THE JOURNAL OF FINANCE • VOL. XLVII, NO. 3 • JULY 1992

The Reaction of Investors and Stock Prices to Insider Trading

BRADFORD CORNELL and ERIK R. SIRRI*

ABSTRACT

Trading by corporate insiders and their tippees is analyzed in Anheuser-Busch's 1982 tender offer for Campbell Taggart. Court records that identify insider transactions are used to disentangle the individual insider trades from liquidity trades. Consistent with previous studies, insider trading was found to have had a significant impact on the price of Campbell Taggart. However, the impact of informed trading on the market is complicated. Trading volume net of insider purchases rose. Contrary to the broad implications of adverse selection models, Campbell Taggart's liquidity improved when the insiders were active in the market, and the insiders received superior execution for their orders.

THIS PAPER EXAMINES INSIDER trading surrounding the 1982 acquisition of Campbell Taggart, an NYSE-traded baking company, by Anheuser-Busch, the nation's largest brewer. News of the impending acquisition was leaked by one of the Anheuser-Busch directors and sequentially transmitted to a small group of individuals that proceeded to purchase a large amount of Campbell Taggart stock. During the criminal and civil litigation that followed this event, insider purchases were identified. We use the court records to isolate individual insider transactions from the flow of background trading, permitting analysis of the market's reaction to the onset of informed trading.[1] Because the insider trading was not revealed to other market participants, the Campbell Taggart incident presents a unique laboratory for studying the dissemination and incorporation of private inside information into market prices.

* Cornell is from the University of California, Los Angeles, and Sirri is from the Harvard Business School. The authors would like to thank Walter Suhre and Anheuser-Busch for allowing us to make use of the insider trading data. Larry Harris graciously provided the Fitch data while he was visiting the New York Stock Exchange. Erik Sirri acknowledges financial support from the HBS Division of Research. We acknowledge the helpful comments and suggestions of Dan Asquith, Jennifer Bethel, Bob Comment, Al Fansome, Bruno Gerard, Stuart Gilson, Larry Harris, Michael Jensen, Josh Lerner, David Meerschwam, Lisa Meulbroek, André Perold, Richard Ruback, Catherine Shenoy, Andrei Shleifer, Sheridan Titman, Peter Tufano, Ivo Welch, Bill Wilhelm, an anonymous referee, and the seminar participants at Harvard Business School and UCLA.

[1] We are grateful to Walter Suhre of Anheuser-Busch for allowing us to make use of the insider trading data. As a condition for using these data, we agreed not to disclose the names of insiders, other than Paul Thayer, and to reveal only those details of the case that can be gleaned from publicly available documents.

Unlike earlier studies that make use of daily insider transactions, this paper analyzes individual insider purchases within the trading day. These insiders had a significant impact on the price, volume, and liquidity of Campbell Taggart shares, but in a manner that is surprising in light of current theoretical models of the consequences of informed trading. Insider purchases bid up the share price of Campbell Taggart, but they did not lead to a widening of the bid-ask spread, as predicted by standard adverse selection models (Bagehot (1971), Copeland and Galai (1983), Glosten and Milgrom (1985), Kyle (1985)). Even more surprising, market liquidity actually rose while the insiders were trading. The insiders also appear to have obtained superior execution for their trades relative to contemporaneous liquidity traders.

We attribute these seemingly anomalous results to the presence of what Black (1986) and DeLong, Shleifer, Summers, and Waldmann (1990) call noise traders. Noise traders, as distinct from liquidity traders, trade on the basis of what they believe, falsely, is special information. Though DeLong et al. (1990) offer technical traders and followers of stock market gurus as examples of noise traders, we focus on "falsely informed traders," who are defined as agents who fail to recognize the extent of the inside information reflected in the market price, and thus incorrectly believe they have superior information. Fundamental analysts who fail to realize that insiders have entered the market are prime candidates to become falsely informed traders.

If falsely informed traders had believed that the original pre-insider trading price of Campbell Taggart was fair, they would have sold the shares to insiders at a small premium above the market price. Such selling reduces the market maker's adverse selection problem because they can broker trades between the truly informed and the falsely informed rather than trading directly with informed buyers. Trading by the falsely informed and other noise traders is consistent with the large rise of the Campbell Taggart volume, net of the insider trades, during the insider-trading period.

Though previous researchers have not had access to a comparable database, a number of other papers have examined the impact of potentially informed trading. Jarrell and Poulson (1989) show that 40% of the total price increase associated with successful tender offers occurs before the first public announcement of a bid or related event. They attribute this run-up to news media rumors and bidders' toehold purchases. They also find that insider trading allegations are correlated with pre-bid price run-ups, but the sign of the correlation is the opposite of what one would expect: there are relatively smaller run-ups in cases where insider trading activity is alleged. They conclude that the prebid run-up may have little to do with insider activity.

In contrast, this paper finds that insider trading in Campbell Taggart caused a substantial price run-up before the tender offer announcement, consistent with the findings of Meulbroek (1990). Using a collection of Securities and Exchange Commission (SEC) files on illegal insider trading before takeover bids, Meulbroek finds that insiders incorporate a large fraction of their information into share prices before the information is made public. She

reports that 44% of the preannouncement price run-up occurs on days in which insiders are trading. However, her data are not sufficiently disaggregated and detailed to allow a trade-by-trade analysis of the impact of insider trading.

Section I reviews the history of Anheuser-Busch's acquisition of Campbell Taggart, explains how the inside information was generated and transmitted, and describes the insider trading data. Section II discusses some empirical implications of models of informed trading. Section III presents the empirical results, including a trade-by-trade analysis of the behavior of Campbell Taggart's stock price in response to the insider trading. The final section discusses the implications of the findings and summarizes our conclusions.

I. The Acquisition of Campbell Taggart by Anheuser-Busch

A. Acquisition History

The history of Anheuser-Busch's acquisition of Campbell Taggart is drawn from publicly available documents filed in the case of Anheuser-Busch Companies v. A. G. Edwards et al. (United States District Court (1988)) and in the case of the SEC v. Paul Thayer et al. (United States District Court (1984)). The SEC case was settled when Thayer consented to pay the U.S. Treasury Department $550,000, an amount based on the trading profits of his friends and tippees.[2] The Anheuser-Busch v. A. G. Edwards case also was settled, but its terms were undisclosed.

In late May 1982, Anheuser-Busch's Policy Committee and its Corporate Planning Department decided to include Campbell Taggart as one of a small number of companies under consideration for acquisition. On June 8, Anheuser-Busch informed its investment banker that it had narrowed the list of possible targets to four firms, including Campbell Taggart. On June 11, Anheuser-Busch retained a law firm specifically to advise it concerning the possible acquisition of Campbell Taggart. Between June 11 and June 22, there were numerous meetings and contacts by telephone among representatives of Anheuser-Busch, its investment banking firm, and its attorneys to discuss the acquisition.

On June 23, Paul Thayer, a director of Anheuser-Busch, attended an Anheuser-Busch board of directors meeting in St. Louis, Missouri, at which the possible acquisition of Campbell Taggart and other companies was discussed. Following the board meeting he kept himself informed of the firm's growing interest in Campbell Taggart.

On June 30, Thayer told a Dallas stockbroker of Anheuser-Busch's impending acquisition of Campbell Taggart. After receiving the information, the stockbroker purchased shares of Campbell Taggart for friends and associates of Thayer and for himself. It was the first purchase of Campbell Taggart by the group of insiders.

[2] In a related suit by the U.S. Justice Department, Thayer pleaded guilty to charges of obstruction of justice and perjury and was sentenced to four years in prison.

On July 6, Thayer, while on vacation in Canada, telephoned the chairman of Anheuser-Busch's board of directors during which the firm's acquisition of Campbell Taggart was discussed. Immediately following that call, Thayer telephoned the same Dallas stockbroker.

Finally, on July 28, Thayer attended a meeting at which the Anheuser-Busch board authorized management to approach Campbell Taggart regarding a merger. After the meeting, Thayer called a close friend of the Dallas stockbroker.

Between June 30 and August 2, the Dallas stockbroker disclosed, by way of private conversations, information regarding the proposed transaction to a group of friends and associates. In response to this information, these individuals purchased Campbell Taggart stock.

By August 2, the increase in Campbell Taggart's stock price and the extraordinary rise in trading volume had caught the attention of the financial community. Given the growing speculation regarding the stock, Anheuser-Busch and Campbell Taggart decided to issue a joint press release on August 3, disclosing their mutual interest in exploring a merger. Soon thereafter, the two firms settled on a final offer price of cash and stock valued at approximately $38 per share, representing a 63% premium over the premerger price on June 1 of $23.25 per share.

