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Short sales in the NYSE batch open and NASDAQ opening cross

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Abstract

Purpose – The purpose of this paper is to study short sales trading as part of the New York Stock Exchange (NYSE) batch open and National Association of Securities Dealers Automated Quotations (NASDAQ) opening cross. The paper examines whether short transactions at the open can predict future returns.

Design/methodology/approach – The study tests to see if short transactions in the NYSE opening batch trade and NASDAQ opening cross are informative of future returns.

Findings – It is found that a stock's opening-trade short volume is predictive of its short volume for the rest of trading day, positively related to its previous-day price change, and positively related to its overnight price change at the opening trade on option-expiration Fridays when the stock is part of the Standard and Poor (S and P) 500 index.

Originality/value – While previous research shows that intraday short sale trades are informative, this is the first paper to examine the opening trade of the day, and whether these short sales are informative.

Keywords Short selling, Market microstructure, United States of America, Stock exchanges, Trade

Paper type Research paper

1. Introduction

In Release No. 34-64383, the SEC explains that the Dodd-Frank Wall Street Reform and Consumer Protection Act mandates the SEC to study the benefits of publicly reporting trade type in real-time through the consolidated tape, including if a trade is a short sale. Benefits potentially exist from having immediate knowledge of short selling in US markets because short sellers are informed traders (e.g. Diamond and Verrecchia, 1987; Dechow *et al.*, 2001) and because Aitken *et al.* (1998) show that prices quickly react when short sales are transparent. Immediate knowledge of short sales executing in the NYSE batch open and NASDAQ opening cross should be particularly beneficial as Madhavan and Panchapagesan (2000) refer to the opening trade as crucial as it occurs at a time of high uncertainty during the day, and they show that informed traders affect the opening price through market-on-open orders. Further, Barclay and Hendershott (2003) explain that the opening trade is informative because the opening trade reveals public and private information that has accumulated during the overnight non-trading period. Therefore, informed short sellers likely reveal information during the batch open and opening cross, so transparent short sales in the opening trade may reduce uncertainty surrounding the trade[1].

Currently, both NASDAQ and the NYSE offer fee-based short sale data at the individual security level, allowing investors a somewhat delayed knowledge of short sales occurring in a stock. For a fee of $500 ($100) per month, NASDAQ (NYSE) will

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provide one user a daily download that includes previous-day total short volume for each stock trading on the market. Investors can also receive monthly short sale transactions data. Intraday short sales from the previous month are included in the NASDAQ subscription, but the NYSE requires a $500 fee for a subscriber to receive previous-month short sale transactions data for individual securities[2]. Therefore, information for daily short volume in a security is available once a trading day has ended (as early as 1:00 a.m. EST the next morning for NYSE stocks), but intraday short sale data (including opening-trade short sales) is only available on a monthly basis from the NYSE and NASDAQ. We examine how opening-trade short sales are related to both short volume and price changes occurring after the opening trade to uncover potential benefits of immediate knowledge of short sales in the opening trade. Our findings suggest that real-time reporting of short sales throughout the day is not necessary to achieve some benefits from transparent short sales. Benefits exist in having only knowledge of short sales that execute in the batch open or opening cross of a stock as we find that opening-trade short sales alone are indicative of both short selling that occurs during the rest of the day and future price movements.

Brooks and Moulton (2004) show that higher total opening volume precedes higher total volume for the day, so we determine if opening-trade short sales are related to the level of short sales over the remainder of the day, which we term intraday short sales. We not only find a positive relation between short volume in the opening trade and the level of intraday short sales but also show that opening-trade short sales are related differently to previous-day short selling than are daily short sales. We find that opening-trade short sales decrease as previous daily short selling increases while opening-trade short volume is higher when intraday short volume is higher. Therefore, we contribute by showing the potential benefit of immediate knowledge of opening-trade short sales being a predictor of intraday short selling in a stock separate from the indication provided by previous daily short volume.

Diether *et al.* (2009) show that daily short sales increase in contemporaneous returns and before negative returns. Therefore, we look to see if short volume in the opening trade is related to price changes that occur on the previous day, on the same day, and on the day after the opening trade. We calculate price changes measured from the opening trade to the close for the same day (intraday price changes) and find a negative relation between short sales in the opening cross and intraday price changes for NASDAQ stocks that are subject to price tests. Therefore, a potential benefit of transparent short sales in the opening cross is that investors who see a NASDAQ stock experience increased short selling in its opening cross can expect price declines if the stock is facing short sale price tests[3]. Next, we show that NYSE stocks have negative returns on the day following increased short sales in the opening trade. Hence, a potential benefit of having real-time knowledge of opening-trade short sales is that investors can anticipate negative daily returns in NYSE stocks with increased batch-open short sales. Last, we determine that short selling in the opening trade increases with previous-day abnormal returns, even though opening-trade short sales decrease with higher previous-day short volume while intraday short sales are held constant.

We further investigate the potential benefits of transparent opening-trade short sales in S&P 500 stocks. Transparency of short sales may reduce uncertainty caused by information asymmetry. However, uncertainty in S&P 500 stocks is not likely to be as high as for other stocks because Chen *et al.* (2004) conclude that investor awareness increases for a firm that is added to the index and because Denis *et al.* (2003) report that scrutiny of management increases for members of the S&P 500. Therefore, benefits

from transparency of short sales in the opening trade may differ for S&P 500 stocks compared with other firms. We find that potential benefits continue to exist for real-time reporting of short selling in the opening trade of S&P 500 stocks. Increased opening-trade short volume in S&P 500 stocks is an indication of higher intraday short sales and of negative next-day returns for these stocks.

We also examine short sales that execute in the opening trade of S&P 500 stocks on option-expiration Fridays. Stoll and Whaley (1990) show that price changes on option-expiration days are likely due to non-informational, program trading. Barclay *et al.* (2008) show that program trading causes increased buy-order pressure in the opening trade of S&P 500 stocks and that the increased pressure results in temporary price movements. In light of these studies, the evidence that short sellers are contrarian in contemporaneous returns and that short sellers serve as liquidity providers during periods of increased buy-order pressure (Diether *et al.*, 2009) leads us to believe that opening-trade short volume increases on option-expiration Fridays as short sellers provide liquidity in the opening trade or as they attempt to profit from temporary price increases in S&P 500 stocks. We find that short sales tend to increase in the opening-trade for S&P 500 stocks on option-expiration Fridays, but we find that opening-trade short volume for S&P 500 stocks is not related to intraday short volume or future price changes. Therefore, it appears that short sellers provide liquidity in the opening trade for S&P 500 stocks on option-expiration Fridays, but we find no added potential benefit from real-time knowledge of opening-trade short selling in S&P 500 stocks on expiration days.

