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An Empirical Analysis of Illegal Insider Trading

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ABSTRACT

Whether insider trading affects stock prices is central to both the current debate over whether insider trading is harmful or pervasive, and to the broader public policy issue of how best to regulate securities markets. Using previously unexplored data on illegal insider trading from the Securities and Exchange Commission, this paper finds that the stock market detects the possibility of informed trading and impounds this information into the stock price. Specifically, the abnormal return on an insider trading day averages 3%, and almost half of the pre-announcement stock price run-up observed before takeovers occurs on insider trading days. Both the amount traded by the insider and additional trade-specific characteristics lead to the market's recognition of the informed trading.

THIS PAPER INVESTIGATES THE stock price effects of insider trading, that is, the illegal trading in securities by individuals or firms possessing important non-public information. Whether insider trading affects stock prices is central both to the current debate over whether insider trading is harmful and pervasive, and to the broader public policy issue of how best to regulate securities markets.

While opponents of insider trading argue that insider trading decreases market liquidity, produces abusive managerial practices, and is unfair to uninformed investors, proponents of insider trading champion its benefits. Manne (1966) and Carlton and Fischel (1983), for example, assert that insider trading fosters efficient capital markets by improving the accuracy of stock prices.[1] Specifically, insider trading promotes quick price discovery which mitigates the incentive for many individuals to collect the same information.

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[1] Security prices that reflect all relevant information enhance the allocative efficiency of capital markets. A firm's stock price also guides decisions made by other firms. For instance, a potential entrant may judge the incumbent firm's probability by its stock price and base its entry decision on this estimate.

The belief that insider trading is pervasive also rests on the assumption that insider trading creates significant stock price movements. Alleging widespread insider trading, Keown and Pinkerton (1981) note that, on average, 40 to 50% of the price gain experienced by a target firm's stock occurs *before* the actual takeover announcement. The view that insider trading is widespread contributed to the demand for legislation; in response, Congress substantially increased insider trading penalties in 1984, and again in 1988. The conclusion that price run-ups prior to takeover announcements reflect insider trading, however, is contingent on the untested assumption that insider trading affects stock prices.[2]

This paper's analysis of insider trading also has broad implications for the debate over how best to regulate securities markets. At the center of this debate is the issue of whether trading introduces noise into prices or leads to the incorporation of private information. These two alternatives have very different public policy implications. The view that trading introduces noise into prices leads to regulation designed to curb trading, whereas the belief that trading incorporates information implies such regulation is unnecessary. This issue is challenging to investigate empirically because isolating trading based on private information is difficult.[3]

This paper also complements previous empirical insider trading research. That work focuses not on illegal insider trading, but on legal transactions by corporate insiders, and asks whether corporate insiders can predict future stock price movements. The transactions investigated are routine trades that corporate insiders (officers, directors, and owners of at least 10% of any equity class) must report to the Securities and Exchange Commission (SEC).[4,5] Seyhun (1986), examining transactions reported to the SEC, finds that corporate insiders earn excess returns that are on average small. Elliot, Morse, and Richardson (1984) and Givoly and Palmon (1985) analyze the timing and frequency of corporate transactions surrounding news announcements. Both studies conclude that corporate insiders do not trade on inside information.

Unlike prior research, this study concentrates on how informed trading affects stock prices. Previous work uses self-reported corporate transactions

[2] Jarrell and Poulsen (1989), for example, assert that legitimate sources, such as media speculation concerning the upcoming takeover and the bidder's purchase of shares in the target firm, contribute to the target's stock price run-up.

[3] French and Roll (1986) employ an indirect approach by examining price volatility. They report that prices are more volatile during exchange trading hours than during non-trading hours, and conclude that most stock price movement occurs in response to informed trading.

[4] See Lorie and Niederhoffer (1968), Pratt and DeVere (1970), Jaffe (1974), Finnerty (1976), Elliot, Morse, and Richardson (1984), Givoly and Palmon (1985), Seyhun (1986), and Rozeff and Zaman (1988).

[5] Corporate insiders must report their trades within 10 days following the last day of the month in which the trading occurs. The SEC publishes these transactions in its monthly *Official Summary of Insider Transactions*.

data, which are less appropriate for addressing this issue. The corporate transactions are by definition not based on material, non-public information. Because corporate insiders cannot legally trade on such information, they would most likely refrain from reporting their violative transactions to the SEC.[6] Instead, this paper employs illegal insider trading detected by the SEC and subsequently cited in a civil case to examine excess returns on the days of illegal insider trading. In contrast to the executive transactions used in prior work, the SEC has alleged that the trades in this data source are based on superior inside information.

The results reveal that insider trading is associated with immediate price movements and quick price discovery, supporting one component of Manne's and Carlton and Fischel's assertion that insider trading is beneficial. The extent to which insider trading aids in price discovery in the sample can be substantial. The cumulative abnormal return on insider trading days is half as large as the price reaction to the public revelation of the information on which the insider trades. This ratio suggests that the stock market detects imformed trading and impounds a large proportion of the information into the stock price before it becomes public.

The paper also examines insider trading before takeovers to gauge the importance of the price movement that occurs on insider trading days. Forty-three percent of the run-up in the target firm's stock price occurs on insider trading days. Moreover, the run-up that occurs on insider trading days is greater than the run-up that occurs either on days with public news announcements or on days without news announcements or insider trading. This association of insider trading with pre-announcement price run-up provides a foundation for the argument that insider trading is widespread.

Finally, the paper investigates the mechanism by which inside information becomes incorporated into the stock price. An examination of the insider trading volume implies that both the amount traded by the insider trader and trade-specific characteristics, such as trade size, direction, and frequency, signal the presence of an informed trader to the market. The finding that the market responds to trade-specific characteristics, successfully detecting the possibility of insider trading, provides further evidence that trading leads to the incorporation of private information.

This paper consists of five sections. Section I briefly reviews the laws regulating insider trading and their enforcement by the SEC. Section II contains the sample construction and description. Section III consists of the empirical analysis. It investigates potential sample selection bias, the source of the price run-up that occurs prior to takeovers, and how inside information becomes incorporated into price. Section IV concludes.

[6] In fact, few of the defendants in insider trading cases are corporate insiders required to report their transactions to the SEC. Only 24% of the defendants are employees (most of whom are not required to report their trades to the SEC) of the firm whose stock they trade.

I. Laws Regulating Insider Trading

The Securities Exchange Act of 1934 and the 1968 Williams Act Amendments regulate insider trading.[7] SEC rule 10b–5, implementing section 10(b) of the 1934 Act, states, in part, that an insider must disclose material inside information or refrain from trading. Under section 10(b), insiders are not only corporate insiders, but anyone who obtains material, non-public information from a corporate insider, or from the issuer, or who steals such information from another source. Information is material if a substantial likelihood exists that a reasonable investor would consider it important in making his or her investment decisions. An intent to deceive, manipulate, or defraud is generally required for violation.

SEC rule 14e–3, adopted under the Williams Act, imposes stricter regulations on tender offer information; unlike rule 10b–5, rule 14e–3 violation does not require *scienter*, that is, an attempt to deceive, manipulate, or defraud, nor does it require that the insider breach a fiduciary or other duty in disclosing the tender offer information. Instead, rule 14e–3 declares that if substantial steps have been taken to commence a tender offer, or if a tender offer has commenced, trading while in possession of material non-public information acquired directly or indirectly from an insider is fraud, regardless of how or for what reason a person received it. In practice, however, the SEC has not brought charges of 14e–3 violation without accompanying 10b–5 charges.

The SEC has primary responsibility for enforcing insider trading regulations. Although the SEC typically brings civil charges against a defendant, it may also refer cases to the Justice Department for criminal prosecution, or, if the defendant is a regulated market professional, the SEC may suspend or revoke his or her license.[8] The majority of insider trading cases are civil cases in which the SEC seeks the return of the insider's profit gained or loss avoided, and asks the court to issue an injunction prohibiting further insider trading violations.[9] Approximately 70% of defendants charged in a civil insider trading case settle with the SEC rather than litigate.

During the 1980s, Congress increased insider trading penalties substantially through the Insider Trading Sanctions Act of 1984 (ITSA) and the Insider Trading and Securities Fraud Enforcement Act of 1988 (1988 Act). ITSA boosted both civil and criminal penalties, and extended these penalties to trading in derivative instruments. Specifically, ITSA allowed, but did not require, the SEC to seek a civil penalty of up to three times the insider's

[7] Section 16 of the 1934 Act requires certain corporate insiders, in particular officers, directors, and 10 percent owners of any class of equity securities, to report their registered equity holdings in the company's stocks to the SEC. Section 16 also requires corporate insiders to return to the issuer any profit earned on holding periods of less than six months, and to refrain from short sales. Unlike section 16, section 10(b) of the 1934 Act applies to more than registered corporate insiders.

[8] Regulated market professionals include brokers, dealers, and investment advisors.

[9] If the defendant receives an injunction and continues to violate insider trading regulations, the court may cite the violator with contempt, a criminal violation.

profit gained or loss avoided. ITSA also raised maximum criminal fines from $10,000 to $100,000.

Interest in insider trading regulation intensified following the Dennis Levine and Ivan Boesky cases, and in 1988 Congress again stiffened insider trading sanctions. The 1988 Act increased maximum criminal fines to $1,000,000 for individuals, raised the maximum jail term from 5 to 10 years, and required that securities firms actively set up procedures to prevent insider trading by the firm or its employees. Whereas ITSA protected a firm from treble damage liability if an employee accused of violating insider trading law did not act on behalf of the firm, the 1988 Act held a firm liable if its employees engaged in insider trading while the firm knowingly or recklessly disregarded this fact.[10]

II. Sample Construction and Description

The sample consists of individuals charged with insider trading by the SEC in civil or administrative cases during 1980–1989.[11] The starting point for sample construction is a list, prepared by the SEC's Enforcement Division, of all defendants formally charged with insider trading during 1980–1989. Public and non-public SEC documents provide trading information for the defendants on this list.

The information available in public sources is typically quite limited. Litigation releases (SEC news releases describing the charges and outcome in a case) usually reveal the type of inside information, the name of the security traded, and sometimes the profit gained or the loss avoided from insider trading. Court complaints, documents on the SEC files with the courts to bring charges against a defendant, also lack detailed information, often contributing little more than the litigation releases. The scarcity of publicly available information about insider trading cases is largely attributable to the high proportion of defendants that settle before trial. Since 70% of complaints are filed with an accompanying settlement document, these complaints need not be as detailed as complaints filed for litigated cases. In fact, by limiting the information in a complaint, the SEC controls information leakage concerning its investigative techniques.

