns of Panels A and B), the abnormal return patterns disappear almost

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entirely. The fact that value-weighted returns are 0 suggests that the results for the equal-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. 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- versus value-weighted results.

Overall, these results suggest that stock acquirers with high adjusted short interest (especially small acquirers) underperform after the merger announcement and that cash acquirers with low adjusted short interest outperform following the announcement. This evidence supports our hypothesis that firms self-select based on their degree of overvaluation to engage in stock or cash mergers.

D. Returns of Acquirers versus Nonacquirers

An important question is whether acquirers exhibit abnormal returns that are statistically different from the returns of nonacquirers with the same level of short interest. In particular and as discussed in Section I, prior research provides evidence that firms with high short interest underperform in the future (e.g., Asquith and Meulbroek (1995), Asquith et al. (2005)). In other words, is there anything unique about the overvaluation signal embedded in short interest for acquirers versus nonacquirers? If short interest is a sufficient statistic for acquirer misvaluation, that is, there is no additional information about misvaluation that is not correlated with short interest, then one would expect that the performance of acquirers and nonacquirers per short interest level would be indistinguishable. If, however, short interest is not a sufficient statistic for acquirer misvaluation, then one would expect to observe a difference in the performance of acquirers and nonacquirers for a given level of short interest. We empirically investigate this issue by comparing the abnormal performance of acquirers and nonacquirers, controlling for their level of adjusted short interest.

To determine whether the alphas of acquirers are statistically different from those of nonacquirers, we perform the following test. Instead of using only the sample of calendar-time portfolios based on acquirers, we add to the sample a series of calendar-time portfolios based on nonacquirers (restricted to the relevant adjusted short interest quintile). Therefore, this sample has twice as many portfolio-months.

For each adjusted short interest quintile in our sample, we run the following calendar-time regression, which captures the differences between the alphas of the acquirers and those of the universe of firms:

$$r_{i,t} - r_f = \alpha + \beta I\,(\text{Acquirer}_i) + \gamma_1 \text{MKT} + \gamma_2 \text{SMB} + \gamma_3 \text{HML} + \gamma_4 \text{MOM} + \varepsilon,$$

where $I(\text{Acquirer}_i)$ is an indicator for whether the observation is part of the acquirer-based calendar-time portfolios (as opposed to being part of the nonacquirer-based calendar-time portfolios). In Panels A and B of Table 7, we present the coefficients on $I(\text{Acquirer}_i)$ for regressions with 3 and 4 factors, respectively. The results in the panels show that none of the acquirer indicators

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is statistically different from 0, although 80 of the 132 coefficients presented are negative.

These results suggest that short interest is a sufficient statistic for the over- or undervaluation of acquirers. The somewhat negative coefficients indicate that acquirers could be at the extreme levels of valuations within each short interest bin. Overall, our findings are consistent with previous papers that have documented underperformance of stock acquirers and overperformance of cash

TABLE 7

Postannouncement Returns of Acquirers versus Nonacquirers

Table 7 presents calendar-time portfolio regression results testing whether acquirers have different returns from those of nonacquirers with the same short interest level. For each short interest quintile, we run the following calendar-time regression:

$$r_{i,t} - r_f = \alpha + \beta I(\text{Acquirer}_i) + \gamma_1 \text{MKT} + \gamma_2 \text{SMB} + \gamma_3 \text{HML} + \gamma_4 \text{MOM} + \varepsilon,$$

where $I(\text{Acquirer}_i)$ is an indicator of whether the observation belongs to an acquirer (as opposed to a nonacquirer). The table reports the coefficients of the acquirer indicator and standard errors. The sample includes firms that engaged in an acquisition between 1989 and 2007. Adjusted short interest is measured in month $t - 1$ relative to the first month of the returns. Quintiles of short interest are assigned on each calendar month. Acquirers enter a portfolio 1 month after the merger announcement and stay for the number of months specified in the columns (the horizon). A portfolio-month must have 10 or more stocks to be included in the analysis. Monthly portfolio returns are regressed on 3-factor (Panel A, excluding momentum) or 4-factor (Panel B) models. *, **, and *** indicate two-tailed significance at the 10%, 5%, and 1% levels, respectively.

