

The impact of illegal insider trading in dealer and specialist markets: Evidence from a natural experiment[☆]

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Abstract

We examine insider trading in specialist and dealer markets, using the trades of stockbrokers who had advance copies of a stock analysis column in *Business Week* magazine. We find that increases in price and volume occur after informed trades. During informed trading, market makers decrease depth. Depth falls more on the NYSE and Amex than on the Nasdaq. Bid-ask spreads show increases on the NYSE and Amex, but not on the Nasdaq. We find none of these pre-release changes in a nontraded control sample of stocks mentioned in the column. Our results show that insider trading has a negative impact on market liquidity; depth is an important tool to manage asymmetric information risk; and specialist markets are better at detecting information-based trades.

JEL-Classification: G12, G14, K22, D82

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1. Introduction

Many market participants believe that insider trading poses a threat to the operation of financial markets. However, this proposition is difficult to test because there are few studies of insider trading in which researchers can actually say they know for sure that traders used material, nonpublic information. Most studies rely on the position of a trader (e.g., company official or board member) to infer access to, and use of, such information.

In this study, we examine data from a recent court case on insider trading that involved 116 publicly traded companies. Five stockbrokers acquired information on these firms from *Business Week's* "Inside Wall Street" (IWS) column, which they received the day before its public release. Although not based directly on company news, trades based on prior knowledge of the IWS column yielded abnormal returns. Because the brokers traded only a third of the 116 stocks, this episode offers a natural experiment on the impact of informed trading in financial markets. Also, because the stocks involved were listed on the NYSE, Amex and Nasdaq, the data yield the first comparison of the effects of illegal insider trading in dealer and specialist markets.

For all stocks traded by the stockbrokers and for most other IWS stocks, we have data on transactions and quotes for three days around the insider trading day. Court records from the civil and criminal cases identify the brokers' trades within the transaction stream. By aggregating the trade and quote data in 15-minute intervals, we obtain a detailed picture of market behavior during and immediately following periods of insider trading activity.

We find strong evidence that illegal insider trading has a negative impact on market liquidity. Our analysis shows that market makers adjust both depth and spreads to manage the risk presented by informed traders.¹ Depth falls in both specialist and dealer markets, but spreads increase only in specialist markets. All these informed trades involve purchases, and we find that only ask depth changes significantly. Relative to the average quoted depth on the previous day, ask depth is 38% lower for NYSE and Amex stocks during insider intervals. After controlling for

¹ Throughout the paper, we use the term "market makers" to refer to all liquidity providers, including specialists, dealers and limit-order traders.

lower Nasdaq depth, ask depth for Nasdaq stocks falls by only 3% during insider intervals.² These depth results are stronger when we exclude nine traded stocks featured in non-*Business Week* news stories before the insider trading period. The spread increases involve effective spreads more than quoted spreads, with market makers in specialist markets providing less price improvement during insider trading intervals. Overall, specialist markets reduce depth and price improvement more than dealer markets in response to insider trading.

We also examine how private information becomes impounded in stock prices. Because the IWS information was short-lived, these stockbrokers were pressed to act on Thursday afternoon. Faced with this constraint, we find that they tended to single out smaller, less liquid companies, which might have made their actions more detectable to others.

We find that Thursday trading volume is not unusual until the first insider trades. Though buying pressures do develop once insiders start trading, we see significant increases in the number of trades and volume only after the brokers finish trading. The Thursday volume increase is large (almost two-thirds of the previous day's total volume), but the brokers' trades only account for a small part of the increase. Court records show that the IWS information was shared beyond the defendants, but trades by the brokers' associates do not explain the additional volume. The trades of all the individuals identified by the Securities and Exchange Commission (SEC) with access to the IWS information make up no more than 9.2% of the volume increase for insider-traded stocks. We suggest that the increased buying reflects noise trading by either "falsely informed" or mimicking and momentum traders. As defined by Cornell and Sirri (1992), falsely informed traders are those who "fail to recognize the extent of the inside information reflected in the market price, and thus incorrectly believe that they have superior information." Such traders may greatly increase volume until the extent of their misinformation is revealed.

Overall, the buy-side activity is higher both during and after insider trading intervals, and prices rise markedly across these intervals. However, consistent with the mimicking or

² For Nasdaq stocks, we aggregate ask (*bid*) depth quotes across all market makers quoting the best ask (*bid*) price. By doing so, we ensure that our depth figures are comparable for Nasdaq- and exchange-listed stocks.

momentum view, prices do not increase enough that all of the information in the IWS column is reflected in the Thursday closing price, because abnormal returns are also observed on Friday.

