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Short Sales Are Almost Instantaneously Bad News: Evidence from the Australian Stock Exchange

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ABSTRACT

This paper investigates the market reaction to short sales on an intraday basis in a market setting where short sales are transparent immediately following execution. We find a mean reassessment of stock value following short sales of up to −0.20 percent with adverse information impounded within fifteen minutes or twenty trades. Short sales executed near the end of the financial year and those related to arbitrage and hedging activities are associated with a smaller price reaction; trades near information events precipitate larger price reactions. The evidence is generally weaker for short sales executed using limit orders relative to market orders.

THIS ARTICLE ANALYZES THE INTRADAY price behavior surrounding short sales executed using market and limit orders within a transparent setting. A number of recent studies have focused on daily or monthly stock price behavior surrounding short selling activity in U.S. markets (e.g., Senchack and Starks (1993), Figlewski and Webb (1993), Conrad (1994), Hanley, and Seyhun (1994), Asquith and Meulbroek (1996), and Dechow et al. (1997)). This research has been motivated by the continued interest of market regulators in short selling activity and the controversy surrounding the desirability, restrictions, and disclosure requirements related to short selling (see Janvey (1992) and Ramsay (1993)).

In particular, several studies such as that by Figlewski and Webb (1993) have examined the relationship between short positions and subsequent abnormal returns without finding a strong relationship. Asquith and Meulbroek (1996), in contrast, focus on firms with large short positions and find a strong and consistent relationship. Dechow et al. (1997) find a correlation between short selling strategies and strategies based on fundamental analysis. These results are consistent with short sellers being able to identify

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temporarily overpriced securities even after taking into account high transactions costs. If this is the case, a short sale should represent bad news with the market reacting appropriately. The major contribution of the present study of short sales on the Australian Stock Exchange (ASX) is to confirm that short sales are bad news, and to precisely measure the negative cumulative abnormal return on both a fifteen-minute interval and transaction-to-transaction basis.

This study extends prior research in three main ways: first, through studying a market setting in which information on short trades is *transparent* just after execution; second, by analyzing price behavior utilizing abnormal returns based on precisely matched trades following short selling activity on an *intraday* basis; and third, by differentiating between short trades executed through market orders and limit orders. We conclude that in a market environment in which short sales are fully transparent moments after execution, they are almost instantaneously bad news.

In the United States, the only short selling related information that is made public is the aggregate level of short interest for individual stocks. This short interest is reported in the financial press on a monthly basis. Hence, short trades are not transparent at the time of trade and only the change in the monthly short position can be observed, rather than short trading per se. The lack of market transparency with respect to short trades impedes the ability of the market to quickly impound any information conveyed by short selling activity. As a consequence of these institutional features, the analysis of prior researchers has been primarily limited to an examination of price behavior surrounding monthly short interest announcements made in the press.

On the ASX, however, trade data which include short sales information has historically been sold to brokers and institutions on-line in real time. The ASX also requires brokers to report to the exchange (but not to other market participants) in real time whether an order placed is short. This information is captured electronically by the exchange through the Stock Exchange Automated Trading System (SEATS). The capture of these data enables us to extend prior literature by analyzing market behavior surrounding short trades in a market setting where short sales are transparent immediately following execution.

As a consequence of the monthly reporting of short interest in the United States, a trading day has been the finest observation interval used in prior research to analyze short selling (e.g., Senchack and Starks (1993)). The data utilized in the current study include all orders placed and trades executed on the ASX, and these data have been captured in real time. This enables us to extend the literature by examining market behavior surrounding short selling activity on an intraday basis. Figlewski and Webb (1993, p. 763) highlight the significance of analysis along these lines when they state "Although ideally we would also like to examine data on short sale transactions, these are unavailable for individual stocks." Intraday analysis provides more precise measurement of the market reaction and speed of

adjustment to short selling activity, with a lower probability of extraneous events influencing the analysis (see Brown, Clinch, and Foster (1992)). The nature of trading and reporting on the ASX also provides for the identification of a precise event time. Senchack and Starks (1993), referring to U.S. data, suggest that the monthly reporting of short interest, and the fact that some traders know of short sales at the time of trade (e.g., New York Stock Exchange (NYSE) specialists and the brokerage house executing the short sale), make it difficult to determine the information release date with any precision.

The remainder of this paper is organized as follows. Section I provides an overview of the institutional arrangements for short selling on the ASX. Section II provides some theoretical discussion which predicts price behavior around short trades. Section III describes the data and method, and Section IV reports the results. The final section summarizes our findings and provides suggestions for future research.

I. Institutional Setting

SEATS is a fully automated trading system used to execute trades on the ASX, and is best described as an electronic open limit order book (see Glosten (1994)). Trading through SEATS requires brokers to enter orders (acting either as principal or agent) through networked terminals in their offices. Orders that match (price) are automatically traded; unexecuted orders are left on display.

Short selling on the ASX can be undertaken for a group of securities listed in the ASX Trading Rules.[1] A short sale on the ASX is normally executed by borrowing scrip from another investor (typically via a broker) and selling the shares through SEATS. All ask orders that would result in a short sale if executed are tagged by traders as "short sell orders" as they are entered on SEATS. This information is captured by the ASX for regulatory reasons, but it is not disseminated. Hence, SEATS traders are not able to distinguish short sell orders from regular sell orders. When orders are executed, full trade details are distributed to brokers and institutions by the Market Information Division of the ASX. The dissemination of this information is electronic via a real-time feed known as 'signal C,' and occurs immediately upon execution of trades.[2] Signal C includes a field that identifies short sales. As a consequence of the trade information dissemination mechanism on the

[1] Section 2.18 of the ASX Trading Rules contains the regulations which apply to short selling on the ASX. As of January, 1994, Appendix 6.6 of the ASX Trading Rules listed approximately 150 securities which could be sold short. The requirements for a stock to be included in the list are that it must have more than 10 million shares on issue, have a market capitalization exceeding $20 million, and possess "sufficient liquidity" (ASX Trading Rule 2.18 (13)).