SEC non-public case files supplement the information available from public sources.[12] The SEC case files contain more detailed trading and descriptive information than either the litigation releases or the court complaints. The

[10] In addition, the 1988 Act authorized private citizens who traded at the same time as the insider to seek damages in federal court limited to the profit gained or the loss avoided by the insider trade. It also allowed the SEC to pay bounties (up to 10% of the ITSA penalty) to informers, and permitted the SEC to cooperate with foreign governments. See Pitt and Groskaufmanis (1989) for further information.

[11] In an administrative case, the SEC disciplines brokers, dealers, and investment advisors. The SEC may suspend or revoke the license of these regulated market professionals in an internal hearing.

[12] Data made available by the Office of Commissioner Joseph Grundfest.

information collected for each defendant includes the charges brought, penalties incurred, profits earned, number of securities traded, type and source of the inside information, transaction dates, and aggregate volume traded. Appendix A details the type of data collected for each defendant. Missing and incomplete case files prevented the inclusion of every defendant charged with insider trading. As Table I reflects, the sample includes 69% (320 of 464) of all defendants during the 1980–1989 period.[13] The number of 1989 defendants appears low relative to other years since the sample includes only cases completed by September 1990. Table I also presents the distribution of

Table I

Number of Defendants in Insider Trading Cases Brought by the SEC in the Years 1980–1989 and Number of Insider Trading Episodes by Year in Which Trading Occurs

"Number of Civil Defendants" is the number of defendants in SEC civil cases with at least one defendant charged with insider trading, listed by year in which the SEC charged the defendants with insider trading. The actual insider trading violations, reported in the "Number of Insider Trading Episodes" column, usually occur in an earlier year. An insider trading eposide involves one or more defendants using inside information to trade in the stock of a specific firm. The count includes only the insider trading associated with the defendants included in the sample. The 1989 count excludes pending cases.

Year	Number of Civil Defendants	Number of Defendants in Sample	Percent in Sample	Number of Insider Trading Episodes	Percent of Total Episodes	Cumulative Percent
1974	—	—	—	3	2	2
1977	—	—	—	3	2	3
1978	—	—	—	5	3	6
1979	—	—	—	8	4	10
1980	23	18	78	13	7	17
1981	27	18	67	22	12	30
1982	42	33	79	29	16	46
1983	79	60	76	19	10	56
1984	30	13	43	27	15	71
1985	32	27	84	23	12	83
1986	73	48	66	15	8	91
1987	79	49	62	9	5	96
1988	59	34	58	7	4	100
1989	20	20	100	—	—	—
Total	464	320	69	183		100

[13] This figure slightly understates the proportion of defendants in the sample, since the number listed as the number of defendants charged with insider trading (464) also includes some defendants charged in the same civil suit as an inside trader, but who are not themselves charged with insider trading. For example, a recent suit charged Drexel Burnham Lambert with numerous securities violations, including insider trading. The same complaint also charged Victor Posner with failure to disclose beneficial ownership. Both Drexel and Posner are included in the count of 464 total defendants, but only Drexel is in the insider trading sample.

insider trading episodes by year. Although the sample of inside traders begins with defendants charged in 1980, the events on which the defendants trade begin as early in 1974. The insider trading episodes occur from 1974 to 1988, with 66% of the sample clustered between 1981 and 1985.[14]

Table II presents summary statistics describing the defendants' trading, holding period profits, and assessed penalties. The "Total profit gained" reflects insider trading profits when the defendant buys based on positive inside information.[15] Conversely, "Total loss avoided" reveals the loss an insider avoids by selling prior to negative news. The "Average profit per security" sums these two profit measures and divides by the number of securities in which the defendant trades.[16]

Table II shows that among the defendants who traded, the median defendant transacted in one security and reaped $17,628 in profit per security. The minimum figures for each profit measurement are negative because sometimes adverse news unknown to the insider lead to holding period losses.

Table II

Trading Activity, Holding Period Profits, and Penalties of Illegal Inside Trading Defendants

"Loss avoided" occurs when defendants sell before a drop in the stock price to avoid a loss. "Ave. profit/security" = (Total profit gained + Loss avoided)/Number of securities traded. "Immediate tippees" are people to whom defendant disclosed inside information directly. "Total tippees" includes immediate tippees plus remote tippees, who receive inside information indirectly. "Penalty/profit" = Total penalty/(Total profit gained + Loss avoided).

	Median	Standard Deviation	Minimum	Maximum	*N*
Total profit gained	24,673	2,286,736	(1,517)	23,832,480	211
Total loss avoided	23,575	100,480	(21,741)	471,365	25
Number of securities traded	1.00	6.52	1.00	54.00	255
Ave. profit/security	17,628	394,414	(10,871)	3,972,080	198
Number of immediate tippees	1.00	2.47	1.00	17.00	95
Number of total tippees	2.00	4.01	1.00	22.00	92
Immediate tippee profit	39,103	2,109,121	0	19,030,000	89
Remote tippee profit	158,113	410,108	0	1,794,717	31
Total penalty	21,000	1,872,902	0	25,150,020	255
Ave. penalty/security	19,349	418,902	0	5,100,000	210
Penalty/profit	1.00	0.95	0.00	9.29	169

[14] In 1981, John Shad became SEC Chairman and vowed to "come down on insider trading with hobnail boots."

[15] The profits in Table II are the SEC's profit calculations. In most cases, the profits are the defendant's holding period profits (calculated from actual buy and sell prices) rather than the profits as measured by abnormal returns. My later analysis does not rely on the SEC-provided profit measure, but instead calculates the abnormal returns.

[16] The insider may transact in more than one security, earning profits in some securities and avoiding losses in others.

Notice that each category in Table II includes only defendants appropriate to that category, causing the number of defendants per category to differ. More specifically, 255 defendants contribute to the calculations of "Number of securites traded." This category does not include the 14% of defendants who do not trade at all, and are charged only with tipping. The count also excludes several defendants for whom information concerning the number of securities traded is unavailable. Similarly, the calculations for the "Number of immediate tippees" category includes only defendants who tip and for whom information on the number of tippees exists.[17] The penalties assessed the typical insider trader are low relative to the amount gained by trading. The median penalty-to-profit ratio is 1.00, indicating that in general the defendants have to repay only the profit they obtain.

Despite extensive media publicity concerning large insider trading profits and long prison terms, Table II shows that most cases involve small amounts and minor penalties. The following examples illustrate typical defendants that compose the sample. In 1986, the SEC brought civil charges against Anthony A. DePalma, an officer of Diasonics, Inc. DePalma was primarily responsible for a division that accounted for 75% of Diasonics' revenue. Before a 1983 third-quarter earnings announcement that revealed larger than anticipated losses, DePalma sold Diasonics stock, thereby avoiding losses of approximately $71,125. DePalma settled prior to trial, consenting to a permanent injunction and agreeing to repay $71,125 (see Litigation Release No. 11333, Dec. 30, 1986).[18]

The second example concerns a Prudential-Bache broker, Robert D'Elia, who arranged to buy information from an employee of a financial printer. From July 1980 to October 1981, D'Elia and his father, Albert D'Elia, obtained material, non-public information about forthcoming merger and acquisition bids, including Humana's bid for Brookwood Health Services, BTR's bid for Posi-Seal International, and National Medical Enterprises' bid for Cenco, Inc. The D'Elias traded in the takeover targets and tipped others who traded. Robert D'Elia repaid $22,257 in illegal profits, and each defendant consented to a permanent injunction barring him from further violations of Rule 10b–5 and 14e–3.

In a criminal case arising out of the insider trading scheme, the D'Elias were convicted of criminal conspiracy and Robert D'Elia was also convicted of fraud in the purchase of securities and fraud in connection with tender offers. Robert D'Elia was sentenced to three years of probation, 1000 hours of community service, and fined $30,000. Albert D'Elia received three years of probation and a $100,000 fine (see Litigation Release No. 11499, July 28, 1987).

[17] Most inside trading defendants (65%) do not disclose the inside information to others.

[18] An injunction prohibits further inside trading violations. The courts may cite a defendant that receives an injunction and continues to violate insider trading regulations with contempt, a criminal charge.

From the sample of defendants, I construct a sample of stocks in which insider trading occurred. Often more than one defendant trades in a given stock. I consolidate the defendants' trading activity by stock. The next section describes the sample of stocks and the initial analysis of the data.

III. Empirical Analysis

The 320 defendants engaged in 229 different episodes of insider trading, representing trading in the securities of 218 companies. For the most part, each episode of insider trading corresponds to trading in the securities of a different firm, although several firms had more than one episode of insider trading. For example, insider trading occurred prior to the Limited's April 1984 hostile tender offer for Carter Hawley Hale, and again before the Limited's second hostile tender offer for the same firm in November 1986.

Firms are excluded from the sample if their stock does not trade on the NYSE, AMEX, or NASDAQ, if the inside information remains non-public, if no record of the public announcement of the inside information exists in the *Wall Street Journal* or on the *Dow Jones Broadtape*, if the only day the insider trades is on the day the inside information becomes public, or if recent listing of the stock on a major exchange prevents the collection of enough price data to estimate the market model parameters. I eliminated the cases where the inside information remains non-public because without a public announcement, determining whether insider trading increases stock price accuracy requires a subjective evaluation.[19]

Table III describes the final sample. The sample includes 98 (54%) NYSE stocks, 54 (30%) NASDAQ stocks, and 34 (17%) AMEX stocks. These firms have a mean equity value of $602 million, and a median equity value of $155 million. Table III indicates that most insider trading episodes (79% of the sample) are associated with corporate control transactions: friendly and hostile tender offers, mergers, leveraged buyouts (LBO), restructurings, and major share acquisitions. The remaining insider trading episodes concern earnings announcements, bankruptcies, financial fraud, and miscellaneous news. Overall, most insider trading episodes (87%) involve news that positively affects the stock price.

Some inside traders used options and warrants to take advantage of their inside information. The insider trading involved stocks on 529 (91%) of the 582 different days of insider trading in the sample, call options on 47 days (8%), put options on 2 days (0.3%), and warrants on 4 days (0.7%). The

[19] A breakdown of the 46 exclusions is as follows. Eleven firms exit the sample because stock price data is unavailable from CRSP. The inside information never becomes public for 5 firms. For 16 firms, no announcement of the inside information could be found in the *Wall Street Journal* or the *Dow Jones Broadtape*. Nine firms are dropped because the inside trader only transacts on the day the inside information becomes public. Incomplete price data prevents the inclusion of 5 firms.

