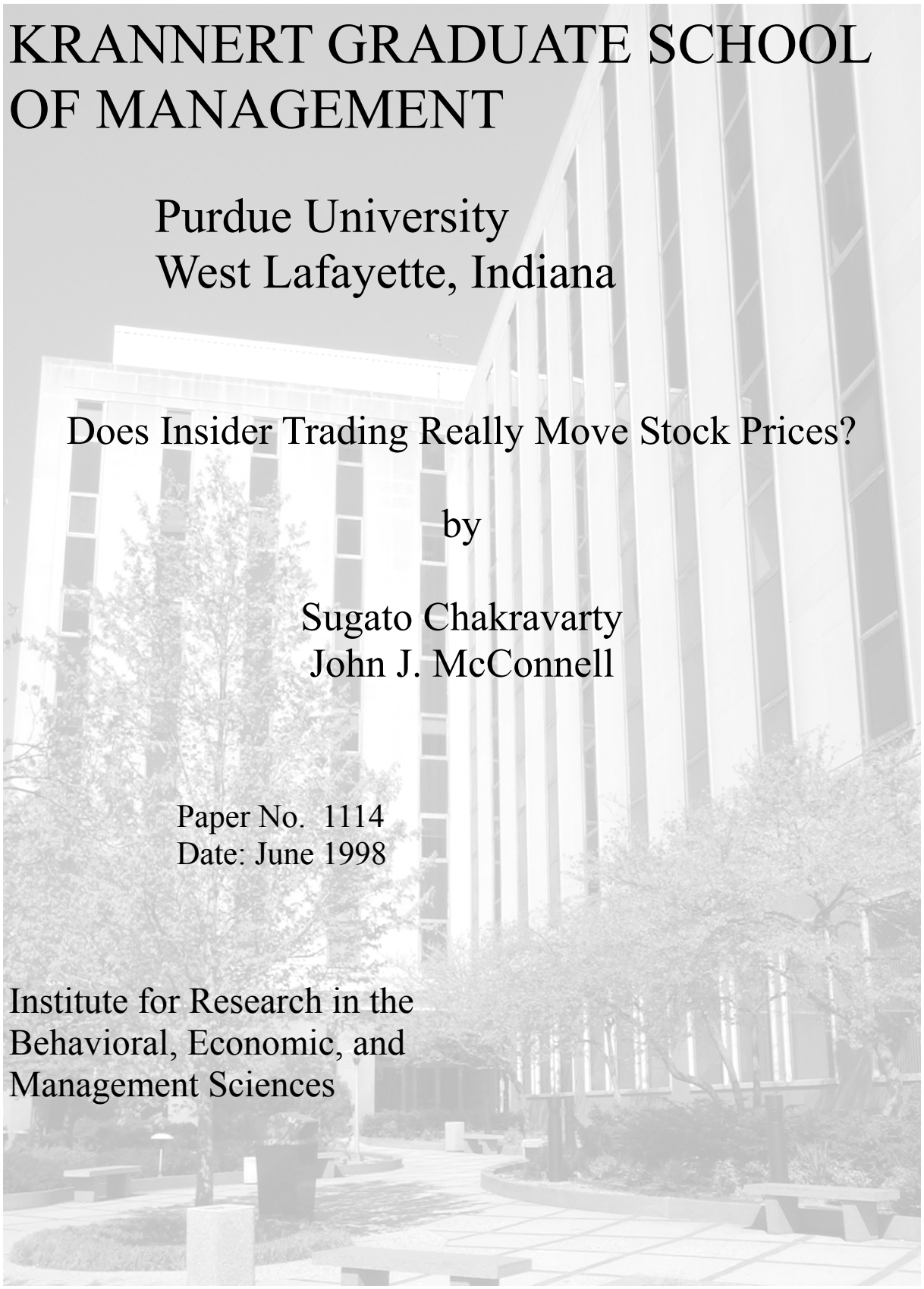

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Does Insider Trading Really Move Stock Prices?

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Does Insider Trading Really Move Stock Prices?

Abstract

Prior studies have reported a positive correlation between insider trading and stock price changes. The implication of these studies is that insider (i.e., informed) trades have a differential impact on price discovery than non-insider (i.e., uninformed) trades. Based on these results, various scholars have argued for the legalization of insider trading to facilitate rapid price discovery. We analyze the trading activity of a confessed inside trader, Ivan Boesky, in Carnation's stock just prior to the acquisition of Carnation by Nestle, and find that our tests are unable to distinguish the price effect of Boesky's (i.e., informed) purchases of Carnation's stock from the effect of non-insider (i.e., uninformed) purchases. Our conclusion survives extensive robustness tests and has methodological and public policy implications.

Does Insider Trading Really Move Stock Prices?

I. Introduction

In 1934, the U.S. Congress passed the Securities and Exchange Act restricting company insiders from trading on the basis of material, nonpublic corporate information. But the debate over the benefits and drawbacks of insider trading continues with both legal and economic scholars weighing in (Manne (1966), Carlton and Fischel (1983), Dennert (1991), Fishman and Hagerty (1992), Leland (1992), Estrada (1995), and Fried (1996), among others). The primary argument against insider trading is that it would work to the disadvantage of outside investors who would then exit the marketplace, taking their capital with them. The argument in favor of allowing insider trading is that such trading leads to more informative security prices.

Three recent empirical studies (Meulbroek (1992), Cornell and Sirri (1992) and Chakravarty and McConnell (1997)) have been interpreted to imply that insider trading leads to more "rapid price discovery". At least two of these three investigations have been cited in the legal literature as support for the legalization of insider trading. For example, Estrada (1995, footnote 21) writes that "...Meulbroek (1992) and Cornell and Sirri (1992) present solid evidence establishing that insider trading corrects prices significantly and in the right direction." The three studies of insider trading cited above have several features in common. Each study uses detailed data on trading by illegally informed insiders and in each instance the inside trader(s) is a buyer. Also, each of the studies uses a measure of insider trading to estimate the impact of such trading on stock prices.[1] For example, Meulbroek (1992) uses an indicator variable to identify the days in which insider trading occurred. Cornell and Sirri (1992) compute the fraction of total daily volume attributable to insiders. Chakravarty and McConnell (1997) use daily and hourly insider trading volume. In each instance, the authors conclude that insider trading is significantly correlated with stock price run-ups. The implication of these

[1] Another stream of research focuses on the impact of legal trades by corporate insiders on stock prices. (Jaffe (1974), Seyhun (1986) and Eckbo and Smith (1998)).

studies is that insider (i.e., informed) trades affect price discovery differently than non-insider (i.e., uninformed) trades.