Panel A. Intercepts from Calendar-Time Portfolios (3 factors)

		3-Factor *I*(Acquirer) = alpha(Acquirer) − alpha(Nonacquirer) over . . .					
		Equal-Weighting			Value-Weighting		
		Months					
Payment	Short Interest of Acquirers ($t-1$)	6	12	24	6	12	24
All	Q1	41.2	9.9	−0.7	12.7	−23.6	−39.6
		(32.2)	(26.6)	(23.0)	(31.8)	(31.2)	(24.8)
	Q2	−5.5	16.1	1.0	−2.0	11.6	9.6
		(26.1)	(22.6)	(18.4)	(21.8)	(19.9)	(17.4)
	Q3	−16.1	−3.8	−10.0	−7.9	−16.9	−0.3
		(20.1)	(20.3)	(17.4)	(26.1)	(20.3)	(18.0)
	Q4	−23.5	−20.9	−14.7	−9.4	−8.5	−16.0
		(16.9)	(17.0)	(16.1)	(18.4)	(16.6)	(16.4)
	Q5	10.6	10.1	−2.1	−4.9	−6.2	−25.4
		(22.3)	(21.5)	(21.0)	(25.4)	(26.2)	(26.3)
Avg. no. of months		432	444	448	432	444	448
Avg. no. of firms in portfolio		4,332	8,276	15,999	4,332	8,276	15,999
Stock	Q1 + Q2	−26.6	−28.4	−14.6	13.1	−7.5	−14.0
		(41.3)	(31.3)	(24.3)	(34.3)	(24.8)	(21.7)
	Q3	−36.1	−5.2	−10.1	−2.7	−2.4	4.2
		(37.3)	(29.7)	(22.2)	(37.6)	(27.1)	(24.0)
	Q4 + Q5	−26.7	−8.8	−15.7	−29.3	−10.1	−7.4
		(26.0)	(23.5)	(23.2)	(29.8)	(28.1)	(26.9)
Avg. no. of months		146.0	199.3	218.7	146.0	199.3	218.7
Avg. no. of firms in portfolio		27.5	46.6	88.8	27.5	46.6	88.8
Cash	Q1 + Q2	12.4	23.3	10.6	35.6	14.4	4.5
		(29.9)	(25.1)	(20.9)	(34.1)	(29.5)	(23.7)
	Q3	3.2	4.2	−10.8	8.3	−15.5	−8.0
		(33.5)	(24.8)	(20.2)	(39.2)	(31.8)	(24.5)
	Q4 + Q5	41.9	21.9	13.4	33.3	15.1	21.4
		(23.1)	(19.5)	(18.2)	(21.5)	(18.4)	(16.1)
Avg. no. of months		180.0	203.0	220.0	180.0	203.0	220.0
Avg. no. of firms in portfolio		28.7	53.5	98.8	28.7	53.5	98.8

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TABLE 7 (continued)

Postannouncement Returns of Acquirers versus Nonacquirers

Panel B. Intercepts from Calendar-Time Portfolios (4 factors)

		4-Factor *I*(Acquirer) = alpha(Acquirer) − alpha(Nonacquirer) over . . .					
		Equal-Weighting			Value-Weighting		
		Months					
Payment	Short Interest of Acquirers ($t-1$)	6	12	24	6	12	24
All	Q1	40.5	8.6	−1.6	12.5	−24.2	−40.2
		(31.3)	(25.8)	(22.2)	(31.8)	(31.1)	(24.5)
	Q2	−7.0	15.4	0.3	−2.2	11.4	9.2
		(24.9)	(21.7)	(17.6)	(21.8)	(19.8)	(17.0)
	Q3	−16.8	−4.3	−10.5	−8.2	−17.1	−0.6
		(19.1)	(18.1)	(15.2)	(26.0)	(19.9)	(17.3)
	Q4	−24.2	−21.4	−15.2	−9.2	−8.6	−16.3
		(15.6)	(13.8)	(12.5)	(18.4)	(16.1)	(14.8)
	Q5	9.7	9.7	−2.5	−5.3	−6.5	−25.8
		(19.6)	(17.6)	(16.2)	(25.0)	(24.3)	(22.5)
Avg. no. of months		432	444	448	432	444	448
Avg. no. of firms in portfolio		4,332	8,276	15,999	4,332	8,276	15,999
Stock	Q1 + Q2	−26.8	−28.4	−14.6	13.0	−7.5	−14.0
		(40.7)	(30.8)	(23.7)	(34.3)	(24.8)	(21.6)
	Q3	−37.1	−6.4	−10.3	−3.2	−2.7	4.1
		(36.5)	(27.8)	(20.7)	(37.4)	(26.9)	(23.7)
	Q4 + Q5	−26.7	−8.8	−15.7	−29.3	−10.1	−7.4
		(25.3)	(20.9)	(19.4)	(29.8)	(27.5)	(25.0)
Avg. no. of months		146.0	199.3	218.7	146.0	199.3	218.7
Avg. no. of firms in portfolio		27.5	46.6	88.8	27.5	46.6	88.8
Cash	Q1 + Q2	12.2	23.1	10.4	35.6	14.4	4.4
		(29.2)	(24.5)	(20.3)	(34.1)	(29.6)	(23.5)
	Q3	2.8	4.2	−10.8	8.1	−15.5	−8.0
		(33.1)	(24.0)	(18.9)	(39.1)	(31.4)	(23.9)
	Q4 + Q5	41.9	21.9	13.4	33.3	15.1	21.4
		(20.6)	(16.7)	(15.2)	(21.5)	(17.7)	(14.5)
Avg. no. of months		180.0	203.0	220.0	180.0	203.0	220.0
Avg. no. of firms in portfolio		28.7	53.5	98.8	28.7	53.5	98.8

