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# Informed trading before analyst downgrades: Evidence from short sellers ☆

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ABSTRACT

This paper studies short-selling prior to the release of analyst downgrades in a sample of 670 downgrades of Nasdaq stocks between 2000 and 2001. We find abnormal levels of short-selling in the three days before downgrades are publicly announced. Further, we show that this pre-announcement abnormal short-selling is significantly related to the subsequent share price reaction to the downgrade, and especially so for downgrades that prompt the most substantial price declines. Our findings are robust to various controls that might also affect short-selling such as pre-announcement momentum, three-day pre-announcement returns, and announcement-day share price. In addition, the results are independent of scheduled earnings announcements, analyst herding, and non-routine events near downgrades. Further evidence suggests that tipping is more consistent with the data than the prediction explanation which posits that short sellers successfully predict downgrades on the basis of public information about firms' financial health. Finally, we present evidence that downgraded stocks with high abnormal short-selling perform poorly over the subsequent six months by comparison with those with low abnormal short-selling. Overall, our results support the hypothesis that short sellers are informed traders and exploit profitable opportunities provided by downgrade announcements.



## 1. Introduction

Financial analysts play a crucial role in the dissemination of information in financial markets. Prior research suggests that analyst stock recommendations have at least short-term investment value (see, e.g., Stickel, 1995; Womack, 1996; Barber, Lehavy, McNichols, and Trueman, 2001; Jegadeesh, Kim, Krische, and Lee, 2004; Green, 2006). Further, given the proclivity of analysts to make more favorable than unfavorable recommendations or recommendation changes, their unfavorable announcements are usually associated with more dramatic market reactions (see, e.g., Womack, 1996; Barber, Lehavy, McHichols, and Trueman, 2001; Hsieh, Ng, and Wang, 2007).[1] Clearly, the potentially negative impact of an

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[1] Besides their preference for making favorable recommendations, financial analysts are plagued by conflicts of interest. Notably, some studies (e.g., O'Brien McNichols, and Ling, 2005, and Juergens and Lindsey, 2006) show a linkage between an analyst's coverage of a company and that company's investment banking relation with the analyst's brokerage firm. Because of such relations, analysts usually are reluctant to reveal negative news about their client companies. In addition, Irvine, Lipson, and Puckett (2007) find that institutional buying increases abruptly in the days immediately preceding analysts' positive initial recommendations. They suggest that the evidence is consistent

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unfavorable recommendation change (or downgrade) on share price could provide a strong incentive for investors to acquire information about an upcoming downgrade and to profit by short-selling the company's stock before the announcement.

A recent episode highlights this issue. In March 2007, the Securities and Exchange Commission (SEC) filed a complaint against several individuals for trading shares, from 2001 to 2006, ahead of upcoming changes in stock recommendations by the Wall Street brokerage subsidiary of UBS AG.[2] A number of the recommendation changes were downgrades of the stocks' investment quality, and, allegedly, the named individuals profitably sold shares short in advance of the public announcement of those downgrades. Although this case indicates a potential link between profitable short sales and subsequent downgrades, no research has studied the overall magnitude and significance of short-selling prior to analyst downgrades.

This paper addresses that gap in the literature by examining whether short-selling in the days leading up to downgrade announcements is abnormally high relative to the stocks' usual amount of short-selling. Theoretical models, such as Diamond and Verrecchia (1987), suggest that short sellers are able to take advantage of information by trading shares before negative information reaches the public. Applying that theory to downgrades, we propose the informed front-running hypothesis: If short sellers are informed traders, the returns accompanying downgrades should be negatively associated with the levels of abnormal short-selling in those stocks in the days just before the announcements. However, a lack of correlation between pre-announcement short-selling and the price changes brought on by the downgrades would be consistent with at least two alternative explanations: (1) most short sales are initiated by uninformed speculators or hedgers, and (2) informed investors are deterred from using short sales to exploit their informational advantage due to potential legal or regulatory constraints.

Employing a unique data set containing daily short sales in Nasdaq stocks between 2000 and 2001, we find evidence supporting the informed front-running hypothesis. First, using different proxies for a stock's normal short-selling, we show that the average daily short-selling from day $-3$ to $-1$, relative to the downgrade date, is about four times higher than the normal level during our sample period.[3] The second, and more important, evidence is that pre-downgrade short-selling is significantly and negatively correlated with two-day stock price changes associated with the downgrades (i.e., from day 0 to $+1$). This relation is especially pronounced for downgrades that prompt the most substantial percentage declines in share price. Moreover, our findings remain strong in tests that control for the downgraded stock's share price momentum, returns in the three days prior to the announcement, and the level of the share price on the announcement day.

We establish that our results are not driven by potentially confounding events that occur around the downgrades. In particular, to minimize the impact of those events, we exclude the following, possibly tainted observations from our sample: cases in which a quarterly earnings announcement occurred between five days before and one day after the company's downgrade, and downgrades published in the two days following significant but non-routine corporate news events (e.g., dividend changes or revision of management forecasts).[4] Test results from various samples suggest that short sellers do not simply respond to publicly available information. Instead, they are able to anticipate and exploit the price declines that result after the downgrades are publicly announced.

It is important to recognize that the informed front-running hypothesis is consistent with two possible explanations.[5] One is that the correlation between pre-announcement abnormal short-selling and announcement-day price declines associated with downgrades arises because investors tend to sell short the stocks they predict will do poorly, and their judgments coincide with those of analysts who eventually, but independently, decide to downgrade shares of weak firms. This view, labeled the prediction hypothesis, is based on the supposition that both short sellers and analysts use the same valuation-relevant information (e.g., accounting or stock price variables) to assess the financial health of firms.

An alternative view, labeled the tipping hypothesis, suggests that short sellers short a firm's stock by taking advantage of the tip they receive from a brokerage firm about a forthcoming downgrade. We examine the relative claims of the prediction versus tipping hypotheses. Although we do not have data that clearly link the identities of sellers and dealers involved in the trades (and are, accordingly, unable to probe possible links between specific short sellers and the brokerage firms that release analyst downgrades), our empirical evidence leans toward the tipping hypothesis.

In addition, our study provides evidence on the ability of unusual pre-announcement short-selling to predict the share price performance of downgraded firms over the subsequent six months. These tests are motivated by the notion that any significant linkage between these variables would further confirm the informational role of

(*footnote continued*)
with the notion that institutional investors receive tips prior to the release of analyst recommendations.

[2] See US Securities and Exchange Commission Litigation Release No. 20022 (March 1, 2007). See also BusinessWeek (2007a, 2007b). Recently, at least one member of UBS's Investment Review Committee pleaded guilty in a scheme around insider trades based on analyst recommendations (Wall Street Journal, February 27, 2008).

[3] The three-day period is the focus of our study because an analyst's decision that a stock should be downgraded must undergo internal review and the process normally takes several days. In the interval between the submission of the decision and the approval and announcement of the downgrade, investors could learn or be informed of the forthcoming downgrade.

[4] We also expand our search to 20 days before announcements. Results are similar. And, we perform several robustness checks to make certain that our results are not caused by other confounding events.

[5] We are grateful to the referee for suggesting additional tests to clarify this issue.

abnormal short-selling before downgrades. Prior research into monthly exchange-reported data on short interest indicates that short interest can predict stock performance over the near future. For example, Asquith and Muelbrook (1995) and Desai, Ramesh, Thiagarajan, and Balachandran (2002) show that firms with high levels of short interest earn negative abnormal returns for up to 12 months. Our analysis extends this line of research by showing that downgraded firms with high levels of pre-announcement abnormal short-selling underperform those with low levels by approximately 2% per month over the following six months. In these tests, we adjust the difference in the returns of these groups for contemporaneous market movements or firm characteristics and find that the magnitude of the difference remains economically significant. This evidence indicates that unusually high levels of short-selling contain information about the subsequent stock price performance of downgraded firms.

This paper also contributes to the literature on short-sale transactions (as opposed to the research focusing on monthly measures of short interest) that has developed in response to newly available data on daily short sales. Using NYSE firms during the period 2004–2005, Daske, Richardson, and Tuna (2006) examine but do not find evidence of increased short-selling preceding bad news in either earnings announcements or management forecasts. Other studies, however, suggest that short sellers are informed. Christophe, Ferri, and Angel (2004) find that the short-sale transactions in the five days prior to earnings announcements are negatively linked to post-announcement stock returns for Nasdaq firms in the fall of 2000. Diether, Lee, and Werner (2009) examine data produced by the SEC's experimental project known as Regulation SHO and report that increased short-sale transactions predict negative abnormal returns in at least the short run. Finally, Boehmer, Jones, and Zhang (2008) explore NYSE order data from 2000 to 2004 and show that a value-weighted (VW) portfolio of highly shorted stocks underperforms lightly shorted stocks by approximately 1.2% over the next 20 trading days.

The findings we report here shed light on the important policy issues regarding whether certain brokerage clients benefit from pre-announcement material information. By showing the abnormally high short-selling in the days immediately prior to downgrades, which is not related to changes in downgraded firms' earnings or to other significant corporate events, we provide some evidence that the activity alleged by the SEC regarding tipping in the case of the subsidiary of UBS AG might have been common. Thus, our work calls into question the fairness of the special treatment accorded to certain groups of equity market participants (e.g., investors who are tipped about upcoming downgrade announcements), which could be construed as a violation of SEC Rule 10b-5.

The remainder of the paper is organized as follows. Section 2 describes the data used in the study and includes sample summary statistics. Section 3 presents the empirical results. Section 4 provides robustness checks on the main results and includes an assessment of the tipping versus the prediction hypotheses. Section 5 examines subsequent stock returns of downgraded firms, and Section 6 concludes.

## 2. Sampling procedure and distribution of downgraded firms

In this section, we describe the formation of the sample of downgrades, the source of our short-selling data, features of the sample, and some financial characteristics of the downgraded firms.

### 2.1. Formation of the sample

We obtain analyst recommendation changes from First Call, a real-time database of consensus earnings estimates and recommendations. The majority of US brokerage firms use First Call to disseminate their research reports electronically to institutional clients. As noted by Green (2006), once the compliance department of a brokerage approves an analyst's report, it is typically sent immediately to First Call for distribution. One of the benefits of First Call's information for academic researchers is that it contains the date that each analyst published his or her recommendation. Such dating is critical in this study because we are interested in daily short-selling behavior in the days just preceding a recommendation downgrade. One limitation of First Call's data set, however, is that it contains only the brokerage firm reporting the recommendation and not the individual analyst making the recommendation. Thus, we are unable to investigate whether there is unusual short-selling prior to downgrades by individual analysts (e.g., those from All-America Research Team ranked by *Institutional Investor* magazine).

Because we have short-selling data only for Nasdaq stocks, we examine the downgrades of the firms listed on that exchange alone. The data set contains daily short-selling and other trade information on more than 3,000 Nasdaq stocks for the sample period September 13, 2000–July 10, 2001. It is important to recognize, however, that many of the stocks in the data set were thinly traded or had very low prices. Consequently, to avoid the well-known problems posed by such shares and to focus on stocks liquid enough to attract short sellers as well as analysts, we follow Christophe, Ferri, and Angel (2004) and confine our analysis to those Nasdaq stocks that met two conditions: (1) the stock traded every day during our sample period, and (2) the stock had at least 50 trades per day on average during that time. A total of 1,314 stocks passed these screens, and we restrict our examination to the downgrades of the firms in that group.

Following Womack (1996) and Green (2006), we focus on First Call-reported recommendation changes that were disseminated by the top 14 brokerages, as identified in the October 2000 issue of *Institutional Investor*. In addition, our sample includes only the recommendation downgrades by these top 14 brokerages that are designated as "real-time" in the First Call database. Focusing on real-time recommendations is essential to ensure that our sample of downgrade observations contains an accurate

record for the specific days on which such recommendations were published.

To minimize any confounding issues from the possible clustering of analyst downgrades (e.g., Welch, 2000), we eliminate from our sample any downgrade that was preceded during the previous week by another downgrade from a top 14 brokerage firm. We also restrict the sample to firms that did not have a quarterly earnings announcement within the window of five trading days before to one trading day after the downgrade date. These procedures protect our results from the potential impacts of herding behavior by analysts and of market reactions to date-certain earnings disclosures.[6] In addition, because stocks with low prices could be difficult to short (D'Avolio, 2002) and offer modest profits from short-selling, we exclude companies with a stock price less than $5 on the date of the downgrade. Besides this price restriction, we require all sample firms to have information on share price, total shares outstanding, and trading volume available on the Center for Research in Security Prices (CRSP) tape. Finally, we code the dates of the few downgrades that occurred on Saturday or Sunday as the first following trading day. As a result of these screens and provisions, our sample consists of 670 downgrades of Nasdaq stocks during our sample period.

### 2.2. Data on trades and short sales of Nasdaq stocks

The source of the short-sale data is Nasdaq's Automated Confirmation Transaction Service (ACT), which processed the majority of transactions in Nasdaq-listed stocks during our study period. The data set includes all processed trades (excluding odd-lots) from the daily 9:30 am–4:00 pm sessions between September 13, 2000 and July 10, 2001.[7] Every ACT record includes the stock's ticker, date and time of trade, number of shares traded, price, and whether ACT has reported the trade to the public. To avoid double-counting, which might arise with trades executed through an Electronic Communication Network (ECN) such as Island, we restrict our sample to only transactions that were reported to the public, whether executed through an ECN or on another venue.[8]

Two kinds of market participants, National Association of Security Dealers (NASD) dealers and customers of those dealers, are able to sell shares short, but their motivations are different. Dealers sell short largely for the management of inventories, while customers do so because of anticipated or potential declines in price. It is important to be able to distinguish between the two groups of short sales because the hypothesis of front-running involves only the short sales by customers. Two tools help to distinguish one type of short sale from the other. The first is ACT's protocol for reporting a trade: (1) a market-maker in a trade with a non-market-maker reports; (2) the seller in a trade between two market-makers files the report; (3) the NASD member in a trade with a non-NASD member reports; and (4) the seller in a trade between two members is responsible for reporting. The other tool is Nasdaq's daily file of quotations, which identifies who, during each day, served as a market-maker in a stock. (Most large market-makers actively quoted on their stocks every day.)