Because we examine short sales in the opening trade on option-expiration days (a non-informational event), we also study opening-trade short sales following earnings announcements because they provide information and because short sellers possess some of their greatest informational advantage around earnings announcements (Boehmer *et al.*, 2010). Specifically, we examine opening trades that follow earnings announcements that are made outside normal trading hours. Berkman and Truong (2009) report that earnings are announced outside of normal trading hours more than 40 percent of the time for stocks in the Russell 3,000 index, which represents 98 percent of the US equity market as it includes the 3,000 largest stocks by market capitalization. Blau and Pinegar (2010) study daily short selling to show that short sellers profit by being able to process information that is contained in earnings announcements. However, opening-trade short sales that follow a non-trading period (NTP) earnings announcement may differ from daily short selling after the announcement because Holden and Subrahmanyam (1992) show that informed traders are quick to reveal information as they aggressively trade for profit around an information event. Therefore, short sellers will likely reveal information in the opening trade following an earnings announcement made outside normal trading hours, making transparency of these trades potentially beneficial as informed trading reduces uncertainty following the information event. We focus on the potential benefit of viewing short sales in the opening trade when a NTP earnings announcement beats the consensus estimate because Brooks *et al.* (2003) report that positive non-trading period surprises are more likely to affect the following opening trade.

Our contribution to understanding benefits of transparent short selling after an earnings announcement differs from Blau and Pinegar (2010) in two ways. First, we do not look at daily short selling but study opening-trade short sales. Second, we do not study the relation of opening-trade short sales to all earnings announcements but only to NTP earnings announcements. Our findings suggest there is some benefit to having

immediate knowledge of short sales executed in the opening trade following a NTP earnings announcement that beats expectations. Batch-open short sales increase with the size of the positive surprise revealed in a NTP earnings announcement.

This paper looks at short sale volume that occurs as part of the NYSE batch open and NASDAQ opening cross. While others study the predictive power of daily short sales (e.g. Christophe *et al.*, 2004), we contribute by offering evidence of potential benefits to having immediate knowledge of opening-trade short sales as they indicate future market activity and changes. First, short sales in the opening trade of NYSE and NASDAQ stocks are indicative of the level of short volume that occurs during the rest of the trading day, but are negatively related to previous-day short selling when intraday short sales are held constant. Second, traders may benefit from the transparency of opening-trade short sales in developing expectations of next-day returns for NYSE stocks and of intraday price movement for NASDAQ stocks facing short sale price tests. Part of the current mandate to the SEC is to study the potential benefit of either publicly reporting trade type through the consolidated tape or non-publicly reporting trade type to the commission. Our study offers evidence that minimal public reporting of trade type, such as in the batch open and opening cross, is potentially beneficial without publicly reporting short sales over the remainder of the day.

2. Data

Our sample includes stocks that are identified as ordinary NYSE and NASDAQ common stocks by having a CRSP share code of 10 or 11 (ordinary common shares) and by having a CRSP exchange code of 1 or 3 (NYSE and NASDAQ firms, respectively). Since we study short selling in the opening trade, we limit the selected NYSE and NASDAQ stocks to those that have at least one trade occurring before 10:30 a.m. on every day of our sample period of January 2005, to December 2006, so that sample stocks have at least one trade during the first hour of normal trading on every day of the sample. Further, we follow the convention of requiring a minimum share price for sample stocks (e.g. Diether *et al.*, 2009) by only selecting firms that have a CRSP opening or closing price of at least \$5 on each sample day. Our selection methods yield a total of 1,760 sample firms.

We use the TAQ database to identify each stock's daily batch open or opening cross as the first recorded trade for each stock that occurs at or after 9:30 a.m. on each day. We match the TAQ opening trade for each stock on each day to Regulation SHO short sales data. If a short sale occurs on the same date at the same time as the batch open or opening cross, we consider the short sale to be executed in the opening trade[4]. For each stock on each day, we calculate a normalized opening-trade short volume so that our tests measure abnormal levels of short selling in the opening trade. The normalized measure is calculated by dividing each stock-day opening-trade short volume by the mean opening volume for the stock, measured over all sample days. We divide by mean opening volume because we are interested in how stock-day short sales in the opening trade vary relative to the stock's normal opening activity. We use several other variables for each sample stock. These include daily short volume, obtained by summing all shorted shares for each sample day; intraday short volume, which is daily short volume less short volume in the opening trade; intraday price change, which is the closing price minus the opening price; abnormal daily return, calculated as the stock's daily CRSP return less the CRSP equally weighted return for the day; and firm size, which we calculate as the CRSP shares outstanding value multiplied by the CRSP closing price for the day.

Sample firms are divided in two ways, so that the majority of our tests are conducted on four different stock groups. Because the opening process differs between NYSE and NASDAQ markets, we divide the sample into NYSE and NASDAQ stocks. Of 1,760 sample firms, 1,072 (688) are NYSE (NASDAQ) stocks. The NYSE's batch open in each stock begins at 9:30 a.m.. Before the batch open, traders can submit market and limit orders and floor participants can indicate their interest to the specialist. For the opening call, the specialist consolidates the orders that have been submitted and sets the opening price while absorbing any order imbalance. NASDAQ's opening cross takes place at 9:30 a.m.. Before the cross occurs, traders can submit three types of orders to the opening-cross book. Like the NYSE, they can submit market on open orders and limit orders to trade in the opening cross. Unlike the NYSE where the specialist normally absorbs any imbalance that exists for the opening trade, NASDAQ participants can submit imbalance only orders that will trade only if an order imbalance exists during the cross. When the cross occurs, the regular-hours book is added to the opening-cross book, and the official opening price is the price that maximizes the number of shares traded. On the NYSE, only the specialist and floor participants are able to view all order information used in the opening call, but on NASDAQ, information on potential opening prices and order imbalances are disseminated across the system at normal intervals during the minutes before the opening cross[5].

We also divide the sample according to whether or not a stock is part of the Regulation SHO pilot study that runs from May 2005 to April 2006. Pilot stocks (stocks that are part of the pilot study) are exempt from the SEC price test which, during our sample period, requires a short sale in a stock to execute only at a price higher than the last price (an "uptick") or at a price equal to the last price if the last price is higher than the previous price (zero-plus tick), and pilot stocks are exempt from short-sale price tests that may be imposed by an individual market during our sample period. Non-pilot stocks remain bound by price test(s) for short sales during our sample period. We separate the sample stocks into pilot and non-pilot groups since a trader may feel it necessary to short a non-pilot stock in the opening trade if she expects prices to begin declining after the opening trade. However, shorting a pilot stock with similar expectations will not require the same immediacy since shares can be shorted even if prices decline from the opening price. Division along the pilot-stock dimension results in 570 pilot stocks and 1,190 non-pilot stocks. After separating the sample based on market and whether or not the stock is part of the pilot study, we have four groups on which most of our testing is performed: 346 (726) NYSE pilot (non-pilot) stocks and 224 (464) NASDAQ pilot (non-pilot) stocks.

