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Short-Selling Prior to Earnings Announcements

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ABSTRACT

This paper examines short-sales transactions in the five days prior to earnings announcements of 913 Nasdaq-listed firms. The tests provide evidence of informed trading in pre-announcement short-selling because they reveal that abnormal short-selling is significantly linked to post-announcement stock returns. Also, the tests indicate that short-sellers typically are more active in stocks with low book-to-market valuations or low SUEs. The levels of pre-announcement short-selling, however, mostly appear to reflect firm-specific information rather than these fundamental financial characteristics. We believe that these results should encourage financial market regulators to consider providing more extensive and timely disclosures of short-selling to investors.

CORPORATE EARNINGS ANNOUNCEMENTS are scheduled events at which firms often disclose surprising news. Investors with private information can establish short positions in the stocks of firms they expect to report negative earnings surprises or refrain from shorting shares in companies that might announce positive surprises. This paper employs a unique data set to explore key features of short-sales transactions prior to the earnings announcements of 913 Nasdaq firms in the fall of 2000. The data set consists of records from Nasdaq's Automated Confirmation Transaction Service (ACT), which processed the vast preponderance of transactions in these stocks during that interval. The ACT records contain substantial information, including the identification of short sales.

This paper examines two issues. The first is whether short-selling in the days leading up to an announcement differs from short-selling in times when no announcement is imminent. After showing that there is a rather sharp difference, we proceed to investigate whether the unusual levels of short-selling in pre-announcement days reflect the ability of some investors to

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successfully anticipate the content of the announcements. If short-sellers are primarily informed traders, atypical increases in short-selling should occur with some frequency prior to negative earnings surprises and unusual declines in short-selling should appear before favorable announcements.[1] On the other hand, if uninformed speculators and/or hedgers dominate short-selling, pre-announcement short sales should be more or less uniformly dispersed across positive, neutral, and negative earnings surprises.

We perform several tests on the link between pre-announcement short-selling and post-announcement stock price changes. The first type consists of multivariate regression models that we apply to our full sample and to subsamples that have special properties or characteristics. These tests uncover a significantly negative relationship between unusual levels of short-selling in the days before the announcement and the immediate post-announcement change in stock prices. This result is consistent with the notion that a significant portion of the short-sellers are informed traders. The other type of test is a nonparametric examination of the subsample of cases in which short-selling is unusually high or low. This test's results also strongly suggest that abnormally large changes in short-selling often precede substantial stock price reactions to announcements.

The second issue we examine is whether short-sellers use fundamental analysis of publicly available data in choosing their targets. Specifically, we explore the connection of short-selling with both the well-documented post-announcement drift in earnings and the susceptibility of growth firms (i.e., those with low ratios of book value to market value) to large negative stock returns if they report even moderately disappointing earnings. Our examination covers both the typical short-selling that occurs away from the announcement and the divergence of pre-announcement short sales from that typical level.

The tests suggest that, in periods without announcements, short-sellers generally tend to be more active in growth stocks than in value stocks, and in stocks with low standardized unexpected earnings (SUEs) than in those with a high level of that characteristic. This fact is consistent with the notion that such stocks provide better opportunities for substantial declines in price over time. Though not able to resolve the question fully, the tests uncover some evidence that the short-sellers' pre-announcement transactions are partially influenced by those fundamental attributes of firms. However, it appears that pre-announcement behavior is more likely to be driven by information specific to the upcoming announcements of the individual firms.

Collectively, the empirical results presented here raise a key question of market policy: Should U.S. stock markets become more transparent and issue more frequent and detailed reports about short sales? In a study of the Australian market, Aitken et al. (1998) find that its standard, trade-by-trade disclosure of

[1] Indeed, informed traders should only short-sell when the expected profits exceed the costs of short-selling. Consequently, a slightly negative earnings surprise would lead to no unusual short-selling.

short-selling is quickly reflected in share prices. Presently in the United States, by contrast, the publicly available information on short-selling is limited to the exchanges' monthly reports of *short interest* on individual stocks, where short interest represents the total number of a stock's shorted shares on one specific day during that month. If unusual amounts of short-selling precede significant declines or increases in stock prices, regulators should consider requiring markets to make more extensive and timely disclosures of short-selling activity. Such an increase in the information available to investors could improve market efficiency and the orderliness of movements in security prices.

This research into a large set of transactions data complements prior empirical analysis into the level of and changes in the exchanges' reported short interest.[2] Though these reports give only a monthly figure (and fail to distinguish the short interest of dealers from that of customers), this body of research has revealed interesting patterns. For example, Desai et al. (2002) examine a broad sample of Nasdaq stocks, and after controlling for market, size, book-to-market, and momentum factors, find that high short interest precedes significantly negative abnormal returns over the subsequent year. Asquith and Meulbroek (1996) confirm this result for firms listed on the NYSE and AMEX. Dechow et al. (2001) report that short-sellers in NYSE and AMEX stocks generate positive abnormal returns by targeting companies with low ratios of fundamentals (such as cash flow, earnings, book value, and value as measured using the Ohlson (1995) model) to stock price. Senchack and Starks (1993) report a significantly negative return in the period surrounding a substantial increase in short interest and also find that greater increases in unexpected short interest lead to greater negative returns. Choie and Hwang (1994) report confirming results with regard to performance relative to the S&P 500 Index. Safieddine and Wilhelm (1996) find that short interest grows before seasoned equity offerings and has an impact on their price discounts.

Our paper's focus on an extensive, market-wide set of transactions also complements some recent studies that have examined a subset of short-selling transactions through access to the equity lending activities of a single custodian bank. For example, Geczy, Musto, and Reed (2002) explore the potential profitability of a variety of short-selling strategies while incorporating the costs of borrowing shares in the equity lending market. They find that investment strategies based upon going short (long) on growth (value) stocks, large (small) market capitalization stocks, and low (high) momentum stocks can all potentially generate net profits. D'Avolio (2002) reports that most stocks are relatively easy to borrow (with only about 9% of stocks on "special"); that "recall risk" is relatively rare (thus, the risk of a "short squeeze" is low); and that stocks that are apparently impossible to borrow tend to be small, illiquid companies that trade for under $5 per share. Reed (2001) investigates loan rates in the equity lending market around earnings announcements dates. As predicted by the Diamond and Verrecchia (1987) model, Reed finds an increased stock price

[2] This review of the literature excludes the work on execution quality of short-sell orders, such as Alexander and Peterson (2002).

reaction associated with negative earnings announcements when short-selling is costly.

The remainder of the paper proceeds as follows. Section I describes the data and sample; Section II presents estimations and results; and Section III contains a summary and conclusion.

I. Data and Sample

A. Data

The source of our data is ACT, which processes the vast preponderance of trades in stocks listed on the Nasdaq National Market System (NMS). Market participants in Nasdaq-listed stocks are required to report their trades to ACT within 90 seconds of execution.[3] In addition to the price and volume statistics that Nasdaq releases to the public, ACT data also contain an identifier that indicates whether the customer of a Nasdaq market maker is selling short. This data field is regularly audited by NASD Regulation to ensure compliance with the Nasdaq Short Sale Rule, which determines whether a short sale order can be executed.[4]

The focus of this study is short sales that ACT designates as "customer short." (ACT also has a category called "customer short *exempt*." These sales are free from the restrictions of the Nasdaq Short Sale Rule because they involve activities such as the arbitrage of positions on options exchanges or foreign markets, the hedging of deliveries due within a few days, and the distribution by an underwriter of an IPO.) We believe that almost all of the short sales designated "customer short" are trades in which the sellers anticipate subsequent share price deterioration or relative underperformance.[5] The reason is that any seller in a short transaction who has the right to claim exemption from the rule would do so, because the exemption allows the sale to be executed when short-selling would otherwise be prohibited. Accordingly, the (nonexempt) short transactions we analyze should contain no trades motivated by considerations of inventory management or cross-market hedging.[6]

[3] ACT reporting is not required for odd lots, although some odd lots are reported anyway to ACT because they need to use the clearing services of DTCC. Also, ACT reporting is not required for trades conducted completely outside the United States and for informal trades between individuals that do not involve the use of a broker/dealer. We believe the total volume of these nonreported trades to be very small.

[4] Nasdaq's Short Sale Rule (Rule 3350) is analogous to the "uptick" rule for NYSE-listed securities. The major difference is that it uses a bid-test instead of a tick-test. Generally, the rule prohibits short-selling at the bid if the current bid price is lower than the preceding bid. See also NASD's Notices to Members, 94-68 and 94-83.

[5] A customer might sell short as part of a market-neutral or hedge strategy involving a long position in another stock. The motivation for this action obviously encompasses an expectation of relative underperformance.

[6] It is interesting to note that ACT rules do not require qualified Nasdaq market makers to flag their own short trades. Because we look only at trades by customers, this fact does not influence our results. However, this fact does mean that the short-selling by dealers expecting price declines is not integrated into our data.

Despite the obvious and unique value of this data set, it does have two limitations. First, ACT files do not identify purchases that "cover" or reverse short sales. Thus, the data support the computation and analysis only of "gross" short-selling for any stock in any given period and do not permit a calculation of "net" short activity. Second, ACT records do not indicate whether a seller transacting through the Small Order Execution System (SOES) is shorting. Nonetheless, since SOES handled only about 2% of all Nasdaq transactions in 2000, the number of missed short sales is probably not large.[7]

The records we received from ACT contain a starting sample of 3,710 Nasdaq-listed common stocks that had a four-letter ticker symbol and were traded through NMS during the entire time from September 13 to December 12, 2000.[8] This period begins after the late August-Labor Day time of limited trading and ends several weeks before the end of the calendar year when short-selling might reflect some tax-related concerns. During this four-month sample period, the Nasdaq's trading volume was slightly above the typical level for surrounding months. According to Nasdaq's website "www.marketdata.nasdaq.com," the daily average number of traded shares per month between January 1999 and September 2002 had a mean (median) of 1.6 billion (1.8 billion). In our sample months, the daily average ranged from 1.8 to 2.2 billion shares. By contrast, our sample period's stock returns were atypically low. According to CRSP, the average monthly return on the Nasdaq equally weighted index between January 1999 and September 2002 was 0.68%, with a median of −0.35% and a standard deviation of 9.76%. The returns of that index in our sample period ranged from −4.51 to −16.82%. Because of this fact, we carefully conduct several tests (described later in further detail) of the possibility that our results might spuriously reflect the declining stock prices during this period.