It is important to note that NASD rules in effect during our sample period required all dealers to identify all their short sales.[9] Accordingly, dealer short sales in a stock on a day consist of all short trades in the stock made by NASD members who functioned as market-makers for the stock that day. Similarly, the customer short sales in a stock on a day are all short trades in that stock on that day which were made by customers of the NASD dealers or by NASD members who were not acting as market-makers on the day.

ACT records list some short sales as "exempt" from the bid-test in the Nasdaq Short Sale Rule.[10] During our sample period, Nasdaq allowed this designation for short sales by investors who proved they were arbitraging positions on options or foreign markets. It also allowed exemption for such activities as convertible bond arbitrage. We do not include shares shorted in exempt sales in our analysis, because we seek to focus only on the shares shorted by customers in anticipation of profit from price decline or relative underperformance. Therefore, our tests concentrate only on the shares shorted by customers in non-exempt sales of the stock of downgraded firms.[11]

One concern regarding the recorded set of customer non-exempt short sales is that some of them might have been arbitrage trades that could have been, but were not, submitted as exempt.[12] That is, some investors might not have claimed exemption because of the costs of creating special arbitrage accounts or of possible audits of claimed exemptions. Several considerations suggest, however, that

[6] For robustness checks, we also exclude downgrades in which there were earnings announcements within 10 days before downgrades. Our results remain unchanged following this alternative procedure.

[7] These data were obtained through a special agreement when Michael Ferri was Vice President for Economic Research at Nasdaq. The data were extracted only for the sample period covered in this study, and we are unaware of any comparable Nasdaq data available for any other time periods. We acknowledge that this sample period is relatively short, which could impact the generalizability of our results Boehmer, Jones, and Zhang (2008) have a large and detailed but proprietary data set that applies to short and other trades on the NYSE for the 2000–2004 interval.

[8] Despite the unique value of our data set, we note two limitations. First, ACT files do not identify purchases that cover (or reverse) short sales. Second, ACT records do not indicate whether a seller transacting through the Small Order Execution System (SOES) is shorting. Because SOES handled only about 2% of all NASDAQ transactions in 2000–2001, the number of missed short sales is trivial. (See the NASDAQ website, www.marketdata.nasdaq.com, for more details.)

[9] Page 3 of Chapter 9 in the *NASDAQ Trader Manual* (revised January 2000).

[10] Dealer short sales could also receive the exempt status, but dealer activity is not pertinent to this paper.

[11] An important fact about the ACT data is that surprisingly few shares were recorded as sold in exempt customer trades. These shares amounted to less than one-tenth of 1% of daily volume and less than 5% of the shares sold in nonexempt short transactions.

[12] It is unlikely that any customer-shorted or dealer-shorted trades marked as exempt are speculative in nature. The exemption is available only for non-speculative activities, and trades marked as exempt could be subject to eventual audit for potential abuse.

the possibility of some misclassifications does not introduce bias into our tests. First, only a small number of sample companies had outstanding convertible bonds or were involved in attempted mergers or acquisitions during the sample period, and most of those efforts were short-lived. Therefore, the two leading motivations for shorting shares to offset long positions were not pertinent to the great majority of the sampled stocks. Second, even if some sales flagged as non-exempt did arise from hedging or arbitrage, they were unlikely to be systematically linked with analyst downgrades. In sum, we believe that the ACT data for non-exempt short sales by customers provide a valid and valuable measure of the actions by investors seeking to profit from anticipated price declines or relative underperformance by the sampled Nasdaq stocks.

### 2.3. Features of the sample

Panel A of Table 1 displays the number of downgrades that appear in our sample during each month of our sample period and the returns on several stock indexes during those same months. Because of our sampling procedure, our first downgrade observation did not occur until September 27, 2000. Thus, September 2000 contains the fewest number of downgrades (13).[13] During the other months, the number of downgrades fluctuated substantially, ranging from 47 (October 2000 and June 2001) to 112 (March 2001). Because our sample period took place after the internet stock-price bubble burst, it is interesting to examine whether the number of downgrades in a month is related to contemporaneous movements in market indexes. To shed light on this issue, the last four columns of Panel A report monthly returns for the value-weighted and equally weighted indexes of the Nasdaq Market and also the CRSP universe. The latter includes all NYSE, Amex, and Nasdaq firms covered by CRSP. It seems that downgrades were not highly correlated with overall market movements. For example, two of the worst monthly market returns occurred in November 2000 and February 2001, when the number of downgrades was only 65 and 52, respectively.[14]

Panel B in Table 1 illustrates the frequency of firms appearing in the sample. A total of 325 unique firms are represented in our 670 downgrade observations; 166 of these 325 firms (51%) appear only once in our sample of downgrades; 69 companies appear twice; and, in the extreme case, one firm appears 10 times.[15] Panel C provides a different perspective and displays the number of brokerage firms announcing a downgrade of a sample firm on the same day, as well as the magnitude of the change in recommendations. In 605 out of 670 cases (or 90%), only one brokerage downgraded the company on a downgrade date. In the remaining 65 instances, two or more brokerages announced downgrades of the same firm on the same day. To avoid clustering, we treat multiple downgrades of the same company on the same date as a single observation. Because our sample selection screens remove analyst downgrades that occurred around earnings announcements, it is unlikely that those simultaneous downgrades were caused by a disappointing earnings report. Nonetheless, we do recognize that clustered or simultaneous downgrades could have been triggered by other types of unexpected negative news. We perform a robustness check on this issue in a later section.

The right five columns of Panel C show the distribution and magnitude of downgrades grouped by the number of analysts downgrading the same company on the same day. The magnitude of a downgrade is measured in terms of movement within five levels of recommendation: 1 (strong buy), 2 (buy), 3 (hold), 4 (sell), and 5 (strong sell).[16] Based on the magnitude of downgrade, each sample observation fits into one of these groupings: 1 to 2, 1 to 3, 2 to 3, 3 to 4, and 3 to 5. The summation of all observations based on the magnitude of downgrade (last five columns) equals the number of analysts downgrading the same company on the same date (first column) multiplied by the total number of downgrades in that group (second column). The following example from the row for "Four" in the first column illustrates the way to interpret this table: Four analysts issued same-day downgrades of a firm on three separate occasions. Of those 12 downgrades, seven dropped the firm from 1 to 2 (or from "strong buy" to "buy") and five reduced the recommendation from 2 to 3 (or from "buy" to "hold").

The table reveals that analysts seldom make large downgrades, i.e., lower a recommendation by more than one level. Instead, most downgrades drop firms only to the next level. For example, for the 605 cases in which only one analyst downgraded the firm on the downgrade date, 516 recommendations were changed to the next level: 292 changed from 1 to 2, 220 changed from 2 to 3, and four changed from 3 to 4. The 89 other and large downgrades by a single analyst consist of 83 cases downgrading from 1 to 3 and six cases from 3 to 5. For our entire sample, 114 observations are classified as large downgrades. Prior research by Jegadeesh, Kim, Krische, and Lee (2004) and Mikhail, Walther, and Willis (2007), among others, indicates that larger downgrades are associated with more negative price movements. Consequently, in a later section, we examine whether large downgrades are accompanied by greater increases in unusual pre-announcement short-selling.

[13] To be more specific, we report statistics on short-selling up to 10 days prior to the downgrade. Because our short-selling data set begins on September 13, 2000, our first sample downgrade observation is on September 27, 2000 (the 11th trading day of our sample).

[14] We also investigate the relation between past market movements and analyst downgrades by examining the rank correlation between the number of downgrades in a month and the average return on the NASDAQ VW index during days −10 to −29 relative to each downgrade. The rank correlation is positive (coefficient=0.32) but insignificant ($p$-value=0.41). The correlation coefficient between the number of downgrades in a month and the average return on the NASDAQ EW index (instead of the VW index) is even weaker.

[15] PMC-Sierra, Inc appears 10 times in our sample of downgrades.

[16] First Call reports analyst recommendations according to this five-point rating system. If a brokerage firm uses a different scale, First Call converts the analyst's rating to the five-point system.

**Table 1**
Key features of sample of downgrades.

Analyst downgrades are obtained from First Call. Observations are limited to those made by the top 14 brokerage firms ranked by *Institutional Investor* in October 2000. The sample consists of Nasdaq firms with at least 50 trades per day on average during the sample period of September 2000 through June 2001 and a stock price of at least $5 on the downgrade date. To ensure an accurate time stamp, the sample is restricted to downgrades classified as "real-time" by First Call. To minimize the impact of confounding events, the sample includes only downgrades in which the company did not experience another downgrade in the preceding week, and the company did not make an earnings announcement during the preceding five trading days. Panel A presents the number of downgrades by year and Nasdaq and total market monthly returns. In this panel, we include only one observation for those cases in which the company received more than one downgrade from top 14 brokerage firms on the same day. The total market includes all NYSE, Amex, and Nasdaq firms covered by CRSP. Panel B presents the frequency that each firm appears in the sample. Panel C presents the number of analysts downgrading a sample company on the same day and the distribution of the magnitude of the downgrade. We utilize the rating categorizations reported by First Call: 1 (strong buy), 2 (buy), 3 (hold), 4 (sell), and 5 (strong sell).

*Panel A*: *Number of downgrades by month and monthly returns to market indexes*

| Date | Number of downgrades | Nasdaq VW return (percent) | Nasdaq EW return (percent) | Total market VW return (percent) | Total market EW return (percent) |
|---|---|---|---|---|---|
| September 27–30, 2000 | 12 | −0.47 | 0.61 | −5.11 | −4.01 |
| October 2000 | 47 | −8.40 | −6.83 | −2.46 | −6.68 |
| November 2000 | 65 | −23.15 | −16.13 | −10.26 | −11.86 |
| December 2000 | 82 | −5.00 | −0.53 | 2.04 | −0.70 |
| January 2001 | 86 | 12.31 | 2.03 | 3.95 | 22.50 |
| February 2001 | 52 | −22.68 | −10.83 | −9.93 | −7.45 |
| March 2001 | 112 | −14.37 | −8.11 | −7.03 | −7.27 |
| April 2001 | 60 | 15.13 | 12.08 | 8.39 | 7.64 |
| May 2001 | 107 | −0.21 | 9.04 | 1.06 | 6.22 |
| June 2001 | 47 | 2.52 | 2.06 | −1.75 | 0.77 |
| Total | 670 | | | | |

*Panel B*: *Frequency of firms' appearances in the sample*

| | |
|---|---|
| Total number of downgrade observations | 670 |
| Number of separate firms in the sample | 325 |
| Number of times each firm appears in the sample | |
| One | 166 |
| Two | 69 |
| Three | 38 |
| Four | 30 |
| Five | 10 |
| Six | 7 |
| Seven | 2 |
| Eight | 2 |
| Nine | 0 |
| Ten | 1 |

*Panel C*: *Distribution of downgrades by number of analysts issuing announcements on the same day and the magnitude of the downgrade*

| Number of analysts downgrading the company | Number of downgrades | Magnitude of downgrade | | | | |
|---|---|---|---|---|---|---|
| | | 1 to 2 | 1 to 3 | 2 to 3 | 3 to 4 | 3 to 5 |
| One | 605 | 292 | 83 | 220 | 4 | 6 |
| Two | 49 | 48 | 13 | 37 | | |
| Three | 11 | 11 | 7 | 14 | 1 | |
| Four | 3 | 6 | | 6 | | |
| Five | 1 | | 3 | 2 | | |
| Six | 0 | | | | | |
| Seven | 1 | 3 | 2 | 2 | | |
| Total | 670 | | | | | |

### 2.4. Financial characteristics of the downgraded firms

Table 2 contains sample firm descriptive statistics for a variety of accounting, stock price, and earnings variables. As shown in Panel A of the table, the mean book value of assets for sample firms at the end of the fiscal quarter preceding the downgrade announcement was slightly below $4 billion, and the mean market value of equity on the downgrade date exceeded $13 billion. The typical sample firm reported positive earnings per share (EPS median=$0.10) though the sample mean value for EPS is −$0.33.