An important aspect of this data collection is that the revelation of the asymmetric information was an endogenous event. Anheuser-Busch announced its merger intentions *because* of the price and volume behavior of Campbell Taggart. Informed traders who attempted to trade slowly to protect their information may have failed to obtain their desired quantity of shares because of the unexpected joint announcement of merger talks by Anheuser-Busch and Campbell Taggart.[3]

In the criminal and civil litigation that ensued from the transaction, significant effort was spent tracking down the flow of insider information. The result of the investigation was a list of insider trades, identified by the trader and by the brokerage house through which the trade was cleared. Table I tabulates this trading activity in summary form. A complete list of all insider trades, with the name of the trader and the brokerage firm disguised, is contained in the Appendix.[4] In all, 38 insiders bought a total of 265,600 shares of stock, representing 29% of Campbell Taggart's volume from June 30 to August 2 and 1.8% of its total outstanding shares. None of the shares purchased by insiders were sold until after the August 3 public announcement of the potential merger. The magnitude of insider trading was large compared with past trading volume: insider purchases equaled 121% of the

[3] A related point is that the actions of the insiders were not discovered on the basis of price and volume movements in Campbell Taggart. Their actions were discovered by the SEC in an investigation of suspicious trading in another firm, which in turn caused the SEC to examine the complete trading history of these individuals. This mitigates against having a selection bias in the use of the Campbell Taggart data.

[4] As noted earlier, a precondition for our use of this data is that we keep the names of all traders and brokers confidential.

Table I

Insider Trading Activity in Campbell Taggart from June 30 to August 2, 1982

The columns of the table give the date, the closing price of Campbell Taggart on the NYSE, the total daily trading volume of Campbell Taggart (in thousands of shares), the number of insider trades, the number of insiders who traded, and the total volume of shares purchased by insiders (in thousands), respectively. In all, the insiders bought shares in Campbell Taggart in 124 transactions, acquiring a total 265,600 shares over 23 trading days.

Date	Closing Price	Total Volume (thousands)	Number of Insider Trades	Number of Inside Traders	Insider Volume (thousands)
6/30/82	25.750	38.2	1	1	0.1
7/01/82	27.000	65.6	8	4	9.0
7/02/82	25.750	46.5	0	0	0
7/06/82	25.875	3.8	0	0	0
7/07/82	25.750	35.2	1	1	1.5
7/08/82	26.000	1.8	0	0	0
7/09/82	25.500	4.7	0	0	0
7/12/82	26.250	28.4	2	1	2.9
7/13/82	26.250	12.2	4	1	5.2
7/14/82	27.000	30.2	3	2	8.1
7/15/82	27.000	10.5	1	1	3.8
7/16/82	26.750	46.9	3	2	20.0
7/19/82	26.625	5.2	1	1	0.3
7/20/82	26.375	1.8	0	0	0
7/21/82	26.125	18.1	2	1	5.0
7/22/82	26.750	9.1	9	2	6.1
7/23/82	27.000	32.1	10	7	16.3
7/26/82	27.750	25.2	12	5	21.9
7/27/82	28.250	64.0	13	9	44.6
7/28/82	29.125	90.0	25	15	67.2
7/29/82	28.500	154.1	6	5	23.7
7/30/82	29.000	63.9	14	9	22.3
8/02/82	29.625	128.6	9	5	33.5
8/03/82	30.625	219.0	0	0	0.0
8/04/82	29.500	215.4	0	0	0.0
8/05/82	30.000	195.7	0	0	0.0
8/06/82	30.000	134.6	0	0	0.0
8/09/82	31.750	360.7	0	0	0.0

total Campbell Taggart share volume in March 1982, three months before the leak, and 55% of its average monthly share volume calculated over the prior two years.

The pattern of trading in Campbell Taggart reflected the information flow to the various insiders. Table I shows that as information was passed from Thayer to the various insiders, the number of inside purchases accelerated. There was an initial burst of insider buying following the first leak on June 30, an acceleration following the second leak on July 6, and a final jump about the time of the Anheuser-Busch board meeting on July 28.

B. Extent of the Information Diffusion

The analysis in Section III assumes that all trades not made by one of the 38 insiders are uninformed trades. It is critical to verify the soundness of this assumption. If it is not true, then conclusions based on the estimates of trade informativeness will be incorrect. There are several reasons for believing that there was no direct information leakage to other traders outside of the identified group of 38 individuals. First, our sample arose through the costly and extraordinary effort of Anheuser-Busch in preparation for civil litigation against brokerage firms that employed two of the key insiders. Attorneys for Anheuser-Busch began by deposing all the individuals identified by Mr. Thayer as having received information from him. Anyone identified in those depositions was subsequently deposed. The process continued until all tippees identified in any deposition were questioned. The depositions were then cross-checked for consistency. The process terminated only when attorneys for Anheuser-Busch felt they had sufficient evidence to argue at trial that all insider traders had been identified.

Second, the attorneys also checked for evidence of direct leakage of information regarding the transaction. Their search was based in large part on the paper by Jarrell and Poulson (1989), who discuss a variety of signs that indicate a company is in play.[5] Such signs include filing a Schedule 13D, acquisition of a toehold by a potential bidder, and defensive action, such as poison pills, by the target company. None of these factors were present in the case of Campbell Taggart. The only potential suitor was Anheuser-Busch and it had not purchased a significant toehold because it was planning to negotiate a merger with the company. There was no evidence of rumors, street talk, accumulation by arbitrageurs, or other indications that Anheuser-Busch's intentions had been leaked to the market at large. In addition, Campbell Taggart did not put any kind of anti-takeover measure into place or do anything else to indicate to the market that it was a merger target. 5

Third, the *Wall Street Journal* and the *Dow Jones News Wire* (the *Broadtape*) were searched for news stories or real-time information releases about either Anheuser-Busch or Campbell Taggart during the period from June 1 through August 2, 1982. There were no stories about the possibility that Campbell Taggart was a takeover candidate, nor was there any indication that Anheuser-Busch was considering an acquisition. The only news about these two firms that appeared was related to either dividend announcements, earnings news, or general operations of their respective businesses.

Fourth, the behavior of short interest in Campbell Taggart is consistent also with the hypothesis that the tender offer was known only to a few insiders.[6] The midmonth short interest data are drawn from the Daily Stock Price Record and manually cross-checked against the monthly short interest

[5] At the time of the investigation, the Jarrell and Poulson (1989) paper was in manuscript form.

[6] Short interest is the net number of shares of a security that have been sold short and have yet to be closed out.

figures that appear in The New York Times. The mid-June 1982 short interest in Campbell Taggart was 255,969 shares, whereas July, August, and September figures were 255,406 shares, 6,300 shares, and 100 shares, respectively.[7] These data show that the aggregate short-interest positions remained unchanged in mid-July, when the insiders had been purchasing shares for more than two weeks, but they changed drastically in August, after the merger was announced. This pattern supports the paper's maintained assumption that the inside information resided with a small group of traders.

Finally, the behavior of the Anheuser-Busch stock price is not supportive of the view that the information was leaked directly to the market. Panel A in Figure 1 plots the daily price and volume of Anheuser-Busch's stock during the period from March 1, 1982, to October 29, 1982.[8] Notice that on August 3, 1982, when the merger with Campbell Taggart was announced, Anheuser-Busch's stock price fell from 54 $\frac{1}{2}$ to 49 $\frac{5}{8}$, a drop of 7.89% (net of the market). The price drop at the announcement is statistically significant ($t = 5.22$), which suggests that knowledge of the impending merger was not public information. Furthermore, this drop is large in relation to the announcement day return for other bidders. Mitchell and Lehn (1990) report that for a sample of 401 firms that announced acquisitions over the period 1982–1986, the average announcement day return was only −0.21%. The comparatively large negative return for Anheuser-Busch suggests there was no direct information leakage to the market from the insiders tipped by Thayer, most of whom knew that Anheuser-Busch was the acquirer. If the market had partial information about Anheuser-Busch's intentions as a bidder, the large reaction of −7.89% on the announcement day would have already been reflected in the market price. In contrast, Anheuser-Busch stock price rose 5.4% (net of the market) during the month insiders were trading.

The reaction of Anheuser-Busch trading volume is consistent also with the view that the market was unaware of the firm's interest in Campbell Taggart. Panel A in Figure 1 shows that the daily volume approximately doubles in the period following August 3, 1982. Furthermore, almost four million shares of Anheuser-Busch were traded on August 3. There is no evidence of unusual share volume in Anheuser-Busch during the insider trading period from June 30 through August 2.

Conversely, the behavior of Campbell Taggart's stock price shows strong evidence of insider trading. Panel B of Figure 1 plots its daily price and volume from March 1, 1982 to October 29, 1982. The figure shows that Campbell Taggart stock began to react when the insiders were trading, before the August 3 announcement by Anheuser-Busch. In addition, there is surprisingly little price reaction to the August 3 merger announcement, when the stock price rose only 4.4% net of the market ($t = 2.41$).

[7] No short interest data were reported in either of our sources prior to June 1982.

[8] The S & P 500 was flat or falling slightly during the insider trading period. We explicitly control for market movements in the analysis in the next section.