Unlike other studies of insider trading, we have data on stocks for which nonpublic information was available to the five brokers but they took no action. These stocks form an ideal control group to determine whether the observed liquidity and price effects are really a consequence of insider trades. After removing stocks for which there are other information events, we find no effects like those observed for the traded stocks. Depth and spreads do not change; volume is normal; and there is no significant price appreciation, on Thursday afternoon. Thus, it appears as if no information has leaked to the market for these stocks.

To isolate the effects of these insiders' trades, we develop an additional control sample based on order flow imbalances. Chordia, Roll, and Subrahmanyam (2002) find that signed order imbalances affect bid-ask spreads and returns. Thus, it is possible that the responses we observe are due partly to market makers' reacting to order imbalances rather than to informed order flow. Our control sample uses the same set of *Business Week* stocks, but in the six months before these brokers began trading. We match stocks to order imbalances observed on the day of informed trading. After re-estimating the models with the control sample, we use these regression estimates to net out the effects of order imbalances from the data in the informed trading period. Regressions using these adjusted data show depth and spread adjustments during informed trading periods, though spreads increase significantly only for exchange-listed securities. In general, order imbalances are not responsible for our adverse liquidity results.

The data also allow us to examine the informed traders' exit strategies. The returns from trading on IWS information are short-lived. Therefore, stocks must be promptly resold for informed trades to yield abnormal returns. We find that these brokers were slow to adjust their exit strategies and close their positions the next day. They learned this rule eventually, as their holding period consistently decreased during the sample period.

The paper proceeds as follows. Section 2 discusses related theoretical and empirical studies. Section 3 describes the data and offers graphical evidence on the impact of insider

trading. Section 4 analyzes abnormal returns to insider trading on IWS stocks. Section 5 develops the statistical analysis of trades, spreads and depth. Section 6 concludes.

2. Related literature

Most theoretical models of market making focus on the bid-ask spread as the tool used to react to informed trading (e.g., Glosten and Milgrom, 1985; Glosten, 1989; Easley and O'Hara, 1992; Madhavan, 2000). Recent models by Kavajecz (1998) and Dupont (2000) examine how specialist market makers can optimally change both quoted depth and spreads during informed trading periods. Kavajecz forecasts that depth will fall and spreads widen when adverse selection increases. Dupont, who also considers quantities and prices, provides predictions closest to our results. He models the trade-off between unprofitable trades with informed traders and profitable trades with liquidity traders. A higher spread or lower depth reduces losses to insiders, but also reduces liquidity trading because uninformed traders are price sensitive. Informed trades are distinguished in his model when the information signal is more precise, which causes larger-size orders. Dupont demonstrates that these larger orders cause quoted depth to react proportionally more than bid-ask spreads to informed trading. Therefore, in empirical research, depth changes are more likely to be observable than spread changes during informed trading.

The ability to detect spread and depth changes depends on the nature of the information event. Empirical research establishes that expected events, such as earnings announcements, affect both spreads and depth.³ In contrast, relatively little is known about how spreads or depth react to unexpected events, such as those created by informed traders. The sole evidence to date comes from Meulbroek's (1992) analysis of SEC files on insider trading between 1980 and 1989, and from case studies by Cornell and Sirri (1992) and Chakravarty and McConnell (1997, 1999) of two NYSE stocks targeted by corporate insiders in the 1980s.

³ Liquidity falls just before and immediately following announcements regarding earnings (e.g., Lee, Mucklow, and Ready, 1993; Kavajecz, 1999), dividends (Koski and Michaely, 2000), and takeovers (Foster and Vishwanathan, 1994; Jennings, 1994). See Kim and Verrecchia (1994) and Krinsky and Lee (1996) for discussions of earlier empirical studies analyzing spread behavior around such expected information events.

Meulbroek (1992) focuses on price discovery in 183 cases of insider trading. She finds that the average cumulative abnormal return per episode is large (6.85%) and amounts to 47.6% of the abnormal return on the day the information becomes public. She also finds that the median insider's trading represents only 11.3% of the stock's trading volume. However, Meulbroek makes the case that the trades of insiders (as opposed to falsely informed or momentum traders) account for most of the extra volume on insider days. She hypothesizes that insider trade-specific characteristics and not trading volume *per se* impound the inside information into security prices.