The data in Panel B indicate that one of every 50 shares outstanding is traded each day (share turnover) for the

**Table 2**
Financial characteristics of downgraded firms.

This table contains descriptive statistics for the firms in our sample of 670 downgrades. Total assets, earnings per share (EPS), and sales are taken from the company's last fiscal quarter preceding the downgrade date. Market value is the company's market value of equity on the downgrade date. The book-to-market ratio is calculated as the book value from the last fiscal quarter preceding the downgrade date divided by the market value of equity on the downgrade date. Stock return volatility is the standard deviation of the downgraded firm's daily return from six months until 10 days before downgrade announcement. Share turnover, defined as the average ratio of daily trading volume to total shares outstanding, is measured over the same period. Momentum is defined as the downgraded firm's six-month cumulative return during the period ending 10 days before the downgrade date minus the return on the Nasdaq equally-weighted portfolio during the same period. Number of First Call estimates is the total number of estimates reported in the First Call database before the downgrade announcement. The dollar earnings surprise is defined as the actual EPS minus the median analyst estimate for EPS. The percentage earnings surprise is the dollar earnings surprise normalized by the absolute value of actual EPS. The last row reports the percentage of sample observations with a negative dollar earnings surprise.

| Variables | Mean | Median | 25th | 75th | Standard deviation |
|---|---|---|---|---|---|
| *Panel A*: *Accounting variables* | | | | | |
| Total assets (millions of dollars) | 3,941 | 992 | 411 | 2,410 | 9,985 |
| EPS (dollar) | −0.33 | 0.10 | −0.25 | 0.28 | 2.64 |
| Sales (millions of dollars) | 587 | 151 | 61 | 341 | 1,461 |
| Market value (millions of dollars) | 13,272 | 1,855 | 673 | 6,337 | 47,155 |
| Book-to-market | 0.208 | 0.325 | 0.159 | 0.592 | 0.136 |
| *Panel B*: *Stock price and return variables* | | | | | |
| Stock return volatility | 0.070 | 0.070 | 0.053 | 0.086 | 0.023 |
| Share turnover | 0.022 | 0.019 | 0.011 | 0.029 | 0.015 |
| Momentum | −0.231 | −0.286 | −0.545 | 0.012 | 0.424 |
| Share price on day of downgrade (dollar) | 27.36 | 22.97 | 13.50 | 35.00 | 20.15 |
| *Panel C*: *Earnings variables* | | | | | |
| Days since last earnings announcement | 51.3 | 48.0 | 33.0 | 70.0 | 24.4 |
| Number of First Call earnings estimates | 12.6 | 11.0 | 7.0 | 18.0 | 7.5 |
| Earning surprise (percent) | 0.009 | 0.018 | 0.000 | 0.054 | 0.427 |
| Earnings surprise (dollar) | −0.026 | 0.010 | 0.000 | 0.030 | 0.552 |
| Percentage of sample observations with negative earnings surprise | 22.5% | | | | |

typical firm. In addition, the six-month stock return momentum for most firms (relative to the Nasdaq equally-weighted index) is negative with a sample median of −28.6%. Panel C shows that 48 days have elapsed since the most recent earnings announcement for the typical sample firm and that the median earnings surprise (measured relative to the median analyst estimate) was $0.010. Further, the mean and median market-adjusted returns during day 0 to +1 relative to that recent earnings announcement date are 0.2% and −0.2%, respectively.[17] Neither excess return is significantly different from zero. This result is interesting because it suggests that many downgrades might not have been due to recent disappointing earnings performance.[18]

## 3. Market reaction to downgrades and the behavior of short sellers

In this section, we examine stock returns and short-selling in the days surrounding the downgrade announcements of our sample. As part of this analysis, we investigate whether evidence exists that short sellers are skilled traders by examining whether there is a significant linkage between a firm's pre-announcement abnormal short-selling and its post-downgrade abnormal stock price reaction. We follow the approach of Asquith, Pathak, and Ritter (2005) and define a stock's daily short-selling as the number of shares shorted in non-exempt sales divided by thousands of total shares outstanding on that day. Daily abnormal short-selling is the difference between a stock's daily short-selling and its normal amount of daily short-selling, which we estimate with different approaches, described in the next subsection.

### 3.1. Estimation of normal short-selling

Our first approach to estimating a stock's normal level of daily short-selling follows a matching portfolio procedure that has appeared in many studies, including Loughran and Ritter (2000), Dechow, Hutton, Meulbroek, and Sloan (2001), and Desai, Krishnamurthy, and Venkataraman (2006). This approach involves orming a matching portfolio for each downgraded stock according to two firm characteristics: market capitalization and the book-to-market ratio. The initial step in forming these benchmark portfolios is to sort the 1,314 Nasdaq firms that meet our screens for adequate liquidity and share price into five size-based groups according to their prior-year market

[17] The two days returns were measured in excess of the return during the same days on the NASDAQ equally-weighted index.

[18] We do recognize that many of the instances in which earnings just met (or barely exceeded) the analyst consensus forecast could be due to companies reporting street numbers to First Call that do not include some (purportedly transitory) expenses that would otherwise be included per Generally Accepted Accounting Principles (GAAP). Nonetheless, our two-day return evidence is consistent with the findings of Bradshaw and Sloan (2002) that investors react more to the street, not the GAAP, numbers when determining stock prices.

capitalization.[19] Firms within each size quintile are further sorted into one of five portfolios using their prior-year fiscal year-end book-to-market equity ratio.[20] Then, we match each downgraded firm with one of these 25 portfolios according to the firm's own size and book-to-market ratio. Finally, we estimate a downgraded stock's normal daily short-selling on a day as the median amount of short-selling on that day for the firms in its matching portfolio. Similarly, under this method, we estimate a downgraded stock's normal daily return as the median return for the firms that are in its matching portfolio.[21]

Analyst recommendations might be influenced by the two matching characteristics in the aforementioned procedure. If so, this could induce bias into the estimates of abnormal short sales. For example, it is well documented that analysts tend to cover large firms (see, e.g., Bushan, 1989; Womack, 1996). They are also likely to use the book-to-market ratio as one of the criteria for forming or changing their recommendations (Jegadeesh, Kim, Krische, and Lee, 2004). In addition, our first matching procedure implicitly assumes that corporations with similar size and book-to-market ratios should have similar short-selling patterns. To ensure that our tests do not suffer from problems caused by these issues, we conduct additional tests with a different approach for estimating normal daily short-selling and returns. This second approach is based upon the firm's own trading pattern (denoted as the trading-pattern approach). Specifically, a sample firm's normal daily short-selling is estimated as its median value for daily short-selling during the entire sample period. As a result, abnormal short-selling is estimated as the difference between a firm's daily short-selling on a day and its median value of daily short-selling. Our test results are robust to both metrics.[22]

As a prelude to those estimation results, Panels A and B of Fig. 1 display daily abnormal short-selling and abnormal stock returns in the days surrounding our sample of downgrades.[23] Panel A presents both the mean and median abnormal short-selling (obtained using the trading pattern approach) for sample firms during the period 20 days prior to 10 days following the downgrade announcement. Panel B presents mean and median abnormal return, defined as the difference between the downgraded firm's daily return and the return on the Nasdaq equally-weighted index on the same date. The initial evidence revealed in these figures suggests that analyst downgrades are associated with substantial negative stock returns and increases in short-selling. Both mean and median abnormal returns are the lowest while mean and median abnormal short-selling are the highest on the announcement date (day 0). Even more interesting, both mean and median abnormal short-selling appear to increase in the days just prior to the announcement, with the greater increase occurring in the mean, even though abnormal returns do not exhibit a similar pattern. The larger increase in the mean abnormal short-selling versus the smaller increase in the median is consistent with the possibility that short sellers selectively target firms they will short in the days preceding a downgrade announcement. Whether this elevated short-selling is linked to the stock price reaction following the downgrade is an issue explored in our empirical specifications.

### 3.2. A univariate analysis of abnormal returns and short-selling around downgrades

Table 3 contains summary statistics for stock returns and daily short-selling for our sample of downgraded firms in the days surrounding the announcement. Panel A displays returns for different holding periods relative to the date of the downgrade, returns on the corresponding matching portfolio firm based on size and book-to-market characteristics, and returns on the Nasdaq equally-weighted portfolio during the same time periods. Abnormal returns for the downgraded firms are displayed in two separate ways. The first is the difference between the return of the downgraded firm and the return of its matching portfolio firm, and the second is the difference between the return of the downgraded firm and the contemporaneous return of the Nasdaq equally-weighted portfolio. The statistical significance of each difference is also presented.

Panel A reveals that, consistent with numerous studies, analyst downgrades are associated with negative abnormal returns. When measured relative to the matching portfolio firm, the mean abnormal announcement return from day 0 to 1 is an economically large −6.1%, and the median (in brackets) is also substantial, at −4.2%. Both are statistically significant at the 1% level. The three-day abnormal return preceding the downgrade announcements (days −3 to −1) is also negative, but the magnitude is much smaller. The mean abnormal return is −1.5%, while the median is −0.7%. When measured relative to the Nasdaq portfolio, the abnormal returns exhibit a similar pattern. Finally, the mean (−0.8%) and median (−0.9%) post-announcement abnormal returns from day 2 to 10 indicate that the market response to analyst downgrades dissipates rather quickly for our sample firms when measured relative to the matching portfolio firm. Neither value is significantly different from zero.

[19] The top quintile includes the companies in CRSP NASDAQ Market Capitalization deciles 9 and 10; the next quintile contains the companies in deciles 7 and 8, etc.

[20] We also perform tests using portfolios based on size alone. Because the results are similar to those based on the two-dimensional matching, they are not reported here.

[21] As described below, our estimations also include a measure of each downgraded stock's normal return.

[22] In addition, we examine a third metric for estimating abnormal short-selling. In this approach, we assign each sample firm to a short-selling decile portfolio that is formed based upon short-selling during the early days of the sample period. In estimations using this approach, abnormal short-selling is defined as a firm's short-selling (divided by thousands of total shares outstanding) on a day minus the median amount of short-selling (divided by thousands of total shares outstanding) on that day for the firms in the same matching portfolio as the sample firm. Results using this approach are similar to those presented herein and are available upon request.

[23] Because the figures display abnormal short-selling and return beginning 20 days before the downgrade date, it pertains to the 638 (out of 670) sample downgrades that occurred 21 days or later into the sample period.

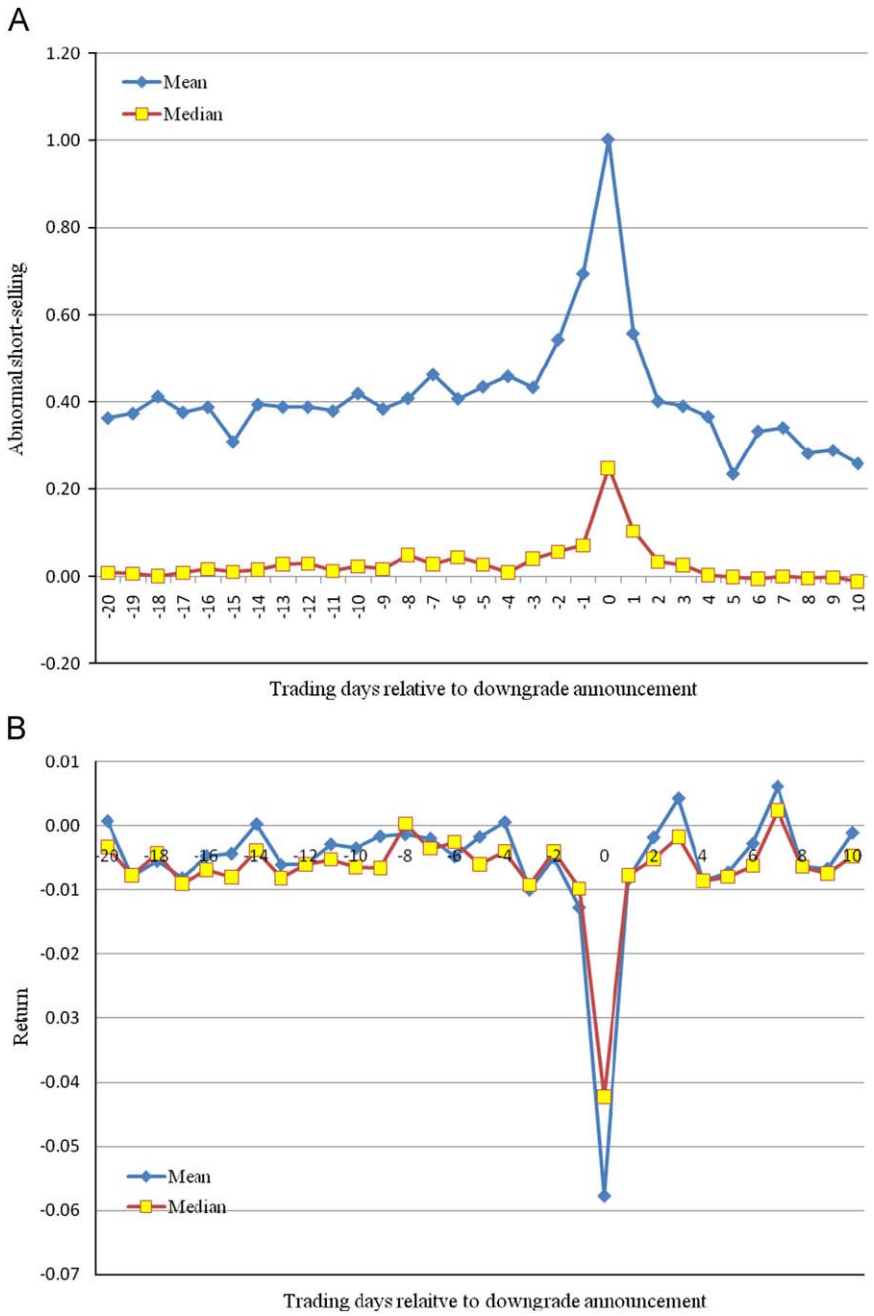


**Fig. 1.** Abnormal daily short-selling and returns around analyst downgrades. The plots show the daily mean and median of abnormal short-selling (Panel A) and returns (Panel B) from 20 days before to 10 days after analyst downgrades. The sample includes 670 downgraded firms between September 2000 and June 2001. The daily short-selling for each sample firm is calculated as the ratio of shorted shares to thousands of shares outstanding. The abnormal daily short-selling for each sample firm is the difference between the daily short-selling and the median value of daily short-selling over the entire sample period. The abnormal daily return is the difference between the sample firm's daily return and the return on the Nasdaq equally-weighted index on the same date.