To minimize the potential for drawing improper inferences from thinly traded stocks, we drew from the starting sample only those stocks that (1) traded every day in the sample period and (2) had an average daily volume of at least 100 trades per day in each third of the sample period: September 13 to October 12, October 13 to November 12, and November 13 to December 12. A total of 1,393 stocks met these criteria.[9]

For each firm in this set, COMPUSTAT PC Plus was searched for a record of an earnings announcement that occurred between September 19 and December 12, 2000. (The September 19 cutoff was necessary because short-selling is examined in this study over several pre-announcement days.) COMPUSTAT records the date when an earnings announcement is first reported in the news media (such as the *Wall Street Journal* or the Dow Jones News Service). The accuracy of these dates was verified with a subsequent search on the Dow Jones Interactive Publications Library, which also contained a time stamp for each announcement. With this time stamp, we identified the

[7] See Nasdaq's website, www.marketdata.nasdaq.com, for more details.

[8] Using only stocks with four-letter ticker symbols excludes ADRs and many foreign firms.

[9] Visual analysis of the data also revealed two firms with such suspicious data that we were obliged to remove them from the sample.

first trading day when the stock price could reflect the new information contained in the announcement. If the announcement occurred before or during trading hours on the announcement day, that day is designated as the first trading day (day = 0). However, if a firm's announcement occurred after trading hours, the *next* trading day is designated as the first trading day (day = 0). (Hereafter in this paper, the term "earnings announcement day" represents the first trading day when the newly revealed information contained in the earnings announcement can be revealed in the stock price.) Excluding those corporations for which we could not find a precise time and day of announcement pared the group of usable stocks to approximately 1,100.

Our last rule in selecting the sample rests on the finding of D'Avolio (2002) that stocks with low prices can be difficult to short. Consequently, every stock whose price did not remain above $10 in the 5-day period prior to the announcement is deleted. This restriction, which is also justified by the fact that stocks with low prices present only limited profits from short-selling, resulted in a final sample of 913 stocks.

B. Sample Statistics

Table I presents information about this sample. Panel A compares it to all the Nasdaq NMS stocks with four-letter ticker symbols and CRSP records for the month of October 2000. (CRSP lists a total of 3,993 such stocks for this month.) With this data, we formed two sets of deciles on the basis of end-of-month market value (equal to price per share times outstanding shares) and total number of traded shares in the month. Clearly, the sample of 913 stocks consists mainly of the large and actively traded Nasdaq NMS issues. Panel B provides information on the monthly distribution of earnings announcements and short-selling for these 913 firms. Most announcements occurred during October; the fewest were made in December. Panel C provides evidence that announcements follow a day-of-the-week pattern, with the most occurring on Thursdays and the least on Fridays.

Table II presents summary information on the overall pattern of short-selling for the sample firms. As shown in Panel A, the mean amount of average daily shares sold short during the entire sample period of 64 days is 53,000. These short sales on average represent 3.53% of total traded shares. Some sample firms experience substantial short-selling, as indicated by the maximum value of 27.28% for the percentage of shorted shares. The corresponding statistics for the starting sample of 3,710 Nasdaq NMS stocks that were in existence every day during the 64-day sample period are generally lower. This general difference is not surprising given our sample selection criteria. The 913-firm sample, by construction, contains the more actively traded (and well known) firms. Panel B provides statistics on holding-period returns for the 913 sample stocks during the five days preceding the announcement $(-5,-1)$, for both the 913 sample stocks and the CRSP Nasdaq equally weighted index for the 2-day holding period $(0,+1)$ beginning on the day of the earnings announcement, and for sample stocks for contiguous 2-day holding periods not including

Table I

Comparative Size and Trading Volume, the Monthly Distribution of Earnings Announcements and Short-Selling, and the Weekday Pattern of Announcements for 913 Nasdaq Stocks: Fall 2000

In Panel A, the decile break points for both market value and trading volume are based on 3,993 common stocks that CRSP lists as having a four-letter ticker symbol and as being traded on the Nasdaq NMS in October 2000. Market value is measured as of the last trading day of October 2000 and equals the price per share times the number of outstanding shares. Trading volume is measured as the number of shares traded during October 2000.

Panel A: Deciles of Nasdaq Stocks by Market Value and Trading Volume

	Market Value			Trading Volume		
	Minimum, in $000's	Maximum, in $000's	Number of Sample Stocks	Minimum, in 00's of Shares	Maximum, in 00's of Shares	Number of Sample Stocks
1	0	19,612	0	0	996	0
2	19,612	36,267	0	996	2,431	0
3	36,267	59,242	0	2,431	4,837	0
4	59,242	94,588	3	4,837	9,047	2
5	94,588	146,176	20	9,047	15,953	11
6	146,176	243,295	35	15,953	26,595	81
7	243,295	409,913	100	26,595	45,270	185
8	409,913	736,632	149	45,270	77,750	173
9	736,632	1,843,862	334	77,750	177,206	213
10	1,843,862		272	177,206		248

Panel B: Monthly Distribution of Sample Earnings Announcements, Trading Volume, and Shorted Shares as a Percentage of Total Traded Shares

	September	October	November	December
Number	23	661	218	11
Average daily trading volume (millions of shares)	1,004	1,141	1,050	1,260
Shorted shares as % of total traded shares	3.06	3.32	3.36	3.07

Panel C: Weekly Pattern of Sample Earnings Announcements

	Monday	Tuesday	Wednesday	Thursday	Friday
Number	132	234	231	290	26

days (0,+1).[10] The mean (median) 2-day return following the announcement is −0.99% (−0.70%). The corresponding mean (median) return on the Nasdaq index is −0.27% (0.20%). These facts imply that the average announcement consisted of a small negative earnings surprise.

[10] The 5-day holding period return is the percentage change in price from the last trade's price on day $t - 6$ to the last trade's price on day $t - 1$; the two-day (0,+1) holding period return is the percentage change in price from the last trade's price on day −1 to the last trade's price on day +1. Nasdaq 2-day holding period returns are based on the CRSP record of the Nasdaq equally weighted index.

Table II

Key Characteristics of Short-Selling for 913 Nasdaq Stocks: Fall 2000

The average daily shorted shares that equals a stock's average daily number of shares sold short over the 64-day sample period are shown. A stock's average shorted shares as a percentage of total shares is (average daily shorted shares over the 64-day period/average daily total shares traded over the period) × 100. A stock's average daily volume is the average daily number of shares traded over the 64-day sample period. The 5-day holding period percentage return (−5,−1) is measured from the last transaction price on day −6 to the last transaction price on day −1. The 2-day holding period percentage return (0,+1) is measured from the last transaction price on day −1 to the last transaction price on day +1. Outside period (0,+1) represents the average 2-day return for sample firms over contiguous 2-day periods not including days (0,+1). The Nasdaq 2-day holding period return (0,+1) is the return on the Nasdaq equally weighted index. All days are specified relative to the day that the earnings announcement is first reflected in the stock price (day = 0). The sample consists of 913 Nasdaq-listed stocks during the fall of 2000. The set of "All Nasdaq stocks" contains the 3,710 Nasdaq National Market System stocks that had four-letter ticker symbols, that were reported in the Nasdaq ACT data used for this study, and that were listed on the System throughout the entire sample period studied here.

Panel A: Shorted Shares and Total Shares

	Average Daily Shorted Shares (000's)		Average Shorted Shares to Average Total Shares (%)		Average Daily Volume (000's Shares)	
	913 Stocks	All Nasdaq Stocks	913 Stocks	All Nasdaq Stocks	913 Stocks	All Nasdaq Stocks
Mean	53	15	3.53%	1.54%	1,515	489
Median	12	4	2.95	0.63	366	71
Maximum	2,005	2,000	27.28	28.63	68,734	68,735
Minimum	0.14	0	0.17	0	144	0

Panel B: Holding Period Returns (%)

	Period (−5,−1) for 913 Stocks	Period (0,+1) for 913 Stocks	Outside Period (0,+1) for 913 Stocks	Period (0,+1) for Nasdaq Index
Mean	0.90	−0.99	−0.67	−0.27
Median	0.37	−0.70	−0.80	0.20
Maximum	45.66	79.17	83.13	9.52
Minimum	−73.29	−67.86	−82.28	−8.97

II. Estimations and Results

A. General Pattern of Short-Selling Prior to Earnings Announcements

Beginning with Ball and Brown (1968), a wide body of empirical research has demonstrated an association between accounting information and security returns. An earnings announcement is a known-in-advance disclosure that may result in a stock price reaction (either positive or negative) as the information contained in the announcement becomes impounded into the stock price. Consequently, an announcement date provides short-sellers with a specific opportunity to profit if there is a disappointing earnings statement (which