Table I reports summary statistics for our sample. We find that short sales make up 17 percent of daily volume for both NYSE groups and represent 19 and 18 percent of daily volume for NASDAQ pilot and non-pilot stocks, respectively. Since we focus on short sales during the opening trade, we separate daily volume into opening trade volume and intraday volume. Intraday short volume accounts for a similar proportion of total intraday volume as daily short selling does for total daily volume. NYSE pilot (non-pilot) stocks have 21 percent (18 percent) of opening volume in short sales; whereas a much higher proportion of the opening volume on NASDAQ is made of short sales: 29 and 30 percent for pilot and non-pilot stocks, respectively.

The opening trade normally occurs quickly after the market officially opens as the mean time for the batch open is in the minute of 9:32 a.m. for both NYSE groups, and the mean time of the opening cross for both NASDAQ groups is no more than 11 seconds after normal trading begins. We find that the first short sale occurs within two minutes, on average, for all four groups.

	Minimum	Maximum	Mean	Median
Panel A: NYSE pilot stocks				
Opening volume	100	8,807,600	24,785	5,400
Opening short volume	0	1,109,500	5,184	900
NOSV	0	108.23	0.26	0.09
Opening time	9:30:00 a.m.	10:20:52 a.m.	9:32:05 a.m.	9:31:22 a.m.
First short sale time	9:30:00 a.m.	4:01:48 p.m.	9:33:10 a.m.	9:31:41 a.m.
Daily volume	3,200	289,330,500	1,483,565	546,800
Daily short volume	100	24,191,500	253,833	108,400
Intraday volume	2,800	283,191,000	1,458,779	537,800
Intraday short volume	0	24,191,500	248,649	106,100
Opening price	5.15	206.70	38.36	34.91
Close price	5.28	205.10	38.37	34.93
Intraday price change	−10.72	9.26	0.01	0.00
Daily return (%)	−41.58	45.88	0.06	0.02
Abnormal daily return (%)	−42.23	45.66	0.01	−0.04
Firm size	83,524	230,757,903	9,335,902	2,598,367
Panel B: NYSE non-pilot stocks				
Opening volume	100	11,822,000	22,519	5,000
Opening short volume	0	2,113,300	4,132	400
NOSV	0	330.02	0.23	0.05
Opening time	9:30:00 a.m.	10:29:46 a.m.	9:32:00 a.m.	9:31:21 a.m.
First short sale time	9:30:00 a.m.	4:00:00 p.m.	9:33:58 a.m.	9:31:56 a.m.
Daily volume	2,200	338,334,200	1,321,639	528,550
Daily short volume	100	45,390,100	220,791	97,650
Intraday volume	2,100	337,248,600	1,299,120	520,400
Intraday short volume	100	45,390,100	216,659	95,700
Opening price	5.07	555.50	37.79	33.77
Close price	5.02	553.86	37.78	33.76
Intraday price change	−21.55	32.59	−0.01	0.00
Daily return (%)	−43.48	52.51	0.06	0.00
Abnormal daily return (%)	−43.05	51.97	0.00	−0.05
Firm size	127,450	459,191,780	9,885,114	2,525,337
Panel C: NASDAQ pilot stocks				
Opening volume	1	9,848,167	4,834	1,200
Opening short volume	0	3,765,985	1,380	100
NOSV	0	211.81	0.28	0.02
Opening time	9:30:00 a.m.	10:21:13 a.m.	9:30:08 a.m.	9:30:02 a.m.
First short sale time	9:30:00 a.m.	8:00:00 p.m.	9:32:33 a.m.	9:30:04 a.m.
Daily volume	3,140	285,372,365	1,391,493	358,502
Daily short volume	100	52,124,003	270,403	65,860
Intraday volume	2,718	285,370,505	1,386,659	354,713
Intraday short volume	100	52,109,882	269,023	64,939
Opening price	4.95	138.28	26.99	23.90
Close price	4.97	137.27	27.00	23.91
Intraday price change	−10.60	10.01	+0.00	0.00
Daily return (%)	−62.00	48.21	0.05	0.00
Abnormal daily return (%)	−62.04	48.09	−0.01	−0.08
Firm size	119,476	174,930,030	2,938,513	941,571

Table I.
Sample summary statistics

(*continued*)

	Minimum	Maximum	Mean	Median
Panel D: NASDAQ non-pilot stocks				
Opening volume	1	3,756,143	5,205	1,100
Opening short volume	0	1,845,490	1,582	100
NOSV	0	64.99	0.29	0.02
Opening time	9:30:00 a.m.	10:29:23 a.m.	9:30:11 a.m.	9:30:02 a.m.
First short sale time	9:30:00 a.m.	8:00:00 p.m.	9:33:19 a.m.	9:30:04 a.m.
Daily volume	3,327	592,924,962	1,330,874	305,298
Daily short volume	100	100,018,527	239,578	52,940
Intraday volume	2,811	592,918,262	1,325,670	302,015
Intraday short volume	0	100,015,427	237,996	52,024
Opening price	4.94	153.97	27.16	24.10
Close price	4.92	154.35	27.19	24.13
Intraday price change	−11.80	9.85	+0.00	0.00
Daily return (%)	−63.46	47.10	0.07	0.00
Abnormal daily return (%)	−64.60	47.44	0.01	−0.07
Firm size	64,947	299,754,020	3,498,719	854,158

Notes: Statistics are presented for daily observations of 346 (726) NYSE pilot (non-pilot) common stocks and 224 (464) NASDAQ pilot (non-pilot) common stocks that have at least one trade occurring before 10:30 a.m. EST on everyday of our sample period of January 2005 to December 2006, and that have either an opening or closing price of $5 on each trading day. Opening trades refer to the NYSE batch open or the NASDAQ opening cross, and intraday refers to the trading period after the opening trade through the closing of the same day. NOSV is a stock's short volume in the opening trade divided by the stock's mean total opening volume over the entire sample period. Intraday price change is calculated as the day's close price minus the opening price. Daily return is the CRSP daily return for a stock, and abnormal daily return is the CRSP daily return for a stock less the CRSP equally weighted return for the day. Firm size is daily market cap calculated from CRSP outstanding shares values and the close prices for stocks, reported in units of $1,000

Table I.

Prices remain relatively flat during our sample period. The mean daily closing price is one cent above the mean daily opening price for NYSE and NASDAQ pilot stocks. For NYSE (NASDAQ) non-pilot stocks, the mean daily closing price is one cent below (three cents above) the mean daily opening price. For all four groups, the mean daily abnormal return is within one basis point of zero.

3. Methods

We are interested in the relation between a stock's short volume in its opening trade and four measures for the stock: intraday short sales for the same day, intraday price change for the same day, daily return for the following day, and the previous-day return.

