# Do Financial Analysts Restrain Insiders' Informational Advantage?

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## Abstract

We investigate the competitive relationship between financial analysts and firm insiders for price-sensitive information and its influence on liquidity and price discovery. Without the presence of analysts, insiders have complete monopoly over information, influencing market equilibrium and liquidity. If analysts really compete for information (as in Fishman and Hagerty (1992)) they can reduce insiders' informational advantage with a consequent improvement of traders' welfare (as in Holden and Subrahmanyam (1992)). We empirically investigate this hitherto ignored role of analysts by using a sample of stocks that lost *all* analyst coverage, thus giving insiders complete monopoly over price-sensitive information. The departure of analysts, which is a highly publicized event, leads to important changes in liquidity and market equilibrium. Using a matching-firm methodology to address possible endogeneity, we find that liquidity decreases significantly, price efficiency deteriorates rapidly, information asymmetries increase, and institutional shareholders and liquidity-motivated traders leave the stock. The impact of insiders' trading on adverse selection costs and price efficiency becomes larger and their trades become more profitable. We also find that an important role of analysts is their ability to make price-sensitive information available to the market and this information gets reflected quicker in prices, suggesting that analysts make a significant contribution to market quality by competing with insiders for information.

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## 1.0 Introduction

How does competition between sell-side analysts and firm insiders for price-sensitive information affect market equilibrium and liquidity? In their theoretical papers, Fishman and Hagerty (1992) and Khanna, Slezak and Bradley (1994) predict that firm insiders and research analysts compete for the pool of price-sensitive information. Without the presence of analysts, firm insiders have a monopoly over information, allowing them to maximize the benefits from informational rents resulting in an impact on market equilibrium. Holden and Subrahmanyam (1992) show that competition between informed agents wipes out any informational advantage, leading to deeper markets and more information revelation.

The empirical literature so far has focused only on competition between analysts but has failed to investigate the competitive relationship between analysts and insiders and the resulting impact on liquidity. This paper aims to fill this gap in the literature.

The role of securities analysts and their contribution to market equilibrium remain ambiguous. While Brennan and Subrahmanyam (1995) find that analysts generate private information and that competition among them leads to lower adverse selection costs, Easley et al. (1998), Roulstone (2003), and Piotroski and Roulstone (2004) argue that analysts' role is a marketing one in which they re-package public information.

A different role that has not yet been investigated is that of analysts as agents competing with insiders for price-sensitive information. We explore this role in this paper. Firm insiders have access to better information about the firm's prospects relative to outsiders at no cost. Informed outsiders have to expend resources obtaining such information. Insiders' informational advantage over outsiders should impact traders' welfare and the trading process. The presence of an informed outsider poses competition to insiders and reduces insiders' expected trading profits. If the informed outsider's information is made public rapidly, as Brennan and Subrahmanyam (1995) show, then they should create a more level-playing field for traders because the informational gap between them and the informed traders is reduced.

Fishman and Hagerty (1992) show that the presence of insiders produces two adverse effects on trading: first, informed outsiders are less likely to acquire information, and second, informed outsiders have an informational disadvantage relative to insiders. Liquidity traders can suffer along with informed outsiders from the monopolistic presence of insiders. Traders may defend themselves in different ways in such a scenario: spreads may widen in response, and traders may ultimately leave the stocks, leading to lower liquidity and possibly less efficient prices. Fishman and Hagerty conclude that whether insiders are beneficial or costly to traders depend on certain conditions, such as the cost incurred by outsiders to collect information and the precision of insiders' information.

The effect of analysts depends on the quality of information they acquire. If sell-side analysts really produce and disseminate valuable information, they should help lower insiders' informational advantage, bringing a consequent increase in benefits to liquidity traders. Even if analysts' reports suffer from biased research and conflicts of interest (Michaely and Womack, 1999 and Agrawal and Chen, 2008) or if analysts simply re-package public information (Easley et al. (1998), Roulstone (2003), and Piotroski and Roulstone (2004)), they can still pose some level of competition to insiders as long as they contribute to the price discovery process. Kelly and Ljungqvist (2008) show that this is the case: the departure of analysts produces a permanent price impact and a reduction of the stock's market capitalization. This evidence is consistent with the view that sell-side coverage is valuable and influences prices, even though analysts may suffer from biases.