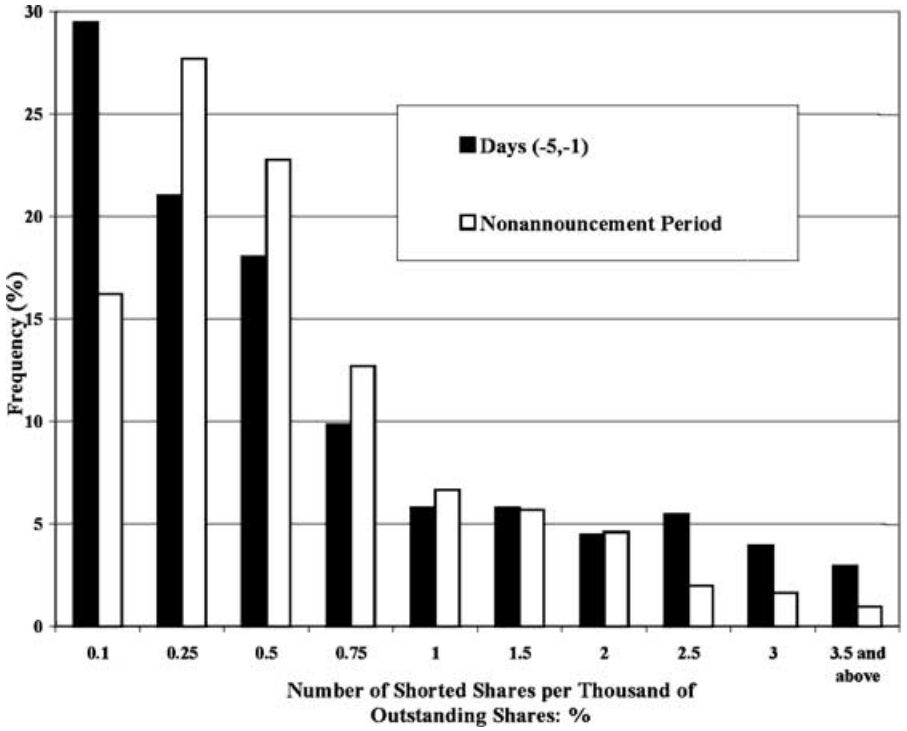
results in a stock price decline) by engaging in informed trading and/or simple speculation.

Whether or not short-sellers specifically target these dates and engage in an unusual amount of short-selling is an empirical issue that, because of a lack of data, has heretofore not been investigated. Therefore, we begin with an examination of the general pattern of short-selling during the five days preceding the earnings announcement (days -5 to -1) as compared to the general pattern of short-selling during the "nonannouncement period," which we define as the 57 days of the sample period outside of days -5 to $+1$. Use of a multi-day pre-announcement interval is appealing because it is unlikely that short-selling related to the announcement occurs only on one (or two) days prior to it. Indeed, theoretical work by Kyle (1985) argues that informed traders have an incentive to disguise their private information by engaging in a number of relatively smaller trades rather than a single large trade. Consequently, informed investors might well distribute their short-selling over several days prior to the announcement. In addition, the use of a multi-day interval gets support from the findings of Reed (2001) that equity lending market loans (and therefore short positions) typically last from one to several days. The risk of adopting a long pre-announcement interval, on the other hand, is that information and short-selling unrelated to the announcement might be accidentally incorporated into the testing. Accordingly, we chose a 5-day pre-event period.

To explore how short-selling might be different in the pre-announcement period from other times, we compare the *distributions* of average daily shorted shares as a percentage of a firm's total outstanding shares in two periods: the five days preceding the announcement, and the nonannouncement period. (CRSP files supplied the total shares outstanding for September 30, 2000.) Figure 1 presents this comparison and indicates that the distribution of the five pre-announcement days has much thicker tails and a lower median than the distribution of the nonannouncement period.

It is possible, of course, that these distributional differences are due to unusually high or low trading volume prior to the earnings announcement, with short-selling as a percentage of trading volume remaining relatively constant. To consider this possibility, we employ a second metric, *relative short-selling*. Relative short-selling is defined as the ratio of a firm's shorted shares to traded shares, and it is also measured for both the five days preceding the earnings announcement and the nonannouncement period. The distributions of relative short-selling for sample firms during these two separate periods are presented in Figure 2, which exhibits the same basic pattern as that in Figure 1. The frequency of observations around 1% and above 8% is much higher during the 5-day pre-announcement window than during the other 57 days. Also, the median for the 5-day pre-announcement window is clearly lower than that for the nonannouncement period.

Taken collectively, these figures convey two noteworthy points. First, the known-in-advance earnings announcement date does not generate increased



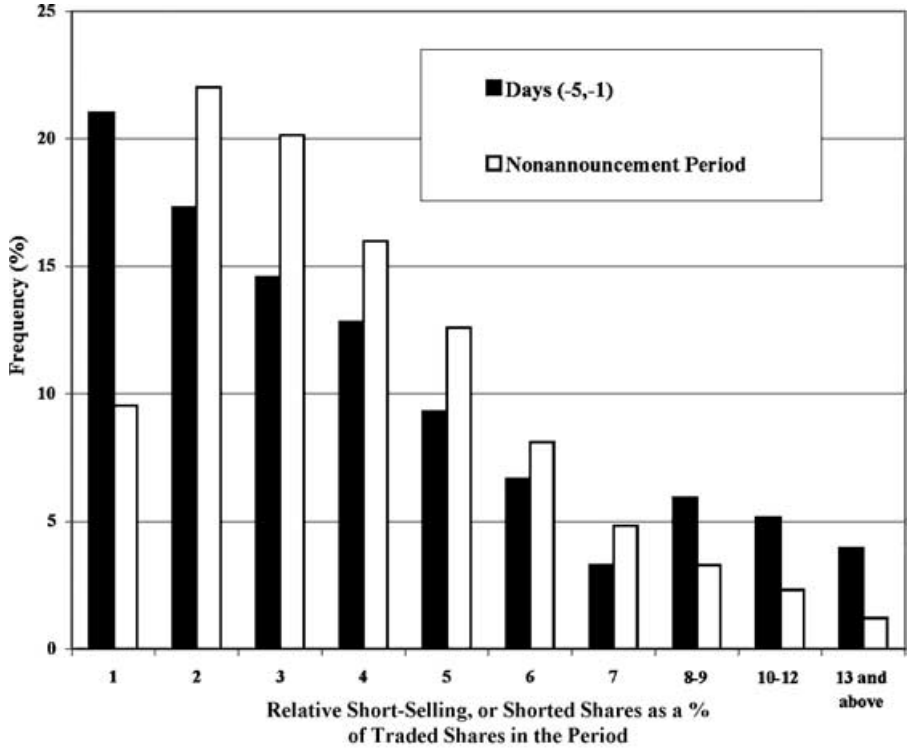
Note: The nonannouncement period consists of the 57 sample days before −5 and after +1.

Figure 1. Average daily shorted shares per thousand of outstanding shares for 913 Nasdaq stocks in Fall 2000: Distributions for days (−5,−1) prior to earnings announcements (day 0) and for the nonannouncement period.

short-selling across most stocks. In fact, the majority of stocks experience lower amounts of short-selling in the pre-announcement period than in the days of the nonannouncement period. Second, a fairly large minority of stocks is subject to large increases in short-selling in the days leading up to the announcement. This pattern definitely suggests selectivity, or targeting, by investors who are prepared to transact in substantial volume for specific shares, which could be consistent with informed trading. The next several sections present a formal investigation of this possibility.

B. Short-Selling by Informed Traders Prior to Earnings Announcements

If short-sellers engage in informed trading prior to earnings announcements, there should be a significant relationship between *abnormal* short-selling in the days prior to the announcement and the ultimate stock price reaction once the information contained in the earnings announcement becomes publicly available. For this analysis, abnormal short-selling is defined as the percentage



Note: The nonannouncement period consists of the 57 sample days before −5 and after +1.

Figure 2. Relative short-selling for 913 Nasdaq stocks in Fall 2000: Distributions for days (−5,−1) prior to earnings announcements (day 0) and for the nonannouncement period.

difference between (1) the average daily number of the firm's shares sold short during the five days preceding the earnings announcement and (2) the average daily number of the firm's shares sold short during the nonannouncement period.[11] Implicit in this approach is the assumption that average daily short-selling during those 57 days is a fair representation of the firm's typical daily level of short-selling.

More formally, a stock's average daily abnormal short-selling during the five days prior to the earnings announcement, $ABSS(-5,-1)$, is measured as

$$ABSS(-5,-1) = \frac{SS(-5,-1)}{AVESS} - 1, \tag{1}$$

[11] Tests for the case of three pre-announcement days generated results that are similar to those reported in this paper. In addition, to examine the sensitivity of the results presented herein to the selection of the window length, we also performed estimates with an 11-day window (−5 to +5). With this longer window, the results obtained resemble these.

where $SS(-5,-1)$ is the average daily number of shares sold short during the five days prior to the earnings announcement, and *AVESS* is the average daily number of shares sold short during the nonannouncement period.

The model for testing whether abnormal short-selling is linked to information about upcoming announcements has the following form:

$$ABSS(-5,-1) = \beta_0 + \beta_1 RET(0,+1) + \beta_2 RET(-5,-1) + \beta_3 ABVOL(-5,-1) + \varepsilon, \quad (2)$$

where $RET(0,+1)$ is the return on the stock from the closing prices of day -1 to $+1$, $RET(-5,-1)$ is the return on the stock from the closing prices of day -6 to -1, and $ABVOL(-5,-1)$ is the average daily abnormal volume in the stock over the interval of day -5 to -1.

The independent variable $RET(0,+1)$ serves as the proxy for the earnings surprise (positive or negative) contained in the announcement. This proxy is chosen because the market's reaction to the announcement reveals whether the announcement contained a surprise. Thus, a negative 2-day return means that the market viewed the announcement as unfavorable (a negative surprise), and a positive return means the report on earnings was more encouraging (a positive surprise) than most investors had expected. Therefore, a statistically significant and negative β_1 would mean that short-selling regularly rises prior to disappointing earnings reports and falls before announcements that lift the prices of the stocks. A nonnegative β_1 would fail to affirm the hypothesis of informed trading.

Of course, alternative proxies for this possible influence on short-selling include defining positive and negative earnings surprises according to some deviation from analysts' forecasts or some divergence from a seasonal projection. However, the market's immediate reaction to the announcement is the preferable approach, because it is most consistent with the likely motivation of short-sellers, which is to profit from a stock's fall in price.