[2] While the trade execution and information dissemination process is fully automated, our discussions with ASX officials suggest that transmission lags (of up to a few seconds) in signal C can occur.

ASX, short selling related activity becomes transparent shortly after the time of trade execution.

The regulations governing short selling are similar to those applying to the NYSE.[3] Investors who short sell on the ASX are required to deposit with their broker a minimum initial margin equal to 20 percent of the value of the stock shorted (institutions are exempted from this rule). Under ASX trading rules, short sellers are permitted to keep the remaining proceeds of short sales. However, if the value of the stock rises by more than 10 percent, the seller must provide additional capital to maintain a 20 percent margin.

Another rule stipulates that short trades on the ASX cannot be made on a price downtick. That is, they must be executed in such a way that the price at which they trade is greater than or equal to the last trade price.[4] As a consequence of this rule, the direct market impact of short trades on the ASX is forced to be zero. However, subsequent trades could be at lower prices due to potential information released by the short sale. These rules, as well as the costs associated with borrowing stock, make short selling costly relative to "regular" sell trades.

II. Theoretical Considerations

A. Informed Short Selling

Diamond and Verrechia (1987) provide a theoretical model which implies that the costs associated with short selling will squeeze liquidity traders out of such order flow. This has the effect of making short orders more informative than the population of regular sell orders. As a consequence, Diamond and Verrechia hypothesize that short sales will precipitate a price adjustment at the time such information is made public. Because short selling on the ASX is transparent shortly after the time of trade execution, all market participants can observe short sales, and, therefore, negative abnormal returns are expected to be associated with short trades. The market reaction is expected to occur within minutes of the trade, unlike in U.S. markets where announcement of past short position in a stock is made up to one month later.

There have been a number of studies of price movements in stocks around the announcement of an increased short interest in stocks. Senchack and Starks (1993, p. 184) only find weak support for the hypothesis that the market reaction to unexpected increased short interest is negative around the announcement date. Hurtado-Sanchez (1978) finds that short interest is not a predictor of current or future stock returns. Likewise, Brent et al.

[3] Brent, Morse, and Stice (1990) provide a succinct description of the institutional arrangements for short selling on the NYSE.

[4] A SEATS operator can enter a short market order which clears the best limit bids. As long as the market order is executed at one price level, and the previous trade was at the same price or lower, the execution will satisfy the ASX trading rules. In other words, the order can clear out a price step but cannot trade down to the next price step.

(1990) find that short interest is not a consistent predictor of short-run stock returns. Figlewski (1981) finds that a portfolio generated from short interest in stocks can generate an abnormal negative return but a strategy based on such a portfolio is not profitable unless the proceeds from the portfolio are available to the investor. Conrad (1994) uses a model to estimate "informed" and "uninformed" short selling. An increase in unexpected informed short selling has the predicted negative effect but unexpected uninformed short selling has a surprising positive effect. Hence, although the evidence is suggestive of support for the Diamond–Verrechia hypothesis, it is by no means conclusive.

Senchack and Starks (1993) and Figlewski and Webb (1993) partition stocks on the basis of whether they have options listed, and analyze the price behavior following monthly short interest announcements. They argue that short selling in options-listed stocks is less likely to be informative, because informed traders utilize the options market where the costs of shorting are lower. Consistent with their conjecture, they find that stocks with traded options are less likely to be associated with negative abnormal returns following the reporting of increases in short interest. This study reexamines the Diamond–Verrechia hypothesis with intraday data. However, as pointed out in prior research, a subset of short selling activity will not be information motivated, or indeed informative. This issue is discussed in the following section.

B. Uninformed Short Selling

Diamond and Verrechia (1987) argue that the reduction in the costs of short selling via the introduction of options trading will increase the speed of adjustment to private information and, as a consequence, reduce the informativeness of short order flow. Figlewski and Webb (1993) provide three pieces of indirect empirical evidence supporting the notion that short trades in optioned stocks are less likely to be informative. First, short selling activity is proportionately greater for optioned stocks. This reflects the market makers' use of their transactional cost advantage in the United States. They also face fewer constraints in short selling to hedge their positions in options.[5] Second, increased short selling activity is associated with higher put prices and lower call prices reflecting the use of the options market by traders with unfavorable information. Finally, short selling activity is associated with greater negative excess returns for stocks without options traded on

[5] Short selling by market makers (the ASX has no official market makers, but there are many brokers that perform the unofficial role of market makers; see Aitken, Garvey and Swan (1995)) need not always be informationally related. Hanley and Seyhun (1994) argue that such non-information motivated short selling will limit research examining the price reaction following short selling activity. Principal trades by market makers on the ASX are primarily executed as off-market trades or "crossings" which are trades where one broker holds both sides of the transaction. Off-market trades and crossings comprise a very small portion of all short sales on the ASX. They can be identified from a condition code in the data and are excluded from the current study.

them. The primary implication of this evidence is that short selling of an optioned stock is less likely to be informed, and, hence, unlikely to precipitate a price reaction.