Cornell and Sirri (1992) and Chakravarty and McConnell (1997, 1999) analyze illegal trading during two takeover attempts. Cornell and Sirri analyze trades made by a director of Anheuser-Busch and his accomplices during that company's 1982 acquisition of Campbell-Taggart. In all, 38 insiders bought 265,600 shares over 23 days, which is equivalent to 29% of the target's trading volume. Unlike Meulbroek (1992), but consistent with our evidence, Cornell and Sirri find a large increase in non-insider, falsely informed trading. Their most striking proposition is that bid-ask spreads are unchanged by insider trading. Further, they argue that liquidity improved while insiders were active, with liquidity measured as the cost of trading an additional share, which is different from the quoted depth measure analyzed in this study.

Chakravarty and McConnell (1997, 1999) analyze Ivan Boesky's purchase of 1,731,200 Carnation shares before Nestlé's 1984 acquisition. They analyze trades on 24 days for about 5% of Carnation's outstanding shares. They find that Boesky's trades made up only one-half of the incremental volume, and that price increases took place both during and following Boesky's trades. As do Cornell and Sirri (1992), they find that spreads were generally unaffected by these trades. They also report that depth was unchanged or improved when Boesky bought shares, with quoted depth changes greater on the bid side than the ask side. However, they question whether "[those] results can or should be generalized to a larger population or to a different time period."

A key contribution of our paper is to show that, although many of these results can be reproduced in a cross-section of insider trading episodes, some important extant results are not general in nature. In particular, we show that informed trading based on material, nonpublic

information leads to spread increases and reduced price improvement in specialist markets. We also show that such trading has a negative impact on depth, and that the magnitude of this impact depends on the type of financial market (specialist or dealer) where the trades are carried out.

Our paper is also related to Corwin and Lipson (2000); Christie, Corwin, and Harris (2002); Garfinkel and Nimalendran (2002); and Heidle and Huang (2002). Those papers analyze information effects on dealer and specialist markets.⁴ Corwin and Lipson find that trading halts on the NYSE are sufficient to resolve price uncertainty. In contrast, Christie, Corwin, and Harris find that halts do not resolve price uncertainty for Nasdaq stocks: spreads more than double after Nasdaq halts, and only decrease 20 to 30 minutes after trading resumes. They argue that Nasdaq dealers, with a limited knowledge of the order flow, may be at a disadvantage to informed investors. This finding is consistent with both Heidle and Huang and Garfinkel and Nimalendran, who find that specialists, located on the exchange floor and managing the entire order flow, appear better at detecting informed trades. Our findings, based on actual insider trades, support these results.

Our paper is also part of the literature on the stock market impact of financial columns, which include the *Wall Street Journal's* "Heard on the Street" (e.g., Lloyd-Davis and Canes, 1979; Liu, Smith, and Syed, 1990; Beneish, 1991) and "Dartboard" (e.g., Barber and Loeffler, 1993; Greene and Smart, 1999; Liang, 1999); *Business Week's* IWS (e.g., Palmon, Sun, and Tang, 1994; Sant and Zaman, 1996); and CNBC's Morning and Midday Call television programs (Busse and Green, 2002). These studies all find significant, but temporary, abnormal returns when good news is reported. For the IWS column, average abnormal returns ranged from 1.2% to 1.9%, with the initial effect negated after 26 trading days. Using recent data, we find abnormal returns more than twice that size, both before and during the insider trading period.

⁴ Other studies document differences in trading between dealer and specialist markets. Most examine differences in trading costs. Examples include Huang and Stoll (1996); Barclay (1997); Bessembinder (1997, 1999); Bessembinder and Kaufman (1997a,b); Clyde, Schultz and Zaman (1997); LaPlante and Muscarella (1997); Barclay et al. (1999); Stoll (2000); Weston (2000); Chung, VanNess, and VanNess (2001); and references cited in those papers.

3. Legal case and data

The events we analyze became public in January 1999, when the SEC charged five stockbrokers with insider trading. The SEC alleged that one of the brokers paid a foreman of the local *Business Week* distributor, *Hudson News Co.*, to fax advance copies of the IWS column.⁵ The broker obtained this information in the early afternoon on Thursdays, before the public release of portions of the magazine over news wire (at 5:15 PM) and electronic distribution on *America Online* (at 7:00 PM). The broker forwarded it to four other brokers who were able to enter trades before the markets had closed.

The *Business Week* scheme started in June 1995 and ended with the February 5, 1996 issue.⁶ The scheme apparently ended only because officials at *Business Week* noticed unusual trading in some of the recommended stocks.⁷ In all, the defendants, members of their families and some of their clients bought \$7.73 million worth of securities mentioned in the IWS column, accounting for about 5% of total Thursday trading in the affected stocks. Court records provide information on the trades of the five brokers and their associates, including the date, volume, and cost of each trade. The time of each trade and profits are available only for the stockbrokers.