Table III

Number of Insider Trading Episodes by Type of Inside Information

"Misc. good news" includes a management change, announcements of casino ventures, a patent announcement, a liquidation, a subsidiary divestiture, a Navy contract award, a license for Interferon, and Canadian Minoxidal approval. "Misc. bad news" includes a lost arbitration suit and failed merger talks.

Type of Inside Information	Total	Percent
All takeover related	145	79
Friendly tender	38	21
Hostile tender	34	18
Friendly merger	50	27
Hostile merger	3	2
LBO	10	5
Restructuring	5	2
Major share acq.	5	2
Negative earnings	12	6
Positive earnings	3	2
Bankruptcy or financial fraud	10	5
Misc. good news	11	6
Misc. bad news	2	1
All positive news	159	87
All negative news	24	13
Total	183	100

limited availability of listed options explains, to some extent, the predominance of stock trading in the sample, Exchange-traded options existed in 37 (20%) of 183 insider trading episodes; inside traders employed options in 19 of these 37 episodes, or half the instances where options were available. For consistency, the analysis to follow investigates the effects of both stock and non-stock trading on the stock price. A cross-sectional analysis does not reveal any significant difference between the stock price reactions to stock and non-stock trades.

I use event study methodology to estimate abnormal returns on insider trading days and on the day the inside information becomes public. This approach requires the dates of insider trading and the public announcement date of the inside information. The dates of the insider trades are from SEC documents, both public and non-public.

The predominance of takeover-related events in the sample complicates the analysis since speculation concerning an upcoming takeover frequently occurs in the media prior to the formal announcement of the takeover. More precisely, news announcements occurring on the same day as the insider trading make isolating the effect of the insider trading difficult. To control for the impact of the confounding news announcements, I collect the dates of

interim news announcements relating to the inside information, as well as the formal announcement date.

For each stock, I searched three related sources for dates of the final announcement of the inside information and any preceding news announcements: the SEC's *Dow Jones Headline Tapes*, the *Dow Jones News Retrieval Service* (*DJNS*), and the *Wall Street Journal Index* (*WSJ Index*).[20] The *Headline Tapes* cover news events dating back to 1982. They give the story headline and the date the story crosses the *Broadtape* or appears in the *Wall Street Journal* (*WSJ*) if the story never crosses the *Broadtape*. The *DJNS* has the entire story, as well as the date and time of day that an announcement crosses the *Broadtape* for selected news events dating back to June 1979.[21] For example, if the inside information involved a tender offer, I used the *Headline Tapes* to find the dates of 13D filings, possible prior tender offers, acquisition rumors, and the final announcement of the tender offer itself. Using the *Headline Tapes* story date offers two advantages over the *WSJ Index* date. First, information reported in the *WSJ* often comes across the *Broadtape* a day before the story appears in the *WSJ*. The *Headline Tapes* date is the earlier of the two dates, and therefore more accurately reflects the date the information becomes public. Second, the *Headline Tapes* also report stories, such as acquisition rumors, that come across the *Broadtape*, which the *WSJ* never reports. Prior to 1982, I use the *WSJ Index* to find news announcements and dates. To determine whether the news releases occurred before or after the market closed for the day, I used the *DJNS*.

A. Basic Specification

I use a modified market model to estimate the stock price impact of insider trading, with a separate OLS regression for each insider trading episode. The basic specification for the modified market model is as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \gamma_i \text{Announce}_{it} + \delta_i \text{Inside}_{it} + \sum_{j=1}^{J} \mu_{ij} \text{News}_{ijt} + \varepsilon_{it} \quad (1)$$

The term R_{it} is the return at time t for firm i ($i = 1, \ldots, 183$), R_{mt} is the CRSP value-weighted market index return at time t, Announce_{it} is a dummy variable which equals one for firm i if the inside information is publicly announced on day t and zero otherwise, Inside_{it} is a dummy variable which equals one for firm i on days of illegal insider trading in firm i's stock and zero otherwise, and News_{ijt} are J dummy variables which control for confounding interim news announcements. The number of news dummies included, J, differs by firm, depending on the number of interim news announcements appearing in the *Wall Street Journal* or on the *Dow Jones*

[20] Dow Jones prepares the *Headline Tapes* exclusively for the SEC.

[21] The *DJNS* is not comprehensive; it covers major news stories, while the *Headline Tapes* cover every story.

Broadtape. The jth news dummy equals one only on the day of the jth interim news announcement.[22]

The coefficient δ_i directly tests whether insider trading affects stock prices. In addition to returns over the event period, the regressions incorporate an additional 150 trading days of returns that contribute to the estimates of the market model parameters, α_i and β_i. The 150-day estimation period ends with the day prior to the earlier of the first insider trade or the first interim news announcement.

For example, in 1985, following speculation reported in the *Wall Street Journal* and on the *Broadtape*, Coastal launched a hostile tender offer for American Natural Resources. In this case, News_1 equals one on 2–28–85, the day the "Heard on the Street" column reported a potential bid and news of American Natural Resources' defensive spinoff plan appeared on the *Broadtape*, and zero on other days; Announce equals one on 3–04–85, the day of the actual bid, and zero other days; and Inside equals one on each of the six insider trading days occurring from 2–14–85 through 3–01–85, and zero otherwise.

Table IV displays distributional characteristics of the Inside and News variables. In total, the sample contains 588 insider trading days, 136 interim news days, and 17 days with both insider trading and interim news announcements. Insiders trade on 3.2 days per episode (median = 2.0), interim news announcements occur on 0.7 days per episode (median = 0.0), and insider trading on days with news announcements occurs on 0.1 days per episode (median = 0.0). Although insider trading on days with interim news announcements is relatively infrequent, later analysis tests whether the results are sensitive to the method of controlling for concomitant insider trading and news announcements. Table IV also reveals that, on average, insider trading takes place 13.2 trading days (median = 6.0) before the inside information is publicly announced. The proximity of the insider trading to the public announcement suggests that insider trading occurs during a period of high price and volume volatility. Section III.*C* investigates the impact of this volatility on the estimates of the price movement on insider trading days.

If insider trading increases the accuracy of securities prices, the abnormal returns on insider trading days will have the same sign as the abnormal return on the day the inside information becomes public. For example, the stock price of the target of a tender offer usually increases when the tender offer is publicly announced. If insider trading in the target's stock results in a more accurate stock price, then insider trading will move the price closer to the stock price realized after the tender offer announcement. More precisely, in this case positive abnormal returns will occur on insider trading days. This

[22] The regressions use a separate dummy variable for each news announcement because any given insider trading episode can have both positive and negative news announcements. Since I am interested in average and total abnormal returns on insider trading days, the regressions use only one dummy variable to represent insider trading days. The results are not sensitive to this specification.

Table IV

Incidence of Insider Trading and News Announcements Across Insider Trading Episodes and the Timing of Insider Trading

	Number of Days			Timing of Trade	
	Insider Trading Days	News Days	Insider Trading and News	Number Days Before Public Announcement	Number Days Between Trades (if > 1 Trade)
Mean	3.2	0.7	0.1	13.2	3.8
(Standard error)	(0.2)	(0.1)	(0.0)	(0.8)	(0.4)
Median	2.0	0.0	0.0	6.0	1.0
Total Sample	588	136	17	—	—

definition of increased stock accuracy is incorrect if insider trading moves prices either to their new full information values or past such values. While theoretically possible, in this sample the price movement on the public announcement day is both significant and in the expected direction, indicating that the proposed definition of increased stock price accuracy is reliable for this sample.

I examine the abnormal returns on insider trading days for each type of inside information, and for the sample as a whole. I consolidate the results across event types by multiplying the abnormal returns on insider trading days by -1 if the inside information is negative news. For each of the 183 insider trading episodes, I calculate both the average abnormal return on an insider trading day and the sum of the abnormal returns across all insider trading days (the cumulative abnormal return).[23]

To evaluate whether the abnormal returns on insider trading days differ significantly from zero, I use two tests. First, the t-statistic tests whether the mean abnormal return and the mean cumulative abnormal returns (CAR) differ from zero. It uses the cross-sectional standard error computed from the abnormal returns and the cumulative abnormal returns grouped by type of inside information. Second, the z-statistic tests whether the mean cumulative abnormal return on insider trading days differs from zero.[24] It equals the sum of the individual regression t-statistics for δ_i divided by the square root of the number of regression coefficients.[25]

$$Z - \text{stat} = \frac{1}{\sqrt{K}} \sum_{i=1}^{K} \frac{\hat{\delta}_i}{s_i} \tag{2}$$

where s_i is the standard error of the estimated coefficient δ_i, and K is the number of insider trading episodes, that is, the number of individual regressions. The z-statistic approach to testing whether the mean insider trading CAR is zero incorporates the information contained in the standard deviation of the individual δ_i coefficients.[26] If volatility increases during the event period, the cross-sectional t-test may be more appropriate.

[23] The average abnormal return on insider trading days for the ith insider trading episode is δ_i, the OLS estimate of the insider trading dummy coefficient. The cumulative abnormal return on insider trading days is defined as $\delta_i \cdot N_i$, where N_i is the number of days insider trading occurs.

[24] See Dodd and Warner (1983) and Warner, Watts, and Wruck (1988) for the derivation of the z-statistic test of abnormal performance.

[25] This approach assumes the individual regression t-statistics are random variables distributed asymptotically $N(0, 1)$. Each t-statistic has at least 47 degrees of freedom.

[26] This information is especially important when considering the mean insider trading CAR because the number of days of insider trading varies by insider trading episode. A cumulative abnormal return of 8% accumulated over eight insider trading days is not equally as likely as an 8% cumulative abnormal return accumulated over one trading day, and the individual regression t-statistics reflect this fact. The z-statistic weights the individual coefficients by their preciseness, and therefore captures some information that the cross-sectional t-statistic misses.

To test whether stock price accuracy increases on insider trading days, I define run-up as the cumulative abnormal return on insider trading days divided by the abnormal return on the public announcement day.[27] Run-up measures both the direction and size of the abnormal returns on insider trading days. Run-up is positive if insider trading moves stock prices in the same direction as the subsequent public announcement of the inside information; run-up is larger the more the insider trading moves prices relative to the public information announcement. To examine whether stock prices become more accurate on insider trading days, or, more specifically, whether the cumulative abnormal return across insider trading days has the same sign as the abnormal return on the public announcement day, I use a binomial sign test to test whether run-up is positive.