For each stock group, we estimate the following cross-sectional, time series models:

$$NOSV_{i,t} = \beta_1 ISS_{i,t} + \beta_2 SS_{i,t-1} + \beta_3 Ab\mathrm{Ret}_{i,t-1} + \beta_4 \ln(Size)_{i,t} + \delta Z + u_{i,t} \quad (1)$$

$$NOSV_{i,t} = \beta_1 IntradayChg_{i,t} + \beta_2 SS_{i,t-1} + \beta_3 Ab\mathrm{Ret}_{i,t-1} + \beta_4 \ln(Size)_{i,t} + \delta Z + u_{i,t} \quad (2)$$

$$NOSV_{i,t} = \beta_1 Day\mathrm{Ret}_{i,t+1} + \beta_2 SS_{i,t-1} + \beta_3 Ab\mathrm{Ret}_{i,t-1} + \beta_4 \ln(Size)_{i,t} + \delta Z + u_{i,t} \quad (3)$$

The dependent variable $NOSV_{i,t}$ is our measure of normalized short volume in the opening trade for stock i on day t. In the first model, $ISS_{i,t}$ is intraday short sales for stock i on day t, calculated as the sum of short sales for the day less the short sales the execute in the opening trade. In Model (2), $IntradayChg_{i,t}$ is intraday price change for stock i on day t, measured as the close price for the day minus the opening price for day. In the third model, $DayRet_{i,t+1}$ is the return for stock i on the day following day t, and it is the CRSP daily return for stock i on day $t+1$. $AbRet_{i,t-1}$ is included in each model and is the stock's abnormal daily return for the previous day, calculated as the CRSP daily return for stock i on day $t-1$ less the CRSP equally weighted return for day $t-1$. We use previous-day abnormal returns to test how opening-trade short volume is related to previous-day returns, as opening-trade short sales should be related to the abnormal portion of previous returns. However, we also use $AbRet_{i,t-1}$ as a control variable in each model because Diether *et al.* (2009) show that short sales increase (decrease) following positive (negative) return days.

Two other control variables are included in each model based on findings from Diether *et al.* (2009). $SS_{i,t-1}$ is defined as total short volume for the stock on the previous trading day, which we scale by 10,000. $SS_{i,t-1}$ is included because daily short selling increases as previous-day short selling increases. Also, $ln(Size)_{i,t}$, the natural log of stock i's market capitalization on day t, is calculated using CRSP closing prices and the number of outstanding common shares. We include the measure of firm size because larger stocks tend to be easier to short than smaller stocks.

In Models (1), (2), and (3), Z is a matrix of four dummy variables, corresponding to whether or not day t is a day when a macroeconomic announcement is made at 8:30 a.m., is a day when a macroeconomic announcement is made at 10:30 a.m., is a day that ends trading for a month, or is a day that ends trading for a quarter. We include the two variables for macroeconomic news since Andersen *et al.* (2004) find that equity-market returns are related to news revealed in macroeconomic announcements. Blau and Pinegar (2010) find that short sellers react to news, whereas Christophe *et al.* (2004) show that short sales increase before negative news. US macroeconomic announcements are made at either 8:30 or 10:00 a.m., so we control for the timing of the announcement as an 8:30 (10:00) a.m. announcement is made before (after) the opening trade. The control variables for a trading day ending a month or quarter are included so that we distinguish between variation in opening-trade short volume that is related to our study and any variation related to end-of-period trading.

Our estimations account for firm fixed effects and time fixed effects. The structure of $u_{i,t}$ is as follows:

$$u_{i,t} = \gamma_i + \alpha_t + \varepsilon_{i,t} \tag{4}$$

where γ and α are estimated fixed parameters. We estimate Models (1), (2), and (3) without an intercept term, so α for the last trading day of the sample is restricted to 0 in Model (4).

For examination of opening-trade short sales for S&P 500 stocks, we use all daily observations from our full sample for the 367 sample firms that are part of the S&P 500 index over our entire sample period. We also include daily observations from options data for each stock as options are heavily traded for S&P 500 stocks. We use total open interest and put-call ratio (both obtained from DeltaNeutral.com) to control for options trading in each stock. Because the number of firms in our S&P 500 sample is relatively low, we do not separate it by market type, but estimate separately for pilot and

non-pilot stocks. We use the following three cross-sectional, time series models:

$$\begin{aligned} NOSV_{i,t} =& \alpha + \beta_1 ISS_{i,t} + \beta_2 OE_t + \beta_3 OE_t \times ISS_{i,t} \\ &+ \beta_4 P/C_{i,t} + \beta_5 OI_{i,t} + \beta_6 OE_t \times P/C_{i,t} + \beta_7 OE_t \times OI_{i,t} \\ &+ B_8 SS_{i,t-1} + \beta_9 Ab\mathrm{Ret}_{i,t-1} + \beta_{10} \ln(Size)_{i,t} + \delta Z + \varepsilon_{i,t} \end{aligned} \quad (5)$$

$$\begin{aligned} NOSV_{i,t} =& \alpha + \beta_1 IntradayChg_{i,t} + \beta_2 OE_t + \beta_3 OE_t \times IntradayChg_{i,t} \\ &+ \beta_4 P/C_{i,t} + \beta_5 OI_{i,t} + \beta_6 OE_t \times P/C_{i,t} + \beta_7 OE_t \times OI_{i,t} \\ &+ B_8 SS_{i,t-1} + \beta_9 Ab\mathrm{Ret}_{i,t-1} + \beta_{10} \ln(Size)_{i,t} + \delta Z + \varepsilon_{i,t} \end{aligned} \quad (6)$$

$$\begin{aligned} NOSV_{i,t} =& \alpha + \beta_1 Day\mathrm{Ret}_{i,t+1} + \beta_2 OE_t + \beta_3 OE_t \times Day\mathrm{Ret}_{i,t+1} \\ &+ \beta_4 P/C_{i,t} + \beta_5 OI_{i,t} + \beta_6 OE_t \times P/C_{i,t} + \beta_7 OE_t \times OI_{i,t} \\ &+ B_8 SS_{i,t-1} + \beta_9 Ab\mathrm{Ret}_{i,t-1} + \beta_{10} \ln(Size)_{i,t} + \delta Z + \varepsilon_{i,t} \end{aligned} \quad (7)$$

Independent variables included in these models that are not previously described include the following: OE_t, which equals 1 when trading day t is one of 24 option-expiration Fridays in our sample period and 0, otherwise; $P/C_{i,t}$, which is the stock-day, put-call ratio; and $OI_{i,t}$, the total open interest for options contracts for stock i on day t. We use $P/C_{i,t}$ as a control variable because investing in a put option can express negative expectations about a stock price in lieu of shorting the stock, and $OI_{i,t}$ is included as a control because Figlewski and Webb (1993) find that option trading facilitates short selling in a stock. The terms where OE_t interacts with other variables serve to test the relation between those variables and short sales that occur in the opening trade specifically on option-expiration Fridays. When estimating Models (5), (6), and (7), we follow Thompson (2011) to control for clustering by firm and by day. Therefore, the standard errors are robust to clustering along two dimensions simultaneously.