The model contains two control variables. The first, $RET(-5,-1)$, represents the movement of the stock price during the five days prior to the announcement. This variable controls for the possibility that upward or downward changes in the stock price might affect the level of short-selling in the days leading up to the announcement. A pre-announcement increase in stock price, for example, might affect short-selling by inducing some investors to short the now "over-valued" stock. With this control variable in place, the model does not wrongly attribute all pre-announcement short-selling to expectations regarding the earnings release. The second control variable, $ABVOL(-5,-1)$, accounts for the potential contemporaneous correlation between abnormal short-selling and spikes in volume, and for the possibility that stocks experiencing sudden increases in volume might be easier to short. Abnormal volume is measured as the percentage difference between (1) the average daily volume in the 5-day interval and (2) the average daily volume in the 57 days of the nonannouncement period.

We estimate the model using OLS for the total sample of 913 firms, as well as for two subsamples determined by the availability of exchange-traded put

options at the time of the earnings announcement.[12] This partition reflects the findings of several studies including Brent, Morse, and Stice (1990), Chen and Singal (2003), and Senchak and Starks (1993), that the level of short interest in the monthly reports is affected by the availability of traded options. Put options provide investors with a direct alternative to short-selling, and therefore, short-selling around an important event such as the earnings announcement might be lower for these firms than for the others.[13]

Results from estimating equation (2) appear in Panel A of Table III. The results for the full sample of 913 stocks reveal a reasonable R^2 and a significantly negative relationship between the post-announcement return, $RET(0,+1)$, and abnormal short-selling before the announcement, $ABSS(-5,-1)$. The parameter estimate of -1.035 implies that if two stocks are similar except for a 1% difference in their post-announcement returns, the stock with the lower return has pre-announcement abnormal short-selling that is on average 1.035 percentage points larger. This fact supports the proposition that at least a meaningful portion of short-selling is motivated by information about the content of the forthcoming earnings report.

In addition, the results suggest that abnormal short-selling is not regularly affected by the contemporaneous return of stocks, because the coefficient of $RET(-5,-1)$ is far from being significant. Finally, the coefficient of $ABVOL(-5,-1)$ is worthy of note. At 1.088, it is positive and significantly different from zero, but the hypothesis that it equals unity cannot be rejected with a high level of confidence. This result suggests that abnormal volume tends to support abnormal short-selling.

Panel A also reports generally similar regression estimates for the subsample of 670 stocks that have tradable put options. The coefficient of $RET(0,+1)$ is once again statistically significant and negative (at -0.754). The fact that the parameter estimate is smaller than the corresponding estimate for the full sample is not surprising, because the availability of put options allows informed traders to exploit their information advantage outside of the channel of short-selling. As with the results for the full sample, the coefficient for abnormal volume is significant and positive.

The fitting of equation (2) to the subsample of stocks without tradable put options generates similar coefficients and test statistics. There is a significantly negative relationship between the post-announcement stock return and abnormal short-selling prior to that announcement. And the parameter estimate associated with the post-announcement return, β_1, is larger for this estimation than for either the full sample or the subsample of firms with tradable put options.[14]

[12] We obtained the data on the existence of traded put options during the month of the earnings announcement from The Options Clearing Corporation via www.optionsclearing.com.

[13] It might be argued that the availability of put options could lead to an increase in short-selling because of the hedging activities of options issuers. However, options issuers would typically receive the "short exempt" designation on their short trades, and therefore their short sales are not included in this study's short transactions data set.

[14] However, a test to determine whether it is significantly larger than the parameter estimate for firms with available put options fails to reject the null hypothesis of equivalence.

Table III

Results of OLS Regressions: Abnormal Short-Selling and Abnormal Relative Short-Selling for 913 Nasdaq Stocks around Earnings Announcements, for Stocks with and without Tradable Put Options, in Fall 2000

$$ABSS(-5,-1) = \beta_0 + \beta_1 RET(0,+1) + \beta_2 RET(-5,-1) + \beta_3 ABVOL(-5,-1) + \varepsilon, \quad (2)$$

$$RELSS(-5,-1) = \gamma_0 + \gamma_1 RET(0,+1) + \gamma_2 RET(-5,-1) + \gamma_3 NORMRELSS + \varepsilon, \quad (3)$$

The results of OLS estimation of these equations, as fitted to the full sample and subsamples determined by the availability of exchange-traded put options at the time of the earnings announcement are shown. The variable *ABSS*(−5,−1) is the average daily abnormal short-selling for the stock in the pre-announcement period, measured as the average daily short-selling in the pre-announcement period divided by the average daily short-selling in the nonannouncement period, all minus 1. The variable *RELSS*(−5,−1) is the ratio of shorted shares to traded shares in the stock in the pre-announcement period. The variable *RET*(0,+1) is the stock's 2-day percentage return following the earnings announcement and measured from the closing price on day −1 to that of day +1. The variable *RET*(−5,−1) represents the stock's percentage return measured from the closing price on day −6 to the closing price on day −1. The variable *ABVOL*(−5,−1) is the stock's abnormal volume in the pre-announcement period, measured as the average daily volume in the pre-announcement period divided by the average daily volume in the nonannouncement period, all minus 1. The variable *NORMRELSS* is the ratio of shorted shares to traded shares in the nonannouncement period. White's (1980) heteroskedasticity-consistent standard errors are in parentheses below the coefficients.

Panel A: Equation (2)

	β_0	β_1	β_2	β_3	Adjusted R^2
Full sample	0.233***	−1.035***	−0.200	1.088***	0.151
($n = 913$)	(0.051)	(0.309)	(0.396)	(0.179)	
Stocks with put options	0.160***	−0.754***	−0.034	0.918***	0.206
($n = 670$)	(0.042)	(0.244)	(0.312)	(0.123)	
Stocks with no put options	0.485***	−2.045**	−0.620	1.634***	0.139
($n = 243$)	(0.169)	(0.997)	(1.290)	(0.515)	

Panel B: Equation (3)

	γ_0	γ_1	γ_2	γ_3	Adjusted R^2
Full sample	0.170	−1.958***	−0.897	1.079***	0.427
($n = 913$)	(0.183)	(0.668)	(0.857)	(0.107)	
Stocks with put options	−0.194	−1.665***	−0.392	1.165***	0.526
($n = 670$)	(0.190)	(0.663)	(0.849)	(0.128)	
Stocks with no put options	0.986***	−2.916*	−1.929	0.877***	0.239
($n = 243$)	(0.431)	(1.793)	(2.336)	(0.145)	

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

C. An Alternative Specification

We next consider an alternative specification to assess the robustness of the estimation results presented in Panel A of Table III. This specification examines the linkage between a firm's relative short-selling in the pre-announcement period, *RELSS*(−5,−1), and the stock price change that follows

the announcement, while controlling for the firm's normal or typical level of short-selling as a percentage of trading volume. More formally

$$RELSS(-5,-1) = \gamma_0 + \gamma_1 RET(0,+1) + \gamma_2 RET(-5,-1) + \gamma_3 NORMRELSS + \varepsilon, \quad (3)$$

where $RELSS(-5,-1)$ is relative short-selling, measured as the ratio of shorted shares to traded shares for the stock over the interval of day -5 to -1; $RET(0,+1)$ is the return on the stock from the closing prices of day -1 to $+1$; $RET(-5,-1)$ is the return on the stock from the closing prices of day -6 to -1; and *NORMRELSS* is normal relative short-selling, or the ratio of shorted shares to traded shares for the stock during the nonannouncement period.

As above, the independent variable that serves as the proxy for the earnings surprise is $RET(0,+1)$. In addition, $RET(-5,-1)$ controls for the possibility that upward or downward changes in the pre-announcement stock price might affect the contemporaneous ratio of shorted shares to traded shares. Finally, *NORMRELSS* cross-sectionally controls for each firm's typical ratio of shorted shares to traded shares during the nonannouncement period.

Results from estimating equation (3) for the full sample of 913 stocks, and the subsamples based upon whether the stock has tradable put options, appear in Panel B of Table III. The results for the full sample corroborate and complement the findings reported above. The estimated γ_1 is negative and statistically significant. The parameter estimate of -1.958 implies that if two stocks are similar except for a 1% difference in their post-announcement returns, the stock with the lower returns has a daily pre-announcement ratio of shorted to traded shares that is 1.958 percentage points higher on average, with all else being held constant. The coefficient γ_3 is highly significant and positive in all cases, and a t-test reveals that it is not possible to reject with confidence the hypothesis that the coefficient equals 1.0. Finally, stock returns of days $(-5,-1)$ do not influence concurrent short-selling to a meaningful extent.[15]

Generally, similar results also arise for the subsamples. Both γ_1 estimates are significantly negative, with the estimate for the subsample without tradable put options being larger than that for the other subsample. Again, however, a test of γ_1 equivalence across the two equations did not lead to a rejection of the hypothesis of equality. In sum, all the estimates reported in Panel B strongly indicate that those in Panel A are not due to the chosen metric for abnormal short-selling or the form of the model used for testing the presence of informed trading by short-sellers.

D. An Additional Test—Periods of Relative Tranquility in the Market

During the time period under consideration, the Nasdaq stock market index was generally in decline, dropping an aggregate of 41.3% from the beginning

[15] We also estimated both equations (2) and (3) with the subsample of stocks whose $RET(0,+1)$ was large enough, in absolute value, to more definitely imply an earnings surprise, such as 3 and 4%. As expected, the measured goodness-of-fit and statistical measures of significance all rose sharply above those generated with the full sample.

of September through the end of December. (The 913 sampled stocks, however, posted a less drastic but still sharp decline of 26.9% over the period.) Given this downward trend, it is necessary to explore whether the results presented above are merely an artifact of substantial short-selling in a generally deteriorating market. Accordingly, we re-estimate both models for subsamples where the absolute value of the change in the Nasdaq equally weighted index was not large during the 2-day post-announcement window. In these comparatively placid cases, the market's overall change is unlikely to bias the test results in favor of a negative link between pre-announcement activity and stock price reaction to the announcement. If the estimates from these subsamples closely resemble those from the entire sample, they would provide direct evidence that the estimates with the full sample are free of this problem.