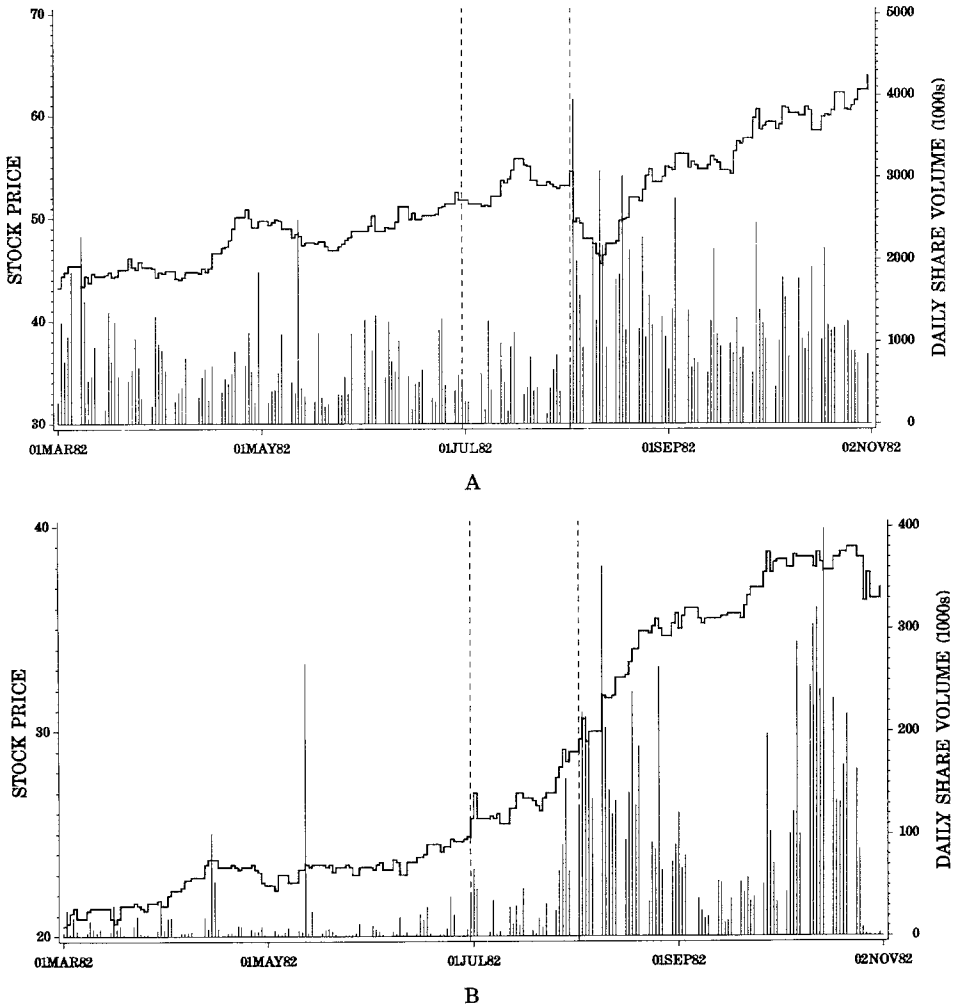


Figure 1. Daily price and volume for Anheuser-Busch and Campbell Taggart from March 1 to November 2, 1982. Panel A plots the Anheuser-Busch daily stock price as a continuous curve which is read off the left-hand axis. The Anheuser-Busch daily volume data (in thousands of shares) are plotted as vertical lines rising from the bottom of the plot and are read off the right-hand axis. Panel B plots the analogous data for Campbell Taggart, corrected for stock splits. Insider trading in Campbell Taggart commenced on June 30, 1982. Anheuser-Busch and Campbell Taggart issued a public statement about their merger discussions on August 3, 1982.

To further detail the actions of insiders, Figure 2 plots the total volume in Campbell Taggart around the insider-trading period. The cross-hatched area below the volume line represents the portion of volume due to insider purchases. There are two striking features of this plot. The first is the large

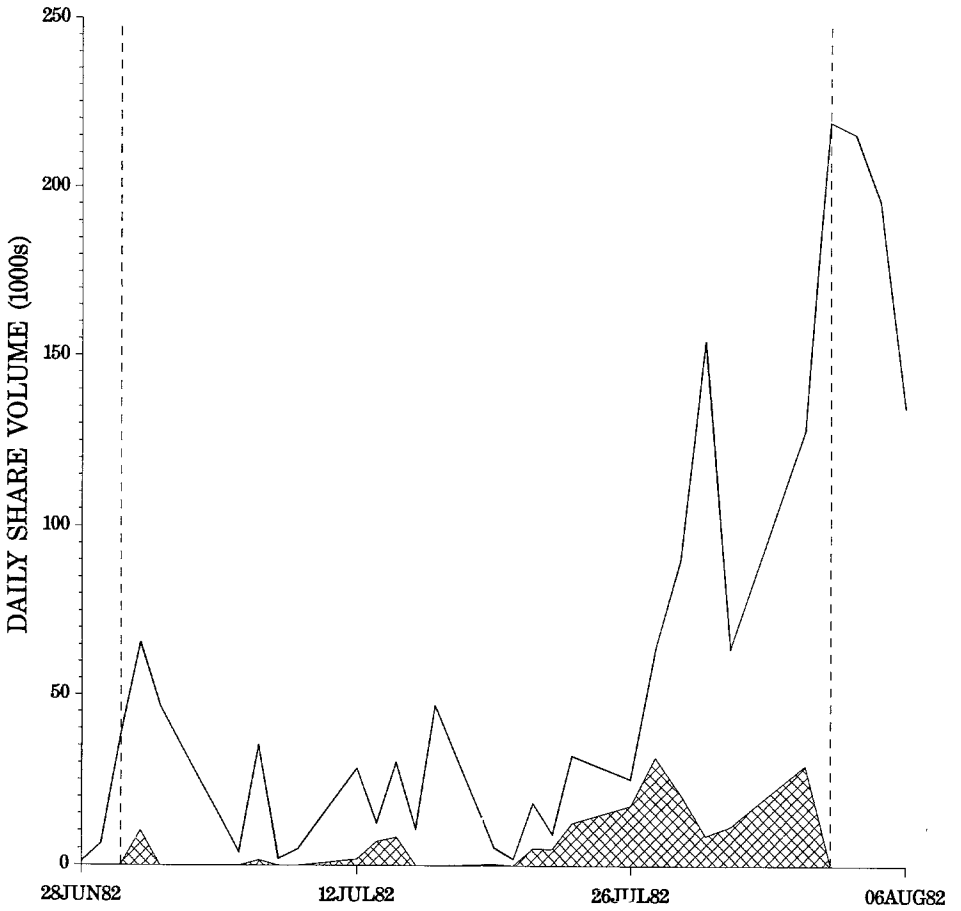


Figure 2. Daily trading volume of Campbell Taggart between June 28 and August 6, 1982. The solid black line represents the total daily volume in thousands of shares. The cross-hatched area represents the portion of trading volume due to the group of 38 insiders. Insider trading commenced on June 30 and ended on August 3 when Campbell Taggart and Anheuser-Busch publicly announced their merger interests. These dates are indicated by the dashed vertical lines.

relative magnitude of insiders' purchases around July 26. Insiders were trading a significant fraction of the shares over this period. The second feature is the general rise in noninsider trading over this period, especially before the merger announcement on August 2.

Overall, these data suggest that the market had no knowledge of Anheuser-Busch's plan to acquire Campbell Taggart. It appears, therefore, that there was no direct leak of the information. The only information available to market participants, other than the insiders, was that which could be inferred from the market impact of insider trades.

II. Empirical Implications of Models of Informed Trading

The debate regarding insider trading was initiated by Manne (1966), who argued that insider trading provides an incentive for managers to release information and leads to more accurate security valuation. However, Manne's work does not address microeconomic questions regarding how insider information comes to be reflected in market prices and the effect insider trading has on other market participants. More recently, this question has been investigated in a series of theoretical papers based on an asymmetric information paradigm. The papers, including Copeland and Galai (1983), Glosten and Milgrom (1985), Kyle (1985), Easley and O'Hara (1987), and Admati and Pfleiderer (1988, 1989), model the reaction of observable market parameters to the onset of informed, or insider, trading. The market is generally assumed to contain three types of agents: liquidity traders, informed traders, and market makers. Liquidity traders transact for reasons that arise outside the financial markets, such as the need to fund purchases of goods and services, and may exercise limited strategic discretion over the timing of their trades (Admati and Pfleiderer (1988, 1989)). Informed traders transact on the basis of information that is not known to other traders in the market. The market maker is assumed both to establish prices each period and to take positions, as necessary, to balance supply and demand at those prices, subject to the constraint that his or her expected profits are zero.

These models predict that as the quality or importance of the information possessed by insiders improves, the bid-ask spread tends to widen. The intuition behind this result is straightforward. Because the spread compensates the market maker for the cost of trading with informed agents, the greater the informational advantage the insiders have over the market maker, the greater the adverse selection problem, and the wider the spread. The market maker makes inferences about the likelihood of informed trading by observing the order flow. If he perceives an increase in the probability of informed trading, the market maker will widen the bid-ask spread as protection and as compensation for the informational disadvantage.

Similarly, the adverse selection models predict that market liquidity will fall as the intensity of informed trading rises, where liquidity is defined as the number of shares that can be traded in the market for a given change in stock price. The intuition is similar to that expressed for the widening of the bid-ask spread. When informed agents are trading, the market maker attaches more importance to the arrival of an order in computing the conditional price of the security. Thus, when a buy order arrives, because it may have come from an informed trader with positive information, the market maker raises his or her posterior assessment of the security's value and therefore raises the price. Conversely, the price is lowered when a sell order arrives. Therefore, when informed traders are perceived to be present in the market, a trade of a given quantity will move prices further, ceteris paribus. In an empirical study of market liquidity around trading halts, Gammill, Sirri, and Fleming (1992) find support for the prediction that market makers

increase their sensitivity to the order flow as the likelihood of informed trading rises.