Panel B presents the mean and median of average daily short-selling during the four different intervals for both the downgraded firms and their matching portfolio firm based on size and the book-to-market ratio. The abnormal daily short-selling for the downgraded firms is also displayed in two ways: first, as the difference between the average daily short-selling of the downgraded firm and its matching portfolio firm and, second, as the difference between the average daily short-selling of the downgraded firm and that firm's median value for

**Table 3**
Returns and short-selling of downgraded firms and matching portfolios.

The firm corresponding to each of the 670 downgrades is assigned to, and compared with, the median firm in one of 25 matching portfolios. Matching portfolios are constructed using a two-way sorting procedure involving separate quintiles based upon size and the book-to-market ratio. Firm size is obtained from the prior-year Nasdaq market capitalization decile portfolio assignment on CRSP. The book-to-market ratio is defined as book value of equity divided by market value of equity at the firm's prior year fiscal year-end. Panel A presents mean and median holding period returns for sample firms, the matching portfolio firms, and the Nasdaq equally-weighed portfolio during the indicated days relative to the downgrade date. In addition, the differences between each firm's return and the return of its corresponding matching portfolio firm and the Nasdaq equally-weighted portfolio are reported. Panel B presents the mean and median of the average daily ratio of shares shorted to thousands of shares outstanding for sample firms and matching portfolio firms. Also, the difference between each firm's short-selling and the short-selling of its corresponding matching portfolio firm is presented. The bottom row reports the difference between the firm's average daily short-selling during the indicated period and the firm's median value of daily short-selling over the entire sample period. In both panels, median values are in brackets. We test whether downgraded firms have different returns and short-selling from their corresponding matching portfolios by using the two-sided t-test and the sign test. ** and * indicate significance at the 1% and 5% level, respectively.

| | Days relative to the downgrade date | | | |
|---|---|---|---|---|
| | −10 to −4 | −3 to −1 | 0 to 1 | 2 to 10 |
| *Panel A*: *Returns* (*N*=670) | | | | |
| (a) Return of downgraded firms | −0.016 | −0.028 | −0.074 | −0.026 |
| | [−0.034] | [−0.019] | [−0.063] | [−0.035] |
| (b) Return of matching portfolio | −0.013 | −0.013 | −0.013 | −0.017 |
| | [−0.023] | [−0.014] | [−0.009] | [−0.018] |
| (c) Return of Nasdaq equally-weighted portfolio | 0.003 | 0.000 | −0.003 | 0.003 |
| | [−0.014] | [−0.001] | [−0.000] | [−0.000] |
| Difference between (a) and (b) | −0.003 | −0.015** | −0.061** | −0.008 |
| | [−0.008] | [−0.007]* | [−0.042]** | [−0.009] |
| Difference between (a) and (c) | −0.019** | −0.028** | −0.071** | −0.028** |
| | [−0.024]** | [−0.021]** | [−0.053]** | [−0.028]** |
| *Panel B*: *Daily short-selling* (*N*=670) | | | | |
| (d) Average daily ratio of shorted shares to outstanding shares of downgraded firms | 1.138 | 1.264 | 1.542 | 1.040 |
| | [0.658] | [0.640] | [0.851] | [0.553] |
| (e) Average daily ratio of shorted shares to outstanding shares of matching portfolio | 0.317 | 0.325 | 0.334 | 0.323 |
| | [0.286] | [0.300] | [0.310] | [0.316] |
| Difference between (d) and (e) | 0.821** | 0.938** | 1.208** | 0.718** |
| | [0.352]** | [0.349]** | [0.523]** | [0.284]** |
| Difference between (d) and the median ratio of shorted shares to outstanding shares during the sample period | 0.427** | 0.553** | 0.831** | 0.330** |
| | [0.140]** | [0.162]** | [0.291]** | [0.099]** |

average daily short-selling during the entire sample period.[24] The panel reveals that abnormal short-selling increases substantially once downgrades are publicly announced. The mean of the sampled firms' average daily ratio of shorted shares to thousands of shares outstanding during the two-day period from day 0 to 1 is 1.542.[25] The corresponding value is only 0.334 for the matching portfolio firms. Consequently, the mean abnormal short-selling, at 1.208, is strikingly high. The median value of abnormal short-selling is lower at 0.523. However, it remains statistically and economically significant. Further, the abnormal short-selling continues for the next nine days. The mean from day 2 to 10 is 0.718, which is more than twice the normal level (0.323), and the median, at 0.284, is also quite significant. Abnormal short-selling, as computed with the downgraded firms' own trading records over the sample period, displays a similar pattern although the magnitudes are smaller.[26]

Importantly, the level of short-selling appears to be elevated before analyst downgrades are announced. The mean of the downgraded firms' average daily short-selling from day −3 to −1 is 1.264, which is more than threefold the mean of the average daily short-selling in the matching portfolios (0.325). The median ratio for downgraded firms, 0.64, is more than twice the ratio for the matching portfolios. Further, as shown in the last four rows of the panel, both the mean and the median of abnormal short-selling increase significantly three days before the downgrade announcement. This result holds for both measures of abnormal short-selling. Overall, these statistics clearly suggest that abnormal short-selling escalates prior to the downgrade announcement, reaches its height in the two days (0,1) surrounding the announce-

[24] Across the 670 sample downgrade observations, the variable representing the firms' median values for average daily short-selling during the entire sample period has a mean of 0.711 and a median of 0.379.

[25] The average number of shares outstanding on the downgrade date for our 670 sample observations is 394,643,330. Therefore, this ratio implies that, on average, 608,501 shares (or 0.154%) per day were shorted over this two-day period.

[26] This is mainly due to the fact that the estimates of normal short-selling are more volatile in the trading-pattern approach than in the matching-portfolio approach. Thus, the former estimates are more likely to be influenced by large ratios of normal short-selling.

ment, and then falls through the days following that event. The findings are consistent with the hypothesis that pre-announcement short-selling anticipates upcoming downgrades. In the following subsections, we use multivariate analyses to explore in depth the interesting linkage that this univariate analysis suggests.

### 3.3. Analyzing abnormal pre-announcement short-selling using the matching-portfolio approach to estimate normal short-selling

If the informed front-running hypothesis is correct and short sellers engage in informed trading of stocks about to lose value because of downgrades, we can expect the short-selling in those companies to increase abnormally. To examine this issue while controlling for other variables that could also influence short-selling, we employ the specification

$$ABSS(-3,-1)_i = \alpha_i + \beta_1 Log(P_0)_i + \beta_2 CAR(-3,-1)_i + \beta_3 MOM_i + \beta_4 CAR(0,1)_i + \varepsilon_i. \quad (1)$$

The dependent variable, $ABSS(-3,-1)$, is abnormal short-selling during the three days before the downgrade announcement. It is calculated as the firm's average daily short-selling minus its normal daily short-selling, where normal daily short-selling is obtained using the matching portfolio approach described in Section 3.1. In our sample of 670 downgrades, 481 (72%) have a positive value for $ABSS(-3,-1)$.

In Eq. (1), the variable of interest is $CAR(0,1)$, defined as the downgraded firm's holding period return from day 0 to 1 minus the median holding period return in the same days for stocks in the downgraded firm's matching portfolio. $CAR(0,1)$ provides the market's assessment of the economic value of the analyst's downgrade. Clearly, not all downgrades are associated with a negative stock price reaction. Thus, if short sellers are sophisticated and capable of anticipating the price impact of a downgrade, they would establish short positions in advance of downgrades that result in negative stock price reactions. In this case, $\beta_4$ is significantly less than zero, indicating that the abnormally high short-selling of downgraded stocks is associated with the subsequent negative price reaction. However, if short sellers are simply hedgers or uninformed investors, we would not observe any significant relation between abnormal short-selling and the share price reactions to downgrades. Thus, an insignificant $\beta_4$ would fail to support the hypothesis of informed front-running.

Eq. (1) also includes three control variables. $Log(P_0)$, the natural logarithm of the share price of the downgraded stock on the announcement date, controls for the likely positive link between a stock's price and short sellers' willingness to short it if they obtain unfavorable information about the firm (D'Avolio, 2002). $CAR(-3,-1)$, the cumulative abnormal return during the three-day pre-announcement period, is defined as the downgraded firm's total return over the three days preceding the downgrade minus the median cumulative total return for companies in the firm's matching portfolio during the same days. This independent variable controls for the possibility that short-term share price increases or decreases affect the level of short-selling in the days leading up to the downgrade announcement.

Similarly, we include the momentum variable, $MOM$, to control for the long-term share price movement. Momentum is calculated as the downgraded firm's six-month cumulative return during the period ending 10 days before the downgrade date minus the return on the Nasdaq equally-weighted portfolio during the same time period. It is not fully resolved whether and how short sellers incorporate past price movements (short or long term) as they decide to sell short. Diether, Lee, and Werner (2009) suggest that many short sellers are contrarians, and a pre-announcement appreciation could lead some of them to short the stock. By contrast, short sellers might be momentum players who aggressively short stocks with declining values. Thus, the coefficients of $CAR(-3,-1)$ and $MOM$ are undetermined, a priori.

A potential shortcoming related to utilizing $CAR(0,1)$ in Eq. (1) is that the specification imposes the assumption that, prior to the announcement, short sellers react symmetrically to both positive and negative abnormal returns following the announcement. To avoid any problem that the assumption of symmetry might cause, we also test the specification

$$ABSS(-3,-1)_i = \alpha_i + \beta_1 Log(P_0)_i + \beta_2 CAR(-3,-1)_i + \beta_3 MOM_i + \delta_1 D(1)_i + \delta_2 D(2)_i + \delta_3 D(3)_i + \delta_4 D(4)_i + \varepsilon_i \quad (2)$$

Eq. (2) replaces $CAR(0,1)$ with four binary variables, $D(1)$–$D(4)$, which equal one if $CAR(0,1)$ falls within one of the following ranges: $>0.1$, 0.025 to 0.1, $-0.1$ to $-0.025$, and $<-0.1$. Lower (i.e., more negative) announcement returns indicate that front-running the announcements could have achieved higher profits. If short sellers are able to anticipate the market's reaction to the upcoming downgrade, $\delta_4$ should have the most significantly positive value among the four coefficients. In our sample of 670 downgrade observations, 32 resulted in a $CAR(0,1)$ greater than 0.1, 99 fell in the category from 0.025 to 0.1, 210 were in the interval from $-0.025$ to $-0.1$, and 178 led to a $CAR(0,1)$ less than $-0.1$.

Table 4 illustrates the correlations between our variables of interest and controls. Abnormal short-selling, $ABSS(-3,-1)$, is significantly positively correlated with the share price on the announcement date, but negatively correlated with both the short-term ($CAR(-3,-1)$) and long term ($MOM$) returns before the announcement. This indicates that short sellers are more inclined to short higher-priced shares and tend to short more (fewer) shares when returns are more negative (positive). In addition, we show that $ABSS(-3,-1)$ is positively correlated with $ABSS(0,1)$.[27] Due to data

[27] ABSS(0,1) is the firm's average daily short-selling from day 0 to 1 minus its average daily amount of normal short-selling during the same period.

**Table 4**
Correlation matrix of key variables.

The firm corresponding to each of the 670 downgrades is assigned to one of 25 matching portfolios. Matching portfolios are constructed using a two-way sorting procedure involving separate quintiles based upon firm size and the book-to-market ratio. Firm size is obtained from the prior-year Nasdaq market capitalization decile portfolio assignment on CRSP. The book-to-market ratio is defined as book value of equity divided by market value of equity at the firm's prior year fiscal year-end. Abnormal short-selling, ABSS(−3,−1), is measured as the difference between the downgraded firm's average daily shorted shares (normalized by thousands of shares outstanding) in the three days preceding the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. $P_0$ is the downgraded firm's stock price on the date of downgrade. CAR(−3,−1) is the cumulative abnormal return in the three-day pre-announcement period and is computed as the downgraded firm's cumulative total return in the three days preceding the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. MOM is defined as the downgraded firm's six-month cumulative return during the period ending 10 days before the downgrade date minus the return on the Nasdaq equally-weighted index during the same time period. CAR(0,1) is the cumulative abnormal return in the two-day post-announcement period and is calculated as the downgraded firm's cumulative total return on the day of and the day following the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. ABSS(0,1) is measured as the difference between the downgraded firm's average daily shorted shares normalized by thousands of shares outstanding in the two days following the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. ** and * indicate significance at the 1% and 5% level, respectively. *P*-values are in parentheses.

| | ABSS(−3,−1) | ABSS(0,1) | CAR(−3,−1) | CAR(0,1) | Log($P_0$) | MOM |
|---|---|---|---|---|---|---|
| ABSS(−3,−1) | 1 | 0.651** | −0.175** | −0.056 | 0.247** | −0.082* |
| | | (0.000) | (0.000) | (0.150) | (0.000) | (0.033) |
| ABSS(0,1) | | 1 | −0.051 | −0.192** | 0.201** | −0.040 |
| | | | (0.189) | (0.000) | (0.000) | (0.304) |
| CAR(−3,−1) | | | 1 | 0.013 | 0.152** | 0.042 |
| | | | | (0.734) | (0.000) | (0.278) |
| CAR(0,1) | | | | 1 | 0.192** | 0.065 |
| | | | | | (0.000) | (0.095) |
| Log($P_0$) | | | | | 1 | 0.416** |
| | | | | | | (0.000) |
| MOM | | | | | | 1 |

constraints, however, we are unable to examine whether (or what portion of) the short trades during these two time periods are initiated by the same set of short sellers. We also note that the correlation between *ABSS*(−3,−1) and *CAR*(0,1) is negative but not statistically significant at standard levels (the *p*-value is only 0.15). This lack of significance is explained by an asymmetric link between pre-announcement short-selling and the returns associated with downgrades. For example, the (unreported) correlation between *ABSS*(−3,−1) and *D*(4) is 0.079 with a *p*-value of 0.041, whereas none of the correlations between *ABSS*(−3,−1) and *D*(1), *D*(2), and *D*(3) are significant.