Table IV presents the results from estimating equations (2) and (3) for the subsample of 573 cases in which the Nasdaq equally weighted index over days (0,+1) had returns between −2 and +2%. (Estimates with subsamples in which the market shifted less than 3% in either direction produced results like these and may be obtained from the authors.) The values presented in Table IV generally resemble those in Table III, though in almost all cases the estimates of β_1 and γ_1 are more negative here than in the regressions for the entire sample. These estimations indicate that the general decline in the overall market during the fall of 2000 is not responsible for the earlier test results and that the estimates based on the full sample are robust with regard to market movements. In other words, the estimations in Table IV suggest strongly that a meaningful number of short-sellers were not simply selling stocks in a wholesale way during a declining market, but were targeting specific stocks about which they appear to have possessed some relevant information.

E. A Nonparametric Test of Cases with Unusual Levels of Abnormal Short-Selling

Following Dechow et al. (2001), we also performed a χ^2-test of the association between unusually high or low levels of abnormal short-selling in the pre-announcement period and the stocks' post-announcement returns. In addition, as a complementary test, we measure unusual short-selling as the difference between *RELSS*(−5,−1) and *NORMRELSS*. This second metric, which we call *abnormal relative short-selling, ABRELSS*(−5,−1) examines how the percentage of shorted to traded shares varies in the pre- versus non-announcement periods.[16] Thus, our tests use one measure based on the number of shorted shares and another based on the ratio of shorted to traded shares.

For each measure, we split the sample into two groups: The highest quintile of *ABSS*(−5,−1) or *ABRELSS*(−5,−1) stocks, and all other sample stocks.

[16] For example, if *RELSS*(−5,−1) is 10%, and *NORMRELSS* is 6%, *ABRELSS* (−5,−1) equals (10−6) = 4%. The estimates of equation (3) justify the use of this variable, because the coefficient of *NORMRELSS* is not different from unity and that of *RET*(−5,−1) is not significant.

Table IV

Results of OLS Regressions for Days When the Nasdaq Index Returns around Earnings Announcements Are between −2% and +2%: Abnormal Short-Selling and Abnormal Relative Short-Selling for 573 Nasdaq Stocks with and without Tradable Put Options, in Fall 2000

$$ABSS(-5,-1) = \beta_0 + \beta_1 RET(0,+1) + \beta_2 RET(-5,-1) + \beta_3 ABVOL(-5,-1) + \varepsilon, \quad (2)$$

$$RELSS(-5,-1) = \gamma_0 + \gamma_1 RET(0,+1) + \gamma_2 RET(-5,-1) + \gamma_3 NORMRELSS + \varepsilon, \quad (3)$$

The results of OLS estimation of these equations, as fitted to the subsamples of announcements at which the equally weighted Nasdaq Index has a return greater than −2% and less than +2% over days (0,+1) are shown. The variable *ABSS*(−5,−1) is the average daily abnormal short-selling for the stock in the pre-announcement period, measured as the average daily short-selling in the pre-announcement period divided by the average daily short-selling in the nonannouncement period, all minus 1. The variable *RELSS*(−5,−1) is the ratio of shorted shares to traded shares in the stock in the pre-announcement period. The variable *RET*(0,+1) is the stock's 2-day percentage return following the earnings announcement and measured from the closing price on day −1 to that of day +1. The variable *RET*(−5,−1) represents the stock's percentage return measured from the closing price on day −6 to the closing price on day −1. The variable *ABVOL*(−5,−1) is the stock's abnormal volume in the pre-announcement period, measured as the average daily volume in the pre-announcement period divided by the average daily volume in the nonannouncement period, all minus 1. The variable *NORMRELSS* is the ratio of shorted shares to traded shares in the nonannouncement period. White's (1980) heteroskedasticity-consistent standard errors are in parentheses below the coefficients.

Panel A: Equation (2)

	β_0	β_1	β_2	β_3	Adjusted R^2
Subsample	0.245***	−1.639***	−0.783	1.093***	0.141
($n = 573$)	(0.075)	(0.495)	(0.584)	(0.227)	
Stocks with put options	0.110***	−0.993***	−0.172	0.867***	0.212
($n = 428$)	(0.053)	(0.338)	(0.402)	(0.135)	
Stocks with no put options	0.650***	−3.715**	2.036	1.833***	0.143
($n = 145$)	(0.253)	(1.832)	(2.124)	(0.567)	

Panel B: Equation (3)

	γ_0	γ_1	γ_2	γ_3	Adjusted R^2
Subsample	0.315	−2.665***	−1.302	1.012***	0.364
($n = 573$)	(0.243)	(0.970)	(1.144)	(0.132)	
Stocks with put options	−0.054	−1.650*	−0.467	1.067***	0.482
($n = 428$)	(0.234)	(0.884)	(1.051)	(0.153)	
Stocks with no put options	1.082	−5.957*	−3.508	0.903***	0.189
($n = 145$)	(0.661)	(3.095)	(3.556)	(0.223)	

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

We then examine how these groups are distributed across three categories of *RET*(0,+1): high returns (i.e., the 20% of sample stocks with the highest 2-day returns), which indicate favorable earnings reports; low returns (i.e., the 20% of sample stocks with the lowest 2-day returns) that imply the market was

Table V

Chi-Square Tests of the Association between Post-Announcement Returns and the Levels of Abnormal Short-Selling and Abnormal Relative Short-Selling Prior to the Announcement: 913 Nasdaq Stocks in Fall 2000

The tests evaluate whether the stocks' classification into the highest quintile or the other four quintiles, based on their abnormal short-selling (Panel A) and abnormal relative short-selling (Panel B) in the five pre-announcement days (−5,−1), is independent of their post-announcement return, *RET*(0,+1). The variable *ABSS*(−5,−1) is the average daily abnormal short-selling for the stock in the pre-announcement period, measured as average daily short-selling in the pre-announcement period divided by average daily short-selling in the nonannouncement period, all minus 1. The variable *ABRELSS*(−5,−1) is a stock's abnormal relative short-selling in the pre-announcement period, measured as *RELSS*(−5,−1) − *NORMRELSS*, where *RELSS*(−5,−1) is the ratio of shorted shares to traded shares in the stock in the pre-announcement period. Low, moderate, and high return quintile(s) represent the 20% lowest, middle 60%, and 20% highest set of sample firms based upon 2-day post-announcement period returns. Probability is the level of significance at which the hypothesis of independence can be rejected.

		Low Return Quintile	Moderate Return Quintiles	High Return Quintile	Total
Panel A: Abnormal Short-Selling, *ABSS*(−5,−1)					
	Expected %	20	60	20	100
Highest quintile	Observations	45	109	29	183
	Percentage	24.6	59.6	15.9	100
Other quintiles	Observations	138	438	154	730
	Percentage	18.9	60.0	21.1	100
				χ^2 statistic	4.38
				Probability	0.11
Panel B: Abnormal Relative Short-Selling, *ABRELSS*(−5,−1)					
	Expected %	20	60	20	100
Highest quintile	Observations	51	103	29	183
	Percentage	27.9	56.3	15.9	100
Other quintiles	Observations	132	445	153	730
	Percentage	18.1	61.0	20.9	100
				χ^2 statistic	9.44
				Probability	0.01

displeased with the announcements; and moderate returns (i.e., the remaining 60% of sample firms) that lie between these values. If short-selling is randomly dispersed across the post-announcement returns, we should find that 20% of the observations for each group fall in the high return quintile, 20% in the low return quintile, and 60% in the moderate return quintiles.

As shown in Panel A of Table V, 24.6% of the stocks in the highest *ABSS*(−5,−1) quintile fall into the low return category, while 15.9% are in the high return category. For the other *ABSS*(−5,−1) quintiles, the corresponding proportions are 18.9 and 21.1%, respectively. As shown in Panel B, 27.9% of the

stocks in the highest *ABRELSS*(−5,−1) quintile fall into the low return category, while 15.9% are in the high return category. For the other *ABRELSS*(−5, −1) quintiles, the corresponding proportions are 18.1 and 20.9%, respectively. The χ^2-test statistics for the two panels reject the null hypothesis of independence between the two variables at 0.11 and 0.01, respectively. In sum, these tests offer some confirmation of the earlier analysis and support the view that a meaningful portion of unusual pre-announcement short-selling represents a targeting by informed traders of the stocks of firms that are likely to announce an earnings surprise.

F. Do Short-Sellers Employ Fundamental Analysis to Make Decisions?

An issue not specifically addressed in the analysis above is the *source* of the information kernel utilized by short-sellers when establishing their short positions. And it is undoubtedly of empirical (and policy) interest whether short-sellers make decisions based upon *publicly* available data, or whether their decisions are driven by special access to *private* information. Although a full resolution of this topic is beyond the scope of this study, we can shed some light on it by examining the linkage between short-selling and two investment strategies based upon fundamental analysis of publicly available data. Specifically, we examine whether short-sellers trade in a manner consistent with an attempt to exploit the well-documented post-earnings announcement drift phenomenon, and whether they focus on companies with low book-to-market ratios because these growth firms tend to have large negative stock returns if they only slightly miss meeting analysts' earnings expectations.

F.1. Post-Earnings Announcement Drift

The anomaly of post-earnings announcement drift has been documented in a variety of studies. Ball and Brown (1968) produced early evidence that after annual earnings are announced, the stock price of the firm continues to drift in the same direction as the already-reported earnings change.[17] Subsequent studies (e.g., Joy, Litzenberger, and McEnally (1977), Latane and Jones (1977), and Rendleman, Jones, and Latane (1982)) focus on quarterly earnings announcements and find that this anomaly can be exploited by forming portfolios based upon SUEs. Bernard and Thomas (1989, 1990) examine competing explanations for this post-earnings announcement phenomenon and conclude that it is most likely market mispricing. The implication of this relationship for short-sellers is that a company's report of negative unexpected earnings in quarter $t - 1$ is likely to be followed by negative abnormal returns for that company when earnings are reported for quarter t. Short-sellers might anticipate a potential profit opportunity that can be exploited by establishing a short position prior to the quarter t announcement.