One interpretation of these models is that when the likelihood of informed trading rises, the market liquidity should fall and the bid-ask spread widen. To the degree that market makers can statistically distinguish informed from uninformed trades, either by trade size (Easley and O'Hara (1987), Hasbrouck (1988)) or time of day (Harris (1986), Admati and Pfleiderer (1988)), those orders deemed more likely to be informed should suffer the lowest liquidity and the poorest execution. Using NYSE transactions data, Sirri (1991) finds empirical support for the information effects of trade size on quote revisions and bid-ask spread width.

Finally, there is an empirical question about the order process of informed traders. If private information becomes widely disseminated, it loses its value to the informed agents. Therefore, in the process of trading, the informed strive both to maintain the privacy of their information and to obtain good execution for their trades. They may do this by trading at certain times of the day, as hypothesized by Admati and Pfleiderer (1988), or by strategically selecting the size of their trades, as hypothesized by Kyle (1985) and Easley and O'Hara (1987). Also, because of the risk that their private information may become public, insiders are generally assumed to use market orders, as opposed to limit orders, to ensure immediate execution of their orders.

Though the models are too stylized to be tested directly using the Campbell Taggart data, they suggest areas of potential interest. In particular, they indicate that it is worthwhile to investigate the impact of informed trading on market liquidity, the bid-ask spread, and the quality of trade execution. Each of these issues is addressed in the following sections.

III. Empirical Analysis

A. Data Description

The empirical analysis blends the actual insider trade data with a time series of trades from the Francis Emory Fitch Corporation. The Fitch data consist of the time of day (to the nearest minute), trade size, and price of the individual transactions in Campbell Taggart from December 1, 1981, through November 2, 1982, when the stock delisted.

To analyze the effects of informed trading, the trades of insiders were manually identified from within the sequence of trades reported by Fitch. For each insider transaction, the data, the price, and the quantity traded are known, but not the time of the trade. For a majority of transactions the price and quantity serve to uniquely identify the trade within the day. However, there are insider transactions that cannot be unambiguously identified within the background flow of trading, particularly in the later portion of the insider trading period, when total trading volume rises sharply. If insider trades cannot be assigned unambiguously, they are omitted from that portion of the

analysis which relies on such an assignment.[9] In all, 78 of the 124 insider trades are uniquely assigned to transactions in the Fitch data. Additionally, there are no instances in which the price/quantity insider trade data are inconsistent (i.e., insider trades that could not be traced) with the transaction data.

Though the Fitch data provide the price of each trade, they do not indicate whether a trade is initiated by a buyer or a seller, nor do they include the bid or ask quotations. Such information is required to estimate the bid-ask spread and the market liquidity. The buy/sell assignment is accomplished by using an algorithm based on "ticks" described in Lee and Ready (1989). The algorithm is validated against a matched sample of data containing bid and ask quotations, and is found to correctly assign 85% of the trades.[10]

Before proceeding to the primary analysis, we examine an assumption of this paper and of most adverse selection models (Kyle (1985), Admati and Pfleiderer (1988)) that informed traders, in an effort to obtain immediacy, purchase shares via market orders as opposed to limit orders. Market makers are generally assumed to be trading *with* the informed, via market orders, as opposed to competing *against* them, via limit orders. However, the data tabulated in Table II suggest that the order placement strategy of the insiders was not limited strictly to market orders. Ten out of 78 of the orders were executed in multiple trades, or "fills," which are the number of separate trades required to execute a single order. Presumably, these multiple fills are due to the use of limit orders by insiders.[11] As an example, an insider might place a limit order to buy 3,000 shares at a specified price P. Eventually, this limit order becomes the highest bid in the market. A market sell order arrives for 1,200 shares, which will execute against the limit buy order at price P. At some later time, another market sell order arrives for 1,800 or more shares. This second trade will go off at P as well, so that the original limit order of 3,000 shares is executed in two fills.

Table II details the occurrence of multiple fill orders in our sample, along with the mean order size at each fill level. Note that this table is partitioned by *order* size, not *trade* size. Hence, the example above would be counted as a "two-fill" order for 3,000 shares. These data show that at least 13% of the insider trades originate from limit orders, contrary to the standard assumption that insiders' demand for immediacy precludes their use of orders whose execution is uncertain. Furthermore, the frequency of 13% probably understates the relative use of limit orders because: a) some fraction of the one-fill orders may arise from limits, and b) limit orders, which are harder for us to

[9] A significant portion of the analysis did not rely on precise intraday identification of the insiders' trades. In such cases, it was enough to know the price, date, and trade size of insiders.

[10] A detailed analysis of the tick-based assignment algorithm and its validation is available from the authors upon request.

[11] This execution pattern could also result from floor traders who execute price-contingent standing orders they hold on behalf of their clients. For our purposes, these are effectively limit orders.

Table II

Execution of Insider Orders for Campbell Taggart from June 30 to August 2, 1982

The 78 orders described in the table are a subset of the 124 orders placed by insiders. The trades which are executed in response to these orders are uniquely identifiable in the transactions data. "Fills" are the number of trades required to execute a single order. For these data, 13% of the orders required two or more fills for completion.

Number of Fills	Frequency	Average Order Size
1	68	1,979
2	7	964
3	1	700
4	1	1,000
5	1	4,000

identify in the data, may be disproportionately represented in the set of insider trades that are unassigned.

Table III presents summary information on the trading of both insiders and all other traders as a function of the time of day and the month of the year. Here and throughout the paper, the month of July is extended to cover the insider period from June 30 to August 2. Therefore, three trading days are added to July, whereas one is subtracted from June and two from August. The first thing to notice in Table III is the large volume of shares traded by the insiders. The number of shares they purchased in July 1982 exceeds the total monthly trading volume in six of the seven preceding months. Thus, the demand for Campbell Taggart shares by the insiders is clearly nontrivial.

Insider trading may be associated with a greater concentration of total trading if insiders are strategically masking their trades in order to lower execution costs. To consider this possibility, both the insider trades and other trades are partitioned by hour. Table III also reports the p-values from tests of the hypothesis that the average hourly trading volume from noon to 2 P.M. is equal to the average trading volume over the other four trading hours of the day. The far right column of Table III, which totals the hourly trading volume across months, shows that in the aggregate Campbell Taggart has a statistically significant "U"-shaped daily trading volume pattern: trading is highest at the beginning and end of the day. However, the column July(I) shows that the insiders do not trade exclusively at the beginning or the end of the day. Though they appear to trade more heavily in the morning, we cannot reject the hypothesis that their trading volume is equally distributed throughout the day.

An interesting feature of this data collection is that it demonstrates that insiders do attempt to hide their identity when executing trades. The table in the Appendix shows that 5 of the 38 insiders used more than one broker for

Table III

Hourly Share Volume for Campbell Taggart from December 1, 1981 to August 31, 1982

Entries in the table are the total share volume (in hundreds of shares) traded during the indicated month and hour. The column July (N) reports the July trades for noninsiders, and the column July (I) reports the July trades of insiders. For the purposes of this analysis, the month of July is defined to run from June 30 to August 2. The far right-hand column Total (N) tablates the trading volume of noninsiders from December through August. The *p*-value is the significance level of a test for "U-shaped" daily trading volume. The test compares the average trading volume from 12 P.M. through 2 P.M. to the average volume in the other four hours of the trading day.

Time of Day	December	January	February	March	April	May	June	July (N)	July (I)	August	Total (N)
10–11 A.M.	435	385	369	318	1,212	176	567	1,744	627	3,970	9,176
11–12 A.M.	382	96	261	207	326	509	189	1,576	601	5,767	9,313
12–1 P.M.	109	99	225	562	533	125	413	774	316	4,054	6,894
1–2 P.M.	72	45	392	526	162	151	234	449	283	2,716	4,747
2–3 P.M.	225	106	395	201	173	114	95	963	126	4,715	6,987
3–4 P.M.	347	613	299	145	267	105	192	973	332	5,847	8,788
Unmatched Insider Trades									371		
Total volume	1,570	1,344	1,941	1,959	2,673	1,180	1,690	6,480	2,656	27,069	45,905
p-value	0.004	0.020	0.872	0.023	0.536	0.311	0.629	0.032	0.491	0.05	0.001

their executions. The proportion is even greater considering that only 24 of the 38 insiders traded more than once. A clear example of this behavior is seen on July 30, when trader T4 executed trades with brokers B6, B7, and B9 all on the same day. This behavior may be due to both the desire to evade the scrutiny of the SEC as well as the desire to receive good executions for the orders.

B. Effect of Insider Trading on Daily Prices of Campbell Taggart

Before analyzing the trade-by-trade data, daily price changes are examined to determine the macroscopic effect of insider trading on share price. If the insiders are incorporating information as they trade, then prices should behave differently on days when insiders are active in the market. To see if insider trading is affecting prices, the following augmented market model for daily returns is estimated:

$$R_{\mathrm{CTI},t} = a + bR_{mt} + D_1\mathrm{INPER}_t + D_2\mathrm{IDAY}_t + D_3\mathrm{IFRACTION}_t + e_t. \quad (1)$$

In equation (1), $R_{\mathrm{CTI},t}$ is the daily return on Campbell Taggart; R_{mt} is the equally weighted market proxy; INPER_t is a dummy variable that is equal to 1 in the insider period (June 30 to August 2, 1982), and 0 otherwise; IDAY_t is a dummy variable equal to 1 if any insiders trade shares on day t, and 0 otherwise; and $\mathrm{IFRACTION}_t$ is the fraction of Campbell Taggart daily volume attributable to insiders on day t.