Lastly, we examine opening-trade short volume on days that follow an earnings announcement made between the previous close of normal trading hours and the opening trade. We refer to this type of earnings announcement as an NTP announcement. The first opportunity for information in an NTP announcement to affect prices during normal trading hours is the opening trade that comes after the announcement, so we follow Christophe *et al.* (2004) by labeling the trading day that begins with the opening trade after an NTP announcement as the announcement day. When an announcement is made during normal trading hours, the same day is considered the announcement day.

For testing, we only use sample firms for which we have I/B/E/S data on all eight normal quarterly earnings releases that are made during our two-year sample period. This requirement results in sample groups of 265 (551) NYSE pilot (non-pilot) firms and 187 (392) NASDAQ pilot (non-pilot) firms. Using the I/B/E/S data, we define a positive (negative) earnings announcement as one where actual earnings are greater than (less than) the consensus estimate for the announcement. We use the following

cross-sectional, time series regression model for testing:

$$NOSV_{i,t} = \alpha + \beta_1 NTPPos_{i,t} + \beta_2 NTPNeg_{i,t} + \beta_3 NTPPos \times Sur_{i,t} + \beta_4 NTPNeg \times Sur_{i,t} + \beta_5 SS_{i,t-1} + \beta_6 Ab\mathrm{Ret}_{i,t-1} + \beta_7 \ln(Size)I, t + \delta Z + \varepsilon_{i,t} \quad (8)$$

Model (8) is estimated using only earnings announcement days; therefore, each firm has eight time-series observations. $Sur_{i,t}$ is the surprise associated with stock i's announcement on day t. $NTPPos_{i,t}$ ($NTPNeg_{i,t}$) equals 1 when the stock-day announcement is a NTP announcement with a positive (negative) surprise and equals 0 otherwise. We also include variables for the interaction of $Sur_{i,t}$ with $NTPPos_{i,t}$ and $NTPNeg_{i,t}$. Other variables in the model are described previously. We follow Thompson (2011) in our estimation procedure for Model (8) so that the standard errors are adjusted for clustering by firm and time.

4. Empirical results

Regression results from Models (1), (2), and (3) are reported in Table II, with results for each of the four stock groups reported in different panels. We hypothesize that there is a positive relation between opening-trade short sales and intraday short sales. We find that opening-trade short sales significantly increase as intraday short sales increase for NYSE and NASDAQ stocks in both pilot- and non-pilot stock groups. For NYSE stocks, opening-trade short sales tend to increase by about 0.3 percent of normal total opening volume as intraday short volume increases by 10,000 shares. Short sales in the opening-cross for NASDAQ pilot (non-pilot) stocks tend to increase by 0.03 percent (0.02 percent) of normal total opening volume when intraday short sales increase by 10,000 shares. These results indicate that having immediate knowledge of the level of opening-trade short sales may serve as an indication of the level of short selling over the remainder of the day. Since opening-trade short volume is related to intraday short volume, we test the relation of opening-trade short sales to future price movements while determining if it is related to previous-day returns.

We hypothesize a negative relation between opening-trade short sales and future price movements, measured as either intraday price change or next-day return. We also expect a positive relation between opening-trade short sales and previous-day return. We find no significant relation between intraday price changes and short selling in the opening trade for pilot stocks, on either market. We suspect that short sellers in pilot stocks do not feel pressure to trade ahead of intraday price changes because short sales in pilot stocks are not subject to pricing tests for much of our sample period. Non-pilot NYSE (NASDAQ) stocks exhibit a positive (negative) relation between opening-trade short sales and intraday price changes. For NYSE pilot and non-pilot firms, batch-open short sales increase as next-day returns decrease. These findings are consistent with short sales increasing in contemporaneous returns and/or increasing before negative price changes. Our findings suggest that there are benefits to transparent short sales in the opening-trade. First, public reporting of opening-cross short sales would serve as an indication of intraday price movement for a NASDAQ stock that is subject to a short-sale price test such as on the day after a short-sale circuit breaker activates for the stock. Second, though we find no significant relation between NASDAQ opening-cross short sales and next-day returns, our findings suggest that

Panel A: NYSE pilot stocks			
$ISS_{i,t}$	0.0031***		
	(0.000)		
Intraday $Chg_{i,t}$		0.0040	
		(0.174)	
$Dayret_{i,t+1}$			−0.5431***
			(0.000)
$SS_{i,t-1}$	−0.0003***	0.0012***	0.0012***
	(0.000)	(0.000)	(0.000)
$Abdayret_{i,t-1}$	0.3916***	0.3966***	0.3909***
	(0.000)	(0.000)	(0.000)
$Lnfirmsize_{i,t}$	0.0655***	0.0758***	0.0739***
	(0.000)	(0.000)	(0.000)
R^2	0.16	0.15	0.15
F-statistics (two-way fixed effects)	33.98***	32.59***	32.46***
	(0.000)	(0.000)	(0.000)
Panel B: NYSE non-pilot stocks			
$ISS_{i,t}$	0.0029***		
	(0.000)		
Intraday $Chg_{i,t}$		0.0229***	
		(0.000)	
$Dayret_{i,t+1}$			−0.3284***
			(0.000)
$SS_{i,t-1}$	−0.0005***	0.0011***	0.0011***
	(0.000)	(0.000)	(0.000)
$Abdayret_{i,t-1}$	0.9103***	0.8928***	0.8759***
	(0.000)	(0.000)	(0.000)
$Lnfirmsize_{i,t}$	0.0986***	0.1003***	0.1006***
	(0.000)	(0.000)	(0.000)
R^2	0.11	0.11	0.11
F-statistics (two-way fixed effects)	33.57***	32.70***	32.48***
	(0.000)	(0.000)	(0.000)
Panel C: NASDAQ pilot stocks			
$ISS_{i,t}$	0.0003***		
	(0.000)		
Intraday $Chg_{i,t}$		−0.0035	
		(0.618)	
$Dayret_{i,t+1}$			−0.0290
			(0.866)
$SS_{i,t-1}$	−0.0002***	−0.0000	−0.0000
	(0.006)	(0.546)	(0.569)
$Abdayret_{i,t-1}$	0.7168***	0.7159***	0.7178***
	(0.000)	(0.000)	(0.000)
$Lnfirmsize_{i,t}$	0.0212	0.0218	0.0218
	(0.256)	(0.244)	(0.244)
R^2	0.26	0.26	0.26
F-statistics (two-way fixed effects)	49.29***	49.12***	49.20***
	(0.000)	(0.000)	(0.000)
Panel D: NASDAQ non-pilot stocks			
$ISS_{i,t}$	0.0002***		
	(0.000)		
Intraday $Chg_{i,t}$		−0.0121***	
		(0.004)	