In the current investigation, we demonstrate that the three studies cannot be used as the basis for such a conclusion. To do so, we use the Lee-Ready (1991) algorithm to decompose non-insider trading volume into buyer-initiated and seller-initiated volume. We then estimate a regression in which the dependent variable is the stock return and the independent variables include insider buying volume, non-insider buying volume, non-insider selling volume and certain control variables. The appropriate test then is not whether the regression coefficient corresponding to the insider buying volume is significantly different from zero, but whether the coefficient corresponding to the insider buying volume is significantly different from the coefficient corresponding to the non-insider buyer-initiated volume. If this condition is satisfied, we can conclude that insider trading moves prices (and leads to more rapid price discovery).

Our null hypothesis is that insider trading does not differentially affect stock prices. The data employed involve Ivan Boesky's purchases of Carnation's stock prior to the acquisition of Carnation by Nestle in 1984 (Chakravarty and McConnell (1997)). During the summer of 1984, Ivan Boesky acquired a substantial position in Carnation's stock. He later admitted to buying this stock on the basis of illegally obtained insider information. Other details of this case are provided in section II.

When we decompose the non-Boesky volume into buyer-initiated and seller-initiated volume, we find that both Boesky's purchases and non-Boesky buying volume are positively and significantly correlated with Carnation's stock price changes, while non-Boesky selling volume is negatively correlated with Carnation's stock price changes. A chi-square test of equality of the regression coefficients for the Boesky-buy and the non-Boesky-buy volume fails to reject the null hypothesis of equality at the 0.10 level of significance and provides no evidence that the market differentiated between Boesky's purchases and other purchases. Insider trading does not appear to lead to more rapid price discovery than does any other trading.

We also analyze the Boesky data with the empirical procedures used by Meulbroek (1992) and Cornell and Sirri (1992). We show that when we follow their empirical procedures, we are led to the conclusion that Boesky's trades affected prices. However, when we modify their procedures, consistent with our prescription of first distinguishing between non-insider purchases and non-insider sales[2], and then compare insider purchases with non-insider purchases, the effect of insider purchases is statistically indistinguishable from the effect of non-insider buyer-initiated volume.

There are two implications of our study. The first is methodological. Future studies of the effect of insider trading on price should consider insider trading as well as a non-insider buying and non-insider selling in conducting their empirical tests. The appropriate test then is whether the effect of insider trading is different from the effect of non-insider trading.

The second implication relates to public policy. Studies like those of Meulbroek (1992), Cornell and Sirri (1992) and Chakravarty and McConnell (1997) imply that insider (i.e., informed) trading moves prices more so than does non-insider (i.e., uninformed) trading. Legal scholars have used these results to argue for the legalization of insider trading. We show that the effects of insider trading and non-insider trading (in the same direction) are statistically indistinguishable. Thus, the results of the three studies cited above cannot be used to argue for the legalization of insider trading.[3]

II. A Brief Background

Between June 5, 1984, and August 31, 1984, Ivan Boesky acquired 1,711,200 shares of Carnation stock which constituted just under 5% of Carnation's outstanding shares. Over the same time period,

[2] Specifically, a modification of the Cornell and Sirri (1992) study involves decomposing the daily non-insider volume into the daily non-insider buyer-initiated volume and the daily non-insider seller-initiated volume. Similarly, a modification of the Meulbroek (1992) study involves partitioning the non-insider trading days into days dominated by non-insider purchases and days dominated by non-insider sales.

[3] From an ideological perspective, we favor the legalization of insider trading. We merely note that these studies cannot be used to support that position.

Carnation's stock price increased from $59.75 to $75.50, a 26% run-up in comparison with an increase of only 8.5% in the S&P 500 Index over the same interval. On Tuesday, September 4, 1984, Nestle and Carnation jointly announced that Nestle would make an offer to purchase all of the outstanding shares of Carnation at $83.00 per share.

Subsequently, the Securities Exchange Commission (SEC) charged that Boesky traded in Carnation's stock on the basis of illegally obtained information. Boesky acknowledged that he had received material non-public information regarding the Nestle takeover of Carnation from Martin Siegel, an investment banker at Kidder, Peabody & Co. Although Siegel denied providing Boesky with illegal information, he did acknowledge receiving $700,000 from Boesky for "consulting" services. Table 1 summarizes certain important dates leading up to the takeover of Carnation by Nestle.

At the time of his purchases of Carnation stock, Boesky was a well-known stock arbitrageur with a reputation for identifying takeover targets (and taking substantial positions in these stocks) prior to the actual takeover bid. Popular publications suggested that there were people (so-called "Boesky watchers") who made it their business to try to know what 'Ivan was up to' at all times.[4]

We use the above setting, along with the partitioning of non-Boesky trades into buyer-initiated and seller-initiated volume, to examine the impact of insider trading on Carnation's stock price.

III. Data

Our empirical analysis makes use of three data sets: (1) a time-stamped record of Boesky's trades in Carnation's stock over the period of June 6, 1984 through August 28, 1984; (2) a time series of trades and quotes in Carnation's stock from the database of the Institute for the Study of Security Markets (ISSM) for the

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[4] "Ivan Boesky, Money Machine", *Fortune* (August 6, 1984), "Takeover Play Builds an Empire for Ivan Boesky", Business Week (February 27, 1984), "Top Arbitrageur: Ivan F. Boesky; The Secret Life of an Arb", *New York Times* (June 24, 1984).

period January 1, 1984 through August 31, 1984; and (3) the intra-day prices on the three-month S&P 500 Index futures contract obtained from the Chicago Mercantile Exchange (CME) for the period January 1, 1984 through August 31, 1984. Where needed, the hourly returns on the S&P 500 Index futures contract are used as a proxy for an intra-day market index. Other details about Boesky's trading records are given in Chakravarty and McConnell (1997).

Table 2 presents a day-by-day record of Boesky's purchases of Carnation stock, both in terms of actual volume and as a percentage of Carnation's total daily trading volume. All of Boesky's orders were executed the same day they were submitted. Additionally, table 2 shows Carnation's closing stock price on a day-by-day basis and illustrates the substantial run-up in Carnation's stock price that took place during the summer of 1984.

The ISSM database, which contains the date and time of a trade, the price of the trade, and the number of shares traded in round lots, is used in conjunction with the Lee-Ready (1991) algorithm to separate all reported transactions in Carnation's stock over the period January through August of 1984 into buyer-initiated and seller-initiated trades. The Lee-Ready (1991) algorithm works as follows. If a trade occurs at the prevailing bid price or anywhere between the bid and the midpoint of the prevailing bid/ask spread, it is considered to be a seller-initiated trade. Likewise, if a trade occurs at the prevailing ask price or anywhere between the ask and the midpoint of the prevailing bid/ask spread, it is considered to be a buyer-initiated trade. For trades occurring at the prevailing spread midpoint, the tick-test rule is applied to determine the trade initiator. By the tick test rule, a trade is buyer-initiated if the price move from the previous transaction price is upwards, and vice versa. Also, the prevailing bid/ask spread must be at least five seconds old. Otherwise, the previous quote, assuming that it is at least five seconds old, is used to compute the prevailing spread.