Table 5 presents results from the estimation of Eqs. (1) and (2). We utilize the generalized method of moments (GMM) methodology to control for potential bias from heteroskedasticity and serial correlation of the residuals. As shown in Panel A, the level of abnormal short-selling prior to analyst downgrades is negatively correlated with the announcement returns. The coefficient is statistically and economically significant in all three models. For example, the parameter estimate of −1.444 in Model 1 implies that, if two stocks are similar except for a 1% difference in their announcement returns, the stock with the lower return has the pre-announcement abnormal short-selling that is 1.444 percentage points higher than the normal level. Because the average abnormal announcement return is −6.12% (Table 3), Model 1 indicates that the ratio of the average shares shorted relative to total shares outstanding increases by 8.84 percentage points beyond the normal level. The estimate of the increase in short-selling is 9.14 and 9.45 percentage points in Models 2 and 3, respectively. These results support the hypothesis of informed front-running, indicating that short sellers are well informed and trade with their informational advantage before financial analysts release downgrade reports to the public.

It is important to re-emphasize that our sample contains no downgrades that occurred around earnings announcements or within seven days of an earlier downgrade by one or more of the prominent brokerage firms. Thus, our findings are not likely to be caused by event driven downgrades or analyst herding. Nevertheless, our sample firms could remain subject to the release of other confounding information that leads to short-selling and induces analysts to change their recommendations.

The control variables provide interesting insights into key features of the overall pattern of short-selling. As expected from D'Avolio (2002), a positive and statistically significant relation exists between short-selling and announcement-day share price ($P_0$), indicating that short sellers are more active in high-priced stocks that could present greater profit potential from shorting. The coefficients are significant at the 1% level in all three models. In addition, consistent with the univariate results, short-selling transactions are negatively correlated with three-day pre-announcement returns and momentum. This demonstrates that short sellers short more (fewer) shares when the stock price declines (increases). More important, as indicated in Model 3, the association between abnormal short-selling and announcement returns remains strongly negative even after we control for these price changes. Thus, the findings here suggest that short sellers in our sample do not simply respond to share

**Table 5**
Regression analysis of abnormal short-selling activity prior to downgrades.

$$\mathrm{ABSS}(-3,-1) = \alpha + \beta_1 \mathrm{Log}(P_0) + \beta_2 \mathrm{CAR}(-3,-1) + \beta_3 \mathrm{MOM} + \beta_4 \mathrm{CAR}(0,1) + \varepsilon \quad (1)$$

$$\mathrm{ABSS}(-3,-1) = \alpha + \beta_1 \mathrm{Log}(P_0) + \beta_2 \mathrm{CAR}(-3,-1) + \beta \mathrm{MOM} + \delta_1 \mathrm{D}(1) + \delta_2 \mathrm{D}(2) + \delta_3 \mathrm{D}(3) + \delta_4 \mathrm{D}(4) + \varepsilon \quad (2)$$

The results of GMM estimation of these equations are as fitted to the sample of 670 downgrade observations. Panel A presents results from estimation of Eq. (1), and Panel B presents results from estimation of Eq. (2). The variable ABSS(−3,−1) is abnormal short-selling, measured as the difference between the downgraded firm's average ratio of shorted shares to thousands of shares outstanding in the three days preceding the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. $P_0$ is the downgraded firm's stock price on the date of downgrade. CAR(−3,−1) is the cumulative abnormal return in the three-day pre-announcement period and is defined as the downgraded firm's cumulative total return in the three days preceding the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. MOM is defined as the downgraded firm's six-month cumulative return during the period ending 10 days before the downgrade date minus the return on the Nasdaq equally-weighted portfolio during the same time period. CAR(0,1) is the cumulative abnormal return in the two-day post-announcement period and is defined as the downgraded firm's cumulative total return on the day of and the day following the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. D(1) to D(4) are binary variables equal to one if CAR(0,1) falls within one of the following ranges: >0.100, 0.025 to 0.100, −0.100 to −0.025, and <−0.100. Heteroskedasticity and serial-correlation consistent covariance is used in the model estimation procedure. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are in parentheses.

| | [1] | [2] | [3] |
|---|---|---|---|
| *Panel A: Estimation of Eq.* (1) (*N*=670) | | | |
| Intercept | −1.180*** | −1.492*** | −2.450*** |
| | (0.316) | (0.318) | (0.433) |
| Log($P_0$) | 0.659*** | 0.742*** | 0.983*** |
| | (0.112) | (0.113) | (0.140) |
| CAR(−3,−1) | | −3.432*** | −3.512*** |
| | | (0.877) | (0.879) |
| MOM | | | −0.911*** |
| | | | (0.192) |
| CAR(0,1) | −1.444** | −1.494** | −1.544** |
| | (0.638) | (0.619) | (0.626) |
| Adjusted $R^2$ | 0.069 | 0.115 | 0.158 |
| | [4] | [5] | [6] |
| *Panel B: Estimation of Eq.* (2) (*N*=670) | | | |
| Intercept | −1.360*** | −1.601*** | −2.549*** |
| | (0.345) | (0.346) | (0.451) |
| Log($P_0$) | 0.661*** | 0.733*** | 0.972*** |
| | (0.113) | (0.113) | (0.139) |
| CAR(−3,−1) | | −3.318*** | −3.361*** |
| | | (0.876) | (0.882) |
| MOM | | | −0.907*** |
| | | | (0.188) |
| D(1)=1 if CAR(0,1)>0.100 | 0.333 | 0.150 | 0.188 |
| | (0.329) | (0.318) | (0.310) |
| D(2)=1 if 0.025<CAR(0,1)≤0.100 | 0.100 | 0.039 | 0.090 |
| | (0.177) | (0.173) | (0.168) |
| D(3)=1 if −0.100≤CAR(0,1)<−0.025 | 0.231 | 0.244 | 0.202 |
| | (0.151) | (0.150) | (0.145) |
| D(4)=1 if CAR(0,1)< −0.100 | 0.601*** | 0.528*** | 0.546*** |
| | (0.181) | (0.171) | (0.166) |
| Adjusted $R^2$ | 0.072 | 0.114 | 0.156 |

price movement before and around the announcement. Instead, they also trade on the information they acquire before downgrade news become public.

Models 4 to 6 present the results of estimating Eq. (2), in which four binary variables categorize the magnitude and direction of the announcement returns. If short sellers effectively trade soon to be downgraded stocks using their private information, we should observe more abnormal short-selling in the stocks of firms that register more negative announcement returns. Consistent with this conjecture, *ABSS*(−3,−1) is significantly higher for the more negative announcement returns, and this relation is especially dramatic for the cases of returns lower than −10%. Model 4 indicates that there are an additional 0.601 shares (per thousand shares outstanding) shorted on average per day in the three days prior to the downgrade announcement. Model 6 shows that, even when announcement-day share price and current and past share price changes are controlled for, the coefficient of *D*(4) remains significant at the 1% level. Again, the evidence strongly suggests that short sellers are well informed about the magnitude and direction of upcoming analyst downgrades.[28]

### 3.4. Analyzing abnormal pre-announcement short-selling using the trading-pattern approach to estimate normal short-selling

This section reports on tests that employ an alternate measure of normal short-selling. Here, *ABSS*(−3,−1) is measured as the firm's average daily short-selling during the three days preceding the downgrade minus the firm's normal short-selling estimated using the trading pattern approach described in Section 3.1.[29] Overall, as in Table 5, the evidence in Table 6 strongly supports the informed front-running hypothesis: Abnormal short-selling in the pre-announcement period is significantly related to the abnormal announcement return in the estimations of Models 1 to 3.[30]

Models 4 to 6 present regression results using the same binary variables introduced above for different levels and directions of announcement returns. Again, we find that abnormal short-selling is significantly higher for downgraded stocks experiencing abnormal announcement returns less than −10%. In particular, Model 4 indicates that, ceteris paribus, abnormal short-selling is 0.353 percentage points higher for firms with more than 10% abnormal price declines as compared with stocks that experience an abnormal announcement return between −2.5% and 2.5%. This result emerges even after we control for the other variables also relevant to short-selling.

[28] The results in Table 5 are quantitatively similar when the models are estimated for the subsample of downgrades that excludes those announced by UBS AG.

[29] In our sample of 670 downgrades, 453 (68%) have a positive value when *ABSS*(−3,−1) is obtained using the trading-pattern approach.

[30] For all the estimations in Table 6, abnormal returns are measured relative to the Nasdaq equally-weighted portfolio return during the same days.

**Table 6**
Regression analysis of abnormal short-selling prior to downgrades: results from an alternative metric for abnormal short-selling.

$$\mathrm{ABSS}(-3,-1) = \alpha + \beta_1 \mathrm{Log}(P_0) + \beta_2 \mathrm{CAR}(-3,-1) + \beta_3 \mathrm{MOM} + \beta_4 \mathrm{CAR}(0,1) + \varepsilon \quad (1)$$

$$\mathrm{ABSS}(-3,-1) = \alpha + \beta_1 \mathrm{Log}(P_0) + \beta_2 \mathrm{CAR}(-3,-1) + \beta \mathrm{MOM} + \delta_1 \mathrm{D}(1) + \delta_2 \mathrm{D}(2) + \delta_3 \mathrm{D}(3) + \delta_4 \mathrm{D}(4) + \varepsilon \quad (2)$$

The results of GMM estimation of these equations are as fitted to the sample of 670 downgrade observations. Panel A presents results from estimation of Eq. (1) and Panel B presents results from estimation of Eq. (2). The variable ABSS(−3,−1) is an alternative metric for abnormal short-selling, measured as the difference between the downgraded firm's average daily shorted shares normalized by thousands of shares outstanding in the three days preceding the downgrade minus the firm's median daily value of shorted shares normalized by thousands of shares outstanding during the entire sample period. $P_0$ is the downgraded firm's stock price on the date of downgrade. CAR(−3,−1) is the cumulative abnormal return in the three-day pre-announcement period and is defined as the downgraded firm's cumulative total return in the three days preceding the downgrade minus the return on the Nasdaq equally-weighted portfolio during the same three days. MOM is defined as the downgraded firm's six-month cumulative return during the period ending 10 days before the downgrade date minus the return on the Nasdaq equally-weighted portfolio during the same time period. CAR(0,1) is the cumulative abnormal return in the two-day post-announcement period and is defined as the downgraded firm's cumulative total return on the day of and the day following the downgrade minus the return on the Nasdaq equally-weighted portfolio during the same two days. D(1) to D(4) are binary variables equal to one if CAR(0,1) falls within one of the following ranges: >0.100, 0.025 to 0.100, −0.100 to −0.025, and <−0.100. Heteroskedasticity and serial-correlation consistent covariance is used in the model estimation procedure. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are in parentheses.

| | [1] | [2] | [3] |
|---|---|---|---|
| *Panel A: Estimation of Eq.* (1) (*N*=670) | | | |
| Intercept | −0.038 | −0.367* | −0.717*** |
| | (0.220) | (0.221) | (0.263) |
| Log($P_0$) | 0.169** | 0.248*** | 0.336*** |
| | (0.074) | (0.073) | (0.084) |
| CAR(−3,−1) | | −2.901*** | −2.915*** |
| | | (0.682) | (0.681) |
| MOM | | | −0.338*** |
| | | | (0.122) |
| CAR(0,1) | −0.975* | −1.056** | −1.051** |
| | (0.537) | (0.517) | (0.517) |
| Adjusted $R^2$ | 0.011 | 0.074 | 0.083 |
| | [4] | [5] | [6] |
| *Panel B: Estimation of Eq.* (2) (*N*=670) | | | |
| Intercept | −0.126 | −0.351 | −0.660** |
| | (0.246) | (0.238) | (0.278) |
| Log($P_0$) | 0.158** | 0.226*** | 0.307*** |
| | (0.076) | (0.074) | (0.086) |
| CAR(−3,−1) | | −2.834*** | −2.854*** |
| | | (0.684) | (0.683) |
| MOM | | | −0.321*** |
| | | | (0.123) |
| D(1)=1 if CAR(0,1)>0.100 | 0.178 | −0.013 | −0.028 |
| | (0.189) | (0.190) | (0.187) |
| D(2)=1 if 0.025<CAR(0,1)≤0.100 | 0.232 | 0.179 | 0.169 |
| | (0.150) | (0.146) | (0.146) |
| D(3)=1 if −0.100 ≤CAR(0,1)<−0.025 | 0.114 | 0.050 | 0.033 |
| | (0.121) | (0.119) | (0.118) |
| D(4)=1 if CAR(0,1)<−0.100 | 0.353*** | 0.274** | 0.244** |
| | (0.135) | (0.125) | (0.125) |
| Adjusted $R^2$ | 0.008 | 0.067 | 0.075 |

## 4. Additional robustness tests and extensions

The preceding analysis incorporates robustness checks through sample selection and the use of two different metrics for estimating abnormal short-selling. To probe our results further, we conduct additional tests to consider the importance of large downgrades and potentially confounding events. We then extend our analysis by investigating the information source that leads to pre-announcement informed trading by short sellers. More specifically, we examine whether the tipping or the prediction hypothesis best explains short-selling activities prior to downgrade announcements.