[17] For an overview of the literature on the post-earnings-announcement drift phenomena, see Brown (1997).

To investigate this possibility, we examine the connection between short-selling of the sample stocks and their prior-quarter SUE. We estimate SUE by the method utilized in Bernard and Thomas (1990); it equals a company's reported earnings less expected earnings (generated by a time series model whereby earnings are assumed to follow a seasonally adjusted random walk with drift), with this difference normalized by the standard deviation of unexpected earnings over the sample estimation period.[18] We conducted this estimation with the 769 stocks that had a minimum of 10 prior quarterly earnings announcements (the maximum number of quarterly earnings announcements utilized in the estimation of expected earnings was 36).

The test partitions the stocks into quintiles, with quintile 1 containing the stocks with the lowest prior-quarter SUE and quintile 5 holding those with the highest. If short-sellers act on a SUE investment style, they would expect the low-SUE stocks of quintile 1 to experience downward drifting returns at subsequent announcements and therefore would short-sell them. By contrast, the short-sellers would anticipate that the high-SUE stocks of quintile 5 would experience upward drifting returns at subsequent earnings announcements and would therefore not short these shares very intensively.

Panel A of Table VI displays means and medians for SUE, *RET*(0,+1), and several measures of short-selling for each quintile. Some evidence consistent with post-earnings announcement drift is revealed in the row for *RET*(0,+1). The difference in means for quintile 5 versus 1 is 3.86%, and it is statistically significant at the 10% level. An interesting item is the short-selling in the nonannouncement period, as measured by *NORMRELSS*. The mean and median for *NORMRELSS* are larger for the low-SUE firms of quintiles 1 and 2 than for the others. While the differences between quintile 5 and 1 are not statistically significant, the overall pattern of *NORMRELSS* does suggest that short-sellers might generally be more active in the low-SUE stocks. In addition, abnormal relative short-selling, *ABRELSS*(−5,−1), is highest for the low-SUE group; both its mean and median are statistically greater than those of quintile 5. The median values of *ABSS*(−5,−1) for quintiles 5 and 1 are significantly different ($p = 9.84\%$) though the means of *ABSS*(−5,−1) seem largely invariant with respect to the quintiles. Accordingly, this set of tests supplies initial support for a possible linkage between short-selling and SUE.

To explore SUE's role in pre-announcement short-selling more directly, we conduct a test with a specially chosen subsample: the stocks of quintiles 1 and 5 whose announcements, according to the data, are likely to have contained an earnings surprise (either positive or negative). Accordingly, we drew from the sample of 769 SUE stocks only those 234 cases from SUE quintiles 1 and 5 where the post-announcement 2-day return was substantial—that is either greater than +3%, or less than −3%.[19] If short-sellers are making their

[18] In addition, SUEs were also estimated using the method proposed by Latane and Jones (1977). This approach produced results similar to those reported below.

[19] Using a higher threshold, such as 5%, would have produced too small a sample for reliable testing.

Table VI

Short-Selling and Relative Short-Selling in Nasdaq Stocks, Grouped in Quintiles Based on Selected Investment Criteria, for Intervals Related to Earnings Announcements in Fall 2000

Standardized Unexpected Earnings (SUE) is computed for sample stocks for the quarter prior to the fall 2000 earnings announcement by using the method in Bernard and Thomas (1990). SUE equals a company's reported earnings less expected earnings (generated by a time series model whereby earnings are assumed to follow a seasonally adjusted random walk with drift), with this difference normalized by the standard deviation of unexpected earnings over the sample estimation period. For this estimation, stocks were required to have a minimum of 10 prior quarterly earnings announcements. SUE estimates were available for 769 of the sampled 913 stocks. Positive book-to-market value ratios were available for 859. The variable *RET*(0,+1) is the stock's 2-day percentage return following the earnings announcement and measured from the closing price on day −1 to that of day +1. The variable *NORMRELSS* is the ratio of shorted shares to traded shares in the nonannouncement period. The variable *ABSS*(−5,−1) is the average daily abnormal short-selling for the stock in the pre-announcement period, measured as the average daily short-selling in the pre-announcement period divided by the average daily short-selling in the nonannouncement period, all minus 1. The variable *ABRELSS*(−5,−1) is a stock's abnormal relative short-selling in the pre-announcement period, measured as *RELSS*(−5,−1) − *NORMRELSS*, where *RELSS*(−5,−1) is the ratio of shorted shares to traded shares in the stock in the pre-announcement period. The lowest 20% of the stocks are in quintile 1; quintile 5 has the highest. The top item in each cell is the sample mean and the lower one is the median. The final column performs a *t*-test of differences for means and a sign-test of differences in medians for the measures of return and short-selling.

	Quintile 1	Quintile 2	Quintile 3	Quintile 4	Quintile 5	Quintile 5 less Quintile 1
Panel A: Standardized Unexpected Earnings (769 Stocks)						
SUE	−2.13	−0.42	0.26	0.99	2.26	
	−1.86	−0.36	0.26	0.95	2.09	
RET(0,+1)	−1.44%	−2.11%	−1.95%	−0.19%	2.42%	3.86%*
	−0.50	−1.01	−0.16	−0.59	0.31	0.81
NORMRELSS	3.99	3.62	2.86	3.20	3.45	−0.54
	3.16	3.10	2.51	2.75	2.95	−0.21
ABSS(−5,−1)	0.23	0.10	0.26	0.21	0.13	−0.09
	−0.18	−0.24	−0.10	−0.14	−0.28	−0.10*
ABRELSS(−5,−1)	0.81	0.40	0.51	0.59	−0.23	−1.04**
	0.03	−0.06	−0.13	−0.09	−0.51	−0.54**
Panel B: Book-to-Market Ratio (859 Stocks)						
Book-to-Market	0.04	0.11	0.18	0.30	0.68	
	0.04	0.11	0.18	0.29	0.57	
RET(0,+1)	−2.56%	−1.31%	0.54%	−0.38%	−0.80%	1.76%
	−1.54	−1.32	−0.03	−1.28	−0.13	1.41
NORMRELSS	4.03	3.61	3.63	3.46	2.72	−1.31**
	3.98	3.01	2.90	2.76	2.20	−1.78**
ABSS(−5,−1)	0.11	0.04	0.33	0.11	0.36	0.35
	−0.12	−0.28	−0.21	−0.26	−0.17	−0.05
ABRELSS(−5,−1)	0.52	−0.03	0.55	0.35	0.71	−0.19
	−0.02	−0.50	−0.14	−0.19	0.08	0.10

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

pre-announcement short-selling decisions based upon a SUE strategy, abnormal pre-announcement short-selling should be a function of SUE and independent of the eventual sign of the surprise.

Panel A of Table VII presents, for each quintile, the means and medians (and their differences) of both abnormal short-selling and abnormal relative short-selling in these stocks grouped by the sign of the earnings surprise. The within-quintile results suggest that the levels and differences in short-selling do not reflect a stock's SUE. For example, in the lowest quintile, the mean and median for $ABSS(-5,-1)$ and $ABRELSS(-5,-1)$ are below zero for the positive surprises, and both means and one median are above zero for the negative surprises. More importantly, the sign of every significant mean and median is opposite that of the surprise. Further, all differences for the lowest quintile indicate that abnormal short-selling is far greater prior to negative surprises than before positive surprises, and that two of the four values are statistically significant. The results for highest quintile display a similar pattern. With regard to between-quintile differences, only the two medians for $ABRELSS(-5,-1)$ are significantly different from zero. Most of the differences imply that the short-sellers' typical behavior before the negative (or positive) surprises of high-SUE stocks does not diverge very much from their behavior in advance of negative (or positive) surprises among low-SUE stocks. For all these reasons, it is fair to say that these tests argue in favor of the view that SUE is not responsible for very much of the abnormal pre-announcement short-selling.[20]

F.2. Growth versus Value Stocks

Numerous studies find that growth stocks tend to have lower returns than value stocks (see for e.g., Fama and French (1992) and Lakonishok, Shleifer, and Vishny (1994)). A recent study by Skinner and Sloan (2002) reports that this underperformance arises from an asymmetrically large negative stock price reaction to unfavorable earnings surprises for growth (low book-to-market) firms versus value firms. In contrast, they find that the price reaction associated with positive earnings surprises is either not different, or is slightly higher, for growth versus value firms. Thus, the differential in returns between value and growth stocks is essentially attributable to periods when growth firms underperform relative to their expected earnings. Skinner and Sloan report that even slightly missing earnings expectations can lead growth stocks to suffer large drops in price—the "torpedo" effect.

[20] We should note, however, that our failure to find a relationship between SUE and pre-announcement short-selling may in part be due to the characteristics of our sample. Our selection criteria (described in Sec. I) have resulted in a sample of relatively large and liquid Nasdaq stocks. Since Bernard and Thomas (1990) report that the post-earnings announcement drift is smaller for large firms (there is greater information gathering for large firms, so less news is revealed at the earnings announcement), our sample of relatively large stocks may not offer sufficient profit potential for a SUE-based short-selling investment strategy. Whether we would find a more significant relationship between SUE and pre-announcement short-selling for smaller, less liquid stocks is an issue left for future research.