We compute Carnation's stock returns, Boesky buy volume, non-Boesky buy volume, and non-Boesky sell volume on an hourly basis. Initially, we attempted to match the individual Boesky trades (from the quantity, price and execution time information) with transaction records in the ISSM database. By this

visual process, we could match few trades. According to NYSE officials with whom we spoke, this outcome is expected because the ISSM database reports pooled trades that are executed via different trading mechanisms.[5] Additionally, the market maker frequently pools trades for reporting purposes and reports the average execution price for the pool. Thus, a visual matching of trades with the ISSM database is unreliable. Even if a trade appears to match the database with regard to time, price, and quantity, there is no guarantee that the two represent the same trade, except by examining the audit trail for the order. Unfortunately, we do not have access to these records. To circumvent the problem, we use an hourly interval around the stated execution times of Boesky trades to capture the possible effects of Boesky trades on market prices.

The Lee-Ready algorithm categorizes (as buyer-initiated or seller-initiated) about 95% of all reported transactions in Carnation's stock. Table 3 provides the average buyer-initiated and seller-initiated volume per hour and the average number of trades per hour. Based on the Lee-Ready algorithm, during the period January through August, the average number of seller-initiated trades per hour exceeded the average number of buyer-initiated trades per hour and the average seller-initiated volume per hour exceeded the average buyer-initiated volume per hour. Carnation's stock price rose dramatically over this period despite the apparent excess of seller-initiated transactions relative to buyer-initiated transactions. The ISSM database is used to calculate the hourly rates of return on Carnation's stock over the period January 1, 1984 through August 31, 1984. Unfortunately, Carnation data are missing from the ISSM database for forty-two of the one hundred and seventy trading days over the period January 1, 1984 through August 31, 1984. More importantly, of these forty-two days, Boesky traded on four of them, August 7 through August 10. These forty-two days are omitted from the analysis.

We compute Boesky's buy volume as the aggregate of Boesky's purchases within the hour. Non-Boesky buy volume is computed as the total buyer-initiated volume within the hour less the Boesky buy volume within the same hour.

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[5] Also, see Seppi (1990).

Table 4 contains the correlation matrix for the variables used in the various regressions in sections V and VI. The bivariate correlations between the various independent variables range from 0.019 to 0.315. A customary benchmark as to whether multicollinearity is a problem in a regression is that none of the bivariate correlations among the pairs of independent variables exceeds 0.80 (Berry and Feldman (1990)). Each of the bivariate correlations are below (and most are well below) that benchmark. Multicollearity does not appear to be a problem in our regressions.

IV. A Summary of Prior Studies

To put the current study in perspective, we now summarize the empirical procedures and primary results of Meulbroek (1992), Cornell and Sirri (1992) and Chakravarty and McConnell (1997).

Meulbroek (1992) analyzes 320 cases in which the SEC formally charged investors with illegal insider trading during the period of 1980 to 1989. Her purpose is to investigate the impact of insider trading on stock prices. To do so, she estimates a modified market model regression in which the dependent variable is the daily return on a stock that experienced an episode of alleged illegal insider trading. The independent variables are the daily return on a value-weighted market index, an indicator variable to identify the days on which the alleged illegal insider trading occurred, an indicator variable to identify days on which news reports regarding the stock appeared, and an indicator variable to identify days on which neither insider trading nor news reports about the stock appeared. According to Meulbroek, the coefficient of the indicator variable for insider trading days "...directly tests whether insider trading affects stock prices" (p.1672). She concludes that the price movement on insider trading days exceeds the price movement on surrounding days (which had no insider trading or news) and that "insider trading is associated with immediate price movements and quick price discovery" (p.1663). Unfortunately, among the surrounding trading days, she does not distinguish between days dominated by non-insider purchases and those dominated by non-insider sales, and, therefore, she does not test whether abnormal returns are higher on days dominated by non-insider purchases than on

days with insider purchases. Hence, she cannot conclude that insider buying leads to more rapid price discovery than non-insider buying.

Cornell and Sirri (1992) conduct a detailed analysis of illegal insider trading around the acquisition of Campbell Taggart by Anheuser-Busch in 1982. They regress the daily return of Campbell-Taggart on the fraction of Campbell-Taggart daily volume attributable to insiders and find that the coefficient is positive and statistically significant. The authors conclude that "Consistent with previous studies, insider trading was found to have a significant impact on the price of Campbell-Taggart" (p.1031). But Cornell and Sirri do not decompose non-insider volume into buyer-initiated and seller-initiated volume. Thus, they, too, do not test whether the coefficient of the insider purchases is significantly greater than the coefficient of the non-insider purchases.

Chakravarty and McConnell (1997) examine the illegal trading activity surrounding the acquisition of Carnation Company by Nestle S.A. in 1984. They regress both daily and hourly returns on Carnation's stock on Boesky volume and certain control variables. The coefficient of Boesky volume is positive and statistically significantly different from zero. The authors conclude that insider trading appears to facilitate price discovery. But, here again, the authors do not decompose the non-Boesky volume into buyer- and seller-initiated volume, and are unable to determine whether Boesky's purchases moved Carnation's stock price more than the purchases of other traders.

V. Incremental Effect of Insider Trading on Carnation's Stock Returns

A. Boesky and Non-Boesky Buys

In this section, we examine whether Carnation's stock price reacted differently to Boesky and non-Boesky purchases. To do so, we estimate a regression in which the dependent variable is the hourly rate of return on Carnation's stock and the independent variables are the hourly return on the three-month S&P 500 Index futures contract (which serves as a proxy for the market index), non-Boesky buy volume during the

hour, non-Boesky sell volume during the hour, and Boesky buy volume during the hour over the time period January 1 through August 31, 1984. Volume is expressed in units of 10,000 shares.

In classifying trades as buyer- or seller-initiated, the Lee-Ready (1991) algorithm depends upon whether the trade occurs near the bid (seller-initiated) or near the ask (buyer-initiated). During hours in which transactions at the ask outnumber transactions at the bid, trades will more frequently be identified as buyer initiated. Consequently, purely due to bid/ask bounce, returns during these hours will tend to be positive. The opposite will occur during hours in which transactions at the bid outnumber transactions at the ask. Thus, even if prices over the hour are unchanged, use of the Lee-Ready classification scheme in combination with bid/ask bounce could induce a spurious correlation between hourly returns and buyer- or seller-initiated trades. To control for the bid/ask bounce, we include an indicator variable in our regressions. We define $Q_{L,t}$ ($Q_{F,t}$) which takes the value +1 if the last (first) trade of hour t is a buy and -1 if the last (first) trade of hour t is a sell. The independent variable ($Q_{L,t}$ - $Q_{F,t}$) which can take values of {+2, 0, -2} is used in the hourly returns regression to control for the bid/ask bounce effect.