The regression is estimated for the period from June 1, 1980 through November 2, 1982 and the results are reported in Table IV. When only the dummy variable for the period of insider trading, INPER_t, is used as an explanatory variable, its coefficient, D_1, is positive and (marginally) significant as expected. This is consistent with the idea that insiders, buying on the basis of their favorable information, drive the price of Campbell Taggart up during this period. Somewhat surprising is the result of the second specification in line two of Table IV, which adds IDAY_t, the dummy variable for active insider trading days, to the regression model. The coefficient D_2 is positive and significant. However, the INPER_t coefficient for the 1-month insider period, D_1, is now negative and marginally significant. The excess returns on Campbell Taggart occur only on days when insiders trade, consistent with the findings of French and Roll (1986) and Meulbroek (1990). There is no evidence of a "contagion" effect, which might occur if the trading activity of insiders induces others to buy. Had the insiders tipped their hand to the market, the stock price presumably would have risen more or less continuously throughout the insider trading period. The results of Table IV show that such is not the case. On average, prices rise on days when insiders are buying, and they fall or remain constant on other days. The final specification in Table IV replaces the IDAY_t dummy with $\mathrm{IFRACTION}_t$, a parametric representation of the volume of shares traded by insiders. The findings, reported on line three, do not change significantly: Campbell Taggart prices

Table IV

Regression of Daily Campbell Taggart Returns on the Market Index and Variables Which Control for the Trading Activity of Insiders for the Period July 1, 1980 to November 2, 1982

$$R_{\mathrm{CTI},t} = a + bR_{mt} + D_1\mathrm{INPER}_t + D_2\mathrm{IDAY}_t + D_3\mathrm{IFRACTION}_t + e_t$$

$R_{\mathrm{CTI},t}$ is the daily return of Campbell Taggart and R_{mt} is the equally weighted market index, where both variables are expressed as a percentage. INPER_t is a dummy variable equal to 1 if t is in the insider period (June 30–August 2) and 0 otherwise. IDAY_t is a dummy variable equal to 1 if any insiders trade shares on day t and 0 otherwise. $\mathrm{IFRACTION}_t$ is the percentage of Campbell Taggart volume that was traded by insiders on day t. The t-statistics are shown in parentheses.

Intercept	Beta	Insider Period Dummy	Insider Day Dummy	Insider Fraction Dummy		
a	b	D_1	D_2	D_3	R^2	F
0.108	0.468	0.674			0.044	13.8
(1.43)	(5.00)	(1.75)				
0.107	0.475	−1.18	2.66		0.061	13.0
(1.43)	(5.13)	(−1.72)	(3.27)			
0.107	0.474	−0.084		0.0041	0.052	11.0
(1.43)	(5.10)	(−0.16)		(2.31)		

rise only on days when insiders purchase shares. Thus, the basic results are robust with respect to the specification of insider trading.

C. Bid-Ask Spread Behavior

This section examines the impact of insider trading on the bid-ask spread for Campbell Taggart. Because the bid-ask spread is not directly observable in our data, it must be estimated. Two techniques are used: Roll's (1984) serial covariance measure and a direct measure based on nonzero price changes. The Roll measure is simply

$$\mathrm{BAS} = 2\ Sqrt(-\mathrm{Cov}(dP_t, dP_{t-1})) \tag{2}$$

where BAS is the bid-ask spread and $dP_t = P_t - P_{t-1}$ is the price change between transactions at t and $t - 1$. As Roll notes, this estimate is independent of the time between observations of the price. All that is required is that the expected price change is 0. It is possible (and is, in fact, the case) that the sample serial covariance will be positive over some periods, which causes the estimated bid-ask spread to be undefined.

The second, or "direct," method of estimating the bid-ask spread is implemented as follows. Based on the buy/sell algorithm, each transaction is labeled with either an "*S*" if it is seller initiated, or a "*B*" if it is buyer initiated. A series of trades can therefore be represented as a series such as "*BBSBSSB*" and so on. Each time the assignment changes from a *B* to an *S*

or vice-versa, the price change is calculated. The absolute value of the series of price changes is averaged during the time period to estimate the bid-ask spread. Note that both this technique and the Roll procedure measure the *effective*, as opposed to the *quoted*, spread. The effective spread will be narrower than the quoted spread for two reasons. First, trades may execute within the quoted bid-ask spread if either there are standing orders being worked by floor brokers or the specialist elects to improve upon the current quotes. Second, revisions in the quotes lead to a narrower effective spread (Stoll (1989)). For instance, if a purchase occurs at the ask at time t, following the purchase the quoted bid and ask prices will rise so that a subsequent sale at time $t + 1$ occurs at a higher bid price than the bid quoted at time t, causing the effective or realized spread to be less than the quoted spread.[12]

The two bid-ask spread estimates, aggregated by month, are presented in Figure 3. Each pair of bars in the figure represents the estimates of the bid-ask spread for a single month using these two measures. The insider trading period is contained in the month of July. Neither of these measures appears to increase appreciably over this time period. In fact, with the exception of some possible narrowing of the direct measure of the spread in August after the merger announcement, these data show little pattern at all. Though not presented here, similar results are obtained when the spreads are estimated on a weekly basis.

The result contrasts with the predictions of adverse selection models. Because of losses to informed traders, the models predict that the market maker widens the bid-ask spread to increase revenues from liquidity traders. One explanation for this discrepancy is that our estimates of the spread are too noisy to detect any variation. Another explanation that is not inconsistent with the adverse selection models is a commensurate increase in the arrival of noninformed traders. As Figure 2 and Table III both show, the volume of noninformed trading rose sharply while insiders were buying. Thus, the informed trading attracted other noninformed volume. This induced volume ameliorated the market maker's adverse selection problem. Not only do these traders provide additional revenue to the market maker by paying the spread, they are more likely to cross-trade with the informed agents directly, freeing the market maker from his obligation to participate in the potentially informed trading.

The reason the noninformed traders arrive to transact is unclear. They may be drawn by tape-watching practices. Or, as we discuss in more detail below, they may be what Treynor (1989) refers to as value-based traders. These are individuals who, though uncertain about a security's exact price, will sell shares if the price rises above an "ask" price boundary determined by fundamental analysis, and will conversely buy shares if the price falls below a value determined "bid" boundary. Note that as the second and third specifications of the regression in Table IV demonstrates, this induced unin-

[12] See Stoll (1989) for a discussion of the differences between these spreads.

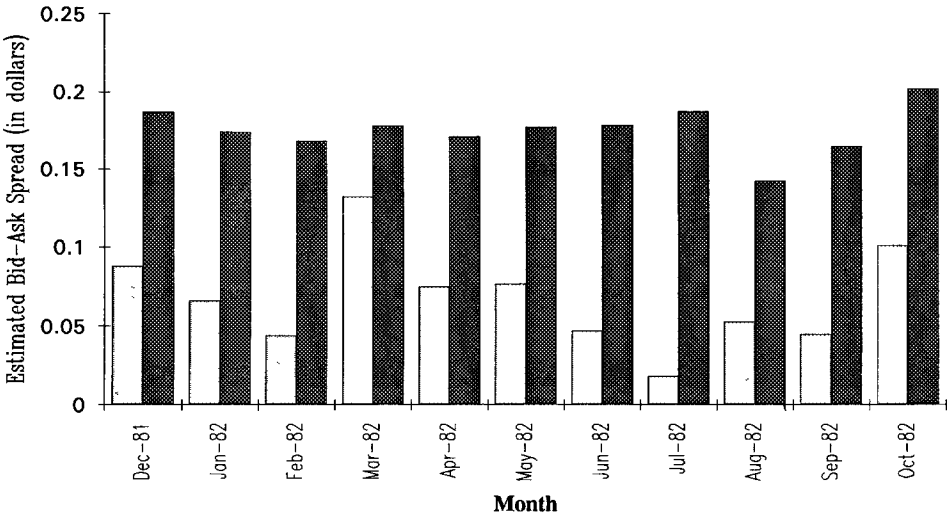


Figure 3. Monthly estimates of the dollar value of the bid-ask spread of Campbell Taggart from December 1981 to October 1982. The spread is estimated using two methods. The lighter bars represent the value of the spread calculated from the Roll (1984) serial covariance measure. The darker bars represent an estimate of the spread computed from the absolute value of the average price-change between a buy and a sell.

formed volume did not incorporate any of the inside information into the price of Campbell Taggart.