Table VII

Measures of Abnormal Short-Selling and Abnormal Relative Short-Selling Prior to Large Positive and Negative Earnings Surprises, for Nasdaq Stocks Grouped by Selected Investment Strategies, in Fall 2000

A large positive earnings surprise is one that precedes a rise of greater than 3% in the price of the stock over days (0,−1); a large negative surprise is one that occurs before the stock's price falls by more than −3%. The variable *ABSS*(−5,−1) is the average daily abnormal short-selling for the stock in the pre-announcement period, measured as the average daily short-selling in the pre-announcement period divided by the average daily short-selling in the nonannouncement period, all minus 1. The variable *ABRELSS*(−5,−1) is a stock's abnormal relative daily short-selling in the pre-announcement period, measured as *RELSS*(−5,−1) − *NORMRELSS*, where *RELSS*(−5,−1) is the ratio of shorted shares to traded shares in the stock in the pre-announcement period. Standardized Unexpected Earnings (SUE), computed as in Bernard and Thomas (1990), were available for 769 stocks, and 586 had (0,+1) returns outside of +3% to −3%. Positive book-to-market value ratios were available for 859 stocks, and 663 had (0,+1) returns outside of +3% to −3%. The highest quintile has the highest 20% of the stocks by book-to-market ratio or SUE. The top item in each cell is the sample mean and the lower one is the median. The hypothesis that the mean or median is equal to zero is evaluated either by a two-tailed *t*-test or a two-tailed sign test. Two-tailed *t*-tests evaluate the differences in means and a two-tailed sign test evaluates differences in medians.

	Lowest Quintile			Highest Quintile			Difference: Highest − Lowest Quintile	
	Positive Surprises	Negative Surprises	Difference	Positive Surprises	Negative Surprises	Difference	Positive Surprises	Negative Surprises
Panel A: SUE								
Number	55	61		56	62			
ABSS(−5,−1)	−0.12	0.32**	0.42	−0.01	0.40**	0.42	0.11	0.08
	−0.31**	−0.13	0.18	−0.38**	−0.08	0.30**	−0.07	0.05
ABRELSS(−5,−1)	−0.12	1.26**	1.37**	−0.36	0.29	0.65	−0.24	−0.97
	−0.28*	0.52**	0.80**	−0.76**	−0.25	0.51*	−0.48*	−0.77*
Panel B: Book-to-Market								
Number	63	71		62	70			
ABSS(−5,−1)	−0.02	0.34	0.36	0.13	0.58**	0.45*	0.15	0.25
	−0.18*	−0.08	0.10	−0.35**	0.16	0.51**	0.17	0.24
ABRELSS(−5,−1)	0.24	1.02**	0.78	0.20	1.43**	1.23**	−0.04	0.41
	−0.01	0.08	0.09	−0.22	0.73**	0.95**	−0.21	0.65

* and ** indicate statistically significant at the 10% and 5% levels, respectively.

One implication of these findings is that short-sellers might target the stocks of growth firms because they offer greater potential for profits when earnings surprises are negative. We explore the importance of the growth aspect of stocks to short-selling with tests similar to those presented for the issue of SUE. The number of sample firms with positive book-to-market ratios at the end of the month preceding the earnings announcement was 859. The first test partitions these 859 stocks into quintiles on the basis of this metric. Panel B of Table VI presents measures of book-to-market, *RET*(0,+1), and short-selling prior to the announcement and in the nonannouncement period for each quintile. Quintile 1 contains the growth firms (i.e., those with the lowest book-to-market ratios), while quintile 5 contains value stocks (those with the highest ratios).

The results strongly suggest that relative short-selling in the nonannouncement period (*NORMRELSS*) is higher for growth stocks than for the others. In both its mean and its median, this measure declines from quintile 1 to 5. In addition, both the mean and median of *NORMRELSS* are significantly higher for the growth stocks in quintile 1 than for the value stocks in quintile 5. On the other hand, neither measure of pre-announcement short-selling—*ABSS*(−5,−1) and *ABRELSS*(−5,−1)—is significantly different between quintiles 1 and 5. Taken collectively, these results indicate that short-sellers generally target growth stocks, but their actions in the days just prior to the earnings announcement do not vary according to a stock's book-to-market value ratio.

To further explore this question, we again conduct tests with a subsample of stocks whose post-announcement returns suggest an earnings surprise. The subsample consists of the 266 stocks that are in quintiles 1 and 5 according to book-to-market value ratios, and had a *RET*(0,+1) either above 3% or below −3%. Panel B of Table VII presents, for each quintile, the means and medians (and their differences) of both abnormal short-selling and abnormal relative short-selling in these stocks grouped by the sign of the earnings surprise. The results reveal that the growth-value distinction does not play as large a role in pre-announcement short-selling as the anticipated earnings announcement. Of the eight measures (four means and four medians) for short-selling before positive earnings announcements in both quintiles, five indicate that short-selling drops below its normal level. Importantly, every mean and median that is statistically significant has a sign that is opposite that of the surprises. Further, each of the eight between-quintile differences in means and medians is statistically insignificant and therefore does not support the view that short-sellers' activity before the negative surprises of growth (or value) stocks varies from their behavior in advance of negative surprises among growth (or value) stocks. In sum, the statistics of Panel B clearly attribute much more of the abnormal pre-announcement short-selling to anticipation of earnings surprises than to the distinction between growth and value stocks.

A potential criticism of the results presented in Table VII is that there may be insufficient control for confounding effects arising from the existence of different short-selling strategies. For example, some short-sellers may establish their positions on the basis of completely private (correct) information about the forthcoming sign of the earnings surprise, whereas others may utilize

book-to-market ratios or SUE to form positions. If private (correct) information is a predominant strategy, and if its occurrence is uniformly distributed across high and low SUE (or book-to-market) quintiles, the results presented in Table VII may simply reflect this private information trading.

To investigate this possibility more explicitly, we next estimate the following models for both the SUE and book-to-market samples:

$$ABSS(-5,-1) = \beta_0 + \beta_1 RET(0,+1) + \beta_2 RET(-5,-1) + \beta_3 ABVOL(-5,-1) + \beta_4 LOWQUINTILE + \beta_5 INTERACTION + \varepsilon, \quad (4)$$

$$RELSS(-5,-1) = \gamma_0 + \gamma_1 RET(0,+1) + \gamma_2 RET(-5,-1) + \gamma_3 NORMRELSS + \gamma_4 LOWQUINTILE + \gamma_5 INTERACATION + \varepsilon, \quad (5)$$

where *LOWQUINTILE* is a binary variable that takes on the value 1 if the stock's SUE or book-to-market ratio places it in the lowest quintile of stocks ranked by the measure; *INTERACTION* is the product of *LOWQUINTILE* and a binary variable that takes on the value 1 if the stock's *RET*(0,+1) places it in the lowest quintile of stocks ranked by that measure; and all other variables are as defined above.

The variable *LOWQUINTILE* reveals whether, after controlling for the existence of other private (correct) information through the parameter estimate for *RET*(0,+1), short-sellers establish positions on the basis of SUE (or book-to-market). The variable *INTERACTION* can indicate whether short-sellers use SUE (book-to-market) as a filter for initially identifying candidates for short-selling and then successfully pick the subset of stocks within this group that experience negative earnings surprises. Results from estimating equations (4) and (5) are presented in Panels A and B of Table VIII, respectively.

The results in Panel A provide some evidence consistent with the possibility that short-sellers employ a book-to-market strategy for determining pre-announcement short-selling. The β_4 parameter estimate for the book-to-market sample is 0.263 and is significant at the 10% level. However, the results do not support the contention that short-sellers follow a SUE strategy, as the β_4 estimate for the SUE sample is not statistically different from zero. In addition, there is no evidence that short-sellers use either SUE or book-to-market as a filter for initially identifying target stocks and then pick the stocks within that group that ultimately report negative earnings surprises. Both β_5 estimates in Panel A are negative and insignificantly different from zero. The results in Panel B are confirming. Therefore, some evidence points to a book-to-market investment strategy, but none hints at a SUE strategy. By contrast, a much more statistically significant relationship exists between abnormal short-selling and the post-announcement return.

G. The Potential Predictive Value of the Disclosure of Unusual Levels of Short-Selling

In this section, we consider the potential predictive power of unusually high or low short-selling. The results presented above indicate that a meaningful

Table VIII

Results of OLS Regressions: Impact of Low Standardized Unexpected Earnings and Book/Market Ratio on Abnormal Short-Selling and Abnormal Relative Short-Selling in Nasdaq Stocks around Earnings Announcements: Fall 2000

$$ABSS(-5,-1) = \beta_0 + \beta_1 RET(0,+1) + \beta_2 RET(-5,-1) + \beta_3 ABVOL(-5,-1) + \beta_4 LOWQUINTILE + \beta_5 INTERACTION + \varepsilon \quad (4)$$

$$RELSS(-5,-1) = \gamma_0 + \gamma_1 RET(0,+1) + \gamma_2 RET(-5,-1) + \gamma_3 NORMRELSS + \gamma_4 LOWQUINTILE + \gamma_5 INTERACATION + \varepsilon \quad (5)$$

The results of OLS estimation of these equations, as fitted to the full sample are shown. The variable *ABSS*(−5,−1) is the average daily abnormal short-selling for the stock in the pre-announcement period, measured as the average daily short-selling in the pre-announcement period divided by the average daily short-selling in the nonannouncement period, all minus 1. The variable *RELSS*(−5,−1) is the ratio of shorted shares to traded shares in the stock from day −5 to −1. The variable *RET*(0,+1) is the stock's 2-day percentage return following the earnings announcement and measured from the closing price on day −1 to that of day +1. The variable *RET*(−5,−1) represents the stock's percentage return measured from the closing price on day −6 to the closing price on day −1. The variable *ABVOL*(−5,−1) is the stock's abnormal volume from day −5 to −1, measured as the average daily volume from day −5 to −1 divided by the average daily volume in the nonannouncement period, all minus 1. The variable *NORMRELSS* is the ratio of shorted shares to traded shares in the nonannouncement period. The binary variable *LOWQUINTILE* takes on the value 1 if the stock's standardized unexpected earnings (SUE) or book-to-market ratio places it in the lowest quintile of stocks ranked by the measure. The variable *INTERACTION* is the product of *LOWQUINTILE* and a binary variable that has the value 1 if the stock's *RET*(0,+1) places it in the lowest quintile of stocks ranked by that return. White's (1980) heteroskedasticity-consistent standard errors are in parentheses below the coefficients.