(*continued*)

Table II.
Cross sectional, time series regressions for full sample

$Dayret_{i,t+1}$			0.0253
			(0.807)
$SS_{i,t-1}$	−0.0000	0.0001	0.0001*
	(0.642)	(0.101)	(0.065)
$Abdayret_{i,t-1}$	0.7203***	0.7205***	0.7225***
	(0.000)	(0.000)	(0.000)
$Lnfirmsize_{i,t}$	0.0644***	0.0640***	0.0653***
	(0.000)	(0.000)	(0.000)
R^2	0.30	0.30	0.30
F-statistics (model)	93.80***	93.45***	93.54***
	(0.000)	(0.000)	(0.000)

Notes: Results are presented for cross sectional, time series regression models with estimates allowing for fixed effects across both cross sections (firms) and time series (trade date). The dependent variable in all models is $NOSV_{i,t}$, which equals the stock-day, opening-trade short volume divided by the stock's mean opening-trade total volume over the sample period. $ISS_{i,t}$ is stock-day short volume less stock-day short volume in the opening trade; $Intraday\ Chg_{i,t}$ is stock-day close price minus the opening price for the stock on the same trading day; and $Dayret_{i,t+1}$is the CRSP next day return for the stock minus the CRSP equally weighted return for the next day. $SS_{i,t-1}$ is a stock's previous day's short volume scaled by 10,000, $Abdayret_{i,t-1}$ is a stock's previous-day CRSP return minus the CRSP equally weighted return for the previous day, and $Lnfirmzize_{i,t}$ is the natural log of the stock-day market cap. *p*-values for statistical significance are reported in parentheses below the corresponding coefficient estimates and the *F*-statistics testing for the presence of fixed effects vs the null hypothesis of poolability. Results for independent variables denoting whether day t is one when a microeconomic announcement is made at 8:00 or 10:00 a.m. or whether day t ends a monthly or quarterly trading period are not reported because all were insignificant. ***, **, *significance at 1, 5, or 10 percent levels, respectively

Table II.

there is potential benefit to real-time reporting of NYSE batch-open short selling because increases in batch-open short sales indicate negative returns for the next day in both pilot and non-pilot firms. Across all models and groups, the *F*-statistic for testing whether model fixed effects exist is highly significant. Therefore, we reject the null hypothesis of no fixed effects in the model.

Control variable results for short sales in the opening trade tend to be consistent with previous studies. Opening-trade short sales significantly increase with previous-day abnormal returns across all groups. This finding offers further evidence that short selling in the opening trade is predictive of intraday short selling as both opening-trade and daily short selling are positively related to previous-day returns. In Models (2) and (3), previous-day short selling is positively correlated with opening-trade short sales except for insignificant results in NASDAQ pilot stocks. However, in Model (1) short selling in the opening trade is negatively correlated with previous daily short selling while being positively correlated with intraday short selling. Therefore, while previous-day short volume has predictive power for daily short selling (Diether *et al.*, 2009), we suggest that opening-trade short sales are a different indicator of the level of short volume for the same day because opening-trade short sales decrease as previous-day short volume increases while intraday short sales are held constant. For all models, short selling tends to increase in the opening trade as firms are larger, although results are not significant for NASDAQ pilot stocks. For brevity, we do not report coefficient estimates for matrix Z because coefficients of all four variables for trading day characteristics are not significant.

Because uncertainty may be lower around the opening trade for S&P 500 stocks, we use Models (5), (6), and (7) to repeat our tests using only observations for firms that are part of the S&P 500 index over our entire sample period. However, we add variables to these models to determine whether short sales increase for S&P 500 stocks in the opening trade on option-expiration days and to determine if the results change on expiration days. Our previous results hold on days that are not option-expiration days as we find that opening-trade short sales for S&P 500 stocks behave similarly to our full NYSE sample. Opening-trade short volume increases for pilot and non-pilot S&P 500 as intraday short volume increases, as intraday prices increase, and as next-day returns decrease. Further, opening-trade short volume continues to be a different indicator of intraday short sales as opposed to previous-day short selling because we find that opening-trade short volume is negatively related to short volume on the previous day. We also show that short sales increase in the opening-trade of pilot and non-pilot S&P 500 stocks on option-expiration days, but the increase on expiration days is not related to intraday short sales or future price changes for either pilot or non-pilot stocks. This finding suggests that short sellers are not necessarily acting as informed traders during the opening trade for S&P 500 stocks on expiration days. Short sellers may be acting as liquidity providers for increased buying pressure that occurs due to program trading in the opening trade for index stocks on expiration days. To conserve space, we again do not report coefficient estimates from matrix Z because coefficient estimates for all four variables describing a trading day characteristic remain insignificant (Table III).

Table IV presents results from our tests for whether positive or negative earnings surprises affect short sales in the opening trade that follows an NTP earnings announcement. We use only announcement-day observations for firms in our full sample that have an observation for each of the eight quarterly earnings announcements made in our two-year sample period. Results show that, across all groups, stocks have higher short volume in the opening trade on days that follow a positive NTP earnings announcement. On days following positive NTP earnings announcements, short selling in the batch open increases in the size of the positive surprise revealed for NYSE firms, but there is no significant change in opening-cross short selling as positive surprises get larger. We find that NYSE and NASDAQ pilot firms as well as NASDAQ non-pilot firms exhibit increased opening-trade short sales on days following a negative NTP announcement, whereas short selling decreases in the opening trade when NYSE non-pilot firms make a negative NTP announcement. No group shows a significant response to the size of a negative surprise in a NTP announcement.

As our results for negative NTP announcements are ambiguous and because Brooks *et al.* (2003) conclude that positive NTP surprises are more likely to affect the following opening trade, we focus the interpretation of our results on days that follow positive NTP announcements. Since contrarian short sellers increase activity with short-term price overreaction, our result of a positive relation between batch-open short volume and the size of positive surprise revealed in a NTP earnings announcement suggests that real-time reporting of short sales in the batch open may indicate what level of overreaction is occurring with a positive NTP earnings announcements for an NYSE stock.