acquirers. Our results further show that these performance differences are well captured by short interest, suggesting they are driven by misvaluation.

E. 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 to exchange their overvalued stock for the targets' less overvalued assets. In contrast, Q-theory suggests that acquirers have higher valuation than their targets because their growth opportunities are higher.

We examine these hypotheses in Table 8, in which we restrict the sample to mergers whose targets are public firms (short interest is observable only for these targets). Our sample size is smaller than that of Rhodes-Kropf et al. (2005) because of the data restrictions we impose on our sample. As described in Section II.A, we apply the data restrictions used in Moeller et al. (2004). We further require short interest for each target.

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TABLE 8

Descriptive Statistics for Public Acquirers versus Targets

Table 8 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 in parentheses. For variable definitions, see Appendix A. The variables in each column are measured at month $t - 1$. *, **, and *** indicate two-tailed significance at the 10%, 5%, and 1% levels, respectively, using *t*-tests.

Variables	Acquirers 1	Targets 2	Difference 3
Panel A. Means and Standard Errors of Overvaluation Proxies for Stock Mergers			
Adjusted Short Interest ($t - 1$)	0.007	−0.002	0.008***
	(0.001)	(0.001)	(0.002)
Market-to-Book ($t - 1$)	3.948	3.227	0.721***
	(0.149)	(0.154)	(0.214)
MB (Firm) ($t - 1$)	0.373	0.125	0.248***
	(0.020)	(0.022)	(0.030)
MB (Sector) ($t - 1$)	0.155	0.128	0.027**
	(0.008)	(0.008)	(0.011)
MB (Long-run) ($t - 1$)	0.528	0.540	−0.011
	(0.021)	(0.023)	(0.031)
N	715		
Panel B. Means and Standard Errors of Overvaluation Proxies for Cash Mergers			
Adjusted Short Interest ($t - 1$)	−0.002	0.000	−0.002
	(0.001)	(0.001)	(0.002)
Market-to-Book ($t - 1$)	3.292	2.640	0.652***
	(0.114)	(0.117)	(0.229)
MB (Firm) ($t - 1$)	0.212	−0.049	0.261***
	(0.020)	(0.022)	(0.042)
MB (Sector) ($t - 1$)	0.153	0.113	0.039***
	(0.006)	(0.008)	(0.014)
MB (Long-run) ($t - 1$)	0.575	0.595	−0.020
	(0.020)	(0.023)	(0.042)
N	364		

Panels A and B of Table 8 report means for adjusted short interest along with the market-to-book ratio and the Rhodes-Kropf et al. (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 the difference (the standard error of the difference is in parentheses).

As theory predicts, Panel A of Table 8 reveals that adjusted short interest is significantly higher for stock 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 (Panel B of Table 8), in comparison, adjusted 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 of Table 8 also provides evidence supporting our conjecture that short interest is a cleaner proxy for over- or undervaluation. Specifically, in Panel B, the firm- and industry-level components of the market-to-book ratio

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indicate that cash acquirers are more "overvalued" than their targets; yet the long-term component is not statistically distinct between cash acquirers and their 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. This result is similar to the results of Rhodes-Kropf et al. (2005), who find that both stock and cash acquirers are overvalued relative to their targets.