### 4.1. Are large downgrades associated with more abnormal short-selling?

Large or more dramatic changes in analyst recommendations usually are associated with substantial share price changes and trading volume, as shown by Jegadeesh, Kim, Krische, and Lee (2004), Mikhail, Walther, and Willis (2007), and Hsieh, Ng, and Wang (2007). Consistent with these studies, we find that large downgrades in our sample (e.g., from 1 to 3, or 2 to 4, etc., using First Call's nomenclature) result in larger stock price declines than other downgrades (e.g., from 1 to 2 or from 2 to 3). In our 670 observations, 110 cases are classified as large. These downgrades have mean and median portfolio-adjusted returns of −8.49% and −4.70%, respectively.[31] In contrast, the mean and median portfolio-adjusted returns for the other 560 downgrades are −5.65% and −4.00%, respectively. Equality of these means is rejected by a one-sided t-test with a *p*-value of 0.028. Equality of medians is rejected by a Wilcoxon rank sum test with a *p*-value of 0.070.

It is plausible that, because large downgrades provide a potentially greater profit-making opportunity, short sellers might have incentives to short significantly more shares before large downgrade announcements. To determine whether the evidence is consistent with this argument, we modify Eqs. (1) and (2) to include an additional binary variable, *D*(*Large Downgrades*). Panel A of Table 7 shows that such downgrades have little impact on the level of pre-announcement abnormal short-selling because all of the coefficients on large downgrades are insignificant. To probe the data further, we modify the equations by an interaction variable between *D*(Large Downgrades) and announcement returns to capture the overall price impact of large downgrades. Again, the results from models 2, 4, and 6 show little evidence that the abnormal short-selling is significantly higher for those downgrades. In Panel B, we employ interaction variables for *D*(Large Downgrades) and the four binary abnormal return variables. The results from estimating these specifications are similar to those in

[31] The portfolio-adjusted returns are obtained relative to the returns on the corresponding size and book-to-market portfolios.

Panel A. Thus, the overall evidence finds little support for the notion that short sellers treat large downgrades differently than others.

The insignificant increase in short-selling among large downgrades, however, can be explained by our earlier finding that large downgrades are usually associated with more negative price reactions. Thus, the potential impact of large downgrades on abnormal short-selling could already be captured in the announcement return variables in the different specifications. Consistent with this interpretation, our previously presented evidence on abnormal short-selling persists in all of the models containing variables related to large downgrades, and we find that abnormal short-selling from day −3 to −1 remains correlated with the announcement returns. Taken together, our findings strongly suggest that short sellers are well informed about upcoming analyst downgrades. They benefit from their information advantage by shorting significantly more on stocks with more substantial negative returns. Finally, their focus is on the post-announcement stock return, irrespective of whether it is accompanied by a large or small downgrade.

### 4.2. Are the results driven by confounding events?

The evidence presented so far supports the hypothesis that short sellers are informed traders and benefit from upcoming analyst downgrades by shorting shares prior to the announcement. We need to be cautious, however, in interpreting the results because a meaningful number of our sampled downgrades could have simply been responses to important events that almost simultaneously triggered the downgrades and prompted short sellers to act aggressively. If so, the correlation between pre-announcement short-selling and announcement returns would be spurious. As noted in Section 2.1, we take several precautions to avoid spurious results. In particular, we remove any downgrade in which the company made a quarterly earnings announcement within the window of five trading days before to one trading day after the downgrade date. Also, we eliminate the influence of the possible clustering of downgrades by deleting those that were preceded during the five previous trading days by another downgrade.

To further ensure the robustness of the results, we employ a sample cleaned of downgrades that also occurred close to other potentially confounding events. Specifically, the sample reflects an additional comprehensive search for company-related news items on Dow Jones News Retrieval and the deletion of any downgrades whose firms were the subjects of business news from day −2 to the downgrade announcement date. When conducting this search some news items seemed positive, such as a dividend increase or a report that earnings were expected to surpass analyst forecasts in the current quarter. Typical items of negative news include a warning by the company regarding future profits and announcements of job cuts due to sector slowdown. Classifying news articles as positive or negative, however, often bumps up against ambiguity. Thus, we follow the most prudent course of simply removing all 73 cases that had such potentially confounding news items irrespective of whether they seemed to be positive or negative stories. With this new sample, we then re-estimate specifications 1 and 2.

The results of those re-estimations appear in Table 8. If our earlier findings had been driven primarily by the presence of confounding events, the re-estimations with the cleansed sample should yield a much weaker or even insignificant link between abnormal short-selling prior to the announced downgrades and the announcement returns. However, as shown in the table, abnormal short-selling remains significantly and negatively associated with the announcement return. In fact, the coefficients are comparable with those presented in Table 5. We also re-estimate the equations with a sample cleaned of 92 cases in which significant firm-related items appeared in the financial press during the 20 days before the downgrades. The results (not reported) from these estimations are not meaningfully different from those we report here. Because of this extensive probe into the robustness of our findings, we are confident that our documented pre-announcement short-selling is not an artifact of corporate news events that emerged in the days preceding analyst downgrades.

### 4.3. Evaluating the tipping versus the prediction hypotheses

So far, we have reported evidence of informed trading by short sellers prior to analyst downgrades. An important issue is whether this informed trading arises because short sellers benefit from a tip they receive from insiders aware of a forthcoming downgrade announcement (the tipping hypothesis) or because short sellers establish positions based upon skillful analysis of the targeted firm's poor fundamentals and analysts concurrently or subsequently analyze a correlated set of data and decide to downgrade the stock (the prediction hypothesis). For this latter hypothesis, the information utilized by short sellers could include, among other factors, recent poor stock price performance, deterioration in financial ratios, or corporate earnings announcements. The short sellers' skill at assessing information, and therefore identifying companies that eventually will get downgraded, accounts for the strong negative linkage between pre-announcement short-selling and post-announcement price declines.

Under the prediction hypothesis, short sellers do not know exactly what day a downgrade will be announced. All they anticipate is that the company's decline in performance is likely to result eventually in a downgrade. For example, a company that experiences a negative earnings surprise could be viewed by short sellers as a likely target for a downgrade at some future date. The fact that the actual date the downgrade might occur is unknown, however, has two important implications. First, due to the fact that the company has experienced a decline in performance, the amount of short-selling of its stock is likely to be elevated above that of the typical firm

**Table 7**
Regression analysis of abnormal short−selling prior to downgrades: results from including a control variable for large downgrades.

This table presents results from GMM estimation of abnormal short-selling activity while including an additional binary variable to control for large downgrades. Large downgrades are those in which recommendations are changed from 1 to 3, 2 to 5, or 3 to 5. We classify 132 cases in the sample as large downgrades. Panels A and B present results from estimations of Eqs. (1) and (2), respectively, with the inclusion of this additional binary variable and some interaction terms. The variable ABSS(−3,−1) is abnormal short-selling, measured as the difference between the downgraded firm's average daily shorted shares normalized by thousands of shares outstanding in the three days preceding the downgrade minus median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. D(Large Downgrade) is a binary variable equal to one for the 132 cases of large downgrades and is zero otherwise. $P_0$ is the downgraded firm's stock price on the date of downgrade. CAR(−3,−1) is the cumulative abnormal return in the three-day pre-announcement period and is defined as the downgraded firm's cumulative total return in the three days preceding the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. MOM is defined as the downgraded firm's six-month cumulative return during the period ending 10 days before the downgrade date minus the return on the Nasdaq equally-weighted portfolio during the same time period. CAR(0,1) is the cumulative abnormal return in the two-day post-announcement period and is defined as the downgraded firm's cumulative total return on the day of, and the day following the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. D(Large Downgrade) × CAR(0,1) is an interaction variable between D(Large Downgrade) and CAR(0,1). D(1) to D(4) are binary variables equal to one if CAR(0,1) falls within one of the following ranges: >0.100, 0.025 to 0.100, −0.100 to −0.025, and <−0.100. D(Large Downgrade) × D(1)…D(4) are interaction variables between D(Large Downgrade) and D(1)…D(4). Heteroskedasticity and serial-correlation consistent covariance is used in the model estimation procedure. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are in parentheses.

| | [1] | [2] | [3] | [4] | [5] | [6] |
|---|---|---|---|---|---|---|
| *Panel A: Estimation of Eq. (1) with an additional binary variable for large downgrades* | | | | | | |
| Intercept | −1.193*** | −1.190*** | −1.519*** | −1.518*** | −2.458*** | −2.457*** |
| | (0.306) | (0.306) | (0.311) | (0.311) | (0.427) | (0.427) |
| D(Large Downgrade) | 0.057 | 0.001 | 0.107 | 0.101 | 0.045 | 0.025 |
| | (0.168) | (0.179) | (0.164) | (0.178) | (0.166) | (0.179) |
| Log($P_0$) | 0.660*** | 0.662*** | 0.745*** | 0.746*** | 0.984*** | 0.984*** |
| | (0.111) | (0.111) | (0.112) | (0.113) | (0.140) | (0.140) |
| CAR(−3,−1) | | | −3.451*** | −3.447*** | −3.519*** | −3.509*** |
| | | | (0.884) | (0.863) | (0.887) | (0.865) |
| MOM | | | | | −0.908*** | −0.909*** |
| | | | | | (0.194) | (0.194) |
| CAR(0,1) | −1.431** | −1.269* | −1.469** | −1.451** | −1.534** | −1.478** |
| | (0.639) | (0.706) | (0.621) | (0.696) | (0.628) | (0.708) |
| D(Large Downgrade) × CAR(0,1) | | −0.720 | | −0.083 | | −0.246 |
| | | (1.646) | | (1.436) | | (1.427) |
| Adjusted $R^2$ | 0.068 | 0.067 | 0.114 | 0.113 | 0.157 | 0.156 |

| | [7] | [8] | [9] | [10] | [11] | [12] |
|---|---|---|---|---|---|---|
| *Panel B: Estimation of Eq. (2) with an additional binary variable for large downgrades* | | | | | | |
| Intercept | −1.383*** | −1.388*** | −1.637*** | −1.639*** | −2.565*** | −2.608*** |
| | (0.333) | (0.333) | (0.337) | (0.338) | (0.444) | (0.443) |
| D(Large Downgrade) | 0.085 | −0.266 | 0.129 | −0.269 | 0.072 | −0.360 |
| | (0.168) | (0.258) | (0.164) | (0.271) | (0.165) | (0.267) |
| Log($P_0$) | 0.664*** | 0.683*** | 0.738*** | 0.758*** | 0.974*** | 1.007*** |
| | (0.112) | (0.112) | (0.112) | (0.113) | (0.139) | (0.139) |
| CAR(−3,−1) | | | −3.339*** | −3.348*** | −3.373*** | −3.381*** |
| | | | (0.882) | (0.873) | (0.890) | (0.879) |
| MOM | | | | | −0.903*** | −0.936*** |
| | | | | | (0.189) | (0.189) |
| D(1) | 0.337 | 0.323 | 0.153 | 0.106 | 0.190 | 0.146 |
| | (0.329) | (0.370) | (0.318) | (0.357) | (0.310) | (0.348) |
| D(2) | 0.103 | −0.033 | 0.043 | −0.107 | 0.092 | −0.083 |
| | (0.177) | (0.185) | (0.173) | (0.179) | (0.168) | (0.173) |
| D(3) | 0.228 | 0.213 | 0.241 | 0.213 | 0.200 | 0.180 |
| | (0.151) | (0.174) | (0.150) | (0.172) | (0.145) | (0.166) |
| D(4) | 0.601*** | 0.494** | 0.527*** | 0.421** | 0.545*** | 0.425** |
| | (0.181) | (0.194) | (0.172) | (0.188) | (0.166) | (0.182) |
| D(Large Downgrade) × D(1) | | 0.030 | | 0.284 | | 0.257 |
| | | (0.474) | | (0.512) | | (0.538) |
| D(Large Downgrade) × D(2) | | 1.005* | | 1.108** | | 1.317** |
| | | (0.548) | | (0.556) | | (0.542) |
| D(Large Downgrade) × D(3) | | 0.138 | | 0.211 | | 0.167 |
| | | (0.389) | | (0.400) | | (0.387) |
| D(Large Downgrade) × D(4) | | 0.674 | | 0.674 | | 0.766 |
| | | (0.516) | | (0.487) | | (0.484) |
| Adjusted $R^2$ | 0.071 | 0.071 | 0.113 | 0.114 | 0.155 | 0.160 |

**Table 8**
Regression analysis of abnormal short-selling activity prior to downgrades: results after eliminating observations with potential confounding events.

$$\text{ABSS}(-3,-1) = \alpha + \beta_1 \text{Log}(P_0) + \beta_2 \text{CAR}(-3,-1) + \beta_3 \text{MOM} + \beta_4 \text{CAR}(0,1) + \varepsilon \quad (1)$$

$$\text{ABSS}(-3,-1) = \alpha + \beta_1 \text{Log}(P_0) + \beta_2 \text{CAR}(-3,-1) + \beta \text{MOM} + \delta_1 \text{D}(1) + \delta_2 \text{D}(2) + \delta_3 \text{D}(3) + \delta_4 \text{D}(4) + \varepsilon \quad (2)$$