Brent et al. (1990) argue that in addition to short selling for the purposes of speculation or hedging, short selling also takes place for arbitrage reasons.[6] They also attribute the higher incidence of short positions among optioned stocks to arbitrage. An arbitrageur going short in a security is not directly trading on private information (that it is overpriced), but is seeking to exploit pricing inconsistencies in related securities. Hence, it is unlikely that short sales that form part of an arbitrage transaction will precipitate a price reaction (see also Senchack and Starks (1993)). The implication of this is that the lack of a price reaction following short selling may be attributed to an arbitrage transaction involving the underlying security. Both Brent et al. (1990, p. 279) and Senchack and Starks (1993, p. 189) also suggest that index futures arbitrage would account for a considerable proportion of short selling. Again, given that such activity is not motivated by stock-specific information, it is unlikely to cause a price reaction.

Another noninformation motive for short selling is tax related. "Shorting against the box" refers to an economic entity holding short and long positions simultaneously at the end of a financial year, so as to eliminate any risk associated with price volatility and to carry the long position in the stock (and any tax implications) into the next financial year (see Brent et al. (1990)). U.S. evidence that is consistent with tax-motivated short selling includes a seasonal effect in the proportion of short selling activity concentrated at the financial year-end (Brent et al. (1990)), as well as a smaller negative price reaction associated with short selling activity at the end of financial years (Conrad (1994)).

Keim and Madhavan (1995) argue that traders with short-lived information are more likely to use market orders than limit orders. They provide evidence that technical traders are more likely to use market orders. Aitken and Frino (1996a) provide evidence consistent with this notion—trades executed with market orders have greater market impact. This suggests that short trades executed using limit orders are less likely to arise from traders with short-lived information, and hence, are less likely to precipitate an immediate price reaction.

III. Data and Method

The microstructure database used in this study is provided by the ASX, and captured from SEATS on-line in real time. The database contains details of all limit and market orders placed, as well as trades executed on

[6] If all activity in the options market were conducted in this manner, short selling involving a market maker would also be informative, and would be associated with subsequent negative abnormal returns. However, we conjecture that the bulk of short selling activity involving a market maker is inventory related, and therefore, not directly information motivated. A considerable portion of the order flow faced by the market maker must necessarily be uninformed, otherwise the market maker would continually lose money and be forced to shut down.

SEATS. All records include a time stamp to the nearest hundredth of a second, price and volume fields, unique codes that link trades to the buy and sell orders from which they originate, as well as a field identifying the order or trade type (e.g., short sales, fill-or-kill, good-for-day, etc.).[7] The data used in this study comprise all short sales and associated orders that occurred on SEATS from January 1, 1994, through December 31, 1996. Trades in stocks that experienced a change in the basis of quotation (associated with dividend payments or capitalization changes) in the ten hours prior to or following each short trade are excluded from the sample because these events mechanically lead to negative price adjustments. The remaining short trades are partitioned into two categories: those executed using limit sell orders, and those executed using market sell orders, with results reported separately for the two categories.

Initial analysis of the short trades consists of an event study using the two sub-samples (market orders and limit orders). Abnormal returns are estimated in two ways: first for fifteen-minute intervals around the time at which short trades occur[8] and, second, on a transaction-by-transaction basis for thirty trades before and after the short sale.[9] An advantage of the transaction-time approach is that it is less subject to problems associated with nonsynchronous trading. When a particular stock does not trade during a fifteen-minute calendar time interval, its price is assumed to have remained at its previous trade price. This could lead to an understatement of the estimated negative abnormal return utilizing the calendar-time method.

The abnormal return for each time and trade interval is the difference between the actual return on the short sale and the return on a matched "regular" nonshort sale. The matching is comprehensive in that the regular sales are selected from the subset of all trades in the same stock within three months of the short sale which (i) occurred at the same time of day and on the same day of the week, (ii) were executed using the same order type (market or limit sell order), (iii) were of the same tick type (uptick or zero-tick) and (iv) were closest in size (number of shares) to the experimental trade. The time-of-day and day-of-week selection criteria control for the well-known intraday and intraweek patterns in returns (see Brown et al. (1992) and Aitken, Brown, and Walter (1996)), and the other criteria control for factors that are likely to influence the measured market impact of trades.

As a robustness check, and as a more stringent test of the Diamond–Verrechia (1987) hypothesis, short sales are matched with buys on the basis of the criteria above using the fifteen-minute time intervals (except that downticks are matched with upticks). Ask-to-ask (bid-to-bid) returns for the short trades are benchmarked against bid-to-bid (ask-to-ask) returns for buys because the direct market impact of buy trades is expected to be opposite of

[7] Aitken and Frino (1996b) provide a detailed description of the data.

[8] Analysis using 1, 5, 10, 30 and 60 minute observation intervals is also carried out. Findings are consistent across intervals, although noise in the shorter observation intervals due to the problem of thin trading results in statistically weaker results.

[9] We thank the editor for his suggestion to include transaction-by-transaction analysis.

sells. For example, bid-to-bid returns of short trades executed using market orders will reflect the direct market impact of the trade; the ask-to-ask returns of market buy orders will reflect their direct market impact.

In addition to computing abnormal returns using transaction prices, the spread midpoint, bid prices, and ask prices around the experimental and control trades are also used to compute returns for the fifteen-minute interval analysis. The midpoint of the spread has been used in prior research to remove bid-ask bounce induced biases in returns estimated using transaction prices (see Lease, Masulis, and Page (1991), McInish and Wood (1992), and Venkatesh (1992)). Bid-to-bid returns and ask-to-ask returns are also estimated separately in order to provide further analysis of the price discovery process that occurs around short trades.[10] Bid returns directly reflect the price impact of short trades executed using market ask orders, but ask returns are not directly influenced by such short trades. Similarly, in the case of short trades executed with limit orders, ask returns reflect the price impact associated with the market order executing against the short limit order, but bid returns do not.