One additional implication of Q-theory can be tested in Table 8. 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 Panel B of Table 2). In contrast, cash acquirers choose targets whose market-to-book ratios are much lower than that of the average firm. The contrast between stock and cash targets' market-to-book ratios is even higher for the firm-specific error in the market-to-book ratio: The 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)). Taken together, the evidence in Table 8 supports the idea that stock acquirers are motivated by overvaluation, while cash acquirers are motivated by fundamental growth opportunities.

IV. Alternative Explanations

Our tests provide evidence that short interest is predictive of firms' merger choices and is associated with postmerger 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 Sections IV.A and IV.B, we consider two intuitive alternative explanations for our results and assess their viability.

A. Merger Arbitrage Ahead of the Announcement

As discussed earlier, merger announcements allow traders to engage in merger arbitrage: buying targets and short selling acquirers. Graph A of Figure 1 shows strong evidence for merger arbitrage with adjusted short interest spiking at the announcement. One alternative explanation for our results is that traders anticipate merger announcements and begin shorting potential acquirers ahead of such announcements. Boone and Mulherin (2007) find that in the premerger period investment, banks court various targets, while Cai, Song, and Walking (2011) find that information about future mergers tends to leak to the market. Hence, short sellers may know that a merger is on its way. Thus, the buildup in adjusted short interest prior to the merger announcement may reflect traders anticipating the

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opportunity for merger arbitrage and may not necessarily reflect traders' beliefs that these firms are overvalued.

If this explanation is valid, we should see two empirical regularities at the announcement: i) a sharp increase in the shorting of acquirers of public targets (for whom merger arbitrage can now begin in earnest) and ii) a drop in the adjusted short interest of acquirers of private targets (for whom merger arbitrage is impossible). Graph B of Figure 1 examines adjusted short interest around acquisitions of public targets and confirms the rise in short interest for stock and mixed acquirers. However, Graph C, which examines the adjusted short interest of acquirers of private targets, fails to show the expected drop in short interest for these acquirers. In fact, the adjusted short interest of acquirers of private targets increases following the merger announcement. The results in Graphs B and C 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.

We use a multivariate regression to verify that the levels of adjusted short interest in Graphs B and C of Figure 1 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 afterward (results untabulated). These results suggest that short interest positions taken in advance of stock and mixed-payment acquisitions of private targets are not driven by anticipated opportunities for merger arbitrage.

B. Hedging Explanation for Short Selling

A second alternative explanation is that short interest reflects long–short hedging activity rather than a consensus that a firm is overvalued. For example, investors engaged in pairs trading go long in undervalued firms and hedge themselves by shorting fairly valued firms (Dechow et al. (2001)). 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 results from Table 3 (which investigates the ability of adjusted 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, because idiosyncratic firms are unsuited for hedging strategies. For our purposes, if the relation between adjusted short interest and future acquisitions is found among idiosyncratic stocks, it is evidence that short sellers are actively targeting specific firms and not just shorting as a hedging strategy. In addition, given that idiosyncratic firms are difficult to arbitrage, it is likely that these firms would be mispriced and, thus, potentially would 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 or 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 (similar to the analysis in Table 3). We find a nearly monotonic relation between the likelihood of a stock merger and the degree of premerger adjusted short interest for both high- and low-idiosyncratic-risk stocks (results untabulated). 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 of engaging in cash acquisitions and adjusted short interest is not moderated by the level of idiosyncratic risk. Thus, the evidence suggests that it is unlikely that short sellers are taking material short positions in acquirers-to-be as part of a pairs trading strategy.

V. Conclusion

In this paper, we use short interest to identify misvaluation 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 find that stock acquirers with high short interest underperform following the merger announcement, while cash acquirers with low short interest outperform following the merger announcement. Finally, we show that short interest is significantly higher for stock acquirers than for their targets; in contrast, short interest is not significantly different between cash acquirers and their targets. The latter result is important because analysis using market-to-book ratios comes to a different conclusion, possibly because the market-to-book ratio is confounded by the firm's growth opportunities.

We consider alternative explanations for the relation between short interest and acquisitions; however, we do not 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 we find that the higher the level of short interest, the greater stock acquirers underperform following the merger. Consistent with Q-theory, cash acquirers have low short interest, and we find that the lower the level of short interest, the more cash acquirers outperform following the merger.