The results of GMM estimation of these equations are as fitted to the sample of 597 downgrade observations after dropping 73 observations where there is a potentially confounding public announcements on the day preceding, or day of, the downgrade announcement. Panel A presents results from estimation of Eq. (1) and Panel B presents results from estimation of Eq. (2). The variable ABSS(−3,−1) is abnormal short-selling, measured as the difference between the downgraded firm's average daily shorted shares normalized by thousands of shares outstanding in the three days preceding the downgrade minus median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. $P_0$ is the downgraded firm's stock price on the date of downgrade. CAR(−3,−1) is the cumulative abnormal return in the three-day pre-announcement period and is defined as the downgraded firm's cumulative total return in the three days preceding the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. MOM is defined as the downgraded firm's six-month cumulative return during the period ending 10 days before the downgrade date minus the return on the Nasdaq equally-weighted portfolio during the same time period. CAR(0,1) is the cumulative abnormal return in the two-day post-announcement period and is defined as the downgraded firm's cumulative total return on the day of and the day following the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. D(1) to D(4) are binary variables equal to one if CAR(0,1) falls within one of the following ranges: >0.100, 0.025 to 0.100, −0.100 to −0.025, and <−0.100. Heteroskedasticity and serial-correlation consistent covariance is used in the model estimation procedure. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are in parentheses.

| | [1] | [2] | [3] |
|---|---|---|---|
| *Panel A*: *Estimation of Eq.* (1) (*N*=597) | | | |
| Intercept | −1.162*** | −1.450*** | −2.483*** |
| | (0.335) | (0.337) | (0.462) |
| Log($P_0$) | 0.648*** | 0.729*** | 0.990*** |
| | (0.119) | (0.120) | (0.149) |
| CAR(−3,−1) | | −3.594*** | −3.633*** |
| | | (1.029) | (1.034) |
| MOM | | | −0.975*** |
| | | | (0.199) |
| CAR(0,1) | −1.417** | −1.340** | −1.329** |
| | (0.599) | (0.547) | (0.568) |
| Adjusted $R^2$ | 0.072 | 0.121 | 0.173 |
| | [4] | [5] | [6] |
| *Panel B*: *Estimation of Eq.* (2) (*N*=597) | | | |
| Intercept | −1.404*** | −1.603*** | −2.619*** |
| | (0.367) | (0.369) | (0.483) |
| Log($P_0$) | 0.661*** | 0.729*** | 0.986*** |
| | (0.120) | (0.120) | (0.149) |
| CAR(−3,−1) | | −3.424*** | −3.439*** |
| | | (1.031) | (1.040) |
| MOM | | | −0.965*** |
| | | | (0.195) |
| D(1)=1 if CAR(0,1)>0.010 | 0.420 | 0.198 | 0.244 |
| | (0.336) | (0.326) | (0.318) |
| D(2)=1 if 0.025<CAR(0,1)≤0.100 | 0.013 | −0.012 | 0.039 |
| | (0.186) | (0.182) | (0.177) |
| D(3)=1 if −0.100≤CAR(0,1)<−0.025 | 0.304** | 0.292* | 0.249 |
| | (0.158) | (0.156) | (0.153) |
| D(4)=1 if CAR(0,1)< −0.100 | 0.628*** | 0.504*** | 0.505*** |
| | (0.181) | (0.164) | (0.158) |
| Adjusted $R^2$ | 0.080 | 0.123 | 0.174 |

with similar size and book-to-market characteristics.[32] Therefore our measure of *ABSS*(−3,−1), based upon the matching portfolio approach, should be elevated for the firm prior to the downgrade announcement and correlated with that decline in performance.

Second, because short sellers are not aware of the exact day that the downgrade will occur, their short trades will be spread out over many days (or even weeks) prior to the eventual downgrade. Therefore, abnormal short-selling in the days immediately prior to the announcement would be similar to the abnormal short-selling in the days before the analyst submitted the downgrade recommendation for internal review and approval within the brokerage firm (i.e., generally the week prior to the downgrade).

In contrast, if shorting activity consistent with the tipping hypothesis is more prevalent, short-selling in the days immediately preceding the downgrade should be elevated above that of the typical firm with similar size and book-to-market characteristics and also the firm's own short-selling in the prior week(s). This occurs because the short seller knows the day the downgrade announcement will occur and establishes short positions accordingly. (We wish to note here that both hypotheses are consistent with informed front-running and that our prior is that it is very likely short sellers trade on both tips and fundamentals. It is, however, interesting to further investigate which motive dominates the other.)

To assess the relative predominance of these two hypotheses, we undertake two separate analyses. First, we begin by studying the relation between *ABSS*(−3,−1) (obtained using the matching portfolio approach) and earnings performance relative to analyst expectations. According to the prediction explanation, a more negative earnings surprise is likely to be accompanied by higher ABSS if the short seller anticipates that this decline in performance will lead to an analyst downgrade. Table 9 reports the mean and median values for the most recent preceding earnings variables for subsamples categorized by low, medium, and high ABSS. The right column of the table reports *p*-values from tests of the difference between the values for the low and high ABSS terciles. The interesting result revealed in the table is that firms with high ABSS are overall associated with more positive earnings surprises. The mean (median) earnings surprise for the high versus low *ABSS*(−3,−1) terciles are −$0.017 ($0.020) and −$0.052 ($0.010), respectively. In addition, the high ABSS group has a lower percentage of sample firms with negative earnings surprises (10.50%) than the low ABSS group (30.56%). Clearly, the evidence presented here is not consistent with short sellers using declining earnings performance to predict forthcoming downgrades and, therefore, seems inconsistent with the prediction hypothesis.[33]

[32] This line of reasoning assumes that the decline in performance of the firm is not systematic and that therefore, the typical firm with similar size and book-to-market characteristics has not also suffered a similar decline in performance.

[33] At a minimum, it demonstrates that short sellers do not seem to use earnings surprises to predict forthcoming downgrades.

**Table 9**
Earnings variables categorized by different levels of abnormal short-selling (ABSS).

This table reports mean and median of earnings variables for subsamples categorized by abnormal short-selling. Median values are in brackets. ABSS is measured as the difference between the downgraded firm's average daily shorted shares normalized by thousands of shares outstanding in the three days preceding the downgrade and the firm's median daily value of shorted shares, also normalized by thousands of shares outstanding days −6 to −10 relative to the downgrade date. Number of earnings estimates is the total number of estimates reported in the First Call database before the downgrade announcement. The dollar value of earnings surprise is defined as the actual EPS minus the median value of estimated EPS. The percentage of earnings surprise is the dollar value of earnings surprise normalized by the absolute value of actual EPS. The last row reports the percentage of sample observations with a negative dollar value of earnings surprise. The right column reports the p-value associated with the difference between the low and high ABSS subsamples.

| | *Subsamples by ABSS* | | | P-value for the difference: |
|---|---|---|---|---|
| | Low (*N*=212) | Medium (*N*=205) | High (*N*=216) | Low-High |
| Number of earnings estimates | 11.79 | 11.98 | 13.94 | (0.004) |
| | [10.00] | [11.00] | [13.00] | (0.001) |
| Earnings surprise (percent) | −0.001 | −0.017 | 0.043 | (0.351) |
| | [0.012] | [0.012] | [0.029] | (0.000) |
| Earnings surprise (dollars) | −0.052 | −0.007 | −0.017 | (0.582) |
| | [0.010] | [0.010] | [0.020] | (0.000) |
| Percent of sample observations with negative earnings surprise | 30.56% | 26.70% | 10.60% | (0.000) |

A second, and more interesting, analysis is to directly examine how short-selling evolves in the weeks prior to the downgrade announcement. For this investigation, we employ a third measure of abnormal short-selling, *ABSS*(−3,−1), defined as the difference between the firm's average daily short-selling from day −1 to −3 relative to the downgrade date and the firm's median daily short-selling from day −6 to −10.[34]

This newly defined ABSS measure can further resolve the competing claims of the tipping and prediction hypotheses because of two considerations: the interval of (−3,−1) most probably follows the analyst's internal proposal for the downgrade whereas the interval of (−10,−6) certainly precedes the proposal but is near enough in time to likely encompass the arrival of the information that spurs the analyst to propose a downgrade and short sellers to trade on the firm's stock. If the prediction hypothesis is more consistent with the data, this new measure of ABSS should be approximately zero because there is no a priori reason to expect that any elevated short-selling in the three days before the downgrade announcement should be any greater than the short-selling in the week prior to those days. In contrast, if the tipping hypothesis is more consistent with the data, ABSS should be significantly positive because short-selling should increase in the days just preceding the downgrade as information about the forthcoming announcement is privately revealed.

Univariate statistics (not reported in a table) show that the average ABSS for the 616 downgrades is 0.268 and the median is 0.092. Both values are significantly different from zero with *p*-values of 0.001. Further, we find that the short-selling from day −3 to −1 exceeds that from day −10 to −6 in over 62% of the cases (382 of 616). Thus, short-selling is significantly higher in the three days prior to the downgrade, and this initial evidence supports the tipping hypothesis.

To further continue this analysis, we re-estimate Eqs. (1) and (2) with this new ABSS measure and present the estimation results in Table 10.[35] Most of the coefficients reported in the table generally resemble their counterparts from earlier tests, with the exception of the significance of *CAR*(0,1). Panel A shows that, as predicted, *CAR*(0,1) is negatively correlated with ABSS. The coefficient estimates in the models, however, are not statistically significant. This insignificance could be the result of ABSS not varying symmetrically with both positive and negative abnormal announcement returns. In fact, this conjecture is supported by the estimation results presented in Panel B which, show that short sellers trade more when they expect announcement returns to be more negative. All the *D*(4) parameter estimates in Panel B are positive and statistically significantly at least at the 5% level. Overall, the findings presented here suggest that short sellers profit from the tip they receive in the days just prior to the downgrade announcement. We conclude that informed front-running before analyst downgrades is substantially the result of tipping not predicting.

## 5. Subsequent stock performance of downgraded firms

The previous sections have shown that abnormal short-selling regularly occurs shortly before analyst downgrades that result in a negative stock price reaction. In this section, we investigate whether the informativeness of

[34] We obtain the new measure of ABSS after restricting our original sample of 670 observations to include only those that have no earnings announcement during the period of day −12 to +1. This restriction reduces the sample size to 616 observations.

[35] For all the estimations in Table 10, abnormal returns are measured relative to the Nasdaq equally-weighted portfolio return during the same days.

**Table 10**
Regression analysis for testing the tipping versus prediction hypothesis.

$$\text{ABSS}(-3,-1) = \alpha + \beta_1 \text{Log}(P_0) + \beta_2 \text{CAR}(-3,-1) + \beta_3 \text{MOM} + \beta_4 \text{CAR}(0,1) + \varepsilon \quad (1)$$

$$\text{ABSS}(-3,-1) = \alpha + \beta_1 \text{Log}(P_0) + \beta_2 \text{CAR}(-3,-1) + \beta_3 \text{MOM} + \delta_1 \text{D}(1) + \delta_2 \text{D}(2) + \delta_3 \text{D}(3) + \delta_4 \text{D}(4) + \varepsilon \quad (2)$$

To test the tipping versus prediction hypothesis, we use the newly estimated ABSS(−3,−1) as the dependent variable in the regressions. ABSS(−3,−1) equals the difference between the downgraded firm's average daily shorted shares, normalized by thousands of shares outstanding, in the three days preceding the downgrade and the firm's median daily value of shorted shares normalized by thousands of shares outstanding during days −6 to −10 relative to the downgrade date. The table presents results of GMM estimation of these equations, as fitted to the sample of 616 downgrade observations. Panel A presents results from estimation of Eq. (1) and Panel B presents results from estimation of Eq. (2). $P_0$ is the downgraded firm's stock price on the date of downgrade. CAR(−3,−1) is the cumulative abnormal return in the three-day pre-announcement period and is defined as the downgraded firm's cumulative total return in the three days preceding the downgrade minus the return on the Nasdaq equally-weighted portfolio during the same three days. MOM is defined as the downgraded firm's six-month cumulative return during the period ending 10 days before the downgrade date minus the return on the Nasdaq equally-weighted portfolio during the same time period. CAR(0,1) is the cumulative abnormal return in the two-day post-announcement period and is defined as the downgraded firm's cumulative total return on the day of, and the day following the downgrade minus the return on the Nasdaq equally-weighted portfolio during the same two days. The binary variables D(1) to D(4) equal one if CAR(0,1) falls within any of the following ranges: >0.100, 0.025 to 0.100, −0.100 to −0.025, and <−0.100. The estimation procedure uses covariance that is consistent with regard to heteroskedasticity and serial-correlation. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively. Standard errors are in parentheses.

| | [1] | [2] | [3] |
|---|---|---|---|
| *Panel A: Estimation of Eq.* (1) (*N*=616) | | | |
| Intercept | −0.252 | −0.453* | −0.654** |
| | (0.237) | (0.243) | (0.265) |
| Log($P_0$) | 0.159** | 0.208*** | 0.258*** |
| | (0.079) | (0.080) | (0.086) |
| CAR(−3,−1) | | −1.683*** | −1.690*** |
| | | (0.575) | (0.573) |
| MOM | | | −0.198* |
| | | | (0.108) |
| CAR(0,1) | −0.442 | −0.514 | −0.508 |
| | (0.478) | (0.471) | (0.471) |
| Adjusted $R^2$ | 0.004 | 0.026 | 0.028 |
| | [4] | [5] | [6] |
| *Panel B: Estimation of Eq.* (2) (*N*=616) | | | |
| Intercept | −0.461* | −0.589** | −0.755*** |
| | (0.241) | (0.248) | (0.270) |
| Log($P_0$) | 0.171** | 0.211*** | 0.254*** |
| | (0.079) | (0.080) | (0.086) |
| CAR(−3,−1) | | −1.607*** | −1.617*** |
| | | (0.576) | (0.574) |
| MOM | | | −0.176 |
| | | | (0.109) |
| D(1)=1 if CAR(0,1)>0.100 | 0.196 | 0.085 | 0.077 |
| | (0.165) | (0.168) | (0.166) |
| D(2)=1 if 0.025<CAR(0,1) ≤0.100 | 0.162 | 0.135 | 0.129 |
| | (0.159) | (0.155) | (0.156) |
| D(3)=1 if −0.100 ≤CAR(0,1)<−0.025 | 0.200 | 0.155 | 0.145 |
| | (0.134) | (0.132) | (0.131) |
| D(4)=1 if CAR(0,1)<−0.100 | 0.339*** | 0.295** | 0.278** |
| | (0.130) | (0.126) | (0.127) |
| Adjusted $R^2$ | 0.006 | 0.026 | 0.027 |

pre-announcement short-selling is linked to the ensuing medium-horizon return of downgraded firms. This analysis is motivated by prior research that has focused on the relation between high monthly short interest or unfavorable analyst recommendations and subsequent stock price patterns. For example, Asquith and Muelbrook (1995) and Desai, Ramesh, Thiagarajan, and Balachandran (2002) show that firms with high levels of short interest subsequently earn negative abnormal returns for up to 12 months. In work also related to this paper, Womack (1996) finds that, for sell recommendations by analysts, the post-announcement downward drift could extend for six months. Here, we extend both lines of research and examine whether short sellers might possess the capability of predicting the upcoming six-month stock return performance of downgraded firms in our sample.