Control variable results in Table IV show the importance of earnings announcement effects on opening-trade short selling. Previous-day short volume and previous-day abnormal returns do not significantly affect opening-trade short selling on announcement days, as in the full sample. This finding suggests that short sellers

Panel A: Pilot stocks			
Intercept	1.0701***	1.0814***	1.0807***
	(0.000)	(0.000)	(0.000)
$ISS_{i,t}$	0.0004***		
	(0.007)		
Intraday $Chg_{i,t}$		0.0078**	
		(0.040)	
$Dayret_{i,t+1}$			−0.3533**
			(0.031)
OE Day_t	0.8679***	0.8820***	0.8834***
	(0.000)	(0.000)	(0.000)
OE $Day_t \times ISS_{i,t}$	0.0010		
	(0.331)		
OE $Day_t \times$ *Intraday* $Chg_{i,t}$		−0.0075	
		(0.923)	
OE $Day_t \times Dayret_{i,t+1}$			2.4734
			(0.562)
$Put/Call_{i,t}$	−0.0005***	−0.0005***	−0.0005***
	(0.000)	(0.000)	(0.000)
$Open\ Interest_{i,t}$	0.0000	0.0000*	0.0000*
	(0.479)	(0.072)	(0.074)
OE $Day_t \times Put/Call_{i,t}$	−0.0028	−0.0028	−0.0029
	(0.116)	(0.116)	(0.105)
OE $Day_t \times Open\ Interest_{i,t}$	0.0001	0.0004	0.0004
	(0.827)	(0.567)	(0.566)
$SS_{i,t-1}$	−0.0003*	0.0001	0.0001
	(0.060)	(0.166)	(0.332)
Abdayret $_{i,t-1}$	0.4795**	0.3962	0.4045
	(0.047)	(0.113)	(0.101)
Lnfirmsize $_{i,t}$	−0.0386***	−0.0391***	−0.0390***
	(0.000)	(0.000)	(0.000)
R^2	0.04	0.04	0.04
F-statistics (model)	46.53***	41.62***	42.79***
	(0.000)	(0.000)	(0.000)
Panel B: Non-pilot stocks			
Intercept	0.9576***	0.9742***	0.9734***
	(0.000)	(0.000)	(0.000)
$ISS_{i,t}$	0.0004***		
	(0.009)		
Intraday $Chg_{i,t}$		0.0142***	
		(0.000)	
$Dayret_{i,t+1}$			−0.2590**
			(0.013)
OE Day_t	0.9411***	0.9453***	0.9352***
	(0.000)	(0.000)	(0.000)
OE $Day_t \times ISS_{i,t}$	−0.0001		
	(0.871)		
OE $Day_t \times$ *Intraday* $Chg_{i,t}$		0.0205	
		(0.845)	
OE $Day_t \times Dayret_{i,t+1}$			−2.0021
			(0.570)
$Put/Call_{i,t}$	−0.0002***	−0.0002***	−0.0002***
	(0.004)	(0.006)	(0.005)

Table III.
Opening-trade short volume for S&P 500 stocks

(*continued*)

$Open\ Interest_{i,t}$	0.0000	0.0001***	0.0001***
	(0.118)	(0.001)	(0.001)
$OE\ Day_t \times Put/Call_{i,t}$	−0.0018*	−0.0018*	−0.0018*
	(0.054)	(0.055)	(0.056)
$OE\ Day_t \times Open\ Interest_{i,t}$	−0.0001	−0.0001	−0.0001
	(0.788)	(0.699)	(0.705)
$SS_{i,t-1}$	−0.0001	0.0002***	0.0002***
	(0.270)	(0.000)	(0.000)
$Abdayret_{i,t-1}$	0.7796***	0.7431***	0.7325***
	(0.002)	(0.004)	(0.004)
$Lnfirmsize_{i,t}$	−0.0352***	−0.0358***	−0.0358***
	(0.000)	(0.000)	(0.000)
R^2	0.07	0.07	0.07
F-statistics (model)	75.43***	74.32***	74.27***
	(0.000)	(0.000)	(0.000)

Notes: Cross sectional, time series regression estimates are presented where standard errors are adjusted for clustering by two dimensions: firm and day. The dependent variable in both models is the stock-day, opening-trade short volume divided by the stock's mean opening-trade total volume over the sample period. Observations are for S&P 500 stocks in our full sample. $ISS_{i,t}$ is stock-day intraday short volume adjusted by dividing by 10,000. $Intrady\ Chg_{i,t}$ is the stock-day closing price minus the stock-day opening price. $Dayret_{i,t+1}$ is the CRSP next day return for the stock minus the CRSP equally weighted return for the next day. $OE\ Day_t$ equals 1 when the day is an option-expiration Friday and equals 0, otherwise. $Put/Call_{i,t}$ is the stock-day ratio of put volume to call volume, and $Open\ Interest_{i,t}$ is the stock-day total open interest for options trading. $SS_{i,t-1}$ is the stock's previous day's short sale volume scaled by 10,000, $Abdayret_{i,t-1}$ is the stock's previous day's abnormal return calculated as the stock's previous day's return minus the CRSP equally weighted return for the day, and $Lnfirmzize_{i,t}$ is the natural log of the firm's sample-day market cap. Results for independent variables denoting whether day t is one when a microeconomic announcement is made at 8:00 or 10:00 a.m. or whether day t ends a monthly or quarterly trading period are not reported because all were insignificant. ***, **, *significance at 1, 5, or 10 percent levels, respectively based on p-values reported in parentheses below coefficient estimates and the F-statistics for the model

Table III.

do not base their activity in opening trades that follow a NTP earnings announcement on previous daily short selling and previous daily returns. Further, the size of the firm is negatively related to opening-trade short volume on earnings announcement days, while a positive relation exists in the full sample. Blau and Pinegar (2010) conclude that the profitability of short sales following an earnings announcement is due to short sellers' ability to process information revealed in the announcement. Perhaps their informational advantage on announcement days is smaller for larger firms. We find a positive relation between a 10:00 a.m. macroeconomic announcement and short selling in the opening trade for non-pilot stocks on both markets. This finding is consistent with our interpretation of the insignificant relation between opening-trade short sales and intraday changes in pilot stocks. We suggest that when no price tests are required for a short sale, short sellers feel less pressure to trade ahead of intraday price changes.

5. Summary and conclusion

Potential benefits exist from real-time public reporting of short sales in the NYSE batch open and the NASDAQ opening cross because opening trades occur at a time of