Table V presents the results of these tests and summarizes the estimates of the basic specification for the 183 OLS regressions. Panel A separates events related to takeovers from other events, such as bankruptcy or earnings announcements; Panel B partitions the takeover sample by type of takeover event: friendly tender offer, LBO, etc. The first row, labelled "Total," summarizes the results for the sample as a whole.[28] Table V shows, for each type of insider trading episode, the abnormal return on the day the inside information becomes public (the public announcement day), the average abnormal return on an insider trading day, the cumulative abnormal return across insider trading days for an insider trading episode, and the insider trading run-up.

Table V reveals that stock prices move significantly, measured both by cross-sectional t-tests and z-tests, on insider trading days. On average, the abnormal return is 3.06% on the day of the insider trade. Dividing by the cross-sectional standard error of 0.36 yields a t-statistic of 8.50, statistically different from zero. The mean CAR for an insider trading episode is 6.85%, which is also significantly different from zero when compared to its cross-sectional standard error (t-statistic = 8.90). The corresponding z-statistic of 21.61 yields similar inferences.

In addition, the mean run-up index is 47.56%, indicating that the cumulative abnormal return on insider trading days is almost half of the amount of the abnormal return on the day the inside information subsequently becomes

[27] The abnormal return on the public announcement day corresponds to the γ_i coefficient in the regression equation. Run-up is defined as

$$\text{Run-up}_i = \frac{\hat{\delta}_i \cdot N_i}{\hat{\gamma}_i} \tag{1}$$

[28] Negative abnormal returns and cumulative abnormal returns observed for insider trading episodes involving negative inside information reflect losses avoided by the inside trader. That is, a trader with negative inside information anticipates the stock price drop and sells to avoid a loss. Of course, the negative (but insignificant) abnormal returns on insider trading days calculated for the three positive earnings announcements do not reflect a loss avoided, but a plain loss, since the inside trader had a long position in the stock.

Table V

Means and Standard Errors of OLS Regression Results by Type of Inside Information: Abnormal Returns (ARs) Associated with Insider Trading and Run-Up

"Public Announcement Day AR" is the abnormal return on the day the inside information becomes public. "Average AR Per Day of Insider Trading" is the daily average abnormal return on insider trading days. "CAR on Insider Trade Day" is the cumulative abnormal return over all insider trading days in a given stock. "Insider Trading Run-Up" equals "CAR on Insider Trade Days/Public Ann. Day AR." "Sign Test for Run-Up > 0" is the probability level of a one-tailed binomial sign test that run-up > 0. The "Total" time displays the means and standard errors of all insider trading episodes after standardizing the CARs are multiplied by −1 if the announcement day AR is negative.

Panel A

Type of Inside Information	Public Announcement Day AR (γ_i)	Ave. AR per Day of Insider Trading (δ_i)	CAR on Insider Trade Days	Z-Statistic of CAR	Insider Trading Run-Up	Sign Test for Run-Up > 0 (Prob. Level)
Total	18.50%	3.06%	6.85%	21.61	47.56%	< 0.01
(Standard error)	(1.00)	(0.36)	(0.77)		(6.04)	
(N = 183)						
Takeover related	17.46	2.55	6.01	19.35	44.16	< 0.01
(N = 145)	(0.92)	(0.29)	(0.68)		(6.23)	
Negative earnings	−18.62	−1.94	−2.20	−3.06	14.22	0.19
(N = 12)	(2.96)	(0.69)	(2.43)		(16.31)	
Positive earnings	6.78	0.74	−2.72	−0.48	−45.95	0.50
(N = 3)	(1.24)	(1.77)	(3.58)		(53.52)	
Bankruptcy or fraud	−40.96	−5.65	−16.55	−4.36	87.93	0.17
(N = 10)	(9.17)	(2.73)	(6.88)		(40.34)	
Misc. good news	14.43	9.47	16.54	10.36	117.41	< 0.01
(N = 11)	(3.06)	(3.39)	(4.73)		(28.71)	
Misc. bad news	−20.96	−1.65	−8.10	−0.99	48.91	0.50
(N = 2)	(4.43)	(1.54)	(7.88)		(48.05)	

Table V—*Continued*

Panel B: Takeover-Related Events

Type of Inside Information	Public Announcement Day AR (γ_i)	Ave. AR per Day of Insider Trading (δ_1)	CAR on Insider Trade Days	Z-Statistic of CAR	Insider Trading Run-Up	Sign Test for Run-Up > 0 (Prob. Level)
Friendly tender	18.45%	2.50%	5.15%	9.49	34.45%	< 0.01
(N = 38)	(1.82)	(0.61)	(1.04)		(8.54)	
Hostile tender	17.03	2.62	8.15	11.25	58.78	< 0.01
(N = 34)	(1.79)	(0.64)	(1.92)		(13.48)	
Friendly merger	17.64	3.12	6.78	13.48	49.39	< 0.01
(N = 50)	(1.55)	(0.48)	(1.10)		(12.78)	
Hostile merger	21.52	2.31	4.46	2.14	58.36	0.12
(N = 3)	(10.71)	(1.09)	(2.52)		(52.43)	
LBO	13.92	1.06	1.22	1.88	6.60	0.38
(N = 10)	(2.64)	(0.67)	(0.85)		(6.89)	
Restructuring	22.57	0.07	2.06	−0.63	5.12	0.50
(N = 5)	(8.45)	(1.43)	(3.42)		(27.51)	
Major share acq.	10.69	2.50	4.90	2.38	71.78	0.19
(N = 5)	(2.04)	(1.24)	(1.72)		(38.43)	

public.[29] The non-parametric sign test on run-up reveals that stock prices become more accurate on insider trading days. Stock prices move in the correct direction (i.e., have a run-up value greater than zero) on 81% of the insider trading days, yielding a probability level of less than 0.0001 for the hypothesis that the run-up equals zero. Hence, stock price accuracy does increase on insider trading days.

The results for the sample as a whole are fairly robust across type of events, confirming the conclusion that on insider trading days, stock prices move significantly towards values which incorporate the inside information. Takeover-related events, comprising 79% of the sample, mirror the results of the entire sample. In addition, four of the six different event classifications in Panel A, specifically, takeover-related events, negative earnings, bankruptcy/financial fraud, and miscellaneous good news, have z-statistics significantly different from zero. The two categories with insignificant z-statistics, that is, positive earnings announcements and miscellaneous bad news announcements, have very small sample sizes ($N = 3$ and 2, respectively). Also, four of the six categories (takeover-related events, negative earnings, bankruptcy/financial fraud, miscellaneous good news, and miscellaneous bad news) exhibit positive run-up values; three of these four categories have run-up values significantly greater than zero. The general consistency of results across categories suggests that, in spite of the predominance of takeovers in the sample, the conclusions drawn from the sample as a whole apply to the various sub-categories of inside information.

Panel B shows that similar conclusions hold for the various types of takeover-related events in the sample. The z-statistics for the cumulative abnormal returns due to insider trading are significant for five of seven types of takeover-related events; run-up is positive for all of the seven types of takeover-related events, and statistically significant for four of the seven event types. Again, the categories with few observations have insignificant run-up indices.

The coefficients on the news dummies, not reported in Table V, indicate that the average absolute value of the abnormal return on the day of an interim news announcement is 7.94%, with a cross-sectional standard error of 2.38%. Only 48 of the 183 insider trading episodes have interim news announcements preceding the public announcement of the inside information. One potential concern with the basic specification is its ability to separate the effect of insider trading from the effect of concomitant news

[29] Note that the mean run-up index is greater than the ratio of the mean insider trading CAR to the mean announcement day AR. Specifically, the mean ratio is 48%; the ratio of the means is 37%. One explanation for this difference between the two measures is that some large announcement day ARs may not have correspondingly large insider trading CARs. As a result, some individual run-up observations may be low, but the mean ratio does not weight these observations very heavily. The ratio of the means, however, weights these observations relatively heavily. A simple check of the 10 run-up values between 0 and 5% confirms this explanation: the mean insider trading CAR for these observations is 0.58%, while the mean announcement day AR is 31.67%.

announcements. Seventeen days in the sample (or 3% of the total number of insider trading days) also have news announcements. I repeated the analysis using two dummy variables to represent insider trading days: one variable for insider trading days with news and another variable for insider trading days without news, and a dummy variable to represent news days without insider trading.

The results are robust to this specification. For the entire sample, the average abnormal return on an insider trading day without news is 3.02% (standard error = 0.36), which is very close to the 3.06% abnormal return documented in the basic specification. The average abnormal return on an insider trading day with news is 7.45% (standard error = 1.17%), while the average of the absolute value of the abnormal return on days with news and without insider trading is 8.32% (standard error = 0.94). The basic specification appears to adjust adequately for news announcements that appear concomitantly with insider trading. Further analysis continues to rely on the dummy variable method of the original specification.[30]

Inside traders also earn large abnormal returns over short time periods. Table VI indicates that the excess return from the insider's first trade through the public information announcement averages more than 30% over a 14-day period.

The results from the basic specification displayed in Table V suggest that the market detects informed trading and impounds this information in the stock price. The insider-induced price movement is large relative to the subsequent price reaction upon the release of the inside information and is statistically significant. The additional specifications to follow investigate the robustness of these results. These specifications address sample selection issues and try to distinguish between the insider trading effect and the price run-up created by rumors and bidder accumulation of target stock prior to takeover announcements.

B. Testing for Sample Selection Bias

Many insider trading violations remain undetected. Because the sample here consists solely of detected insider trading violations, the estimates of the price effects of insider trading may be biased. Specifically, if unusual price movements either trigger the initial detection of insider trading or influence the decision whether to prosecute, then the sample consists precisely of the insider trading that moves prices the most.

[30] An alternative approach simply excludes days with both inside trading and news announcements. Using this approach leaves 165 insider trading episodes in the sample; 18 insider trading episodes are left with no insider trading dates on which to estimate abnormal returns and hence exit the sample. The results are robust to this specification and look very similar to the dummy variable approach of the original specification. Run-up under the alternative approach is 45% versus 48% under the original specification; the CAR on insider trading days is 6.4% versus 6.8% under the original specification. Further analysis uses the news dummy approach of the original specification, but replicating the tests with the alternative specification produces inferences that are robust to the method of controlling for interim news announcements.

Table VI

Means and Standard Errors of Cumulative Abnormal Returns (CAR) over Insider Trading Holding Period by Type of Inside Information

The insider holding period begins with the first insider purchase or sale and ends when the inside information becomes public, e.g., with a merger announcement. To standardize the insider trading CAR across insider trading episodes involving both positive and negative news announcements, the CARs are multiplied by −1 if the AR on announcement day is negative. Standard errors are in parentheses.