Regression analysis is also carried out to determine under what conditions short trades are more (or less) likely to be informative. The following model, confined to time-interval abnormal returns, is estimated using the four different return metrics (trade-to-trade, bid-to-bid, midpoint-to-midpoint, and ask-to-ask):

$$\mathrm{AR}_{it} = a_0 + a_1\mathrm{OPTIONED}_i + a_2\mathrm{SPIARB}_t + a_3\mathrm{EVENT}_{it} + a_4\mathrm{MONTH}_t, \quad (1)$$

where AR_{it} is the abnormal return for stock i in the fifteen-minute interval following the short sale occurring at time t and all other variables are binary variables which are set to zero except $\mathrm{OPTIONED}_i$ is set to one if the short sale occurs on an optioned stock, SPIARB_t is set to one if the All Ordinaries Index (AOI) exceeds the near-term All Ordinaries Share Price Index (AOSPI) futures contract,[11] EVENT_{it} is set to one if a trading halt occurs in stock i within one day following the short sale, and MONTH_t is set to one if the trade occurs in the last three trading days of the tax year (June).

Following Senchack and Starks (1993) and Figlewski and Webb (1993), the OPTIONED and SPIARB variables are intended to determine the impact of arbitrage and hedge-related short sale activity. Specifically, it has been argued that short sales in optioned stocks are likely to be less informative

[10] Harris, McInish, and Chakravarty (1995) also analyze the bid and ask side of the market separately in their study of price formation in an auction market.

[11] The AOI is Australia's primary market index, comprising approximately 300 companies, with an aggregate market value of over 95 percent of the total value of stocks listed on the ASX. The AOI is the spot index for the Sydney Futures Exchange's Share Price Index (SPI) futures contracts. The "dominant" or most liquid futures contract price is used in the analysis (see Eckman (1992)). While an arbitrage position can take place in any of the SPI contracts, given that most trading activity is concentrated in the dominant contract, it is likely that the more significant arbitrage trades will take place in the dominant contract. Use of the "dominant contract" also reduces any non-synchronous trading problems arising from thin trading.

(precipitate a smaller negative price reaction), and hence a_1 is predicted to be positive. We develop a new variable that proxies for the probability that the short trade is part of index-related arbitrage activity. The SPIARB variable uses the spot-futures basis to identify periods of potential arbitrage. When the spot price exceeds the futures price, there is a high probability of reverse cash-and-carry arbitrage, which is captured by the SPIARB variable. Since short selling activity associated with portfolio arbitrage is less likely to be informative, the coefficient for the SPIARB variable (a_2) is also predicted to be positive.

The EVENT variable measures the incremental information content of short trades that occur prior to trading halts, and captures the abnormal return associated with short trades that occur during periods of perceived high information asymmetry.[12] If an information release occurs soon after the short sale, there is a greater probability that the short sale will be perceived to be informationally motivated, hence a_3 is predicted to be negative.

Finally, following Conrad (1994), MONTH is intended to capture the effects of any tax-related short selling activity at the end of the Australian financial year (i.e., June). Since this is tax related and not informationally related, the coefficient a_4 is expected to be positive.

IV. Results

A. Descriptive Statistics

There were 24,509 short trades executed on SEATS over the sample period. Of these, 7,970 were executed using market orders and 16,539 were executed using limit orders. The exclusion of short trades whose stocks experienced a change in the basis of quotation around the trades leaves 6,676 short trades executed through market orders and 13,505 executed through limit orders. Stocks without a continuous bid or ask around the short trade are also excluded, leaving a final sample of 4,773 and 10,548, respectively.

Table I provides some descriptive statistics that characterize the final sample of short trades. The table shows that our sample includes more than twice as many short trades executed using limit orders as market orders. Both subsamples have a high proportion of trades in optioned stocks (78.6 percent and 75.2 percent), and approximately 29 percent of the time, the AOI is greater than the near-term SPI contract price. Finally, trading halts follow a short sale within one day for 7.69 percent and 6.51 percent of our sample, and 1.78 to 2.10 percent of observations fall in the final three trading days of the financial year. The characteristics of the control trades are very similar to the experimental trades, indicating a good match.

[12] The ASX uses a set procedure for releasing company information. All company announcements are required to be forwarded to the exchange. If the announcement is considered to be "price sensitive", trading in the underlying stock is halted, generally for approximately 10 minutes. Trading halts are a common occurrence on the ASX. For example, there were 7,498 trading halts across 1,217 stocks between August 31, 1992 and February 6, 1995 (Aitken, Frino and Winn (1995)).

Table I

Summary Statistics for Sample of Short Sales and Matched Control Trades

The data used comprise all short trades and associated orders which occurred on the Australian Stock Exchange between January 1, 1994 and December 31, 1996. Trades in stocks which experienced a change in the basis of quotation (associated with dividend payments or capitalization changes) in the ten hours prior to or following each short trade are excluded from the sample. Stocks without a continuous bid or ask around the short trade are also excluded, leaving a final sample of 4,773 and 10,548 short trades executed via market orders and limit orders, respectively. For each short sale in the sample, a matched "regular" sale is identified that controls for time of day, size of trade, and tick direction (i.e. uptick, zerotick, or downtick). Panel A presents summary statistics for the short sale sample and the control sample of regular trades. Panel B presents the limit order samples. "Trade Size in Shares" indicates the average number of shares per trade; "Optioned stocks" identify the observations that correspond to a stock with exchange-traded options; "AOI > SPI (Arbitrage)" identifies situations where the spot index (AOI) is greater than the near-term futures price (SPI); "Followed by Event" identifies observations where a trading halt occurs within one day following the observed short sale; and "Turn of Year" identifies short sales that occur in the final three days of the fiscal year (June).