The IWS column mentioned 116 firms during the eight-month period when brokers had access to the column. Of the 116 firms, the stockbrokers did not trade in 76, leaving 40 traded firms. We remove ten companies to form the traded sample: nine that were traded only by a broker's customer and are missing time stamps, and one that had only stock options traded. Our focus is on the remaining 30 stocks, with stocks without insider trades acting as a control sample.

On the amounts they invested in the 30 stocks, the defendants earned an average holding-period return of 3.48%. The profits vary across traders because not all the brokers bought every

⁵ See, e.g., "Group of Brokers is Facing Charges of Insider Trading," *The New York Times*, January 28, 1999, p. C-21. This case is similar to an earlier, well-publicized case of insider trading involving the same IWS column. In 1988, several security breaches occurred at *Business Week*. A number of people obtained advance copies of the magazine, and information was also leaked from within the company. Eleven individuals were convicted or settled charges of insider trading, including three stockbrokers and *Business Week's* radio broadcaster, who went to prison.

⁶ See *United States v. Joseph Falcone*, 99 Cr. 332 (TCP) and *SEC v. Smath et al.*, 99 CV 523 (TCP).

⁷ See "Is someone sneaking a peek at *Business Week*? Early trading of a few *Inside Wall Street* stocks raises a red flag," by Chris Welles, *Business Week*, February 5, 1996.

stock and because the number of shares purchased varies across both brokers and stocks. At one extreme, the initiating broker earned over \$92,000 on 29 of the 30 stocks, for a holding-period return of 3.81%. At the other extreme, one broker actually lost \$657 on transactions involving 13 of the 30 stocks. The mean (*median*) holding was 6,720 (*5,000*) shares for all five brokers combined. The smallest orders were for 1,000 shares and the largest purchase by a single broker was 21,000 shares in one stock. The brokers often established these positions from smaller lots. As a result, the trade size varies across stocks. The average (*median*) trade size is 1,654 (*1,000*) shares for Nasdaq stocks and 2,064 (*1,000*) shares for exchange-listed stocks.

3.1. Characteristics of the traded companies

Table 1 summarizes the characteristics of the sample firms. It compares traded firms with nontraded firms mentioned in IWS. Data on the rates of return on assets and equity; level and growth rate of sales; assets; and growth rate of net income are from the 1994, 1995, and 1996 Compustat tapes. No Compustat data were found for nine traded and 16 nontraded companies. The table also includes stock listing and the column's sentiment ("Buy", "Neutral" or "Sell"). We use the Dow Jones News Retrieval service to determine whether firms are mentioned in other news articles on the Wednesday or Thursday before the public release of the IWS column.

Table 1

Table 1 shows that the IWS column offers a favorable sentiment on almost all of these stocks. There is no other news on most of them. Thus, IWS provides unexpected positive publicity for most of these companies. In the empirical analysis, to avoid the confounding effects that other news might cause, we distinguish between companies with and without other news.

The Compustat data show that traded companies are smaller than those not traded. In addition, 45% of the traded firms are listed on the NYSE or Amex, compared to 55% on Nasdaq. We find nearly the reverse listing proportions for the control sample of nontraded firms. The traded firms are also less profitable. There is little difference in the growth rate of sales.

However, the average sales of traded firms are less than one-half, and their average asset size is about one-fourth, of that observed for nontraded firms. The stockbrokers likely anticipated that mention in the IWS column would have the largest impact on smaller companies.

3.2. Transaction and quote data

For all 116 stocks, we collect transaction and quote data from the Securities Industry Automation Corporation (SIAC). These data cover three days: Wednesday (the day before the leak of IWS), Thursday (the leak day), and Friday (the first day that the general public can trade on the IWS news). The transaction and quote data include time, volume, trade price, bid and ask prices, and quoted depth. The depth data for Nasdaq stocks are for all market makers quoting the best bid or ask price, which makes them comparable to exchange-listed depth.⁸ We use the Lee and Ready (1991) algorithm to determine trade direction. We summarize the data into 15-minute intervals, which smoothes the data and reduces the effect of larger trades and asynchronous trading on the results. We also exclude all 15-minute intervals containing only zero or one trade.

We manually find brokers' trades in the transactions stream. For many traded stocks, the information from court records unambiguously identifies the stockbrokers' trades. Because some of the brokers' orders are broken into smaller trades, the court records may not uniquely identify some trades. To address this problem, we examine all possible trade sequences that match the brokers' trades around the time stamp and analyze the data in 15-minute intervals. It is rare for any trade sequence to cross between two 15-minute intervals. Still, we conduct the statistical analyses across all sequences of insider trading intervals. Our conclusions are robust to these choices. Therefore, we report results only for regressions on the most likely candidate sequence.