Type of Inside Information	*N*	Insider Holding Period (No. of Trading Days)	CAR Over Holding Period (%)
Takeover related	145	12.5	29.9
		(1.4)	(1.5)
Negative earnings	12	18.4	−30.0
		(7.6)	(4.7)
Positive earnings	3	21.3	3.3
		(11.2)	(4.2)
Bankruptcy or financial fraud	10	26.4	−73.9
		(14.6)	(12.0)
Misc. good news	11	11.2	34.8
		(7.7)	(6.9)
Misc. bad news	2	10.0	−28.1
		(7.0)	(2.5)
Total	183	13.7	32.2
		(1.6)	(1.7)

My examination of and involvement in insider trading cases at the SEC indicate that the price movement on insider trading days does not affect the second step of the selection process, that is, the decision to proceed with a case. The SEC instead concentrates on the legal elements required to establish a violation, none of which involves the price movement on insider trading days. Indeed, the conditions necessary to establish a violation can generate downwardly biased estimates. In particular, violation requires that the inside information on which a defendant bases his trade is *material*. In practice, the courts consider information material if it produces an abnormal price response upon its public release. Proving materiality is easier if the price response is large; accordingly, the SEC decides, in part, to pursue an insider trading case based upon the stock price reaction upon the announcement of the inside information. Large price reactions to announcements of inside information are more likely to occur when the insider has not moved the price very much prior to the announcement. In the extreme, inside traders who move the price so that it incorporates *all* of the inside information preclude a significant stock price reaction when the information is subsequently announced publicly. Thus, the traders who move prices the most may be excluded from the sample, which would bias the estimates towards zero.

On the other hand, the detection process is more likely to upwardly bias the estimates. To explore this issue, I conduct two main tests designed to reveal detection bias. First, I use the source of the SEC case investigation to isolate cases initiated for reasons other than that of unusual price movements on insider trading days. I then compare the price movements on insider trading days from this uncontaminated subsample to the estimates from the remaining sample. Second, the method of detection, and hence the probability of bias, varies by whether the insider trades only one stock or many stocks. I use this inference to test for bias by again comparing the price movement on insider trading days across two subsamples constructed based upon the number of stocks the insider trades. Neither test finds any evidence of detection bias.

The first test for bias relies on the observation that the source of the SEC case investigation conveys information about whether insider trading induced price movements trigger detection in a given insider trading episode. The most frequent source of an investigation of an insider trading episode is a public complaint (41% of episodes), followed by an exchange referral (31%). The remaining categories include SEC-initiated investigations, press stories, issuer referrals, another SEC case, broker referrals, bidder referrals, and miscellaneous.[31] Table VII describes the incidence of these categories.

Some types of detection are more likely to result from insider-induced price movements. For example, stock exchange referrals, SEC-initiated investigations, press stories, issuer referrals, or bidder referrals frequently develop when someone notices a price run-up prior to a takeover and asks whether insider trading could have created the movement. These sources are most liable to yield upwardly biased estimates since detection may result from price movements. I refer to these sources collectively as "Exchange referrals," after the major component of this category.

Other types of detection, specifically, cases which begin as public complaints, SEC investigations of the issuer for unrelated violations, broker referrals, and other referrals, are less likely to evolve from large price movements on insider trading days. Many public complaints, for example, arise when the informant knows the inside trader. Ex-wives are a typical source of public complaints. In one instance, a divorce trial led to the discovery of illegal trading. Former employees of the insider trader are also a frequent source of public complaints. Fellow conspirators sometimes expose

[31] An "SEC investigation" refers to cases where the SEC initiates an investigation without an outside referral. An "Issuer referral" occurs when the firm in which the inside trader transacts contacts the SEC. A "Bidder referral" arises when the bidding firm in a takeover contacts the SEC about the insider trading in the target stock. An "SEC investigation of the issuer for unrelated violations" develops, when, for instance, the SEC investigates a company for financial fraud, and discovers that a corporate insider traded before an earnings announcement. "Broker referrals" usually occur following a public news announcement, such as a merger announcement, that results in a large price revision, and the broker realizes that a client traded prior to this announcement. "Other referrals" are typically referrals from another government agency, such as a state banking agency investigating a merger for reasons unrelated to insider trading.

Table VII

Source of SEC Case Investigation by Number and Percent of Insider Trading Episodes

An "Insider Trading Episode" is one or more defendants trading in a given stock using specific information, such as information about an impending takeover. "SEC investigation" is the case origin when the SEC begins an investigation without an outside referral. "Issuer" refers to the firm that is the subject of the inside information. "Another SEC case" is the case origin when the SEC investigates a company for another reason, for example, financial fraud, and discovers insider trading violations in addition to the other securities violations. The source of the SEC case investigation is missing for some insider trading episodes.

Source of Case	Number of Insider Trading Episodes	Percent of Total
Public complaint	71	41
All exchange referrals	55	31
NASD	19	11
AMEX	15	9
NYSE	15	9
Regional	3	2
CBOT	3	2
SEC investigation	16	9
Press story	16	9
Issuer	5	3
Another SEC case	1	1
Broker	3	2
Bidder	1	1
Other	5	3
Total	174	100

the inside trader, as in the case where a CEO asked his neighbor to place the inside trade. The neighbor later turned in the CEO when they disagreed over who should pay the taxes. Of course, individuals might inform the SEC more frequently when they observe a large price reaction upon announcement of the inside information. This tendency would imply that public complaints cases have large announcement day abnormal returns, but would not imply that these cases have large price movements on insider trading days. Likewise, no obvious bias exists for cases beginning as SEC investigations initiated for reasons unrelated to insider trading and other miscellaneous referrals. These sources, which I refer to as the "Public complaints," again after the major component of the category, are unlikely to generate upwardly biased estimates of the insider-induced price movement and run-up index.

To gauge the impact of incomplete detection, I divide the sample into two groups based upon case source: "Exchange referrals" and "Public complaints." As discussed above, unusual price movements are more likely to trigger detection of "Exchange referral" observations than detection of "Public complaint" observations. Table VIII shows the cumulative abnormal return on insider trading days, the announcement day abnormal return, and insider trading induced run-up by source of case. The results in Table VIII suggest

Table VIII

Detecting Sample Selection Bias by Examining Means and Standard Errors of CARs on Insider Trading Days, Announcement Day ARs, and Insider-Induced Run-Up by Source of the SEC Investigation

"Exchange Referrals" include cases originating as exchange referrals, SEC investigations, press stories, or referrals from the issuer of the stock or the bidding firm. "Public Complaints" include cases originating from public complaints, SEC investigations of the issuer for unrelated violations, broker referrals, and other referrals. "Announcement day AR" is the abnormal return on the day the inside information becomes public, e.g., on the day of a merger announcement. Standard errors of the means are in parentheses.

	Exchange Referrals	Public Complaints	*T*-Statistic for the Difference in Means
CAR on insider trading days	7.9%	5.5%	1.53
	(1.2)	(1.0)	
Announcement day AR	18.6%	16.7%	1.01
	(1.3)	(1.3)	
Run-up	54.0%	39.9%	1.12
	(9.4)	(7.8)	
Number of insider trading episodes	94	80	

that large price movements on insider trading days do not precipitate eventual inclusion in the sample. Although the insider trading CAR is greater for exchange referrals than for public complaints, the difference in the means is not large (the *t*-statistic for the difference in means is 1.53). The insider trading CAR is 7.9% for exchange referrals and 5.5% for public complaints. More importantly, the insider trading CAR for public complaints is still more than five times as large as its standard error. The sample means for the announcement price reaction and the run-up also do not differ significantly by source of case. The mean announcement day abnormal return is 18.6% for exchange referrals, 16.7% for public complaints (*t*-statistic = 1.01), and the run-up is 54.0% for exchange referrals, 39.9% for public complaints (*t*-statistic = 1.12).[32] Even if the exchanges refer cases based upon the size of the insider trading CAR, these results indicate that the estimated insider trading CAR is still large and significantly different from zero for insider trading episodes which do not have this potential bias.

One reason that the exchange referral sample does not exhibit substantive detection bias is that the exchanges look for other signs, in addition to unusual price and volume movements, to detect insider trading. A concentration of orders from one area of the country or from one brokerage house, may,

[32] The results from an alternative specification which includes only public complaints in the "Public complaint" category are almost identical to those reported in Table VIII.

for example, prompt an exchange investigation. To explore the impact of price- or volume-based exchange referrals on the results, I attempt to isolate exchange referral observations where price movements on insider trading days lead to inclusion in the sample. The NYSE examines price and volume movements of more than three standard deviations, so I repeat the tests in Table V after removing all exchange referral insider trading episodes where the absolute value of an abnormal price or volume movement on any insider trading day exceeds three standard deviations, measured using the 150-day estimation period (section III.*E* describes the abnormal volume calculations). The results are robust to these exclusions and are very similar to those reported in Table V. After dropping exchange referral insider trading episodes where the abnormal return on any insider trading day in the episode is greater than three standard deviations from the mean, the average abnormal return on an insider trading day is 3.13% (compared with 3.06% from Table V). Similarly, dropping exchange referrals with abnormal volume leads to an average abnormal return of 3.19% on insider trading days.[33] The NYSE only investigates very large price or volume movements: the average 1989 standard deviation on the NYSE is 2.1%, so a three standard deviation price movement is 6.3%. This 6% trigger for an NYSE investigation is therefore much larger than the average price movement on an insider trading day of 3%. To summarize, perhaps because the exchanges question only very large price movements and have additional methods of detection beyond price or volume movements, the contribution of exchange referrals to sample selection bias is small.

The second main test for sample selection bias divides the sample by the number of stocks the insider trades. When the SEC uncovers insider trading in one stock, it also checks the past trading history of the defendant for suspicious trading around the time of information announcements. Even if a large insider-induced price movement leads to the defendants initial detection, any insider trading discovered later in the investigation may be less likely to be selected based upon the size of the insider-induced price movement.

Table IX divides the sample into two groups by whether the inside trader transacted in only one stock or transacted in more than one stock. Although ideally one would like to exclude from the analysis the insider trading episodes that led to the multi-stock trader's detection, the identity of these stocks are unknown; the time lag from detection to prosecution is sufficiently long that the last insider trade of a defendant is not necessarily the trade that led to detection. Again, the insider trading effect and the run-up do not differ significantly by the number of stocks traded, and the insider trading CAR for the multi-stock traders remains over seven times as large as its

[33] The estimates increase, rather than decrease as one might initially expect, because an entire insider trading episode (consisting of multiple insider trading days) is dropped from the sample when the abnormal return or volume on one of the insider trading days exceeds the three standard deviation cutoff.