	Number of Observations	Mean Stock Price $	Trade Size (in shares)	Optioned Stocks	AOI > SPI (arbitrage)	Followed by Event	Turn of Year
Panel A—Market Order Executed Trades							
Short Sales	4,773	7.363	18,936	78.6%	29.0%	7.69%	1.78%
Matched Regular Sales	4,773	7.355	17,807	77.0%	26.0%	7.18%	1.32%
Panel B—Limit Order Executed Trades							
Short Sales	10,548	7.063	6,695	75.2%	29.4%	6.51%	2.10%
Matched Regular Sales	10,548	7.059	6,508	74.2%	28.0%	6.60%	2.11%

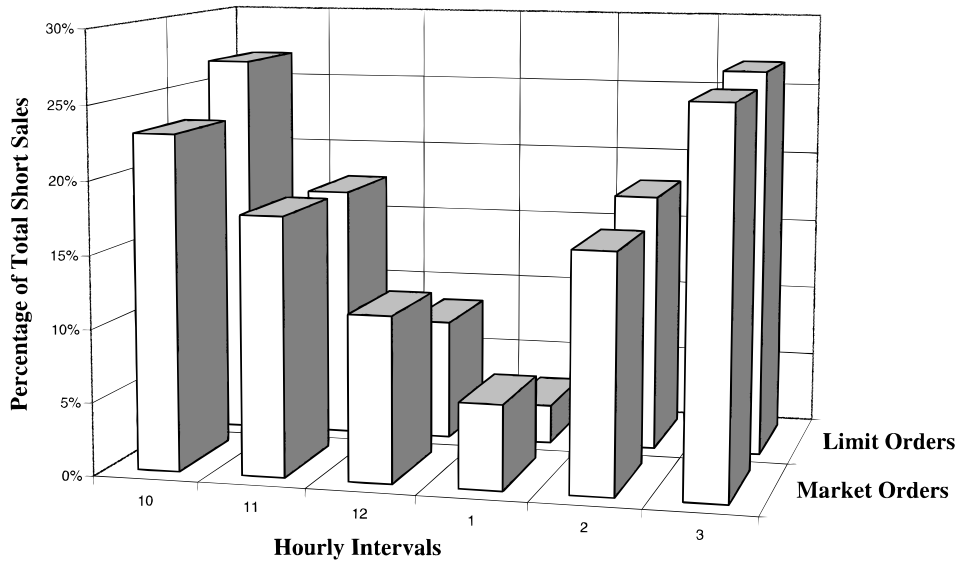

Figure 1. Percentage of Total Short Sales by Hourly Interval. This figure presents the distribution of short sales by order type across the six hourly intervals of the trading day. The data used in this study consist of all short trades and associated orders which occurred on the Australian Stock Exchange over the period from January 1, 1994 through December 31, 1996. After excluding short trades that (1) experienced a change in the basis of quotation, (2) were executed off-market, or (3) were without a continuous bid or ask, the final sample consists of 4,773 and 10,548 short trades executed through market and limit orders respectively. *Percentage of Total Short Sales* are the proportion of trades occurring in each hourly interval, and *Hourly Intervals* are denoted by the time at the start of each interval.

Figure 1 shows the distribution of short sales (in shares) by order type across the six hourly intervals of the trading day. As is the case with total shares traded (Lau et al. (1996), Aitken et al. (1996)), short sales also exhibit a U-shaped pattern across the trading day.

B. Event Study Results

Table II provides the results of the event study analysis based on calendar time for short trades executed using both market orders and limit orders. Panel A sets out the mean abnormal returns in the three fifteen-minute intervals surrounding the short sales executed using market orders. The same information for limit orders is presented in Panel B.

There is a statistically significant negative price reaction across return metrics. The magnitude of the abnormal returns implies that the information conveyed by short market orders causes a mean reassessment in stock value of -0.029 to -0.111 percent depending on the return metric used. The weakest evidence in terms of both statistical significance and magnitude is

Table II

Intraday Price Reaction Surrounding Short Trades

The results of an event study using market orders and limit orders are reported below. The data used comprise all short trades and associated orders which occurred on the Australian Stock Exchange between January 1, 1994 and December 31, 1996. Trades in stocks which experienced a change in the basis of quotation (associated with dividend payments or capitalization changes) in the ten hours prior to or following each short trade are excluded from the sample. Stocks without a continuous bid or ask around the short trade are also excluded, leaving a final sample of 4,773 and 10,548 short trades executed via market orders and limit orders, respectively. For each short sale in the sample, a matched "regular' sale is identified that controls for the time-of-day, day-of-week, size of trade, and tick direction (i.e. uptick, zerotick, or downtick). The abnormal return for each interval is the mean difference between the short trade returns, and the returns for the matched non-short trades. Abnormal returns are estimated for 15 minute intervals around the time at which short trades occur. To remove biases caused by bid-ask bounce, returns are measured in four ways: trade-to-trade, ask-to-ask, midpoint-to-midpoint, and bid-to-bid. The *t* statistics for the difference of the means tests are reported. Panel A reports the mean abnormal returns for the market order sample, while Panel B reports the results for the limit order sample.