As shown in column 2 of table 5, the coefficients of the Boesky buy volume and the non-Boesky buy volume are positive (0.00078 and 0.00098, respectively) with p-values of less than 0.01, while the coefficient of the non-Boesky sell volume is negative (-0.00043) with a p-value of less than 0.01. Furthermore, with a p-value of 0.38, a chi-square test for the equality of the Boesky buy coefficient with the non-Boesky buy coefficient cannot reject the null hypothesis at the level customarily required for statistical significance.

The regression results indicate that Carnation's stock price changes are positively correlated both with Boesky buy volume and with non-Boesky buy volume and that the coefficients of the two variables are not significantly different from each other. But the coefficients appear to be small. Recall, however, that volume is expressed in units of 10,000 shares and that Boesky bought about 1.7 million shares. The implication is that Boesky's purchases moved Carnation's stock price by about 13% over a three-month interval, after controlling

for overall market movements, but his trades had no differential effect on stock prices than did the trades of other buyers.

Our regression examines the contemporaneous correlation between hourly stock returns and volume. It could be that Boesky's (i.e., insider) trades also have a further delayed positive effect on stock price whereas the effect of non-Boesky (i.e., non-insider) trades on stock prices may be limited to the hour in which they occur or, indeed, the effect of non-Boesky trades may even be reversed in subsequent hours. If so, our regression will underestimate the effect of Boesky's buying on Carnation's stock price and/or overestimate the effect of non-Boesky buying on Carnation's price, in which case we will have wrongly concluded that the effect of Boesky (i.e., insider) and non-Boesky (i.e., non-insider) trades have no differential effect on stock price. To determine whether either of these effects is present, the regression is re-estimated except that we now also include Boesky buy volume, non-Boesky buy volume, and non-Boesky sell volume for each of the three prior hours. The results of the regression with the lagged volume variables are presented in column 3 of table 5.

The coefficients of the contemporaneous Boesky and non-Boesky buy volume are still positive with p-values of less than 0.01, while the p-value for the difference between the two is 0.55. The coefficients of the first and second hour of lagged Boesky volume and non-Boesky buy volume are negative with p-values of less than 0.01. Thus, there is a reversal of both the Boesky and non-Boesky buying effect in the hours immediately following the trades. But, the chi-square tests of the equality of the coefficients of the first and second hour lagged Boesky and non-Boesky buying volume have p-values of 0.59 and 0.22 such that, whatever the reversal effect is, it is not different for Boesky and non-Boesky purchases. In the third lagged hour, the coefficients are both positive and not statistically significantly different from each other (p-value equals 0.16).

The conclusion that emerges is that Boesky's (i.e., informed) purchases did have an effect on Carnation's price, but, importantly, our tests are unable to distinguish between Boesky's purchases and the purchases by other, presumably uninformed, investors.

B. Identification of Uninformed Trades

Our analyses and conclusions depend critically on the assumption that the non-Boesky trading volume was uninformed. If some of the trades that we have classified as uninformed were actually informed, our tests could fail to reject the null hypothesis even though the market did distinguish informed from uninformed trades. To provide some assurance that our classification scheme is not to blame for our failure to reject the null hypothesis, we examine more closely the circumstances surrounding the Carnation takeover to come up with other classification schemes for informed and uninformed trading.

As a starter, we checked the SEC records to determine whether any trader other than Boesky was ever charged with illegal insider trading in Carnation stock in the months leading up to the formal merger announcement on September 4, 1984. None were.

We also replicated our regressions with two other definitions of uninformed trades. These two alternative classification schemes are based on the chronology of events leading up to the takeover of Carnation by Nestle as reported in table 1.

On May 3, 1984, Siegel met with Carnation management for the purpose of discussing the possibility of Carnation retaining Kidder Peabody as an advisor on anti-takeover defenses. Given that Siegel may have told people other than Boesky of what he (Siegel) knew, we classify all non-Boesky buyer initiated trades after May 3 as *non-Boesky informed* buys. All non-Boesky buyer-initiated trades from January 1, 1984 through May 2, 1984 are classified as *non-Boesky uninformed* buys and all seller-initiated trades are classified as uninformed. The remaining category is Boesky buy orders.

On February 23, 1984, Dwight Stuart met with representatives of First Boston to discuss selling his interest in Carnation. Suppose that First Boston then began to search for buyers of Stuart's shares. If so, it is possible that investors who learned this information would consider the Carnation company available for sale which would increase the possibility of a bid for the company in the near future. If so, trades after February 23 could reflect the presence of informed traders other than Boesky. To capture this possibility, only buyer

initiated trades between January 1, 1984 and February 22, 1984 are classified as *non-Boesky uninformed* buys, while all non-Boesky buyer-initiated orders from February 23, 1984 through August 31, 1984 are classified as *non-Boesky informed* buys, and all sell orders are classified as uninformed. As before, the remaining category is Boesky buy orders.

The advantage of these classification schemes is that we reduce the likelihood that the non-Boesky uninformed buy category includes informed buyers. This increases the likelihood that the coefficient of the non-Boesky informed buy variable will be significantly different from the coefficient of the Boesky buy variable. The disadvantage, especially in the second classification scheme, is that the short time period covered by the non-Boesky uninformed buy variable reduces the possibility of rejecting the null hypothesis that the coefficient of non-Boesky buy volume is different from zero.

Table 6 presents the results of the two regressions with our alternative measures of non-Boesky uninformed purchases along with the other variables employed in the regressions in table 5. Column 2 (column 3) presents the results in which all buyer initiated trades between January 1, 1984 and May 3, 1984 (between January 1, 1984 and February 13, 1984) are classified as uninformed. The coefficient of Boesky buy volume is positive in both regressions (0.00091 and 0.00091) with a p-value less than 0.01 in each case. The magnitudes of the coefficients of the non-Boesky uninformed buy volume (0.00103 and 0.00095 under classifications 1 and 2, respectively) are remarkably similar to those of the Boesky buy volume in each regression. Importantly, the chi-square tests of equality of the coefficients of the Boesky buy volume and the non-Boesky uninformed buy volume yield p-values of 0.84 and 0.95, respectively, for the two regressions.

For good measure, the coefficients of the non-Boesky informed buy volume of 0.00105 and 0.00105 in the two regressions are similar in magnitude to those of the Boesky buy volume and the non-Boesky uninformed buy volume, and are not statistically significantly different from the coefficients of the corresponding Boesky buy volume (p-values equal 0.54 and 0.53, respectively) nor from the coefficients of the non-Boesky uninformed buy volume (p-values equal 0.96 and 0.86, respectively).