	NYSE		NASDAQ	
	Pilot	Non-pilot	Pilot	Non-pilot
Intercept	4.1015***	2.4178***	1.2074	1.0508
	(0.000)	(0.000)	(0.101)	(0.211)
$ON\ Pos_{i,t}$	0.3794***	0.4228***	0.2390**	0.2902***
	(0.001)	(0.000)	(0.022)	(0.000)
$ON\ Neg_{i,t}$	0.3152*	−0.2018***	0.2984**	0.3178***
	(0.071)	(0.003)	(0.015)	(0.000)
$ON\ Pos_{i,t} \times Surprise_{i,t}$	1.9395**	1.5827**	0.9105	0.2839
	(0.013)	(0.015)	(0.395)	(0.359)
$ON\ Neg_{i,t} \times Surprise_{i,t}$	0.3869	−0.1801	−1.4472	−0.2548
	(0.190)	(0.234)	(0.114)	(0.446)
$SS_{i,t-1}$	0.0000	−0.0001	0.0002	−0.0001
	(0.978)	(0.689)	(0.231)	(0.369)
$Abdayret_{i,t-1}$	0.6013	−0.7802	−0.3229	−0.9675
	(0.809)	(0.617)	(0.884)	(0.474)
$Lnfirmsize_{i,t}$	−0.1638***	−0.0898***	−0.0455	−0.0375
	(0.000)	(0.000)	(0.190)	(0.349)
$Macro\ 8{:}30_t$	0.0882	0.0506	0.1097	0.0649
	(0.341)	(0.473)	(0.351)	(0.368)
$Macro\ 10{:}00_t$	0.1902	0.2355**	0.3307	0.2801*
	(0.294)	(0.048)	(0.103)	(0.064)
$Qtr\ End_t$	0.2045	−0.3381	−0.7506***	−0.7011***
	(0.576)	(0.303)	(0.002)	(0.000)
$Mo\ End_t$	−0.1177	0.0490	0.0584	0.3061**
	(0.242)	(0.757)	(0.783)	(0.022)
R^2	0.02	0.06	0.02	0.02
F-statistics (model)	7.23***	24.05***	4.99***	6.70***
	(0.000)	(0.000)	(0.000)	(0.000)

Notes: Estimates are presented for cross sectional, time series regressions where standard errors are adjusted for clustering by two dimensions: firm and day. The dependent variable is stock-day, opening-trade short volume divided by the stock's mean opening-trade total volume over the sample period. Eight quarterly announcement-day observations are used for each firm. $ON\ Pos_{i,t}$ ($ON\ Neg_{i,t}$) equals 1 when a stock's earnings are announced in the overnight period and the earnings are higher (lower) than the consensus estimate for the stock's earnings. $Surprise_{i,t}$ is calculated as a stock's actual earnings less the consensus estimate for the announcement. $SS_{i,t-1}$ is the stock's previous day's short sale volume scaled by 10,000, $Abdayret_{i,t-1}$ is the stock's previous day's abnormal return calculated as the stock's previous day's return minus the CRSP equally weighted return for the day, and $Lnfirmzize_{i,t}$ is the natural log of the firm's sample-day market cap. $Macro\ 8{:}30_t$ and $Macro\ 10{:}00_t$ are dummy variables taking the value of 1 if a macroeconomic announcement was made at 8:30 or 10:00 a.m. on the firm's announcement day, respectively, and 1 otherwise. $Qtr\ End_t$ and $Mo\ End_t$ take a value of 1 if the firm's announcement day is the last trading day of the quarter or month, respectively, and 0 otherwise. ***, **, *significance at 1, 5, or 10 percent levels, respectively, based on p-values provided in parentheses below coefficient estimates and the F-statistics for the model

Table IV.
Regression results for earnings announcement days

uncertainty due to information asymmetry and informed short sellers may reveal information during the opening trade that could reduce uncertainty. In order to determine whether potential benefits exist, this paper examines how short volume in the NYSE batch open and NASDAQ opening cross is related to short volume for the rest of the day and short volume on the previous day. We also study the relation of

short sales in the opening trade to price changes occurring during the rest of the day and to previous-day and next-day returns.

In our full sample of NYSE and NASDAQ stocks, we find that opening-trade short sales are positively related to intraday short sales but negatively related to previous-day short sales for pilot and non-pilot stocks when we hold intraday short sales constant. We consider this to be a unique finding because Diether *et al.* (2009) show that daily short selling is positively correlated across days. In relation to price movements, we show that opening-cross short volume is negatively related to intraday price movements in non-pilot NASDAQ stocks and that short selling in the batch open is negatively related to next-day returns in NYSE pilot and non-pilot stocks.

Because uncertainty around the opening trade may not be as high for S&P 500 stocks as it is for other stocks, we re-examine opening-trade short sales in S&P 500 stocks and find that abnormally high short volume in the opening trade indicates abnormally high short selling during the day, and it indicates negative next-day returns. Because much of opening-trade volume in S&P 500 stocks on option-expiration days is non-informational program trading, we specifically study opening-trade short sales for S&P 500 stocks on expiration days. We find that opening-trade short sales increase for S&P 500 stocks on option-expiration Fridays but that the expiration-day increase is not related to intraday short volume, intraday price changes, or next-day returns.

After investigating short selling in the opening trade around the non-informational event of option-expiration, we study opening-trade short sales following earnings announcements made during the previous non-trading period because the announcements reveal information. We find that opening-trade short sales tend to increase following positive and negative earnings announcements that are made in the non-trading period, but for NYSE firms, the increase is related to the size of a positive surprise revealed in an announcement.

From our findings, we draw several conclusions about the potential benefits of having immediate knowledge of short sales executed in the opening trade. First, transparent opening-trade short sales would benefit traders as an indication of how much short volume can be expected during the day, but it indicates intraday short volume differently than previous-day short volume indicates intraday short volume. Second, real-time, public reporting of short selling in the opening trade potentially benefits traders as an indication of future price movements. For NASDAQ stocks that face a short sale price test such as after a short-sale circuit breaker, opening-cross short sales indicate intraday price changes. Further, immediate knowledge of batch-open short sales serves as a predictor of next-day returns in NYSE stocks. Lastly, we conclude that potential benefits from publicly reporting short sales do not necessarily require that all short sales be publicly reported. Our results suggest that real-time public knowledge of only opening-trade short volume is beneficial as an indicator of future market activity and price changes.

Notes

1. We use the term opening trade to refer to the NYSE batch open and the NASDAQ opening cross.
2. Information on fee-based, short sale data available from NASDAQ and the NYSE is taken from the following web pages: www.nasdaqtrader.com/Trader.aspx?id = shortsale, www.nyxdata.com/Data-Products/NYSE-Volume-Summary, www.nyxdata.com/nysedata/DataProducts/NYSE/NYSEShortSales/tabid/724/Default.aspx

3. Although price tests for short sale execution are not required normally, SEC Rule 201 requires price tests for a stock after a short-sale circuit breaker is tripped when its price declines by at least 10 percent from the previous day's close. Price tests are required to short the stock for the reminder of the day and the following day. Transparent short sales in the opening trade would be beneficial as an indicator of price changes on the day following a short-sale circuit breaker.
4. If two or more trades in the short sales data match date and time for a stock's TAQ opening trade, we sum the short sale volume for both records so that we account for all short sales that execute in the opening trade. This occurs primarily because exempt and non-exempt trades are reported separately in the data.
5. The summary of similarities and differences between the NYSE batch open and NASDAQ opening cross is taken from Barclay *et al.* (2008), who report that after the NASDAQ begins the opening cross, both markets function nearly identically in their ability to set efficient opening prices.

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Further reading

Stoll, H. and Whaley, R. (1991), "Expiration-day effects: what has changed?", *Financial Analysts Journal*, Vol. 47 No. 1, pp. 58-72.

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