	Trade-to-Trade		Ask-to-Ask		Midpt-to-Midpt		Bid-to-Bid	
	Mean		Mean		Mean		Mean	
15 Minute Interval	Abnormal Return %	*t*-Statistic	Abnormal Return %	*t*-Statistic	Abnormal Return %	*t*-Statistic	Abnormal Return %	*t*-Statistic
Panel A: Market Orders (n = 4,773)								
−3	−0.010	−1.28	−0.006	−0.61	−0.006	−0.62	−0.006	−0.49
−2	0.022	2.45	−0.006	−0.48	0.017	1.34	0.045	2.19
−1	−0.010	−0.88	0.020	1.49	0.020	1.73	0.024	1.78
0	−0.029	−2.98*	−0.077	−5.72*	−0.092	−7.16*	−0.111	−7.38*
+1	−0.003	−0.37	−0.016	−1.48	−0.009	−0.88	−0.001	−0.10
+2	−0.014	−1.77	0.001	0.15	0.004	0.40	0.005	0.46
+3	−0.015	−1.98	−0.006	−0.63	−0.007	−0.72	−0.009	−0.66
Panel B: Limit Orders (n = 10,548)								
−3	−0.003	−0.79	0.002	0.44	0.001	0.18	−0.001	−0.17
−2	0.007	1.44	0.016	2.19	0.011	1.62	0.006	1.03
−1	0.008	1.26	0.001	0.09	−0.002	−0.39	−0.005	−0.81
0	−0.016	−3.24*	−0.031	−4.90*	−0.029	−5.14*	−0.027	−4.46*
+1	0.008	1.72	0.001	0.24	0.004	0.70	0.005	1.03
+2	−0.007	−1.75	−0.006	−1.04	−0.002	−0.50	0.000	0.04
+3	−0.007	−1.53	−0.004	−0.73	−0.005	−1.10	−0.006	−1.28

*indicates significance at the 0.01 level.

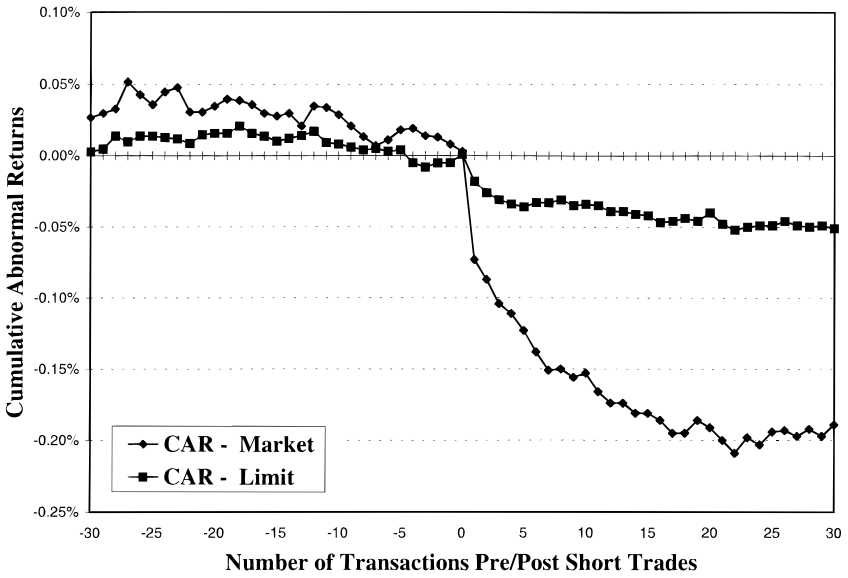

Figure 2. Cumulative Abnormal Returns as a Result of Short Sales from an Intra-day Event Study on a Transaction-by-Transaction Basis. The results of an event study using market orders and limit orders are shown in Figure 2. The data used comprise all short trades and associated orders which occurred on the Australian Stock Exchange between January 1, 1994 and December 31, 1996. Trades in stocks which experienced a change in the basis of quotation (associated with dividend payments or capitalization changes) in the ten hours prior to or following each short trade are excluded from the sample. Stocks without a continuous bid or ask around the short trade are also excluded, leaving a final sample of 4,773 and 10,548 short trades executed via market orders and limit orders, respectively. For each short sale in the sample, a matched "regular' sale is identified that controls for the time-of-day, day-of-week, size of trade, and tick direction (i.e. uptick, zerotick, or downtick). The abnormal return shown for each transaction interval is the mean difference between the short trade returns, and the returns for the matched non-short trades. Abnormal returns computed on a trade-to-trade basis are estimated on a transaction-by-transaction basis (in contrast to calendar time in Table II) around the time at which short trades occur. The results for both the market and the limit order sample are presented.

obtained from trade-to-trade returns, which reflect the noise caused by bid-ask bounce and (potentially) thin trading (i.e., for some stocks there may be no trade in the interval(s) following the short trade).

The cumulative trade-to-trade abnormal returns in transaction time executed using market orders and limit orders are presented graphically in Figure 2. Consistent with the conjecture that thin trading may have resulted in an understatement of the adverse information content of short sales in calendar time (see Section III above), it can be seen that the cumulative abnormal return for market orders is much lower at -0.20 percent. The adverse information contained in a short sale is fully impounded after approximately twenty trades.