Hence, even with our more stringent definition of uninformed purchases, the tests provide no convincing evidence that the market distinguished Boesky's purchases from other purchases. Our conclusion that insider trading does not move market prices more than other trades appears to be robust.

VI. Explorations of the Meulbroek (1992) and the Cornell and Sirri (1992) Empirical Procedures

In this section, we use the Boesky data to examine the empirical procedures employed by Meulbroek (1992) and Cornell and Sirri (1992).[6] The idea is to determine whether their procedures employed with our data yield conclusions similar to theirs. We then investigate whether those conclusions are overturned when non-Boesky volume is partitioned into buyer-initiated and seller-initiated volume. For ease of cross-reference with the original studies, in describing the Meulbroek and Cornell and Sirri studies, we use their notation.

Meulbroek (1992) uses a modified market model regression to estimate the stock price impact of insider trading. Specifically, she regresses daily returns for stock *i* (R_{it}) against the daily returns of a value-weighted index of all NYSE/AMEX stocks (R_{mt}); an indicator variable, $INSIDE_{it}$, to identify days on which illegal insider trading in stock *i* did (1) and did not (0) occur; *j* indicator variables, $NEWS_{ijt}$, to identify days on which news announcements did (1) and did not (0) occur; and an indicator variable, $OTHERDAYS_{it}$, to identify days on which neither insider trading nor news announcements occurred as long as those days fell with in a specified interval prior to the public announcement of the information upon which the insiders were alleged to be illegally trading.

We estimate the same regression with the Boesky data. Carnation's daily stock returns and the daily returns of a value-weighted index of all NYSE/AMEX stocks are obtained from the CRSP daily returns file. $INSIDE_{ct}$ identifies days on which Boesky traded in Carnation's stock, $NEWS_{cjt}$ identifies *j* days of news

[6] We were unable to obtain the Meulbroek (1992) and Cornell and Sirri (1992) data to test our hypothesis. Meulbroek's data are owned by the SEC and not available for public use. Cornell and Sirri are unable to retrieve the data used in their study.

reports regarding Carnation[7], $OTHERDAYS_{ct}$ identifies days, over the interval June 6, 1984 through August 31, 1984, on which Boesky did not trade and no news reports regarding Carnation occurred. This period corresponds to the event period as defined by Meulbroek (1992). Also, consistent with Meulbroek (1992), in addition to returns over the event period, we include an additional 150 trading days of returns prior to June 6, 1984, to estimate the market model parameters. According to Meulbroek's methodology, the 150-day estimation period ends with the day prior to the earlier of the first insider trade or the first interim news announcement. In our case, June 6, 1984 is the day of the first Boesky trade.

The results are presented in column 2 of table 7. The coefficient of $INSIDE_{ct}$ is positive with a p-value of 0.03. The coefficient of $OTHERDAYS_{ct}$ is negative with a p-value of 0.73. The p-value for a chi-square test of the difference between the two coefficients is 0.01. This result is consistent with Meulbroek's finding that insider trading days are accompanied by higher returns than non-insider trading-no-news days.[8]

From our prior identification of trades as buyer- or seller-initiated, we now define a new indicator variable, $BUYDOM_{ct}$, which takes the value 1 if the non-Boesky buy volume on day t is greater than the non-Boesky sell volume on day t, and day t lies within the event period and if day t is not a Boesky trading day or a news day. We refer to these as buyer-dominated days. Otherwise, $BUYDOM_{ct}$ is assigned a value of zero.

We then estimate a regression in which the dependent variable is Carnation's daily stock return and the independent variables are R_{mt}, $INSIDE_{ct}$, $NEWS_{c1t}$, $NEWS_{c2t}$ and $NEWS_{c3t}$ and $BUYDOM_{ct}$. Similar to earlier regressions, the variable $(Q_{L,t} - Q_{F,t})$ is used to correct for the bid/ask bounce effect. Specifically, $Q_{L,t}$ $(Q_{F,t})$ takes the value +1 if the last (first) trade of day t is a buy and -1 if the last (first) trade of day t is a sell. We refer to this regression as a modified Meulbroek model.

The results are presented in column 3 of table 7. The coefficient of $INSIDE_{ct}$ is 0.00964 (with a p-value of 0.011) and the coefficient of $BUYDOM_{ct}$ is 0.01007 (with a p-value of 0.009). A chi-square test of

[7] These dates are given by 6/20/84, 7/3/84 and 7/5/84.

[8] It should be noted that Meulbroek (1992) does not test for the equality of the coefficients of INSIDE and OTHERDAYS. She draws her conclusions from the sign and statistical significance of the coefficient of INSIDE alone.

equality of these two coefficients has a p-value of 0.93. Thus, we cannot reject the null hypothesis of equality of the coefficients at any reasonable level of significance. Based on this analysis, using the modified Meulbroek procedure, insider trading does not influence market prices differentially from non-insider trading. Insider trading does not appear to lead to more rapid price discovery than any other trading.

We now turn to Cornell and Sirri (1992). In table IV (page 1046) of their paper, they present a regression in which the dependent variable is the daily return of Campbell-Taggart stock and the independent variables are the daily returns on an equally-weighted market index (R_{mt}), an indicator variable, $INPER_t$, which is 1 within the insider trading period and zero otherwise, and, $IFRACTION_t$, which is the fraction of Campbell-Taggart daily volume attributable to insiders on day *t*.

We estimate the Cornell-Sirri regression with the Boesky data. R_{mt} is the daily return on an equally-weighted market index; $INPER_t$ is an indicator variable that is equal to 1 during the Boesky trading period (June 1 to August 30, 1984) and zero otherwise; and $IFRACTION_t$ is the fraction of Carnation's daily volume attributable to Boesky on day t. The results are given in column 2 of table 8. The coefficient of $IFRACTION_t$ is positive with a p-value of 0.05. This result is consistent with the results of Cornell and Sirri. Based on this regression, insider trading appears to lead to more rapid price discovery.

We now estimate a regression which includes each of the variables already identified plus three additional independent variables: the fraction of Carnation's daily volume attributable to non-Boesky buyers on day t, $NBBUYFRAC_t$; the fraction of Carnation's daily volume attributable to non-Boesky sellers on day t, $NBSELLFRAC_t$; and the bid/ask bounce correction factor, $(Q_{L,t} - Q_{F,t})$. We refer to this regression as a modified Cornell-Sirri model.