	β_0	β_1	β_2	β_3	β_4	β_5	Adjusted R^2
			Panel A: Equation (4)				
SUE	0.175***	−1.098***	0.538	1.137***	0.135	−0.207	0.22
($n = 769$)	(0.051)	(0.291)	(0.519)	(0.188)	(0.164)	(0.248)	
Book-to-market ratio	0.152***	−1.002***	−0.259	1.125***	0.263*	−0.199	0.20
($n = 859$)	(0.047)	(0.270)	(0.464)	(0.182)	(0.162)	(0.245)	
	γ_0	γ_1	γ_2	γ_3	γ_4	γ_5	Adjusted R^2
			Panel B: Equation (5)				
SUE	−0.299	−2.06***	−1.142	1.187***	0.336	0.009	0.53
($n = 769$)	(0.347)	(0.655)	(0.939)	(0.109)	(0.320)	(0.788)	
Book-to-market ratio	−0.153	−1.708***	−0.900	1.133***	0.456*	0.209	0.48
($n = 859$)	(0.356)	(0.670)	(0.822)	(0.109)	(0.282)	(0.618)	

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

number of short-sellers successfully anticipate earnings surprises with information not generally linked to publicly available data such as SUE or book-to-market. Financial market rulemakers interested in making markets more orderly, fair, and informationally efficient may be interested in the magnitude

of post-announcement price changes associated with unusual levels of pre-announcement short-selling. For example, if unusually high pre-announcement short-selling is followed by large, significantly negative post-announcement returns, rulemakers may want to consider requiring more timely public disclosures of short-selling activity. These would allow the general investor the opportunity to trade on the information conveyed by shifts in the levels of short-selling.

Panel A of Table IX presents 2-day returns following the earnings announcements for firms sorted into quintiles by pre-announcement abnormal short-selling. The first partition in Panel A splits our full sample of 913 companies into the quintile with the highest level of abnormal short-selling and the other 80%. It is also interesting to examine the cases in which "the dog doesn't bark," which are the stocks *with the lowest levels* of abnormal short-selling. Therefore the second partition splits the sample into the quintile with the lowest amount of abnormal short-selling and the remaining 80%.

The results in Panel A provide some interesting findings. As expected on the basis of the foregoing regressions, the stocks with the largest pre-announcement short-selling have mean and median post-announcement returns that are substantially negative and below those of the rest of the sample. For example, the stocks with the highest 20% level have a mean (median) 2-day return following the earnings announcement of −3.72% (−2.70%), and this value is significantly negative at the 1% level of significance. The mean (median) 2-day return for the other 80% of firms is −0.26% (−0.49%), and it is not significantly different from zero. Two-sided *t*-tests and sign tests reject the hypothesis that the means and the medians are equal at the 1% level of significance. For the stocks in the lowest quintile compared to the other 80%, tests cannot reject equivalence of means and medians. Consequently, high rather than low abnormal short-selling is a better predictor of post-announcement returns. However, both partitions reveal that short-sellers are sometimes wrong. For the highest quintile, at the 75^{th} percentile cutoff, the return is 3.81%; for the lowest quintile, at the 25^{th} percentile cutoff, the return is −9.29%. This means that, in at least one out of every four times, very high (low) levels of abnormal short-selling precede positive (negative) post-announcement returns.

The final partition of Panel A reveals the difference between the 2-day returns for the highest quintile of firms versus the lowest. The mean difference is −3.94%, and it is different from zero at the 5% level of significance. The corresponding differences in the median, 25^{th} and 75^{th} percentile are 4.31, 2.17, and 4.68%, respectively. These results suggest that public disclosure of pre-announcement short-selling activity could be of value to general investors for forming hedge portfolios.

Panel B of Table IX presents 2-day returns following the earnings announcements for firms sorted into quintiles by pre-announcement abnormal relative short-selling. The results presented in the panel closely follow the Panel A results. Both the difference in the mean and the median 2-day returns for the highest quintile of firms versus the lowest are significantly negative at the 1% level. The magnitude of the results may well be of interest to financial market

Table IX

Post-Announcement Returns for Subsamples Based on Abnormal Short-Selling and Abnormal Relative Short-Selling: 913 Nasdaq Stocks in Fall 2000

The 2-day returns following the earnings announcement for firms sorted into quintiles by pre-announcement abnormal short-selling and abnormal relative short-selling, $ABSS(-5,-1)$ and $ABRELSS(-5,-1)$, are shown. The variable $ABSS(-5,-1)$ is the average daily abnormal short-selling for the stock in the pre-announcement period, measured as the average daily short-selling in the pre-announcement period divided by the average daily short-selling in the nonannouncement period, all minus 1. The variable $ABRELSS(-5,-1)$ is a stock's abnormal relative short-selling in the pre-announcement period, measured as $RELSS(-5,-1) - NORMRELSS$, where $RELSS(-5,-1)$ is the ratio of shorted shares to traded shares in the stock in the pre-announcement period. Each panel compares the highest quintile with the others, the lowest quintile with the others, and the highest with the lowest quintile. The sample consists of 913 firms, and differences in means (medians) are evaluated with a two-sided t-test (sign test).

	Mean	Median	25th Percentile	75th Percentile	Minimum	Maximum
Panel A: Abnormal Short-Selling, $ABSS(-5,-1)$						
Highest quintile ($n = 183$)	−3.72%***	−2.70%***	−13.60%	3.81%	−64.55%	41.25%
Other 80% ($n = 730$)	−0.26	−0.49	−8.37	7.49	−67.86	79.17
Difference	−3.46***	−2.31**				
Lowest quintile ($n = 183$)	0.22	−0.53	−9.29	8.49	−27.27	79.17
Other 80% ($n = 730$)	−1.25**	−0.80**	−8.84	7.07	−67.86	70.90
Difference	1.47	0.27				
Highest quintile ($n = 183$)	−3.72***	−2.70***				
Lowest quintile ($n = 183$)	0.22	−0.53				
Difference	−3.94**	−2.17				
Panel B: Abnormal Relative Short-Selling, $ABRELSS(-5,-1)$						
Highest quintile ($n = 183$)	−3.63%***	−3.31%***	−13.25%	5.53%	−64.55%	47.62%
Other 80% ($n = 730$)	−0.29	−0.21	−8.21	7.67	−67.85	79.17
Difference	−3.92**	−3.52***				
Lowest quintile ($n = 183$)	0.95	0.69	−7.55	9.46	−50.56	42.35
Other 80% ($n = 730$)	−1.43***	−1.10**	−9.29	6.89	−67.86	79.17
Difference	2.38*	1.79				
Highest quintile ($n = 183$)	−3.63***	−3.31***				
Lowest quintile ($n = 183$)	0.95	0.69				
Difference	−4.57***	−4.00***				

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

rulemakers and may encourage them to consider providing to investors more extensive and timely disclosures of short-selling.

Finally, we examine the attributes of firms where short-sellers are wrong. More specifically, we investigate the book-to-market characteristics of firms where short-sellers established unusually large positions prior to positive earnings surprises. Intuition suggests that such cases may occur when high growth firms that short-sellers perceive to be overpriced manage to meet or exceed their generally expected earnings. Consequently, we take the highest quintile for both $ABSS(-5,-1)$ and $ABRELSS(-5,-1)$, and partition these quintiles into those cases in which the 2-day post-announcement return exceeds 3% (positive earnings surprise) and all other cases. We then compare the book-to-market value of the stocks in the two groups. Although the mean and median book-to-market ratios are lower for the positive earnings surprise firms, they are not significantly lower. For example, the median book-to-market ratio for the $ABSS(-5,-1)$ quintile is 0.16 for the positive earnings surprise firms and 0.20 for the other firms in the quintile. A test of parameter equivalence results in a p-value of 0.31. And similar findings obtain for the highest $ABRELSS(-5,-1)$ quintile. These results suggest that although some unusually high short-selling may occur before the positive earnings announcements of high book-to-market firms, incorrect expectations along an alternative dimension are responsible for a more substantial number of cases. Similar results appear when we examine the SUE characteristics of stocks where short-sellers establish unusually large positions prior to positive earnings surprises.

III. Conclusion

This study has examined the short-selling behavior of investors prior to the earnings announcements of 913 Nasdaq-listed stocks in fall 2000. One finding is that short-selling does not increase consistently across all firms prior to earnings announcements. Rather, for most firms, short-selling is somewhat lower in the pre-announcement days than it is during other days. For a subset of firms, however, short-selling is higher in the pre-announcement period, and this rise is potentially consistent with the existence of informed traders engaging in abnormally large short-selling as they anticipate a negative earnings surprise and a corresponding decline in share price.

Tests of two empirical specifications designed to investigate whether abnormal short-selling prior to the earnings announcement is related to the eventual announcement-period stock price reaction uncover evidence for the presence of informed traders. The statistical results are somewhat stronger for firms without tradable put options, which is consistent with the expectation that some informed traders employ options rather than short-selling to exploit their private information. Restricting the sample to exclude announcement dates when the Nasdaq equally weighted index either rose or declined substantially leads to estimation results similar to those found for the full sample of observations. Consequently, the empirical relationship between pre-announcement

short-selling and post-announcement returns is not an artifact of the generally declining Nasdaq market in fall 2000.

Exploring the linkage between short-selling and two investment strategies reveals some evidence that pre-announcement short-selling is induced by book-to-market ratios, but little indication that SUE plays a role. Rather, a significant portion of pre-announcement short-selling is driven by some other information source that is highly correlated with the post-announcement return.

A high level of unusual pre-announcement short-selling is an indicator of future stock returns at earnings announcement. It is not a perfect indicator because some unusual increases in short-selling precede positive earnings surprises. Nonetheless, in the majority of cases, the post-announcement stock return is negative following unusually high short-selling. An implication of these results is that general investor knowledge of unusual short-selling activity—as it is occurring—could facilitate more orderly price movements and more efficient incorporation of private information into stock prices. Consequently, financial market rulemakers may want to consider requiring more extensive and timely public disclosures of short-selling.

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