As argued earlier, short trades executed using limit orders are less likely to be informationally motivated. Consistent with this conjecture, the negative price reaction in calendar time associated with short sales executed using limit orders is generally weaker in magnitude and statistical significance. The mean reassessment in stock value associated with limit sell orders is between −0.016 percent and −0.031 percent in calendar time. For all metrics except trade-to-trade, market orders are significantly more negative than limit orders. Moreover, a significant negative price reaction is associated with the short sales executed using limit orders. Again the weakest evidence is obtained from the trade-to-trade return metric. However, in transaction time on a trade-to-trade basis the abnormal negative return is lower at −0.05 percent.

The results in calendar time using purchases rather than regular sell orders as the benchmark are very similar to those presented in Table II, hence they are not reported here. These results not only show that our findings are robust with respect to this alternative benchmark, but they actually strengthen support for the Diamond–Verrechia hypothesis by showing that short sales are more informative than either buy orders or regular sell orders. The prior literature on block trades (e.g., Chan and Lakonishok (1993)) suggests that the "regular sell" benchmark is more likely to include liquidity-motivated orders than the "buy" benchmark. Hence, a buy benchmark might be expected to show less evidence of abnormal returns than a sell benchmark because of the greater expected information content in the buy benchmark. However, we find that there is no significant difference between the response to buy and sell orders when they are benchmarked against each other. This may be because short sales cannot be larger than the depth at the best quote because of the zero downtick rule, which excludes both very large short sales and very large (more informative) matching buys.

C. Significance of the Results

As a whole, the event study results provide strong evidence consistent with the Diamond–Verrechia hypothesis that short trades are more informative than regular sell trades because of the restrictions on short selling. Hence they precipitate a significant negative price reaction. As discussed above, the monthly release of short interest information on U.S. stocks has made it difficult if not impossible to obtain anything but relatively weak or suggestive evidence supportive of the Diamond–Verrechia hypothesis. Additionally, results from the analysis that utilizes buy trades as a benchmark are very similar to those reported in Table II, and suggest that the findings are robust to the choice of benchmark.

It is of value to directly assess the economic significance of our findings on the magnitude of the abnormal return following a short sale. One useful point of comparison is the market's response to institutional sales in the United States as documented by Chan and Lakonishok (1993, p. 182). Generally, they find relatively small responses to institutional trades, in part

because they do not concentrate just on large blocks. They find that the mean response to institutional sales between the opening and the sale is a relatively small −0.06 percent. Of greater relevance to our study, this slight fall is followed by a price reversal of 0.08 percent from the trade to closing. By contrast, an institutional purchase results in a mean rise from the opening to the trade of 0.10 percent followed by a further rise of 0.16 percent until the close. These results could be explained if purchases have information content and regular sales are not expected to contain information.

Their mean results for regular sales are actually made up of two partially offsetting elements: relatively small trades that initially depress the price from the opening with a further fall by the close and larger trades that lead to a surprising positive response from the opening and from the trade until the close. Our sample of short sales is of the leading and most frequently traded stocks for which trade size is typically fairly large, although the application of the tick rule ensures that trade size is smaller than average. Arguably, their mean results present the most appropriate basis of comparison. In these terms, our finding of an abnormal return of −0.2 percent on a trade-to-trade basis following a short sale represents an economically as well as statistically significant result.

D. Regression Analysis Results

Table III reports the results of the regression analysis. All *t*-statistics are adjusted for heteroskedasticity using the procedure developed by White (1980). Generally, the results for short sales executed using market ask orders are much stronger than for those executed with limit ask orders.

In all cases, the intercept coefficient is negative and statistically significant, indicating that, on average, short sales have informational content. Three of the four return measures for market orders indicate a return of about −0.2 percent, which is similar to the transaction-by-transaction analysis. The coefficients of OPTIONED across all estimated models are positive and generally statistically significant. Though all coefficients associated with the SPIARB variable are positive, this variable is only statistically significant for short sales executed using market orders when abnormal returns are measured using trade-to-trade and bid-to-bid returns. The SPIARB variable is not statistically significant in explaining abnormal returns associated with short sales executed using limit orders. It is likely that traders seeking to exploit index arbitrage opportunities need to act quickly, and so use market orders to execute trades for a more rapid execution. Overall, the findings for the OPTIONED and SPIARB variables provide evidence that short sales, which are likely to be associated with hedging and arbitrage activities, are less likely to be informationally motivated.

The coefficient associated with the EVENT variable is consistently negative. However, the variable is only statistically significant in explaining abnormal returns associated with market orders. This is also consistent with our argument that short trades that occur less than one day before an im-

Table III
Determinants of Abnormal Returns Following Short Trades

$$AR_{it} = a_0 + a_1\,OPTIONED_i + a_2\,SPIARB_t + a_3\,EVENT_{it} + a_4\,MONTH_t$$

To determine the conditions under which short trades are more (or less) likely to be informative, the regression model set out above is estimated. Abnormal returns (AR_{it}) expressed as percentages are estimated using four different return metrics (trade-to-trade, bid-to-bid, midpoint-to-midpoint, and ask-to-ask) for stock i over the 15 minute interval following the short sale occurring at time t; $OPTIONED_i$ equals one if stock i is an optioned stock, and zero otherwise; $SPIARB_t$ is set to one if the All-Ordinaries Index exceeds the All-Ordinaries Share Price Index futures price on the nearest maturity contract traded on the Sydney Futures Exchange at the start of interval t, and zero otherwise; $EVENT_{it}$ equals one if a trading halt occurs for stock i within one day following the short sale, and zero otherwise; and, $MONTH_t$ equals one if the trade occurs within three trading days of the end of the tax year end (June), and zero otherwise. *Expected Direction* indicates the hypothesized relationship between abnormal returns (AR_{it}) and each variable. All t-statistics are adjusted for heteroskedasticity using White's (1980) method.