### 5.1. Average monthly abnormal returns

Our first step is to sort all 670 downgraded firms into three portfolios based on their abnormal short-selling from day −3 to −1 before downgrades.[36] We then calculate average monthly raw returns along with total market-adjusted and Nasdaq-adjusted monthly returns for up to six months. The measurement period starts two days after the downgrade date to ensure that our monthly returns are not driven by announcement effects. In these calculations, the total market-adjusted return is computed as the return on a downgraded stock in excess of the equal-weighted return on a total-market portfolio, which consists of all NYSE, Amex, and Nasdaq firms covered by CRSP. The Nasdaq-adjusted return is calculated similarly, but only Nasdaq firms are used in forming the benchmark portfolio.[37] After calculating abnormal returns for each firm, we form both equally- and value-weighted portfolios. Because the results yield similar patterns, we report only those from equally-weighted portfolios.

Table 11 presents average monthly returns for the full sample and subsamples based on abnormal short-selling (*ABSS*(−3,−1)). We test if average monthly portfolio returns are different for the low-ABSS versus high-ABSS firms for periods ranging from one month to six months following the downgrade. We first present results based upon raw returns in Panel A. Overall, the monthly returns on downgraded firms are significantly negative, especially during the first month following the downgrade. The mean raw monthly return is −3.25%, and the median figure, −6.55%, is even lower. Both are significant at the 1% level. After the first month, the average returns on downgraded stocks become less negative although most

[36] As in the previous sections, we use two methodologies to estimate normal short-selling. One uses the matching-portfolio (size and book-to-market) approach, and the other uses the trading-pattern (median of the firm's historical short-selling) approach. Both approaches yield similar conclusions. Thus, we report only results from the first approach.

[37] Using both measures is necessary because, as shown in Table 1, the total market and Nasdaq returns are different during our sample period. The results shown in Table 11 are from market equal-weighted and Nasdaq equal-weighted returns. Our results, available upon request, are robust using value-weighted returns.

**Table 11**
Average post-downgrade monthly raw and market-adjusted stock returns (in percent) for the full sample and sub-samples based on abnormal short-selling activities.

Mean and median monthly percentage returns are reported over different holding periods subsequent to the downgrade date. Median values are in brackets. Panel A presents raw monthly returns without adjustments. Panel B presents market-adjusted returns and Panel C presents Nasdaq-adjusted returns. The market-adjusted (Nasdaq-adjusted) returns are defined as the return on a stock in excess of the equally-weighted returns on a market portfolio that consists of all (Nasdaq) stocks in CRSP. Returns are computed starting two days after the downgrade date. In all three panels, we present results for the full sample, and for tercile sub-samples based on abnormal short-selling: ABSS(−3,−1). Abnormal short-selling is measured as the difference between the downgraded firm's average daily shorted shares normalized by thousands of shares outstanding in the three days preceding the downgrade minus the median value for the same measure over the same days for companies in the downgraded firm's matching portfolio. We test whether low ABSS(−3,−1) firms have different returns than high ABSS(−3,−1) firms by using the two-sided t-test and the Wilcoxon rank sum test. ***, **, and * indicate significance at the 1%, 5%, and 10% level, respectively.

| | Month | | | |
|---|---|---|---|---|
| | One | Two | Three | Six |
| *Panel A*: *Raw returns* | | | | |
| Full sample | −3.253*** | −2.004*** | −2.769*** | −1.939*** |
| | [−6.550]*** | [−0.950]*** | [−1.845]*** | [−1.116]*** |
| Low ABSS(−3,−1) | −0.348 | −1.272 | −1.499** | −1.295*** |
| | [−4.034] | [0.146] | [−1.000] | [−0.722]** |
| Medium ABSS(−3,−1) | −4.506*** | −2.624** | −2.693*** | −1.126** |
| | [−6.599]*** | [−2.297]** | [−1.424]*** | [−0.432] |
| High ABSS(−3,−1) | −4.901** | −2.114 | −4.114*** | −3.402*** |
| | [−8.906]*** | [−1.781]* | [−2.687]*** | [−2.359]*** |
| Low ABSS−High ABSS | 4.55* | 0.84 | 2.62** | 2.11*** |
| | [4.87]*** | [1.93] | [1.69]** | [1.64]*** |
| *Panel B*: *Market-adjusted returns* | | | | |
| Full sample | −4.501*** | −3.910*** | −4.621*** | −3.368*** |
| | [−7.146]*** | [−3.245]*** | [−4.031]*** | [−2.237]*** |
| Low ABSS(−3,−1) | −1.862 | −2.873*** | −3.126*** | −2.603*** |
| | [−3.941]*** | [−2.218]*** | [−2.810]*** | [−1.815]*** |
| Medium ABSS(−3,−1) | −4.703*** | −3.874*** | −4.227*** | −2.535*** |
| | [−5.290]*** | [−2.796]*** | [−3.171]*** | [−1.666]*** |
| High ABSS(−3,−1) | −6.937*** | −4.983*** | −6.509*** | −4.971*** |
| | [−9.959]*** | [−6.600]*** | [−5.797]*** | [−3.705]*** |
| Low ABSS−High ABSS | 5.07** | 2.11 | 3.38*** | 2.37*** |
| | [6.02]*** | [4.38]** | [2.99]*** | [1.89]*** |
| *Panel C*: *Nasdaq-Adjusted Returns* | | | | |
| Full sample | −4.295*** | −3.922*** | −4.671*** | −3.607*** |
| | [−6.173]*** | [−3.593]*** | [−4.025]*** | [−2.567]*** |
| Low ABSS(−3,−1) | −1.764 | −2.792*** | −3.092*** | −2.815*** |
| | [−4.955]** | [−2.490]*** | [−2.329]*** | [−2.104]*** |
| Medium ABSS(−3,−1) | −4.100*** | −3.680*** | −4.155*** | −2.760*** |
| | [−4.670]*** | [−2.830]*** | [−3.731]*** | [−2.076]*** |
| High ABSS(−3,−1) | −7.023*** | −5.296*** | −6.766*** | −5.252*** |
| | [−9.781]*** | [−5.978]*** | [−6.191]*** | [−3.907]*** |
| Low ABSS−High ABSS | 5.26** | 2.50* | 3.67*** | 2.44*** |
| | [4.83]*** | [3.19]** | [3.86]** | [1.80]*** |

returns remain significantly negative for six months after the stock is downgraded by financial analysts.

The middle section of the panel reports average monthly returns based on three different levels of abnormal short-selling. Although all downgraded firms are associated with negative monthly returns, a systematic pattern exists between abnormal short-selling and subsequent stock performance. Specifically, the mean and median monthly returns are lower for firms in the high short-selling tercile than those in the low and medium terciles. The return difference between low and high terciles is significant for six months, except for the second month. For example, the mean difference in the first month return between low and high terciles is 4.55% (the median is 4.87%). The findings here suggest that short sellers are able to anticipate the impact of downgrades on subsequent six-month equity returns.

As shown in Table 1, the total market experienced downturns in several months during the sample period. We next control for this effect and re-estimate the post-downgrade performance of downgraded firms. Panels B and C report market- and Nasdaq-adjusted returns, respectively. Here, the return patterns are similar to those in Panel A, but the figures are more negative. It is apparent that downgraded firms significantly underperform the market. The average market-adjusted returns range from −3.4% to −4.6%. More important, after controlling for market movements, the relation remains robust between abnormal short-selling before downgrades and subsequent returns. Higher abnormal short-selling is associated

with more negative market-adjusted returns. Overall, the findings in Table 11 suggest that downgraded stocks with abnormally high short-selling experience lower subsequent returns than those with low short-selling. Although the subsequent share underperformance could last for six months, it occurs most significantly in the first month after downgrade announcements.

### 5.2. Characteristic-benchmark abnormal returns

Section 5.1 shows downgraded firms incur negative monthly excess returns, and the subsequent underperformance after analyst downgrades is more severe for firms with high abnormal short-selling. The analysis was conducted using both monthly raw returns and market-adjusted returns. To conduct an additional test, in this subsection, we employ a characteristic-based approach based on Daniel, Grinblatt, Titman, and Wermers (1997) to further examine post-downgrade abnormal returns. The characteristic-adjusted return is computed as the return on a downgraded stock in excess of the return on its corresponding benchmark portfolio, which is formed based on three characteristics: market capitalization, book-to-market, and prior-year return characteristics.

Specifically, we form the 125 benchmark portfolios using firm size, book-to-market equity ratio, and past-year return. The breakpoints for firm-size are based only on the distribution of NYSE firms. The equally-weighted returns of the 125 characteristic-benchmark portfolios are then calculated. We assign each downgraded stock to a characteristic-benchmark portfolio according to its rank based on size, book-to-market, and prior-year return. The characteristic-adjusted return is then calculated as the difference between the stock's return and that of its corresponding characteristic-benchmark portfolio.

Overall, the (unreported) results using the monthly characteristic-adjusted returns are qualitatively similar to those reported in Table 11.[38] For example, we find that average returns in the full sample are negative, ranging from −0.85% to −1.39%. Those negative returns are mostly driven by downgraded firms that experienced high abnormal short-selling. The average characteristic-adjusted return in that tercile ranges from −0.75% to −3.22% per month. In contrast, firms with low- or medium-ABSS do not suffer from subsequent underperformance. Consistent with the findings from market- and Nasdaq-adjusted returns, the difference in returns between low- and high-ABSS terciles is significant, both statistically and economically. Overall, these results corroborate the conclusion that downgraded firms that experience substantial $ABSS(-3,-1)$ subsequently underperformed.

## 6. Conclusions

Extant research suggests that analyst stock recommendations or recommendation changes are associated with future price movements. This association is more significant for unfavorable recommendations or downgrades because of the apparent reluctance of analysts to reveal negative information to the public. Therefore, the potentially negative impact of an analyst's downgrade on share price could provide strong incentives for informed investors to profit by short-selling prior to the announcement. We term this opinion the informed front-running hypothesis. In this paper, we investigate whether there are systematic patterns in short-selling consistent with this hypothesis. If short sellers are informed traders, their pre-announcement trades should be negatively correlated with the returns associated with the downgrades. In contrast, if short-selling is mostly driven by uninformed speculators or hedgers, or if informed traders are mostly constrained by legal or regulatory issues, we should observe little association between short-selling and the announcement returns.

Overall, our tests strongly support the informed front-running hypothesis. We show a sharp increase in short-selling immediately before analyst downgrade announcements. The average daily short-selling from day −3 to −1 relative to the downgrade date is about four times higher than the normal level. We also present evidence that the level of abnormal short-selling is significantly negatively correlated with two-day announcement returns in tests that control for a large set of potentially influential variables. This indicates that many short sellers tend to accurately anticipate the magnitude of upcoming downgrades and take profitable positions in advance. Further evidence supporting the informed front-running hypothesis is that downgraded firms with high pre-announcement abnormal short-selling have lower stock performance than those with low abnormal short-selling over the subsequent six months.

There are two possibilities that cause trades from short sellers to be profitable. Short sellers could short a firm's stock from the tip they receive from insiders (the tipping hypothesis) or they could establish their short position on the basis of the downgraded firm's poor fundamentals or stock price performance (the prediction hypothesis). Although the informed front-running hypothesis is consistent with both explanations, our findings are most consistent with the tipping hypothesis. In particular, we present evidence that the negative relation between abnormal short-selling and announcement-related share price movements is not driven by scheduled releases of earnings reports or non-routine events that occur before downgrades. Instead, we show that short-selling in the three days before the downgrade is substantially higher than in the preceding week and has a significant link to large price declines associated with downgrade announcements. These findings clearly argue against the prediction hypothesis, which posits that pre-announcement short-selling is coincident with, and not related to, downgrades, because investors and analysts look at the same information for their respective decisions.

The fact that the evidence strongly supports the tipping hypothesis raises serious issues regarding whether some clients of certain brokerage firms benefit from material private information about upcoming

[38] A detailed report from characteristics-benchmark abnormal returns is available upon request.

downgrades. If this is the case, both analysts and investors violate the principle that all market participants deserve fair and equitable treatment. An interesting line of further research, depending on availability of suitable data, is to investigate whether the level of short-selling prior to analyst downgrades was the same before the SEC promulgated Regulation FD as it was after that rule was enacted.

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