The results of the modified Cornell-Sirri regression are given in column 3 of table 8. The coefficients of $IFRACTION_t$ (0.03345) and $NBBUYFRAC_t$ (0.02112) are both positive with p-values of 0.063 and 0.050, respectively. A chi-square test of equality of the two coefficients has a p-value of 0.43. The effect of Boesky

and non-Boesky buying on stock price are statistically indistinguishable. Based on the modified Cornell-Sirri model, insider trading does not lead to more rapid price discovery than does any other trading.

VII. Summary and Conclusion

Three studies in recent years have used data from insider trading cases to examine whether insider trading affects market prices. All three studies conclude that insider trading is significantly correlated with stock price run-ups. At least two of these studies have since been cited in the legal literature to argue for the legalization of insider trading under the premise that these studies demonstrate that insider trading leads to more rapid price discovery. We argue that the appropriate test of this premise is whether insider trading has a different effect on prices than non-insider trades.

We conduct such a test with data employed by Chakravarty and McConnell (1997) in the case of Ivan Boesky's illegal trading in Carnation's stock in the summer of 1984, just prior to Nestle's acquisition of Carnation. We find that Boesky's trades are significantly positively correlated with Carnation's stock price changes, but on inclusion of a variable that captures non-insider buying volume, we find that the coefficients of Boesky's buys and non-Boesky buys are not statistically distinguishable from one another.

The methodological message of our study is that future research of the effect of insider trading on market price should identify the effect of non-insider buying on market price and then determine whether the effect of insider trading differs from non-insider trading. The public policy message is that the studies of Meulbroek (1992), Cornell and Sirri (1992) and Chakravarty and McConnell (1997) cannot be used as a basis for the legalization of insider trading. Specifically, these studies cannot be used to argue that insider trading leads to more rapid price discovery than do trades by any other investor.

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Table 1

Some Salient Facts Leading Up To the Takeover of Carnation by Nestle

Dates in 1984	Action
February 23	• D.L. Stuart (voter for 20% of Carnation stock) meets representatives of First Boston to discuss selling his interest in Carnation. • Carnation stock closes at $53.875
May 3	• M. Siegel (investment banker with Kidder Peabody) meets with Carnation management to discuss the possibility of Carnation retaining Kidder Peabody for anti-takeover defense purposes. • Carnation stock closes at $52.250
June 5	• D.L. Stuart meets with H.E. Olson (Carnation CEO) and T.F. Crull (Carnation President) to discuss sale of Carnation to Nestle. • H. E. Olson calls G. Gordon (Carnation Board Member and CEO of Kidder) to advise him of Olson's talk with D. L. Stuart. • The first of the two meetings between M. Siegel of Kidder Peabody and I. Boesky takes place. • Carnation stock closes at $59.750.
June 6	• I. Boesky buys 45,000 shares of Carnation stock - his first purchase. • Carnation stock closes at $58.875.
August 17	• The second meeting between M. Siegel and I. Boesky takes place. • Carnation stock closes at $69.250.
August 28	• I. Boesky buys 20,000 shares of Carnation stock - his last purchase. • Carnation stock closes at $73.250.
August 31	• Last trading day before the public announcement of Nestle's purchase of Carnation. • Carnation stock closes at $75.500.
September 4	• Nestle S.A. and Carnation jointly announce that Nestle will offer to purchase all Carnation stock at $83.00 per share. • Carnation stock closes at $79.500.

Table 2

Daily Purchases of Carnation's Stock by Boesky
Over the Period June 6, 1984 through August 31, 1984

(1) Boesky Trading Dates	(2) Boesky's Daily Purchases of Carnation Stock	(3) Daily Total Carnation Trading Volume	(4) Boesky Daily Purchases As a Percentage of Daily Total Carnation Volume	(5) Closing Stock Price of Carnation
06/06/84	45,000	491,200	9.2%	$58.875
06/07/84	120,000	374,000	3.2%	$59.250
06/08/84	35,000	149,900	2.3%	$58.125
06/11/84	36,100	1,322,500	2.7%	$57.625
06/12/84	13,900	94,700	14.7%	$57.500
06/13/84	50,000	173,900	28.8%	$58.000
06/20/84	42,500	445,000	9.6%	$58.500
06/22/84	7,500	70,100	10.7%	$58.375
07/02/84	31,300	261,900	12.0%	$63.375
07/03/84	218,700	595,600	36.7%	$64.500
07/05/84	86,500	362,900	23.8%	$63.500
07/06/84	75,000	293,100	25.6%	$64.875
07/09/84	38,500	213,200	18.1%	$63.750
08/03/84	15,000	186,200	8.1%	$62.000
08/07/84	200,000	713,500	28.0%	$66.125
08/08/84	145,300	522,100	27.8%	$67.875
08/09/84	39,700	286,700	13.8%	$66.250
08/10/84	65,400	237,100	27.6%	$67.250
08/20/84	50,000	99,200	50.4%	$70.000
08/21/84	164,500	488,300	33.7%	$72.000
08/22/84	150,000	523,400	28.7%	$70.625
08/23/84	29,000	383,800	7.6%	$70.750
08/27/84	31,500	166,000	19.0%	$71.000
08/28/84	20,000	399,300	5.0%	$73.250

Table 3

Overview of Average Hourly Buyer-Initiated Volume, Average Hourly Seller-Initiated Volume, and the Corresponding Average Number of Buyer-Initiated Transactions, and the Average Number of Seller-Initiated Transactions in Carnation's Stock Over the Period January 1 through August 31, 1984

Each transaction in Carnation stock over the period January 1 through August 31, 1984 is decomposed into a buyer-initiated transaction or a seller-initiated transaction using the Lee-Ready (1992) algorithm. The average hourly volume of these buyer and seller initiated transactions over a given calendar time interval is computed. The numbers in the table are the averages over all hours during that calendar time interval. Similarly, the average number of buyer and seller initiated transactions and the average number of quote revisions is computed. The numbers in the table are the averages over all hours during that calendar time interval.

Variable	January	February	March	April	May	June-August	Days on Which Boesky Bought June-August	Days on Which Boesky Did Not Buy June-August
Average Buyer-Initiated Volume per Hour	3,550	3,420	1,480	1,540	6,040	17,810	23,960	11,660
Average Number of Buyer-Initiated Transactions per Hour	4	2	2	2	3	9	12	8
Average Seller-Initiated Volume per Hour	4,480	5,830	2,300	3,030	8,070	19,415	25,680	13,150
Average Number of Seller Initiated Transactions per Hour	5	4	2	3	4	12	15	9

Table 4

Pearson Correlation Coefficient Matrix for the Regression Variables.

The table presents the correlations among the variables listed below. The variables presented below are the hourly return on Carnation's stock, the hourly return on the three-month S&P 500 Index futures contract, Boesky buy volume by the hour, non-Boesky buy volume by the hour and non-Boesky sell volume by the hour.