Table IX

Detecting Sample Selection Bias by Examining Means and Standard Errors of CARs on Insider Trading Days, Announcement Day ARs, and Insider Induced Run-Up by the Number of Stocks the Insider Trades In

"Trade in More Than One Stock" includes all insider trading episodes where the inside trader participated in other insider trading episodes. "Trade in Exactly One Stock" consists of all insider trading episodes where the inside trader transacted in only one stock and was not involved in any other insider trading episodes. "Announcement day AR" is the abnormal return on the day the inside information becomes public, e.g., on the day of a merger announcement. Standard errors of the means are in parentheses.

	Trade in More Than One Stock	Trade in Exactly One Stock	*T*-Statistic for the Difference in Means
CAR on insider trading days	5.9%	7.8%	1.16
	(0.8)	(1.4)	
Announcement day AR	15.0%	22.7%	3.75
	(0.9)	(1.8)	
Run-up	44.1%	51.3%	0.57
	(7.0)	(10.5)	
Number of insider trading episodes	99	82	

standard error.[34] The insider trading CAR for one-stock traders is 7.8%, whereas the mean insider trading CAR for multi-stock traders is 5.9% (t-statistic for the difference = 1.16). Therefore, the upward bias in the insider trading effect created by sample selection is likely small. In fact, Table IX suggests instead that information announcements that create large price movements lead to investigations and detection. The mean announcement day abnormal return is significantly larger for one-stock traders (22.7%) than the announcement day abnormal return for multi-stock traders (15.0%, t-statistic for difference in means = 3.75). These results reinforce the conclusions from Table VIII: even after eliminating the insider trading episodes most likely to be contaminated from sample selection problems, the estimates of the insider trading CAR are very similar to (and not significantly different from) the estimates for the entire sample, but are still significantly greater than zero.

The above tests suggest that the effect of sample selection on the mean cumulative abnormal return on insider trading days is small. One explanation for the failure to detect significant bias is that an unusually large return on *one* insider trading day is enough to trigger detection. If not all insider trading days in an insider trading episode exhibit similarly high abnormal returns, measuring the cumulative abnormal return across insider trading days mitigates the effect of sample selection bias. I explore the validity of this

[34] A similar segmentation for inside traders that transact in less than 5 stocks versus inside traders that transact in 5 or more stocks yield almost identical results.

explanation by repeating the above tests using only the largest abnormal return on an insider trading day for each insider trading episode (when the insider trading episode involves negative news, I use the smallest abnormal return). No significant difference exists between the largest abnormal return for exchange referrals and public complaints, but the largest abnormal return for one-stock traders is marginally greater (at the 10% significance level) than the multi-stock traders' abnormal return. Thus, even the largest abnormal return across an insider trading episode does not seem enough to trigger detection.

On the whole, then, the evidence suggests that first, the results are robust when one confines the test to a subsample of observations unlikely to be contaminated by sample selection bias, and second, the availability, in general, of more than one insider trading day per episode to measure abnormal returns mitigates sample selection bias even in the subsamples more likely to have this bias.[35]

C. *Other Reasons for Price Run-Up*

One concern with the interpretation of the abnormal returns on insider trading days is that events occurring concomitantly with insider trading and not the insider trading itself create abnormal returns. More precisely, the abnormal returns may reflect either the high price and volume volatility that characterize the period immediately preceding a takeover announcement or a decision by the inside traders to trade on days with high abnormal returns.

Rumors not reported in the media and purchases by bidders and arbitrageurs create stock price movements on insider trading days as well as non-insider trading days. To determine whether rumors, risk arbitrageurs, and bidder buying run-up the stock price, I examine the excess returns on days *without* insider trading or identifiable news announcements. I then investigate the abnormal return on insider trading days net of the price movement observed on surrounding days. The OLS regression estimate the following equation:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \delta_i \text{Inside}_{it} + \sum_{j=1}^{J} \mu_{ij} \text{News}_{ijt} + \zeta_i \text{OtherDays}_{it} + \varepsilon_{it} \quad (3)$$

where OtherDays is a dummy variable that equals one on day t if there is no insider trading or news announcements on day t, and if day t falls within a specified window before the public announcement day. The length of this

[35] The results of Table XI, discussed in detail below, also provide a quick check on the extent of sample selection bias. These results indicate that the pre-announcement price run-up observed before takeovers is independent of whether the sample consists solely of takeovers with detected insider trading. More specifically, the pre-announcement price movement for takeovers with SEC insider trading charges is 13.0 percent, whereas the pre-announcement price movement from prior takeover studies ranges from 11.0 to 13.2 percent. Thus, the sample of takeovers with detected insider trading does *not* consist solely of takeover episodes where the price moved the most prior to the takeover announcement.

window varies by insider trading episode. The window begins on the day of the first insider trade (or the first related news announcement if it occurs earlier) and ends on the day of the public announcement of the inside information. The estimated coefficient, ζ_i, measures the stock price run-up that occurs for reasons unrelated to insider trading or news announcements.

Assuming that rumors and risk arbitrageur and bidder accumulation run up the stock price by roughly the same amount on average whether or not insider trading occurs, one can attribute the portion of the abnormal return on insider trading days that exceeds the average abnormal return on non-insider, non-news days to the effect of insider trading. To measure the insider trading CAR net of any price run-up that occurs in the absence of insider trading, an adjusted insider trading CAR is calculated by subtracting the mean abnormal return on non-insider non-news days from the mean abnormal return on insider trading days, and multiplying by the number of insider trading days in the episode. The adjusted run-up variable divides the adjusted inside trading CAR by the announcement day abnormal return.

$$\text{Adjusted Insider Trading CAR}_i = \left(\hat{\delta}_i - \hat{\zeta}_i \right) \cdot N_i \tag{4}$$

$$\text{Adjusted Run-up}_i = \frac{\text{Adjusted Insider Trading CAR}_i}{\hat{\gamma}_i} \tag{5}$$

Table X reports the abnormal returns on insider trading days, the absolute value of the abnormal returns on news days, and the abnormal returns on days without news or insider trading. It also presents the "Adjusted Insider

Table X

Adjusting Estimates of Abnormal Returns Attributable to Insider Trading for Stock Price Reactions that Occur Absent any Insider Trading Activity

The window to estimate the abnormal returns on days without insider trading or news announcements begins with earlier of first insider trade or news announcement and ends with announcement day. "Adjusted Inside Trade CAR" = (Average AR per day of insider trading − Average AR on days without insider trading or interim news announcements in window) × number of insider trading days. "Adjusted Run-Up" = Adjusted Insider Trade CAR/Announcement Day AR. The abnormal return on insider trading days differs from the earlier Table V result because the sample size drops from 183 to 131. All of the days between the first insider trading date and the public announcement day have insider trading or news announcements for the 52 observations that exit the sample.

Average AR on Insider Trade Days	Average |AR| on News Days	Average AR on Days w/o Insider Trading or News	Adjusted Insider Trade CAR	Adjusted Run-Up
2.31	8.07	0.90	5.23	33.81
(0.32)	(0.80)	(0.28)	(1.25)	(10.09)
		(Number of observations = 131)		

Trade CAR" and the "Adjusted Run-Up." The calculations reveal that stock prices move most on days with public news announcements ($|AR| = 8.07\%$, standard error = 0.80), but that the abnormal return on insider trading days significantly exceeds the abnormal return on days without insider trading or news. The average abnormal return on an insider trading day is 2.31% (standard error = 0.32) and the abnormal return on a day without news or insider trading is 0.90% (standard error = 0.28%).[36] The adjusted CAR on insider trading days is 5.23% (standard error = 1.25), somewhat smaller than the 6.85% CAR on insider trading days from the original specification, but still significantly different from zero. Similarly, the adjusted run-up of 33.81% (standard error = 10.09) is smaller than the 47.56% of the original specification, but significantly greater than zero. Hence, insider trading does not generate all of the price movement on insider trading days, but the price movement on insider trading days clearly exceeds the price movement on surrounding days.[37]

Another explanation for the high abnormal returns on insider trading days relative to the surrounding days is that inside traders intentionally trade on days with high abnormal returns. Perhaps inside traders observe a large price movement in the direction of the inside information and this price movement confirms the accuracy of the insider's potentially uncertain information. The insiders then trade following this price movement. Alternatively, inside traders might anticipate independent rumors, and buy prior to a large stock price movement.

For most insider trading episodes, the time of day of trades is unknown, precluding a direct investigation of whether inside traders transact before or after large price movements on the insider trading day. For a rough sense of

[36] The abnormal return on insider trading days of 2.31% differs from the earlier Table V result because the sample size drops from 183 to 131. All of the days between the first insider trading date and the public announcement day have insider trading or news announcements for the 52 observations that exit the sample. Calculating the adjusted insider trading CAR and the adjusted run-up statistics requires estimates of the abnormal returns on non-news, non-insider trading days. This approach to accounting for other reasons for price run-up therefore excludes these 52 observations.

[37] I tried two additional approaches to estimating the returns on days without insider trading or news announcements. These approaches differ from the method discussed above in the windows used to estimate the abnormal returns on days without insider trading or news. The first approach uses a twenty trading day window prior to the public announcement of the inside information to estimate the abnormal returns on non-insider, non-news days. The second approach uses a ten trading day window, rather than a twenty trading day window. The results from both of these alternate approaches confirm the conclusions from the variable window method discussed above. The adjusted CAR on insider trading days and the adjusted run-up are close to the unadjusted results from Table V, reflecting the small price movements that occur on non-insider trading, non-news days. The abnormal return on days without insider trading or news is 0.06% (standard error = 0.07%) for the twenty day window and 0.36% (standard error = 0.10%) for the ten day window. The adjusted insider trading CAR is therefore 6.81% (standard error = 0.98%) for the twenty day window and 5.63% (standard error = 0.84%) for the ten day window; adjusted run-up is 46.50% (standard error = 7.68%) for the twenty day window and 35.83% (standard error = 6.65%) for the ten day window.

the timing of insider trading relative to price movements, I examined the abnormal returns over the day prior to and the day following an insider trading day. If the above explanations are correct, they should also apply, to some extent, to trading before and after the insider trading day. The average abnormal return the day before an insider trading day is 0.51% (standard error = 0.36%); the average abnormal return the day after an insider trading day is 1.41% (standard error = 0.40%). Both of these figures are considerably less than average abnormal return on 3.06% on insider trading days documented in Table V. The inside trader does not trade following a large abnormal return, nor does he or she trade before such a price movement.