Table 2

Table 2 presents descriptive statistics of the SIAC data. The transaction information is reported in three panels. Panel A provides information for all 30 stocks traded by stockbrokers;

⁸ Tim McCormick at the Nasdaq provided the depth and quote data for all market makers.

Panel B, the information for 21 of these 30 stocks that had no other news on either Wednesday or Thursday; and Panel C, the information on 44 nontraded stocks without other, non-IWS news.

Panels A and B show similar statistics for most variables. The average traded stock price is about \$18 or \$20 with a quoted spread of about \$0.25. Effective spreads range from \$0.12 to \$0.16. Across all three days, there are on average about 12 trades per 15-minute interval for traded stocks, with an average trade size of 1,550 to 1,771 shares. The average number of trades increases from Wednesday (8.3 or 6.7) to Friday (17.1 or 15.1), but the average trade size shows a downward trend. This result is consistent with a publicity effect and with the findings of Sant and Zaman (1996) on the volume impact of the IWS column. The Friday impact we find is in more, not larger, trades, which is evidence that smaller investors are reacting to the IWS news.

Panels A and B also show the changes in average depth and spreads for traded stocks. In Panel A, average ask depth is 8,600 shares on Wednesday, 8,000 shares on Thursday, and 10,000 shares on Friday. The bid depth shows a similar pattern. However, this pattern does not hold for the no-news sample in Panel B. Effective spreads tend to decrease over the three days, with no indication that they may be different on Thursday. Thus, these univariate results are ambiguous as to whether market makers are reacting to informed trading by adjusting ask depth and spreads.

Average returns for traded stocks over these 15-minute intervals vary widely across days in Panels A and B. Returns are positive on Wednesday, increase significantly on Thursday, and are nearly zero on Friday. The Friday results stand out. They can be explained by the fact that the information in the IWS column is impounded into the opening price or the first few trades on Fridays. Thus, the intraday returns show no impact of the IWS column's release.

To measure the degree of buying pressure in the market, we develop a "Buyside" index based on the Lee and Ready (1991) signed trades. Using the Lee-Ready algorithm, we give a trade the value +1 if it is buyer initiated, and -1 if it is seller initiated. To develop a Buyside index value for each 15-minute interval, we sum these values for all trades in that interval. This measure is like Chordia, Roll, and Subrahmanyam's (2002) measure of signed order imbalances, except that the absolute value function is omitted to distinguish between buy and sell imbalances.

As Table 2 shows, buying pressure increases from an average index value of 1.22 on Wednesday to 7.2 on Friday for all traded stocks in Panel A. The results in Panel B show a similar pattern.

Panel C in Table 2 shows the results for 44 nontraded stocks. Some results are similar to those for the traded stocks. Quoted spreads remain steady across all three days. The number of trades increases on Friday, with the Buyside index showing increasing buyer interest. Interval volume, trade count and Buyside interest show the biggest differences from the earlier results: on Thursday, they increase sharply for traded stocks but fall for the 44 nontraded stocks. The average trade size also decreases, from 1,998 shares on Wednesday to 1,355 shares on Friday. Compared to the trade size changes in Panels A and B, this size decrease suggests that there is more interest in these nontraded stocks than in the sample traded by the stockbrokers.

3.3. *Price and volume impact*

Figures 1 and 2 provide additional information on how the market reacts to stockbroker trading and to the IWS column. These figures depict the volume and stock price changes in 15-minute intervals, from the open on Wednesday to the close on Friday. For the 21 traded and 44 nontraded stocks with no non-IWS news, the figures plot the median price and volume changes relative to Wednesday median volumes (Figure 1) and opening prices (Figure 2).

Stockbroker trades lead to increases in volume and price for the affected stocks. Figure 1 shows that, in many intervals after the onset of insider trading (i.e., after 1:00 PM to 2:00 PM on Thursdays), the median trading volume for stocks is more than double the average 15-minute volume on the previous day. This is likely due to falsely informed, mimicking, or momentum, traders. In contrast, there is no discernible increase in volume for the nontraded IWS stocks.

Consistent with the volume increase, Figure 2 shows a rise in the price of traded stocks but no significant price change for nontraded stocks. Much of the price increase on Thursday occurs after the stockbrokers finish trading. Consistent with the evidence in Cornell and Sirri (1992), insiders appear to only start the price discovery process. The median increase relative to the average price on Wednesday exceeds 6%. The overnight price impact between Thursday and

Friday is stronger for traded stocks (median jump of more than 4%) than for nontraded stocks (median jump of about 2%). Figure 2 also shows that, after the open on Friday, there is little price movement for traded stocks, but there is a further 2% upward drift for nontraded stocks.