D. Market Liquidity and the Costs of Trading

One measure of market liquidity is the price change induced by a trade of a given number of shares. By this measure, a relatively liquid market is one that can absorb a large number of shares at the same price that would prevail for a small order. As discussed above, some theoretical models (Admati and Pfleiderer (1988)) suggest that market liquidity is diminished by insider trading. To examine how insider trading affects the liquidity of Campbell Taggart stock, the method of Glosten and Harris (1988) is employed. Retaining their notation, define Q_t to be an indicator variable, taking on a value of 1 if a trade at time t is a purchase and -1 if it is a sale. Let V_t be the volume of shares traded at time t. Let P_t be the observed transaction price at time t, and define D_t to be equal to $(P_t - P_{t-1})$. Successive price changes may therefore be modeled as

$$D_t = c_0(Q_t - Q_{t-1}) + z_0(V_t Q_t) + e_t \tag{3}$$

where c_0 and z_0 are estimated from the regression. The first term on the right-hand side of equation (3) involves a difference in the Q_t terms and reflects the bid-ask "bounce" that would be observed on an order of infinitesimal size. Glosten and Harris (1988) associate this parameter with fixed

ordering costs; it is the effective bid-ask spread for the smallest possible trade. The second term on the right reflects the size of the order, V_t and is associated with the adverse selection component of the spread. A large value for z_0 corresponds to an illiquid market. The per share transaction cost due to bid-ask spread and market impact for a trade of size V_t is $(c_0 + z_0 V_t)$. The cost is computed relative to the midpoint of the effective bid-ask spread.

The results in Table IV suggest that the coefficients of equation (3) may not be constant over the insider period. The table also suggests that the identity of the trader may play a role in the market response to trading. To capture these differences in a framework like equation (3), the regression is augmented to include interaction terms for calendar time and trader identity. The equation estimated is:

$$\begin{aligned} D_t = {} & c_0(Q_t - Q_{t-1}) + z_0(V_t Q_t) \\ & + c_1 \,\mathrm{INPER}_t(Q_t - Q_{t-1}) + z_1 \mathrm{INPER}_t(V_t Q_t) + \\ & + c_2 \mathrm{POST}_t(Q_t - Q_{t-1}) + z_2 \mathrm{POST}_t(V_t Q_t) + \\ & + c_3 \mathrm{ITRADE}_t(Q_t - Q_{t-1}) + z_3 \mathrm{ITRADE}_t(V_t Q_t) + e_t. \end{aligned} \tag{3a}$$

Regression (3a) is estimated over the 11-month period from December 1, 1981, to November 2, 1982. Interaction terms with three dummy variables divide the trades into three groups of interest. INPER_t is a dummy variable that is equal to 1 if the trade at time t occurs in the insider period (June 30–August 2) and 0 otherwise. This assignment is made without regard to whether the trade was actually executed by an insider. POST_t is a dummy variable for the post-insider trading period equal to 1 if the trade t occurs between August 3 and November 2, 1982, and 0 otherwise. ITRADE_t is equal to 1 if the trade t is by an insider, and 0 otherwise. This specification allows the fixed and adverse selection cost components to be estimated separately for each of the three combinations of time period and trader identity. Trade quantities are divided by 10,000 to make the table easier to interpret.

Initially equation (3a) is estimated without the ITRADE_t terms. The results, reported in the first line of Table V, are somewhat surprising. Relative to the coefficients estimated for the preinsider period, c_0 and z_0, neither the fixed component of the spread, c_1, nor the adverse selection measure, z_1, rise during the time when insiders are trading. In fact, the c_1 term, associated with fixed ordering costs, drops significantly when the insiders are trading. As a result, the cost of trading falls over the month-long period when insiders are active in the market. In the preinsider period, the trading cost, $(c_0 + z_0 V_t)$, is approximately 15.2 cents per share for a 10,000 share order. During the insider period, this cost falls to 13 cents. In the period following the insider trading, from August 3 forward, both c_2 and z_2 are negative and statistically significant, and the cost falls still further to 11 cents per share, indicating that market liquidity rose relative to the preceding periods.

The somewhat surprising result that market-impact trading costs fall during the insider period may be due to the reaction of uninformed volume to

Table V

Regression Estimates of Market Liquidity Using Transaction Data for Campbell Taggart from December 1, 1981 to November 2, 1982

$$D_t = c_0(Q_t - Q_{t-1}) + z_0(V_tQ_t) + c_1\text{INPER}_t(Q_t - Q_{t-1}) + z_1\text{INPER}_t(V_tQ_t) + c_2\text{POST}_t(Q_t - Q_{t-1}) + z_2\text{POST}_t(V_tQ_t) + c_3\text{TRADE}_t(Q_t - Q_{t-1}) + z_3\text{ITRADE}_t(V_tQ_t) + e_t$$

The data are 3939 individual trades (price and quantity) of Campbell Taggart. D_t is the price-change between trades at time t and $t-1$. Q_t is an indicator variable equal to 1 if the trade at time t is a buy and -1 if it is a sell. V_t is the size of the trade at t, in units of 10,000 shares. INPER_t is a dummy variable that is equal to 1 if the trade at time t occurs in the insider period (June 30–August 2) and 0 otherwise. This assignment is made without regard to whether the trade was actually executed by an insider. POST_t is a dummy variable for the post-insider trading period equal to 1 if the trade t occurs between August 3 and November 2, 1982, and 0 otherwise. ITRADE_t is equal to 1 if the trade t is by an insider, and 0 otherwise. The t-statistics are shown in parentheses.

		Insider Period		Post-insider Period		Insider Trades	
c_0	z_0	c_1	z_1	c_2	z_2	c_3	z_3
0.085	0.067	−0.015	−0.005	−0.011	−0.031		
(33.15)	(5.58)	(−3.24)	(−0.32)	(−3.25)	(−2.43)		
		$R^2 = 0.445$		$F = 526.6$			
0.085	0.067	−0.006	0.023	−0.011	−0.031	−0.070	−0.056
(33.40)	(5.62)	(−1.10)	(1.24)	(−3.27)	(−2.45)	(−6.09)	(−2.17)
		$R^2 = 0.454$		$F = 408.0$			

insider trading. Figures 1 and 2 show that volume rises significantly both during and after the merger announcement. These additional trades add liquidity to the market. The increase in volume from noninsiders means that the specialist need not take the contra side of each trade, and his adverse selection costs decline. If the uninformed do not fully appreciate the presence of the informed trading, they will unwittingly (and uneconomically) supply liquidity to the market.[13]

The rise in liquidity in the insider period is remarkable in light of the quantity of shares traded by the insiders. This group of 38 individuals purchased more than a typical month's worth of share volume between them. Yet the effects of their trading do not appear to lessen the market's depth. If the cost of adding an additional share to an order is the marginal cost of trade size, then this marginal cost falls while insiders are active.

To test the robustness of this result, transaction costs for insiders and for noninsiders are estimated separately. To the degree that the insiders cannot

[13] Another possibility is that both the rise in liquidity and the increase in uninformed trading are caused by some unknown factor.

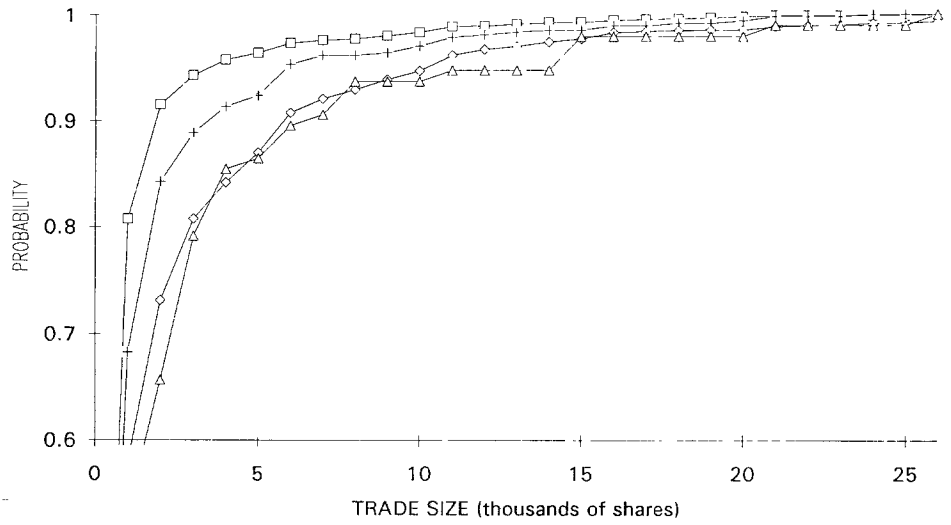
perfectly mask their identities, one expects to see higher trading costs for the informed agents' purchases of Campbell Taggart. To test this, the ITRADE_t terms are included in the regression of equation (3a). These coefficients will measure the incremental trading costs that insiders bear relative to the uninformed. Of course, by definition, this differential can be calculated only during the insider period.

The results are reported on the second line of Table V. Both the fixed ordering cost and the adverse selection cost measures, c_3 and z_3, respectfully, are negative and significant, meaning that, relative to noninsiders, the insiders pay both lower fixed costs of trading as well as lower market impact costs during the one-month period in which they are trading in Campbell Taggart. In this case, insiders' total transaction costs, measured by $(c_0 + c_3) + (z_0 + z_3)V_t$, fall to 4.2 cents per share for 10,000 share trades. Insiders are receiving superior executions relative to both contemporaneous liquidity traders and relative to pre-July 1982 traders.

The second specification also reveals that the transaction costs of noninsiders have actually risen during the insider period. At the level of a 10,000-share trade, the pre-July cost was $(c_0 + z_0V_t) = 15.2$ cents per share. Once the insider transactions are controlled for in the last two columns of Table V, the noninsider trading costs rise to $(c_0 + c_1) + (z_0 + z_1)V_t = 16.9$ cents per share. Thus, the benefits of the liquidity increase indicated by the first regression in Table V are enjoyed only by the informed agents. The liquidity traders are actually incurring higher execution costs during this period.