		Returns Measurement							
		Trade-to-Trade		Ask-to-Ask		Midpoint-to-Midpoint		Bid-to-Bid	
	Expected Direction	Parameter Estimate (%)	White-adjusted t-Statistics	Parameter Estimate (%)	White-adjusted t-Statistics	Parameter Estimate (%)	White-adjusted t-Statistics	Parameter Estimate (%)	White-adjusted t-Statistics
Panel A: Market Orders									
Intercept	*Neg*	−0.20	−6.681***	−0.27	−6.912***	−0.18	−6.332***	−0.09	−3.676***
OPTIONED	Pos	0.13	3.798***	0.22	5.022***	0.12	3.763***	0.02	0.678
SPIARB	Pos	0.06	2.052**	0.03	0.732	0.05	1.609	0.06	2.617***
EVENT	Neg	−0.10	−1.934*	−0.15	−2.327**	−0.13	−2.634***	−0.10	−2.436**
MONTH	Pos	0.23	2.214**	0.28	2.088**	0.22	2.312**	0.17	2.065**
F-statistic			6.726***		8.389***		6.965***		4.435***
Panel B: Limit Orders									
Intercept	*Neg*	−0.10	−6.151***	−0.08	−5.444***	−0.07	−6.203***	−0.07	−4.998***
OPTIONED	Pos	0.09	4.942***	0.07	4.053***	0.07	5.034***	0.07	4.480***
SPIARB	Pos	0.02	1.225	0.03	1.707*	0.02	1.442	0.01	0.646
EVENT	Neg	−0.04	−1.205	−0.01	−0.297	−0.04	−1.518	−0.06	−2.426**
MONTH	Pos	0.04	0.770	0.09	1.757*	0.02	0.541	−0.05	−1.115
F-statistic			7.624***		6.396***		8.246***		7.213***

***, **, *indicate significance at the 0.01, 0.05, and 0.10 levels, respectively.

pending event are more likely to be informationally motivated. The lack of significance of the EVENT variable in explaining abnormal returns associated with short sales executed using limit orders is consistent with the idea that informed market agents trade on decaying information, and hence opt for a quicker execution using market orders.

Finally, the coefficient of MONTH, though consistently in the direction predicted, is statistically significant only in the case of short sales executed using market sell orders. Hence, there is some evidence to support the hypothesis that short selling activity occurring close to the financial year end is less likely to be informationally motivated.

V. Summary and Suggestions for Future Research

This paper builds on prior research by extending the investigation of market reaction to short sales to an intraday framework in a market setting where short trades are transparent shortly after the time of execution. Additionally, by utilizing data from an electronic trading system where both orders and trades are fully transparent, short sales arising from market orders can be differentiated from short sales arising from limit orders. These advantages allow more precise measurement of both the market reaction and the speed of adjustment with a lower probability of confounding events influencing the analysis.

Consistent with prior theoretical and empirical research and utilizing a highly refined matching process, we find a significantly negative abnormal return in calendar time following short sales initiated using both market and limit ask orders. The analysis using market orders is repeated on a trade-to-trade basis in transaction time with even more striking results, indicating a 0.2 percent negative abnormal return within twenty trades. Short sales are almost instantaneously bad news within such a transparent market setting. Consequently, the maintenance of transparency forms part of a policy of continuous disclosure. The evidence relating to short sales executed with limit orders is considerably weaker, suggesting that informed traders are more likely to use market orders. We also find using regression analysis that short sales that are likely to be involved in arbitrage or hedging activities (such as short trades in optioned stocks or those that occur when the spot-futures basis is positive), and trades executed near the end of the financial year are less likely to precipitate a negative price reaction. There is also evidence that short sales executed one day before an information event are more likely to be informationally motivated. The information content of short sales implied by the regression results is similar in magnitude to the transaction-by-transaction event study.

Our results are of economic as well as statistical significance and provide evidence in support of the Diamond–Verrechia (1987) hypothesis that restrictions on short sales discourage liquidity-motivated trades leaving a preponderance of informationally motivated behavior. Due to short sale reporting delays in the United States of up to one month when some market partici-

pants are aware of such trades at the time of occurrence, previous researchers have provided only inconclusive evidence in support of the hypothesis. We also find that the magnitude of the abnormal return is relatively large and of the opposite sign to the market impact of regular institutional sales, as measured by Chan and Lakonishok (1993).

The evidence presented in this paper is also indirectly relevant to assessing the desirability of transparent short selling. The evidence suggests that short sales convey information that results in a significant reassessment of stock value. Hence, an absence of transparent short sales may potentially inhibit the market's ability to impound relevant information. This lack of efficient price discovery is also likely to raise transactions costs. This issue has a direct bearing on the transparency debate, and is suggestive of adverse consequences due to limitations on transparency. A more direct test of this proposition would be to provide comparative evidence on price behavior surrounding short sales in a market setting where short sales are not transparent or, better still, measure the impact on transactions costs and price discovery of a significant change in the rules as to the transparency of short sales.

The ASX is currently moving to stop reporting short sales to the market in real time. If this eventuates, the change will effectively reduce the transparency of short trades since the market will only be informed of short positions at the end of the trading day. Under these circumstances, the transparency of short selling activity will be reduced toward that of the NYSE. A repetition of our analysis following what is essentially a controlled experiment will enable a test of whether the lack of transparency of short sales impedes price discovery, hence reducing the informational efficiency of the market.

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