4. Abnormal returns

Figure 2 suggests that private knowledge of the IWS column may have generated sizable returns. To investigate this possibility, we obtain data from the Center for Research in Security Prices (CRSP) on the high, low and closing prices of all stocks mentioned in the IWS column. These data cover a four-month interval surrounding a stock's mention in the column.

4.1. The before and during periods

The brokers first gained access to the IWS column in June 1995. To examine abnormal returns before this period, we search IWS columns from November 1994 to May 1995. A total of 117 companies are mentioned in those issues. We exclude 26 of these companies, 11 because the data are incomplete in the CRSP data and 15 because the company is mentioned in another news story on Wednesday or Thursday. There remain 81 companies in our final "Before" sample.

We apply the same procedures to companies mentioned from June 1995 to February 5, 1996, when the brokers traded. A total of 116 companies are mentioned during this period. Of these, we eliminate 47 companies to form our final sample: news articles rule out 38 companies, and we exclude the remaining nine companies because daily CRSP data are incomplete for the estimation period. These eliminations leave a total of 69 companies in our "During" sample.

4.2. Event study with closing prices

Business Week magazine is released to newsstands early Friday morning. Some of the information is available on news wires and America Online the night before, but only after the close of trading in the U.S. Thus, if the IWS information is valuable, its impact on stock prices is

expected during trading on Friday. To measure this impact, we use the Campbell, Lo, and MacKinlay (1997) event study methodology for both the Before and During data samples.

We compute stock returns from closing prices on Thursday and Friday. We adjust these returns based on IWS sentiment, i.e., a “Sell” sentiment in the column offers positive profits if returns are negative. We also adjust returns for market effects by estimating a market model. In this model, we use 90 days of close-to-close returns, beginning ten days before the Wednesday of the announcement week. We use this ten-day gap to separate the market-model regressions and the events we are analyzing. We estimate the market model using both the equal- and value-weighted market indexes computed by the CRSP. The results change little with the index choice, so we report equal-weighted results here. We use this procedure for each stock in the sample.

We compute average abnormal returns for the Wednesday, Thursday, and Friday of the week that IWS mentions the company, and we use two tests to determine statistical significance. The J_2 test described in Campbell, Lo, and MacKinlay (1997) gives better power when the average abnormal return is constant across securities. Because the potential cause of these returns is the same source, this is a reasonable assumption. The second test evaluates the likelihood that more than 50% of the abnormal returns are positive. Table 3 presents the results of these tests.

Table 3

Panel A in Table 3 shows the results for the Before sample. There is no evidence of statistically significant abnormal returns for Wednesday or Thursday. However for Friday the average abnormal return is 4.75%, which is different from zero at the 99% level of confidence. Also, 70.3% of the abnormal Friday returns are positive, which is statistically different from 50% (the expected level if the IWS column has no effect). The raw Friday returns are also positive for 75% of the companies mentioned in the column. In other words, in the six months preceding the brokers’ *Business Week* scheme, the IWS column had an impact on the prices of featured stocks.

In Panel B, which shows the During sample results, there is a statistically significant abnormal return of 3.87% for Friday. In contrast with the Before sample, there is also a

significant average abnormal return for Thursday of 1.51%, less than one-half the Friday abnormal return. This result could be due to the *Business Week* information's leaking into the market. In the During sample, 78.3% of the abnormal returns on Friday are positive, which is also statistically significant, and 78% of the raw returns on Friday are positive. Overall, these results show that the stockbrokers could have a reasonable expectation of profiting from advance access to the IWS column, particularly if their holding period was a single day.

4.3. *Holding period*

As Sant and Zaman (1996) show, the returns from trading on the IWS column are short-lived, so we expect the stockbrokers to have closed their positions quickly rather than risk losing their gains. Offsetting this incentive is that rapid turnover can arouse suspicion from exchange authorities or the SEC.

Figure 3 shows that these stockbrokers slowly reduced their trading horizon over the eight months that they traded. In the first two months, the insiders held their stocks for about a week. This period drops by two days in the next two months, and by the end of the eight months to only one and one-half days. Figure 3 suggests that, by then, insiders may have become less concerned with detection and so sought greater profits by shortening their holding period.

5. **Analysis of stockbroker trades**

In this section, we analyze the impact of the five stockbrokers' trades and focus on how financial markets and market makers react to insider trades. We ask if such trading is detected and if market liquidity is improved or harmed in the process.