	Return	S&P500	Boesky buy volume	Non-Boesky buy volume	Non-Boesky sell volume
return	1				
S&P500	-0.043	1			
Boesky buy volume	0.113	0.053	1		
Non-Boesky buy volume	0.233	-0.006	0.019	1	
Non-Boesky sell volume	-0.035	0.053	0.214	0.315	1

Table 5

Regression Analysis of Hourly Returns on Carnation's Stock on Contemporaneous and Lagged Boesky-buying Over the Period January 1, 1984 through August 31, 1984

In the regression, the dependent variable is Carnation's hourly stock return. $(Q_{L,t} - Q_{F,t})$ is the correction for the bid/ask bounce, where $Q_{L,t}$ equals 1 if the last transaction in hour t is buyer-initiated and equals -1 if the last transaction in hour t is seller-initiated, and $Q_{F,t}$ equals 1 if the first transaction in hour t is buyer-initiated and equals -1 if the first transaction in hour t is seller-initiated. The remaining independent variables are the hourly returns on the three-month S&P 500 Index futures contract, the contemporaneous and three lagged measures of non-Boesky Carnation buy volume, the contemporaneous and three lagged measures of non-Boesky Carnation sell volume, and the contemporaneous and three lagged measures of Boesky's buying volume. All volume is measured in units of 10,000 shares. White's (1980) Heteroscedasticity-consistent standard errors are used to compute the p-values of parameter significance. Number of observations = 765.

(1) Independent Variables	(2) Estimated Coefficients (Two-tailed p-values)	(3) Estimated Coefficients (Two-tailed p-values)
Intercept	-0.00021 (0.386)	-0.00016 (0.553)
$(Q_{L,t} - Q_{F,t})$	0.00137 (0.0001)	0.00134 (0.000)
S&P 500 Index Futures	-0.08714 (0.425)	-0.10440 (0.330)
Non-Boesky Buy Volume	0.00098[2] (0.000)	0.00105*A (0.000)
Non-Boesky Buy Volume(-1)		-0.00036*B (0.007)
Non-Boesky Buy Volume(-2)		-0.00026*C (0.049)
Non-Boesky Buy Volume(-3)		0.00048*D (0.000)
Non-Boesky Sell Volume	-0.00043 (0.000)	-0.00027 (0.015)
Non-Boesky Sell Volume(-1)		-0.00002 (0.822)
Non-Boesky Sell Volume(-2)		0.00005 (0.661)
Non-Boesky Sell Volume(-3)		-0.00004 (0.752)

Table 5 continued

(1) Independent Variables	(2) Estimated Coefficients (Two-tailed p-values)	(3) Estimated Coefficients (Two-tailed p-values)
Boesky Buy Volume[1]	0.00078[2] (0.000)	0.00091 *A (0.008)
Boesky Buy Volume(-1)		-0.00048 *B (0.015)
Boesky Buy Volume(-2)		-0.00076 *C (0.000)
Boesky Buy Volume(-3)		0.00016 *D (0.435)
Adjusted R-square	0.17	0.21

1 The Boesky-buying variable is the actual number of shares purchased by Boesky during each hour.

2 The p-value = 0.38 for a chi-square test of equality of the coefficients of the non-Boesky buy volume and Boesky buy volume in the regression in column (2).

*A The p-value = 0.546 for a chi-square test of equality of the coefficients of the non-Boesky buy volume and Boesky buy volume in the regression in column (3).

*B The p-value = 0.594 for a chi-square test of equality of the coefficients of the non-Boesky buy volume(-1) and Boesky buy volume(-1) in the regression in column (3).

*C The p-value = 0.224 for a chi-square test of equality of the coefficients of the non-Boesky buy volume(-2) and Boesky buy volume(-2) in the regression in column (3).

*D The p-value = 0.156 for a chi-square test of equality of the coefficients of the non-Boesky buy volume(-3) and Boesky buy volume(-3) in the regression in column (3).

Table 6

Regression Analysis of Hourly Returns for Carnation's Stock over the Period January 1, 1984 through August 31, 1984, Under Alternative Classifications

In each regression, the dependent variable is Carnation's hourly stock return. The independent variables are: The hourly returns on the three-month S&P 500 Index futures contract (used as a market correction for the returns regression only); $(Q_{L,t} - Q_{F,t})$, where $Q_{L,t}$ equals 1 if the last transaction in hour t is buyer-initiated and equals -1 if the last transaction in hour t is seller-initiated, and $Q_{F,t}$ equals 1 if the first transaction in hour t is buyer-initiated and equals -1 if the first transaction in hour t is seller-initiated; the contemporaneous and three lagged measures of "non-Boesky informed buy volume"; the contemporaneous and three lagged measures of "non-Boesky uninformed buy volume"; the contemporaneous and three lagged measures of "non-Boesky sell volume"; and the contemporaneous and three lagged measures of "Boesky buy volume". All volume is measured in units of 10,000 shares. The non-Boesky buy volume is divided into non-Boesky informed buy volume and non-Boesky uninformed buy volume in the following way. Under classification 1, all non-Boesky buy orders from January 1, 1984, through May 2, 1984, are classified as "non-Boesky uninformed buy". All non-Boesky buy orders from May 3, 1984, through August 31, 1984, are classified as "non-Boesky informed buy ". Under classification 2, all non-Boesky buy orders from January 1, 1984, through February 22, 1984, are classified as "non-Boesky uninformed buy". All non-Boesky buy orders from February 23, 1984, through August 31, 1984, are classified as "non-Boesky informed buy ". The p-values for a two-tailed test of significance of the coefficient estimates are in parentheses below the coefficients. Number of observations = 765.

	Classification 1	**Classification 2**
(1) **Independent Variables**	**(2)** **Estimated Coefficients** **(Two-tailed p-values)**	**(3)** **Estimated Coefficients** **(Two-tailed p-values)**
Intercept	-0.00021 (0.489)	-0.00017 (0.546)
S&P 500 Index Futures	-0.10118 (0.346)	-0.10052 (0.349)
$(Q_{L,t} - Q_{F,t})$	0.00135 (0.000)	0.00135 (0.000)
Non-Boesky INFORMED Buy Volume	0.00105 (0.000)	0.00105 (0.000)
Non-Boesky INFORMED Buy Volume(-1)	-0.00038 (0.005)	-0.00038 (0.005)
Non-Boesky INFORMED Buy Volume(-2)	-0.00028 (0.041)	-0.00028 (0.042)
Non-Boesky INFORMED Buy Volume(-3)	0.00051 (0.000)	0.00051 (0.000)
Non-Boesky UNINFORMED Buy Volume	0.00103 (0.052)	0.00095 (0.093)
Non-Boesky UNINFORMED Buy Volume(-1)	0.00005 (0.923)	-0.00006 (0.920)
Non-Boesky UNINFORMED Buy Volume(-2)	0.00011 (0.834)	0.00006 (0.920)
Non-Boesky UNINFORMED Buy Volume(-3)	0.00006 (0.913)	0.00008 (0.881)