It is possible that our linear specification of the regression in equation (3a) might misrepresent the true price effects of insider trades. To investigate this possibility, the raw trade size distributions for both insiders and others during selected periods are displayed in Figure 4. The graph plots the cumulative distribution of trade size for four groups of traders. The squares represent trades that occurred between December 1, 1981, and June 30, 1982, the period before insiders began trading. The plus signs are the trades by noninsiders during the insider period. The diamonds are the post-announcement trades which occurred between August 3 and November 2. Finally, the triangles represent the insiders' trades. From the plot, we can see that the insiders' cumulative distribution function for trade size plots below the others, indicating that their trades are generally larger then average. However, the difference is slight. The statistics below the chart document that though the mean trade size of insiders is 2,339 shares, almost double the 1,361 shares of liquidity traders for the same period, the median trade size of insiders lies well within the interquartile range of the liquidity traders. Thus, most of the insiders' trades are of median size, while a few large transactions increase the mean. It is therefore unlikely that the parameterization of the regression model is driving the results.

The final measure of trading costs and liquidity decomposes insiders' trades by the broker who handled the order. If some brokers possess either superior execution skills or are particularly adept at handling repeated large orders, effective trading costs may differ across brokers. To search for these



Trade Size Parameters	(Pre-insider) 12/1/81 to 6/29/82	(Liquidity) 6/30/82 to 8/2/82	(Insiders) 6/30/82 to 8/2/82	(Post-insider) 8/3/82 to 11/2/82
Mean	866	1361	2339	2096
Standard Deviation	2186	2844	4275	4068
Median	300	500	700	550
First Quartile	100	200	200	200
Third quartile	700	1000	2000	2000

Figure 4. Cumulative distribution function for Campbell Taggart trades between December 1, 1981, and November 2, 1982. Trade size is expressed in thousands of shares. The trades are subdivided into four data series. The square boxes represent all trades in the pre-insider period, from December 1, 1981 to June 29, 1982. The plus symbols are the noninsider trades in the insider period from June 30 to August 2. The triangles are the insider trades in the same period. The diamonds are liquidity trades after August 2. Statistics on trade size distribution are tabulated below the plot.

effects, we augment equation (3a) to include interaction terms for the six most active brokers in our sample. Thus the variable BROKER_j takes on a value of 1 if the trade is an insider transaction executed by broker number j, and 0 otherwise.

The results of this test are presented in Table VI. The results indicate that Broker 2 appears to have superior execution skills. Both the adverse selection and the ordering cost component are significantly lower relative to the average broker who traded insiders' orders. In fact, the total fixed ordering cost component is actually negative (0.086 + − 0.125) for Broker 2. It could result from the use of limit orders or through careful timing in the order placement. Conversely, Broker 6 appears to be an inferior trader. Broker 6 incurs a trading cost that is 35 cents per share higher than the average

Table VI

Regression Estimates of Execution Quality and Costs of Six Brokers Trading on Behalf of Insiders, Using Transaction Data for Campbell Taggart from December 1, 1981 to November 2, 1982

$$D_t = c_0(Q_t - Q_{t-1}) + z_0(V_tQ_t) + c_1\text{INPER}_t(Q_t - Q_{t-1}) + z_1\text{INPER}_t(V_tQ_t) + c_2\text{POST}_t(Q_t - Q_{t-1}) + z_2\text{POST}_t(V_tQ_t) + \Sigma_{t=3}^{8}[c_j\text{BROKER}_{jt}(Q_t - Q_{t-1}) + z_j\text{BROKER}_{jt}(V_tQ_t)] + e_t$$

The data are 3939 individual trades (price and quantity) of Campbell Taggart. D_t is the price-change between trades at time t and $t-1$. Q_t is an indicator variable equal to 1 if the trade at time t is a buy and -1 if it is a sell. V_t is the size of the trade at t in units of 10,000 shares. INPER_t is a dummy variable that is equal to 1 if the trade at time t occurs in the insider period (June 30–August 2) and 0 otherwise. This assignment is made without regard to whether the trade was actually executed by an insider. POST_t is a dummy variable for the post-insider trading period equal to 1 if trade t occurs between August 3 and November 2, 1982, and 0 otherwise. BROKER_{jt} is equal to 1 if trade t is made by broker j for an insider, and 0 otherwise.

		Coefficients			
Sub-sample	j	c_j	t-statistic	z_j	t-statistic
Entire period	0	0.086	33.60	0.067	5.65
Insider period	1	−0.008	−1.56	0.026	1.41
Post-insider period	2	−0.011	−3.29	−0.031	−2.47
Broker 1	3	0.042	0.34	−0.024	−0.53
Broker 2	4	−0.125	−3.51	−0.089	−4.71
Broker 3	5	0.013	0.35	−0.124	−3.89
Broker 4	6	0.311	1.34	−0.138	−2.24
Broker 5	7	0.094	0.55	−0.020	−0.89
Broker 6	8	0.202	1.76	0.151	3.37

$R^2 = 0.461$, $F = 186.7$.

broker of an insider. Though the small sample size draws these numbers into question, they are at least suggestive of disparate skills among brokers in placing and executing customer orders. This result may reflect a process which Gammill (1989) refers to as "buying out" the information. Market makers enter into losing trades to elicit information from one informed agent and change prices in advance of other informed trades.

IV. Conclusions and Implications

The findings reported here indicate that the process by which the market infers information from insider trading is complicated. The relationship between insiders' purchases and increases in the price of Campbell Taggart can be documented on a day-by-day basis, but not on the basis of a trade-by-trade analysis, despite the stock price rising more than 20% during the

insider buying period. The situation is analogous to observing the flow of a river. Though the current is obvious at a macroscopic level, the flow of water is almost impossible to determine by examining the motions of individual water molecules.

In the case of Campbell Taggart, there are detailed records of each insider trade. In addition, it is known that the traders in Campbell Taggart stock drew some inferences from the insider trading. Campbell Taggart and Anheuser-Busch were forced to announce their tentative merger agreement because of the price and volume surge in Campbell Taggart. However, Anheuser-Busch's stock price did not react until after the merger announcement, which supports the view that there was no direct leakage of information to the marketplace.

Our results have a number of implications for models of market microstructure. First, the assumption that the market can be divided into the three classes of traders (informed traders, liquidity traders, and market makers) that are commonly employed in asymmetric information models is not consistent with the Campbell Taggart results. Not only is there an indication that noise traders are attracted by informed trading, but there is also evidence that falsely informed traders play an important role. The falsely informed are not liquidity traders, because their trades are based on information, but they are not informed traders because they do not have access to inside information. The falsely informed trade based on what they believe is correct fundamental information, but which the insiders know is incorrect.

Second, as a result of noise trading and trading by the falsely informed, adding informed traders to the market does not necessarily reduce market liquidity or cause the bid-ask spread to widen. In the case of Campbell Taggart, any increase in the adverse selection problem was offset by an increase in uninformed trading volume. Thus, rather than bearing added risk during the period of intense insider trading, the market maker was able to match trades between insiders and noise traders at a higher rate. The increased volume led to a drop in adverse selection and inventory-related costs, thereby inhibiting a rise in the effective bid-ask spread.

Third, that the insiders used limit orders and that the quality of executions received by the insiders was above average is curious. Though there has been little formal modeling of the insider behavior in an NYSE-style auction market, the intuitive assumption that insiders use market orders exclusively and receive inferior executions is unsupported here.

Finally, the Campbell Taggart case highlights the distinction that Treynor (1989) draws between the "inside" spread and the "outside" spread. The inside spread measures the cost of transacting short-term in limited volume; it is determined primarily by the costs and risks bourne by the market maker, such as inventory costs and fixed order processing costs. The outside spread measures the cost of transacting in large volume, beyond that which the dealer or any other market makers would accommodate. It is also the dealer's cost of laying off or eliminating a large net position. The outside spread is determined by prices at which, according to Treynor, "value-based"

traders are willing to buy and sell. An example of this type of trader would be a money manager using a discounted cash flow model to bound security prices within a price range. These types of traders naturally sell shares when prices rise, and purchase shares when prices fall, thereby providing an outside spread that contains within it the quoted spread of the market maker.

In the case of Campbell Taggart, liquidity did not fall and the inside spread did not rise during the period of insider trading because the added volume reduced the market maker's cost. Both the market maker and the insiders were apparently able to exploit the falsely informed, or fundamental, traders. However, the long-run impact of episodes like the Campbell Taggart incident may be to increase the outside spread. Fundamental investors who lose to informed agents because of an informational asymmetry will become more aware of the impact of informed trading and demand a larger premium for supplying liquidity. That added premium will increase the outside spread. Thus, one important benefit provided by well-crafted insider trading regulations is reduction of outside spread. Unfortunately, this proposition is difficult to test because the outside spread is unobservable. Whereas the Campbell Taggart case suggests that the outside spread could have been affected by insider trading, it provides no direct evidence to that effect.

Appendix

Insider trades in Campbell Taggart from June 30 to August 2, 1982. For reasons of confidentiality the names of the traders and the brokers are disguised. A unique identifier is associated with each of the 38 traders and 13 brokerage houses. Data are presented chronologically by trading day, and sorted by price and trade size within the day. In all, the insiders bought shares in Campbell Taggart in 124 transactions, acquiring a total 265,600 shares during 23 trading days.