5.1. *Buying interest and interval returns*

We first examine how order flow and returns are affected during and following periods of insider trading. Table 4 provides a regression analysis for all 30 companies traded by the

stockbrokers (Panel A) and the 21-company subset that did not have other news announcements on Wednesday or Thursday (Panel B).

Table 4

Table 4 uses two regression models to explain the Buyside index and interval returns. We correct all regressions for heteroskedasticity using White's (1980) method. Dummy variables capture Thursday and Friday effects relative to Wednesday, and Wednesday effects are captured by the constant. Two companies are listed on the Amex. We combine them with the NYSE companies to form the set of exchange-listed stocks. The "Nasdaq" dummy captures the effect of Nasdaq- versus exchange-listed stocks.

The first specification (Models 1 and 3 in Panel A; Models 5 and 7 in Panel B) includes an "Insider Trading Period" dummy variable to measure the effects when the brokers are trading. Typically, their trades are completed within two 15-minute intervals. We also include an interaction term to capture the differential effects of insider trading on Nasdaq companies.

The second specification (Models 2 and 4 in Panel A; Models 6 and 8 in Panel B) omits the "Insider Trading Period" dummy, but adds a dummy variable covering this period plus the remaining periods in the day. This "Insider Period and Remaining Day" variable captures the effects of other market participants who are learning of, or reacting to, the informed trading. These participants may be relatives or customers of the stockbrokers, or mimicking or momentum traders who notice the presence of informed traders. Because the "Insider Trading Period" and "Insider Period and Remaining Day" variables are highly correlated, we do not include them in the same regressions. Lastly, an interaction term is included to capture the effects of the Nasdaq dealer market on the "Insider Period and Remaining Day" variable.

Do stock orders respond to the IWS column? Table 4 shows that there is significant buy-side interest on both Thursday and Friday relative to Wednesday. Model 1 suggests that buying interest on Friday is more than three times the interest on Thursday (6.4 compared to 1.8). Model

5 shows a somewhat smaller Thursday-to-Friday increase for the 21 traded stocks without other news (5.4 compared to 2.7). Overall, the IWS column stimulates significant trading activity.

Are the trades of the stockbrokers detected? The “Insider Trading Period” dummy is not significant in Models 1 and 5. That is, the brokers’ trading volume itself is not causing order imbalances, which is consistent with the fact that informed trading only makes up about 5% of Thursday volume. However, the “Insider Period and Remaining Day” variable in Models 2 and 6 shows that the Buyside index increases after informed trades, i.e., the market has by then become aware of higher buying interest. The earlier part of Thursday shows no significant change. Thus, the market does appear to detect unusual buying activity, at least after the informed trading.

Table 4 also shows that Nasdaq stocks exhibit significantly higher buying interest than do exchange-listed securities. Although the effect during insider trading is not significant, trading volume increases for Nasdaq stocks after informed trades. The reason for this finding may be that the IWS column has a greater effect on Nasdaq stocks, which are often smaller companies.

Do interval returns react to the stockbrokers’ trades, the follow-up trades, or the release of the IWS information? Figure 2 shows that the price of the 21 traded stocks with no news starts to increase after 1 PM on Thursday (the earliest time for insider trades). Models 3, 4, 7, and 8 in Table 4 confirm that, although the Thursday dummy variable is not significant, both the “Insider Trading Period” and “Insider Period and Remaining Day” dummies are significant. That is, the regressions confirm that interval returns are positive on Thursday once the brokers start trading. However, the “Insider Trading Period” dummy is statistically significant only at the 10% level (Model 3) or at the 5% level (Model 7). This weak significance suggests that, perhaps more than the insiders, it may be mimicking traders not privy to the IWS information who cause the market price impacts. This observation refines Meulbroek (1992) and Cornell and Sirri (1992), who find that abnormal returns are confined to the day or the period in which insiders illegally trade.

Figure 2 also shows that the prices of the traded stocks take a discrete jump between the Thursday close and the Friday open. Thereafter, we see that Friday interval returns are volatile and that some are even negative. The Friday dummy is negative in all of the return regressions,

which verifies that the entire gain from the IWS information is impounded at the open on Friday and also implies that the overall price trend after the Friday open is downward.

Finally, the Nasdaq dummy shows that the Nasdaq stocks offer higher returns than do the exchange-listed stocks. However, the interaction terms between the Nasdaq dummies and the time-period dummies are not significant. Thus, the regressions tell us that there is nothing unique about the returns to Nasdaq- compared to exchange-listed stocks in the afternoon on Thursday.