Insiders would probably not choose to trade on days with high returns to disguise their trades, because such days are likely to be subject to more scrutiny, not less. Indeed, inside traders do not restrict their trading to days with the highest abnormal returns. I ranked days in the 20 days preceding the public announcement of the information into deciles based upon the day's abnormal return. Insider trading occurred on 17.4% of the days in the highest abnormal return decile, a distribution neither uniform nor highly skewed towards days with large abnormal returns.

Cleary, insider trading does not create all of the price movement on insider trading days. The above analysis suggests, however, that alternative explanations for the price movement are unconvincing.

D. Insider Trading and Stock Price Run-Up Before Takeovers

Many observers cite the stock price gain in the target firm's stock prior to a takeover announcement as evidence of widespread insider trading. This perception of unchecked insider trading prompted Congress to boost insider trading penalties. The assertion that the stock price increase prior to a takeover announcement reflects insider trading, however, rests on the assumption that insider trading is an important contributor to this pre-announcement price run-up. The finding that stock prices move more on insider trading days than on surrounding days links insider trading with price movements, but to gauge the importance of the stock price movements, I investigate whether the price run-up in this sample with known insider trading exceeds the run-up documented in prior takeover studies, and whether the price movement on insider trading days contributes significantly to the run-up.

Panel A of Table XI compares the price run-up before takeover announcements in the insider trading sample to the price run-ups before takeovers documented in Keown and Pinkerton (1981) and Jarrell and Poulsen (1989). Keown and Pinkerton examine 194 successful takeovers during 1975–1978, while Jarrell and Poulsen examine 172 successful cash tender offers during 1981–1985. Panel A displays the cumulative abnormal return over 20 trading days preceding the takeover announcement, the announcement day abnormal return, and the proportion of the total price movement that occurs before the takeover announcement. The total price movement and the pre-announce-

Table XI

The Effect of Insider Trading on the Stock Price Run-Up of Target Firms over a 20 Trading Day Window Preceding the Takeover Announcements

CAR$[-i, -j]$ is the cumulative abnormal return from the $-i$th day (relative to day 0, the announcement day) through the $-j$th day. "Target firm total CAR" = CAR$[-20, 0]$. "Pre-announcement CAR" = CAR$[-20, -1]$. "Announcement day AR" = CAR$[-1, 0]$. "Pre-announcement price run-up = (CAR$[-20, -1]$/CAR$[-20, 0]$). K & P results from Keown and Pinkerton (1981) sample of successful acquisitions. J & P results from Jarrell and Poulsen (1989) sample of successful cash tender offers. SEC sample of detected insider trading is not necessarily mutually exclusive with the K & P or the J & P samples. Insider trading days that also have news announcements counted as news days.

Panel A: Run-Up Across Samples

	K & P Sample Acquisitions 1975–78	J & P Sample Tender Offers 1981–85	Takeovers with SEC Insider Trading Charges 1974–88
Target firm total CAR	25.3%	24.9%	30.6%
Pre-announcement CAR	13.2	11.0	13.0
Announcement day AR	12.0	13.9	17.6
Pre-announcement price run-up	52.1	44.2	42.5
Number of observations	194	172	145

Panel B: Components of 20 Trading Day Run-Up in SEC Illegal Insider Trading Sample

Type of Day	CAR	Number of Days	Percent of Total Pre-Announcement CAR
Insider trading days	5.6	2.5	43.1
News days	3.2	0.5	24.9
Days without insider trading or news	4.2	17.0	32.0

ment price run-up in the sample with detected insider trading appears very similar to that of the other samples. The total price movement is 25% in both the Keown and Pinkerton sample and the Jarrell and Poulsen sample, and 31% in the SEC insider trading sample. The proportion of the price movement that occurs before the takeover announcement is 52% in the Keown and Pinkerton sample, 44% in the Jarrell and Poulsen sample, and 42% in the SEC sample.

Panel B of Table XI separates the components of the pre-announcement price run-up in the SEC sample of illegal insider trading. Most of this pre-announcement run-up occurs on insider trading days. During the 20-day period preceding a takeover announcement, insider trading occurs on 2.5 days, news announcements occur on 0.5 days, and the remaining 17.0 days are without either insider trading or news announcements. Forty-three percent of the pre-announcement price movement occurs on insider trading days,

twenty-five percent occurs on news days, and thirty-two percent occurs on days without insider trading or news announcements.[38]

Thus, the pre-announcement stock price run-up prior to takeover announcements in the SEC illegal insider trading sample is not greater than the run-up documented in the earlier takeover studies. In spite of this result, 43% of the pre-announcement run-up in the 20 days preceding a takeover announcement in the SEC sample occurs on the 2.5 days with insider trading, suggesting that in the SEC sample of illegal insider trading, insider trading *is* an important contributor to the pre-announcement price run-up.

E. How Does Inside Information Become Incorporated Into Price?

The conclusion that insider trading creates the significant price revisions observed on insider trading days is premature without a better understanding of the mechanism by which inside information becomes incorporated into stock price. One possibility is that the insider trading volume signals the presence of an informed trader. Easley and O'Hara (1987), for example, present a model where informed traders prefer to trade large amounts. An alternate, but not mutually exclusive, hypothesis is that other trade characteristics, such as trade frequency or direction, lead to the incorporation of the inside information. In the context of examining the price-setting behavior of the NYSE specialist, Petersen and Umlauf (1990) provide empirical support for this hypothesis. Using detailed transactions data, they report that trade size, direction, and number of trades affect the specialist's quotes.

Unfortunately, the time and transaction size of the insider trades are generally unavailable, precluding a detailed transactions level analysis of how the individual trade characteristics may lead to price revisions.[39] Since the daily volume transacted by the inside trader is available, however, the data do permit broader tests of how the inside information becomes incorporated into price. In particular, I examine whether volume on insider trading days is unusually high, whether the inside trading volume constitutes a large portion of the abnormal volume, and whether prices respond differently to a given amount of volume if the volume originates from an inside trader, indicating that trade characteristics other than aggregate volume create price revisions.

A finding of unusually high volume on insider trading days, if generated by the inside trader, would support the theory that informed traders transmit information by trading large amounts. The descriptive statistics in Table XII

[38] This analysis counts days that have both insider trading and news announcements as news days. Using the dual dummy variable approach of Table V produces almost identical results: 44% of the pre-announcement price run-up occurs on insider trading days. In addition, the results are also robust to using the adjusted insider trading CAR from Table X: 41% of the run-up occurs on insider trading days.

[39] Cornell and Sirri (1991) identify many of the transaction times in one insider trading episode, that of Anheuser-Busch's acquisition of Campbell Taggart.

address whether large insider trading volume leads to price revisions.[40] Table XII reveals that 1.0% of the firm's equity value changes hands on an insider trading day; for comparison, the average NYSE turnover is approximately 50% per year, or 0.2% per day. The median inside trader transacts 0.1% of the equity value; the median ratio of the insider trading volume to the firm trading volume is 11.3%.[41] These statistics suggest that volume traded on an insider trading day is high, but that the inside trader's volume is a small part of the total volume.

Although the insider trading volume appears small relative to the total daily volume, the insider trading could supply the marginal volume necessary to produce abnormal returns. A more explicit investigation of whether the seemingly small level of insider trading volume creates the abnormal returns observed on insider trading days examines the volume on insider trading days relative both to firm-specific historical levels and to volume on the surrounding days, and determines the contribution of the insider trading volume to the abnormal volume.

I estimate abnormal volume with a log market model for volume similar to the market model for returns, adjusting for positive serial correlation by adding lagged firm volume to the model and accounting for known day-of-the-week patterns in volume by including day-of-the-week dummies.[42] The

Table XII

Trading Volume of Inside Traders and Total Firm Volume on Days Insiders Trade: Means and Standard Errors

	Mean Volume Traded by Inside Traders	Total Firm Volume on Days Insiders Trade
Number of shares	9,819	113,909
	(991)	(10,246)
Dollar value	300,023	4,121,533
	(35,603)	(594,327)
Percent of equity	0.12	1.04
	(0.01)	(0.07)

[40] Firm volume data come from Iterative Data Services' *Investment Statistical Listing (ISL) Tapes* and from Standard and Poor's *Daily Stock Price Record*. Insider trading volume data come from public and non-public SEC documents.

[41] The mean ratio is considerably more, 41.7%. The explanation for this difference is that insider trading comprises almost 100% of firm volume for a few observations where firm volume is relatively low.

[42] Ajinkya and Jain (1989) describe the log market model for volume. Mulherin and Gerety (1988) document day-of-the-week patterns in volume. When firm volume equals zero, I set the logged volume equal to zero. The mean adjusted R^2 using only the 150-day estimation period for the specification which does not include lagged firm volume or day-of-the-week dummies is 5%. The modified specification using lagged firm volume and day-of-the-week dummies increases the mean adjusted R^2 to 15%. Durbin h-statistic tests on the new specification affirm that the addition of lagged firm volume eliminates the serial correlation in the error terms. Judge et al. (1985, p. 326), describe the Durbin h-statistic test for serial correlation in the presence of lagged dependent variables.

specification used to detect abnormal volume on insider trading days parallels the OLS regressions used to detect abnormal returns (see equation (1)):

$$\log(v_{it}) = \alpha_i + \beta_i \log(v_{mt}) + \lambda_1 \log(v_{it-1}) + \lambda_2 \log(v_{it-2}) + \delta_1 \text{Mon}_{it} + \delta_2 \text{Tues}_{it} + \delta_3 \text{Weds}_{it} + \delta_4 \text{Thurs}_{it} + \gamma_i \text{Announce}_{it} + \eta_i \text{Inside}_{it} + \sum_{j=1}^{J} \mu_{ij} \text{News}_{ijt} + \varepsilon_{it} \quad (6)$$

where v represents trading volume in shares, i subscripts the individual firm, t subscripts days, m represents the market (represented by the total shares traded on the NYSE, AMEX, or NASDAQ),[43] Mon_{it} is a dummy that equals one on Mondays and zero otherwise, etc., and other variables are defined as in equation (1). In addition to returns over the event period, the regressions incorporate an additional 150 trading days of returns that contribute to the estimates of the market model parameters. To determine whether the inside trader is directly responsible for any abnormal volume, I compute the "Abnormal volume net of inside volume" by using firm volume minus insider trading volume instead of firm volume in the above regressions.