Date	Trader	Brokerage Firm	Shares	Price	Total Daily Insider Volume
30 June	T32	B4	100	25.750	100
1 July	T4	B6	1,800	26.125	
	T4	B9	1,000	26.250	
	T34	B4	100	26.375	
	T32	B4	1,900	26.375	
	T15	B4	3,000	26.375	
	T4	B9	100	26.500	
	T4	B9	900	26.625	
	T4	B6	200	26.875	9,000
7 July	T35	B2	1,500	25.750	1,500
12 July	T8	B2	900	25.875	
	T8	B2	2,000	26.000	2,900

Date	Trader	Brokerage Firm	Shares	Price	Total Daily Insider Volume
13 July	T8	B2	300	25.875	
	T8	B2	700	26.000	
	T8	B2	200	26.125	
	T8	B2	4,000	26.250	5,200
14 July	T8	B2	1,800	26.500	
	T8	B2	100	27.000	
	T35	B2	6,200	27.000	8,100
15 July	T35	B2	3,800	27.000	3,800
16 July	T25	B9	5,000	27.000	
	T14	B11	5,000	27.000	
	T25	B11	10,000	27.000	20,000
19 July	T3	B9	300	27.000	300
21 July	T35	B2	3,900	26.000	
	T35	B2	1,100	26.125	5,000
22 July	T29	B9	200	26.000	
	T29	B9	600	26.375	
	T29	B9	500	26.500	
	T29	B9	100	26.625	
	T29	B9	1,000	26.750	
	T29	B9	1,000	26.875	
	T9	B5	1,300	26.875	
	T9	B5	700	27.000	
	T29	B9	700	27.000	6,100
23 July	T11	B1	100	26.875	
	T26	B1	200	26.875	
	T20	B1	500	26.875	
	T20	B1	1,200	27.000	
	T26	B1	2,000	27.000	
	T16	B2	2,000	27.125	
	T9	B5	2,000	27.125	
	T29	B9	2,000	27.375	
	T13	B2	3,000	27.375	
	T29	B9	3,300	27.500	16,300
26 July	T24	B2	1,200	26.750	
	T27	B2	1,300	26.750	
	T9	B5	2,000	27.000	
	T4	B9	2,000	27.000	
	T24	B10	100	27.250	
	T27	B10	100	27.250	
	T4	B6	700	27.250	
	T4	B6	1,300	27.250	
	T16	B2	2,000	27.250	
	T9	B5	1,000	27.375	

Date	Trader	Brokerage Firm	Shares	Price	Total Daily Insider Volume
	T24	B10	3,400	27.375	
	T27	B10	3,400	27.375	18,500
27 July	T19	B8	500	28.125	
	T36	B11	100	28.250	
	T31	B4	1,000	28.250	
	T7	B10	1,000	28.250	
	T7	B10	1,000	28.250	
	T35	B2	2,000	28.250	
	T2	B4	10,000	28.250	
	T15	B4	10,000	28.250	
	T19	B8	100	28.375	
	T32	B4	4,000	28.375	
	T19	B8	1,900	28.500	
	T7	B10	2,000	28.500	
	T4	B9	1,000	28.625	34,600
28 July	T6	B4	100	28.375	
	T17	B4	2,000	28.375	
	T18	B4	2,000	28.375	
	T5	B8	500	28.625	
	T24	B10	750	28.625	
	T27	B10	750	28.625	
	T31	B4	1,000	28.750	
	T4	B6	100	28.875	
	T24	B10	1,750	28.875	
	T27	B10	1,750	28.875	
	T4	B6	100	29.000	
	T23	B2	1,000	29.000	
	T38	B2	1,000	29.000	
	T10	B4	1,000	29.000	
	T37	B9	1,700	29.000	
	T4	B6	1,800	29.000	
	T6	B3	3,000	29.000	
	T33	B2	4,000	29.000	
	T21	B4	5,000	29.000	
	T6	B12	7,400	29.000	
	T15	B13	1,500	29.250	
	T15	B13	500	29.375	
	T15	B13	2,000	29.500	
	T10	B4	6,000	29.500	
	T21	B4	8,000	29.500	54,700
29 July	T1	B4	5,000	28.625	
	T25	B9	5,000	28.625	
	T7	B10	5,000	28.750	

Date	Trader	Brokerage Firm	Shares	Price	Total Daily Insider Volume
	T37	B9	700	28.875	
	T16	B2	3,000	28.875	
	T1	B4	5,000	29.000	23,700
30 July	T35	B2	2,300	28.500	
	T4	B6	100	28.750	
	T22	B4	300	29.000	
	T30	B4	800	29.000	
	T12	B2	1,000	29.000	
	T6	B4	1,900	29.000	
	T21	B4	2,000	29.000	
	T4	B6	2,900	29.000	
	T4	B7	100	29.250	
	T4	B7	1,900	29.375	
	T12	B2	2,000	29.375	
	T24	B2	2,500	29.500	
	T27	B2	2,500	29.500	
	T4	B9	2,000	29.875	22,300
2 August	T33	B2	9,900	29.250	
	T33	B2	100	29.500	
	T19	B8	500	29.500	
	T8	B2	10,000	29.500	
	T28	B12	1,000	29.625	
	T35	B2	4,000	29.750	
	T35	B2	1,000	29.875	
	T35	B2	5,000	30.000	
	T28	B12	2,000	30.500	33,500
Total trading volume of insiders					265,600

REFERENCES

Admati, Anat R. and Paul Pfleiderer, 1988, A theory of intraday patterns, volume and price variability, *Review of Financial Studies*, 1, 3–40.

———, 1989, Divide and conquer, A theory of intraday and day-of-the-week mean effects, *Review of Financial Studies*, 2, 189–224.

Bagehot, Walter, 1971, The only game in town, *Financial Analysts Journal*, 22, 12–14.

Black, Fisher, 1986, Noise, *Journal of Finance*, 41, 529–543.

Copeland, Thomas and Dan Galai, 1983, Information effects on the bid-ask spread, *Journal of Finance*, 38, 1457–1469.

DeLong, J. Brad, Andrei Shleifer, Laurence H. Summers, and Robert J. Waldmann, 1990, Noise trader risk in financial markets, *Journal of Political Economy*, 98, 703–738.

Easley, David and Maureen O'Hara, 1987, Price, trade size, and information in securities markets, *Journal of Financial Economics*, 19, 69–90.

French, Kenneth R. and Richard Roll, 1986, Stock return variances: The arrival of information and the reaction of traders, *Journal of Financial Economics*, 17, 5–26.

Gammill, James F., 1989, The organization of financial markets: Competitive versus cooperative market mechanisms, Working paper 90-010, Harvard Business School.

———, Erik R. Sirri, and Michael Fleming, 1992, Liquidity, efficiency, and profitability surrounding delayed openings and trading halts on the NYSE, Working paper, Harvard Business School.

Glosten, Lawrence R. and Paul R. Milgrom, 1985, Bid, ask and transaction prices in a specialist market with heterogeneously informed traders, *Journal of Financial Economics*, 14, 71–100.

——— and Lawrence E. Harris, 1988, Estimating the components of the bid-ask spread, *Journal of Financial Economics*, 21, 123–142.

Harris, Lawrence E., 1986, A transaction data survey of weekly and intraday patterns in stock returns, *Journal of Financial Economics*, 16, 71–100.

Hasbrouck, Joel, 1988, Trades, quotes, inventories and information, *Journal of Financial Economics*, 22, 229–252.

Jarrell, Greg and Annette Poulson, 1989, Stock trading before the announcement of tender offers, *Journal of Law, Economics, and Organization*, 5, 225–248.

Kyle, Albert S., 1985, Continuous auctions and insider trading, *Econometrica*, 53, 1315–1335.

Lee, Charles and Mark Ready, 1989, Inferring trade direction from intradaily data, Working paper, Cornell University.

Manne, Henry G., 1966, *Insider Trading and the Stock Market* (Free Press, New York).

Meulbroek, Lisa, 1990, An empirical analysis of insider trading and the stock market, Working paper, Massachusetts Institute of Technology.

Mitchell, Mark and Ken Lehn, 1990, Do bad bidders become good targets?, *Journal of Political Economy*, 98, 372–398.

Roll, Richard, 1984, A simple implicit measure of the effective bid-ask spread in an efficient market, *Journal of Finance*, 39, 1127–1139.

Sirri, Erik R., 1991, Price, volume, and bid-ask spread in a specialist market, Working paper, Harvard Business School.

Stoll, Hans R., 1989, Inferring components of the bid-ask spread: Theory and empirical tests, *Journal of Finance*, 44, 115–134.

Treynor, Jack L., 1989, The economics of the dealer function, *Financial Analysts Journal*, November/December, 27–34.

United States District Court, Northern Division of Texas, Dallas Division, (Proposed) Joint Pretrial Order: Anheuser-Busch Companies, Inc. v. Paul Thayer, et al., 1988, CA3-85-0794-R.

United States District Court, Southern District of New York, Complaint for Injunctive and Other Equitable Relief: Securities and Exchange Commission v. W. Paul Thayer, et al., January 5, 1984, 84 Civ. 0066 (CES).