5.2. *Volume effects*

To explore further how the five stockbrokers' trades affect the price process, we examine the number of trades and trade size. If these brokers' trades are unusual, then market makers and other investors may detect their trading more easily. To ensure that our results are comparable across stocks, we standardize the dependent variables relative to their averages across 15-minute intervals on Wednesday, and then omit Wednesday from the analysis. That is, we subtract Wednesday's average and then divide by the same average to standardize these data. The daily dummies are now different from Wednesday if they are significantly different from zero. Table 5 presents these regressions using the set of explanatory variables examined in Table 4.

Table 5

In Table 5, Models 1, 2, 5, and 6 explain the relative number of trades. These results show significant increases in trading on Friday, with the number of trades on Friday significantly greater than Wednesday's trading. Trading also increases sharply on Thursday during the "Insider Trading Period" or the "Insider Period and Remaining Day" intervals. This pattern is notable because these stockbrokers do not trade a large fraction of the volume on Thursday. In contrast to Meulbroek's (1992) findings on trading effects, we find that even a relatively low volume of trading can initiate large price effects, such as those in Figure 2. The number of trades is also higher for Nasdaq- compared to exchange-listed stocks.

In Table 5, Models 3, 4, 7, and 8 explain the results for relative trade size across traded stocks. These models show a negative, but generally insignificant, coefficient on Thursday and Friday. The relative trade size increases significantly only for Nasdaq stocks in these regressions.

Overall, our results indicate that the five brokers and their followers trade more frequently on Thursday and that public investors follow the same pattern after the news becomes known on Friday. The more frequent trading by stockbrokers in short time intervals may have helped market makers identify these informed trades.

5.3. *Insider trades and market making*

A key question in this analysis is how market makers respond to insiders; that is, to what extent do bid-ask spreads and depth adjust to informed trading? In two case studies, Cornell and Sirri (1992) and Chakravarty and McConnell (1997) find no significant effect on spreads. By using a cross-section of companies, we can investigate whether their findings generalize beyond two NYSE-listed stocks. Table 6 shows the results for quoted and effective spreads; quoted minus effective spreads; and ask and bid depths, using 15-minute interval data.

Table 6

As in Table 5, we standardize the dependent variables in Table 6 relative to their average values on Wednesday. Also, we add the relative volume of trading (versus Wednesday) to control for volume effects on spreads and depth. Panel A shows the results for all 30 traded stocks, and Panel B shows the results for the subsample of 21 companies without other news.

Models 1 through 4 (Panel A) and 10 through 13 (Panel B) in Table 6 show the spread results. The coefficients on the Thursday and Friday dummy variables show that quoted spreads are generally lower on both days, but effective spreads are 8% to 12% higher on Friday. These results depend on whether the company is Nasdaq- or exchange-listed. Nasdaq companies have higher quoted spreads, except during insider periods when the net effect is a 3% to 7% decrease. Effective spreads generally show no difference for Nasdaq stocks except in Model 3 where they

decrease during insider trading. Although consistent with Cornell & Sirri (1992), unchanged or reduced spreads are not what we anticipate of market makers who detect informed traders, so we examine spreads more carefully below.

Table 6 also shows how insider trading affects market depth. Models 6 and 7 (Panel A) and 15 and 16 (Panel B) show that insider trades significantly lower ask depth. Because insiders are buying shares, ask depth is the side affected. The 30-stock results in Model 7 show that exchange-listed depth rebounds late on Thursday, but this effect is less significant in the 21-stock results of Model 16. Models 8, 9, 17, and 18 confirm that their purchases do not affect bid depth.

The strength of the depth results on the ask side depends on the market structure. For Nasdaq-listed companies, the 30-stock estimates show a much smaller depth decrease during insider intervals (-1.4% compared to -35.7% for exchange-listed) and the 21-stock estimates show a reduced effect (-24% compared to -75.3%). This result is understandable in the context of a dealer versus specialist market, because the diffuse nature of a dealer market makes it more difficult for a given dealer to determine the information content of the order flow.

Overall, market makers reduce risk by offering a smaller quantity of shares at the posted price. This finding extends the depth results of Lee, Mucklow, and Ready (1993); Kavajecz (1999); and Koski and Michaely (2000), to cases in which informed trading is not expected, with the added distinction that Nasdaq stocks respond less than do exchange-listed stocks.

5.4. Effects of order imbalances on market making

Chordia, Roll, and Subrahmanyam (2002) find that signed order imbalances affect bid-ask spreads. They report that order imbalances cause spreads to change, which might confound our results. For example, the increase in order imbalances indicated by the Buyside index might have caused quoted depth to decrease. Thus, market makers could be reacting to order imbalances, not to informed order flow.

To control for this effect, we collect a sample of order imbalances matched to the actual daily average imbalance on Thursday for the 30 traded stocks. This matched sample comprises