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Appendix A. Variable Definitions

Thomson SDC

Transaction Value: The transaction value as reported in millions of dollars ($m).
Transaction Size: The transaction value scaled by acquirer market capitalization.
Cash Merger: Indicates a 100% cash merger.
Mixed Merger: Indicates a merger consisting of cash and stock.
Stock Merger: Indicates a 100% 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 Ratio: Computed as the number of shares sold short at midmonth divided by the total shares outstanding (from CRSP). All firms are traded on the NYSE, AMEX, or NASDAQ.
Adjusted Short Interest: Computed as the Short Interest Ratio minus the average Short Interest Ratio of other firms traded on the NYSE, AMEX, or NASDAQ exchange in the same month.

CRSP

Announcement Return: Announcement returns are computed as the cumulative market-adjusted returns over the 3 days (days −1, 0, +1) around the merger announcement.
Market Capitalization: Market cap (number of shares outstanding × price), measured in thousands of dollars ($k).
Past Returns: Buy-and-hold raw return for the prior 12 months.
Price: Nominal share price, measured in dollars.
Turnover: Computed as the annual split-adjusted trading volume divided by the average number of split-adjusted shares outstanding over the year before the merger announcement.
Dividends: An indicator variable that equals 1 if the firm has an ex-dividend date in the previous 1 or 6 months (depending on whether the model is the $t-1$ or $t-6$ horizon, respectively), and 0 otherwise.

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: An indicator variable that equals 1 if the acquirer and target are not in the same Fama–French (1997) 48 industry, and 0 otherwise.

13F Thomson SDC

Institutional Ownership: Fraction of shares outstanding owned by institutional investors.

Rhodes-Kropf, Robinson, and Viswanathan (2005)

MB (Firm): Firm-specific error in the market-to-book ratio from Rhodes-Kropf et al. (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 et al. (2005) for further details.
MB (Sector): Sector (industry) error in the market-to-book ratio from Rhodes-Kropf et al. (2005). It equals the difference between the market value implied by a current industry multiple and the market value implied by a long-run industry multiple. See Appendix B and Rhodes-Kropf et al. for further details.
MB (Long-run): Long-run value-to-book ratio from Rhodes-Kropf et al. (2005). It is 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 et al. for further details.

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Appendix B. Rhodes-Kropf, Robinson, and Viswanathan Decomposition of the Market-to-Book Ratio

To test overvaluation explanations for mergers, Rhodes-Kropf et al. (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, which relates the market value of equity to the book value of equity, net income, and leverage:[11]

$$\text{(B-1)} \qquad m_{it} = \alpha_{0jt} + \alpha_{1jt} b_{it} + \alpha_{2jt} \ln(\text{NI})^{+}_{it} + \alpha_{3jt} I_{(<0)} \ln(\text{NI})^{+}_{it} + \alpha_{4jt} \text{LEV}_{it} + \varepsilon_{it},$$

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 (B-1) is estimated by industry-year for the Fama–French (http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html) 12 industries. For each industry-year, α_{jt} represents the multiple applied to accounting information for that industry and year when determining the market value of equity; for each industry, α_j is the average of each year's α_{jt}'s over the sample period.

The multiples estimated with equation (B-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 the intrinsic value and the book value of equity. In addition, the difference between market value and intrinsic value is divided into firm- and sector-specific components:

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

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 (B-1)), α represents sector multiples on the individual items of accounting information, $\nu(\theta_{it};\alpha_{jt})$ is a firm's intrinsic value based on time t accounting information and time t sector multiples, and $\nu(\theta_{it}\,;\alpha_j)$ 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 (B-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 MB (Firm). The second RHS expression in equation (B-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 MB (Sector). The third RHS expression in equation (B-2) captures the difference between firm value implied by long-run multiples and the current book value. This term ". . . is the portion of MB that cannot be attributed to firm-specific deviations from industry average values or to industry-wide waves in valuation levels" (Rhodes-Kropf et al. (2005), p. 579). This long-run value-to-book measure 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 MB (Long-run).

[11] Equation (B-1) is Rhodes-Kropf et al.'s (2005) "Model III." Model I uses only the book value of equity to explain the market value of equity, and Model II uses the book value of equity and net income. The authors report that ". . . the breakdown of M/B across the three models is remarkably consistent" (p. 582); as such, we report results using only components estimated with Model III.

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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 et al. (2005), MB (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.

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