Table 6 continued

(1) Independent Variables	Classification 1 (2) Estimated Coefficients (Two-tailed p-values)	Classification 2 (3) Estimated Coefficients (Two-tailed p-values)
Non-Boesky Sell Volume	-0.00027 (0.020)	-0.00027 (0.018)
Non-Boesky Sell Volume(-1)	-0.00003 (0.819)	-0.00002 (0.833)
Non-Boesky Sell Volume(-2)	0.00004 (0.711)	0.00004 (0.694)
Non-Boesky Sell Volume(-3)	-0.00003 (0.812)	-0.00003 (0.767)
Boesky Buy Volume	0.00091 (0.000)	0.00091 (0.000)
Boesky Buy Volume(-1)	-0.00049 (0.015)	-0.00049 (0.015)
Boesky Buy Volume(-2)	-0.00076 (0.000)	-0.00076 (0.000)
Boesky Buy Volume(-3)	0.00017 (0.413)	0.00016 (0.420)
Adjusted R-squared	0.21	0.20

- Under classification 1 (2), the chi-square test of the equality of the coefficients corresponding to the non-Boesky informed buy volume, non-Boesky uninformed buy volume and Boesky buy volume has a p-value of 0.831 (0.824).
- Under classification 1 (2), the chi-square test of the equality of the coefficients corresponding to the non-Boesky informed buy volume(-1), non-Boesky uninformed buy volume(-1) and Boesky buy volume(-1) has a p-value of 0.632 (0.750).
- Under classification 1 (2), the chi-square test of the equality of the coefficients corresponding to the non-Boesky informed buy volume(-2), non-Boesky uninformed buy volume(-2) and Boesky buy volume(-2) has a p-value of 0.109 (0.102).
- Under classification 1 (2), the chi-square test of the equality of the coefficients corresponding to the non-Boesky informed buy volume(-3), non-Boesky uninformed buy volume(-3) and Boesky buy volume(-3) has a p-value of 0.247 (0.278).

Table 7

A Regression Analysis of the Meulbroek (1992) model with Daily Returns on Carnation's Stock

In the regression, the dependent variable is Carnation's daily stock return. The regression in column (2) is over the period November 1, 1983, to August 31, 1984, which includes, consistent with Meulbroek (1992), a 150 day period prior to the first day of Boesky's trading in Carnation stock on June 6, 1984. The modified Meulbroek (1992) regression in column (3) is over the period January 1, 1984, and August 31, 1984, the period over which we have intra-day transaction data available in Carnation stock. The independent variables are: $(Q_{L,t} - Q_{F,t})$, where $Q_{L,t}$ equals 1 if the last transaction in hour t is buyer-initiated and equals -1 if the last transaction in hour t is seller-initiated, and $Q_{F,t}$ equals 1 if the first transaction in hour t is buyer-initiated and equals -1 if the first transaction hour t is seller-initiated; R_{mt} is value-weighted market proxy; $INSIDE_{ct}$ is a dummy variable which is 1 on days of illegal trading in Carnation's stock and zero otherwise; Three dummy variables $NEWS_{c1t}$, $NEWS_{c2t}$, and $NEWS_{c3t}$ control for (three) interim news announcements; $OTHERDAYS_{ct}$ is a dummy variable which is 1 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 date, and zero otherwise; and $BUYDOM_{ct}$ is a dummy variable which takes the value of 1if day t has positive abnormal non-Boesky buying volume and day t falls within the same window, and zero otherwise.

(1) Independent Variables	(2) Estimated Coefficients (Two-tailed p-values)	(4) Estimated Coefficients (Two-tailed p-values)
Intercept	0.00152 (0.178)	-0.00088 (0.562)
$(Q_{L,t} - Q_{F,t})$		0.00037 (0.698)
R_{mt}	0.35875 (0.020)	0.24773 (0.151)
$INSIDE_{ct}$	0.00725 (0.026)	0.00964[A] (0.011)
$NEWS_{cit}$	0.00725 (0.608)	0.00493 (0.740)
$NEWS_{c2t}$	0.00779 (0.582)	0.00818 (0.577)
$NEWS_{c3t}$	-0.02292 (0.107)	-0.02366 (0.112)
$OTHERDAYS_{ct}$	-0.00087 (0.731)	
$BUYDOM_{ct}$		0.01007[A] (0.009)
Adjusted R-squared	0.05	0.10
Number of Observations	212	129

[A]A chi-square test of equality of coefficients of INSIDE and BUYDOM has a p-value = 0.93.

Table 8

A Regression Analysis of the Cornell and Sirri (1992) model with Daily Returns on Carnation's Stock Over the Period January 1, 1984 through August 31, 1984

In the regression, the dependent variable is Carnation's daily stock return. The independent variables are: $(Q_{L,t} - Q_{F,t})$, where $Q_{L,t}$ equals 1 if the last transaction in hour t is buyer-initiated and equals -1 if the last transaction in hour t is seller-initiated, and $Q_{F,t}$ equals 1 if the first transaction in hour t is buyer-initiated and equals -1 if the first transaction hour t is seller-initiated; R_{mt} is the equally weighted market proxy; $INPER_t$ is a dummy variable that is equal to 1 in the Boesky trading period (June 1 to August 30, 1984) and zero otherwise; $IFRACTION_t$ is the fraction of Carnation's daily volume attributable to Boesky on day t; $NBBUYFRAC_t$ is the fraction of Carnation's daily volume attributable to non-Boesky buyers on day t; $NBSELLFRAC_t$ is the fraction of Carnation's daily volume attributable to non-Boesky sellers on day t. The p-values for a two-tailed test of significance of the coefficient estimates are in parentheses. Number of observations = 128.

(1) **Independent Variables**	(2) **Estimated Coefficients (Two-tailed p-values)**	(3) **Estimated Coefficients (Two-tailed p-values)**
Intercept	0.00059 (0.726)	-0.00757 (0.428)
$(Q_{L,t} - Q_{F,t})$		0.00034 (0.707)
R_{mt}	0.48126 (0.012)	0.33279 (0.085)
$INPER_t$	0.00142 (0.611)	0.00072 (0.791)
$IFRACTION_t$	0.01676 (0.051)	0.03345[A] (0.063)
$NBBUYFRAC_t$		0.02112[A] (0.050)
$NBSELLFRAC_t$		-0.00031 (0.977)
Adjusted R-squared	0.06	0.11

[A] A chi-square test of equality of the coefficients of IFRACTION and NBBUYFRAC has a p-value = 0.43.

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