Table XIII displays the average abnormal returns, abnormal volume, and abnormal volume net of insider trading volume on insider trading days, news

Table XIII

Abnormal Returns, Abnormal Volume, and Abnormal Volume Net of Insider Trading Volume on Insider Trading Days, News Days, and Days without Insider Trading or News

The window to estimate the abnormal returns and abnormal volume on days without insider trading or news announcements begins with earlier of first insider trade or news announcement and ends with announcement day. The abnormal returns are repeated from Table X. "Abnormal volume" estimates use a log market model for volume, with lagged volume added to adjust for serial correlation and day-of-the-week dummies added to adjust for day-of-the-week patterns in volume. "Abnormal volume net of inside volume" uses firm volume minus insider trading volume instead of firm volume in abnormal volume calculations. Standard errors in parentheses.

	Insider Trade Days	News Days	Days without Insider Trading or News
Abnormal return	2.31	6.49	0.90
(percent)	(0.32)	(0.94)	(0.28)
Abnormal volume	0.93	1.46	0.65
(percent $\times 10^{-2}$)	(0.09)	(0.20)	(0.80)
Abnormal volume net of inside volume	0.64	1.46	0.65
(percent $\times 10^{-2}$)	(0.10)	(0.20)	(0.08)
(Number of Observations = 131)			

[43] J. Harold Mulherin provided market trading volume data.

days, and days without insider trading or news.[44] The results suggest that the volume traded by insiders differentiates an insider trading day from a surrounding day. Specifically, total volume on an insider trading day is higher than expected, but the insider trading volume constitutes most of the unusual volume. The mean abnormal volume on insider trading days is 0.93 (standard error = 0.09), that is, volume is 93% higher than expected on insider trading days. After subtracting shares traded by inside traders, firm volume is still 64% higher than expected on insider trading days (standard error = 0.10). The cross-sectional standard errors, in parentheses, indicate that abnormal volume differs significantly from zero for both abnormal volume and abnormal volume net of inside volume.

The column labelled "Days without Insider Trading or News" shows that although abnormal returns are small on non-news, non-insider trading days preceding the public announcement, volume is significantly higher on these days. More precisely, abnormal volume of 65% (standard error = 8%) accompanies an abnormal return of 0.90% on non-news, non-insider trading days. Abnormal volume is significantly higher on insider trading days than on surrounding days without insider trading or news. Much of this abnormal volume, however, is attributable to the inside trader. The abnormal volume net of inside volume is 64% on an insider trading day, very close to the abnormal volume of 65% on a non-news, non-insider trading day. Thus, after subtracting the shares traded by inside traders, the volume on insider trading days does not appear significantly different than the volume on surrounding days close to the announcement of the inside information.[45]

The finding that insider trading volume constitutes much of the abnormal volume observed on insider trading days supports the conjecture that insider trading volume induces abnormal returns, but leaves unanswered whether the market identifies the insider trades through trade characteristics or

[44] The abnormal returns are repeated from Table X. Section IV.*C* describes the method used to calculate the abnormal returns and volume on days without insider trading or news.

[45] I also calculated the abnormal volume on days without insider trading or news over a 20-day window preceding the takeover announcement (supra footnote 43). This method produces lower estimates of the abnormal volume on non-news, non-insider trade days. Specifically, volume is 26% higher than expected on non-news, non-insider trading days during this 20-day window, compared with 65% in the original variable length window. The 20-day window method therefore implies that volume is abnormally high on insider trading days even after subtracting insider trading volume.

One explanation for this difference is that the fixed length of the 20-day window dictates that the 20-day window includes days with little price or volume activity. The 20-day window will sometimes underestimate the magnitude of the increased price and volume activity that precedes the public announcement of the inside information. This underestimation will be most serious for the 52 observations which appear in the 20-day window sample but not the variable window sample. In fact, repeating the analysis using the same reduced variable window sample of 131 firms, but with the 20-day window calculations of abnormal volume on non-news, non-insider trading days, confirms this suspicion. Abnormal volume is 32% higher on insider trading days than on days without insider trading or news (standard error = 9%). This estimate falls between the 54% value of the larger 20-day window sample and the −1% value of the reduced sample with the variable window calculations.

simply observes an unusually high level of volume and suspects the presence of informed trading. To explore this issue, I examine whether the market response to a given level of abnormal volume depends on whether the day is an insider trading day. If the level of volume alone signals informed trading, then the price-volume relationship should not depend on whether the day is an insider trading day. On the other hand, if, for example, number of trades, size, or direction differentiate an insider trade from another trade, then price may be more responsive to trading volume on insider trading days than on other days.

To test this hypothesis, I regress the absolute value of abnormal returns on abnormal volume, with slope and intercept dummy variables to represent insider trading days, news days, and days without insider trading or news. The slope in the abnormal volume coefficient is allowed to vary by firm. More precisely, I estimate the following regression:

$$\begin{aligned} |\mathrm{AR}_{it}| = {} & \alpha + \beta_i \mathrm{AV}_{it} + \lambda_1 \mathrm{Inside}_{it} + \lambda_2 \mathrm{News}_{it} + \lambda_3 \mathrm{OtherDays}_{it} \\ & + \lambda_4 \mathrm{Announce}_{it} \\ & + \gamma(\mathrm{Inside}_{it} \cdot \mathrm{AV}_{it}) + \delta(\mathrm{News}_{it} \cdot \mathrm{AV}_{it}) \\ & + \eta(\mathrm{OtherDays}_{it} \cdot \mathrm{AV}_{it}) + \mu(\mathrm{Announce}_{it} \cdot \mathrm{AV}_{it}) + \varepsilon_{it} \end{aligned} \tag{7}$$

where

|AR|	= absolute value of abnormal return
AV	= abnormal volume
Inside	= dummy that equals one on insider trading days
News	= dummy that equals one on news days
OtherDays	= dummy that equals one on non-news, non-insider trading days surrounding the insider trading day beginning with the earlier of the first insider trading day or the first interim news announcement
Announce	= dummy that equals one on the public announcement day

and i subscripts firms $(1, \ldots, 183)$, t subscripts days.

Table XIV displays the estimates of the variables of interest, the slope dummy variables. The mean coefficient on abnormal volume is 0.55% (standard error = 0.08%), which implies that a 100% increase in abnormal volume is associated with an abnormal price movement of 0.55% on average. The slope dummy for insider trading days is 0.83% (standard error = 0.08%), which is greater than the slope dummy coefficient for days without insider trading or news, 0.27% (standard error = 0.04%). Abnormal returns are more than twice as responsive to abnormal volume on insider trading days than on surrounding days without insider trading or news. The results imply that both the amount traded by the insider and additional unspecified trade-specific characteristics lead to the market's recognition of the informed trading.

Table XIV

Relation between Abnormal Returns (AR) and Abnormal Volume (AV)

Abnormal returns calculated using a market model for returns. Abnormal volume calculated using a log market model for volume, with lagged volume added to adjust for serial correlation and day-of-the-week dummies added to adjust for day-of-the-week patterns in volume. "Days without Insider Trading or News" (represented in the regression by the OtherDays dummy) are non-news, non-insider trading days between the earlier of the first insider trading day or the first news announcement and the public announcement of the inside information. Standard errors in parentheses.

	Coefficients of Slope Dummies for Abnormal Volume			
Mean Coefficient of Abnormal Volume	Inside Trading Days	News Days	Days without Insider Trading or News	Public Announcement Day
	All coefficients $\times 10^2$ (standard errors in parentheses)			
0.55	0.83	1.27	0.27	1.52
(0.08)	(0.08)	(0.13)	(0.04)	(0.16)

IV. Conclusions and Future Research

Using a previously unexplored data source, illegal insider trading detected and prosecuted by the Securities and Exchange Commission, this paper examines the stock price effects of informed trading. The analysis suggests that insider trading increases stock price accuracy by moving stock prices significantly. The abnormal price movement on insider trading days is 40 to 50% of the subsequent price reaction to the public announcement of the inside information. The findings are robust after controlling for pre-announcement news leakage and adjusting for price run-up that may occur in the absence of any insider trading. An investigation of potential sample selection bias reveals that the size of the insider-trading-induced price movements does not affect detection, implying that the estimates of these price movements are not severely biased. Moreover, restricting the sample to observations unlikely to create biased estimates still produces large and significant cumulative abnormal returns on insider trading days.

An examination of the insider trading volume explores the mechanism by which inside information becomes incorporated into the price. The investigation reveals that total volume on an insider trading day is higher than expected, but the insider trading volume constitutes most of the unusual volume. The heightened sensitivity of price to volume of insider trading days indicates that trade-specific characteristics, such as trade size, number of trades, or trade direction, as well as the total volume traded by the insider, lead to the incorporation of the inside information into price.

These results have immediate public policy implications to both supporters and opponents of insider trading regulation. First, there are price discovery benefits of insider trading that should be considered when evaluated future

legislation concerning insider trading penalties. Second, the results provide a foundation for the argument that stock price run-ups before takeover announcements reflect widespread insider trading. Calculations of price run-up over the twenty days preceding the takeover announcement reveal that almost half of this stock price run-up occurs on insider trading days, but the amount of total price run-up over the twenty days is similar to the amount of price run-up documented by earlier merger studies.

The finding that informed trading transmits private information also has public policy implications for more general securities market regulation issues. Since trading leads to the incorporation of private information in stock prices, regulation that impedes trading may also result in less informative prices. Thus, regulation designed to decrease stock price volatility, such as the proposed tax on securities transactions, may actually result in noisier, less-informative stock prices.

An area for future research concerns the effect of insider trading on the probability of takeover. Insider trading could decrease the probability of a takeover by reducing the profitability of the raider's foothold stake (the amount the raider may have acquired before being required to file a 13D to disclose ownership). Insider trading could also raise the cost of takeover by increasing the premium offered to stockholders. If the premium is a fixed mark-up over the stock price, insider trading could increase the required premium by driving up the stock price. The welfare loss resulting from such an increase in the cost of takeovers could be substantial. An empirical investigation of takeover premia and their relation to insider trading may help resolve these issues.[46]

Appendix: Information Collected for Each Defendant

Name
Whether civil case filed
Whether administrative action filed
Whether criminal case filed
Type of employer
Occupation
Number of violative transactions
Number of stocks traded in
Profit gained or loss avoided
Whether nominee accounts used
Whether foreign bank accounts/brokerages used
Whether defendant traded, tipped, or both
Whether defendant was an original source of the non-public information or a tippee
Number and type of tippees
Direct and remote tippee profit

[46] The author is currently conducting this research.

Whether defendant helped produce non-public information
Whether defendant could influence announcement timing
Litigation history
Violations alleged in initial complaint
Legal theory used
Penalties
Case origin
Trading information:
  Name of stock(s)
  Exchange traded on
  Type of security (option or stock)
  Transaction date
  Transaction volume ($ and share) aggregated by day
  Transaction profit
  Type of information traded on
  Source of information
  Date information became public

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