To address these research questions we use a (quasi) natural experiment consisting of stocks in which firms' insiders become monopolists over trade-related information following a ***complete loss*** of research coverage. For the period 1999-2003, we found 558 firms that lost all research coverage for *reasons* other than (a) subsequent bankruptcy, delisting or takeovers, (b) a decrease of institutional shareholdings, or (c) an increase in insiders' presence or trading activity. These coverage terminations are publicized events. The number of stocks dropped by analysts in our time period is unusually high (Khorana, Mola and Rau (2007))[1], driven mainly by restructuring of research departments. Kelly and Ljungqvist (2008) also find evidence of exogenous coverage termination during our period that was the "result of brokerage firms downsizing their research operations in response to adverse changes in the economics of

[1] Khorana, Mola, and Rau (2007) find that the annual average number of firms losing complete coverageover the period 1983-1998 is 8.32% of total firms with coverage. In the period 1999-2003 this average rose to 14.82%.

producing research in the early 2000s" (page 2)[2]. These unusually high rates of coverage termination, together with the various screens we apply, provide a good natural experiment to investigate our research question. A time-series research design like ours produces cleaner results than a cross-sectional design because the magnitude of insiders' presence may determine analyst coverage in the first place (Fishman and Hagerty (1992) and Khanna, Slezak and Bradley (1994)) leading to severe endogeneity issues. The stocks used in our tests do not experience any change in insider holdings or activity prior to coverage termination. Neither do we see any change in institutional shareholders' trading or holdings. In other words, we do not see any crowding-out effect from insiders or institutional blockholders.

We use a matching firm approach to address the issue of endogeneity - between the analysts' decision to drop a stock, firm performance (see Khorana, Mola, and Rau (2007))[3] – and the impact on liquidity. We match sample firms that have lost coverage for reasons other than bankruptcy, delisting or takeovers with a control group based on a propensity-score matching algorithm using (a) industry, (b) sales, (c) market-to-book ratio, (d) z-scores, (e) returns on assets, (f) debt-to-equity ratio, (g) current ratio, (h) price, (i) volume, and (j) bid-ask spreads.

Our strategy for assessing the informational effect of analysts is straightforward. If analysts have any significant role in restraining insiders' informational advantage it will become evident once research analysts leave a particular stock. We examine changes in several areas to detect the impact of the monopolistic presence of insiders, specifically: (a) liquidity, (b) information asymmetries, (c) the equilibrium between informed and uninformed traders, and (d) price discovery and price efficiency.

We first find that analysts' departure has a significantly permanent (negative) impact on liquidity in the year following departure. Both spreads and volume of sample firms are negatively affected relative to the control group. Spreads increase by 30% and volume decreases by half after the drop. Second, institutional blockholders, another group

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[2] The authors provide some specific examples: "At least 20 firms quit the research business altogether. FleetBoston, for example, closed its Robertson Stephens unit in July 2002, with a loss of more than 40 analyst positions and coverage terminations on nearly 600 stocks. Other brokers reduced headcount, often drastically. To illustrate, on May 23, 2003, Citigroup dropped coverage of eight of the 43 sectors its analysts had covered" (page 2).

[3] Khorana, Mola, and Rau (2007) find that the likelihood of coverage loss is related to firm size, performance, financial leverage and bankruptcy risk.

of potentially informed outsiders, leave the stock after the last analysts' report and not before. Third, using both a kalman filtering methodology and the Hasbrouck (1993) methodology we find that the departure of analysts makes the price discovery process less efficient and the volatility around the stock's true price larger. We interpret these results as evidence that analysts make a positive contribution to the price discovery process.

We next investigate whether these results are driven by the restraining role of analysts on insiders. Information generation and dissemination are crucial in trading and we should find that, if analysts have any role, the equilibrium between informed and uninformed traders that existed prior to the analysts' departure should change. First, we use the Glosten and Harris (1988) and Madhavan and Smidt (1991) methodology and find (i) a positive relationship between insiders' holdings and adverse selection costs, and (ii) adverse selection costs become more sensitive to insiders' holdings and volume following the analysts' departure. Second, using the PIN methodology proposed by Easley et al. (1996), we find that the probability of trading with an informed trader increases after the departure of analysts. Thus, there is a contemporaneous change in the trading process: lower presence of liquidity-motivated traders, and a higher presence of information-motivated traders. Third, we find evidence that the role of the analysts is not that of unearthing new (private) information but rather making public existing private information. This result indicates that analysts compete with insiders for the pool of existing private information. These results are inconsistent with the view that analysts' role is just showcasing stocks (Easley, O'Hara, and Paperman (1998)) or disseminating industry-level or macro-level information (Piotroski and Roulstone (2004)).

If insiders are able to use their informational advantage better after coverage termination, then we should find that their trades becoming more profitable after analysts leave. Using the Chan and Lakonishok (1995) methodology, we find that insiders' trades become more profitable after coverage termination.

Our results shed light on how analysts influence trading dynamics by restraining insiders. The existing literature has produced ambiguous results on the informativeness of analysts' reports. Our results show that trading dynamics and market equilibrium change significantly after the departure of analysts. The most likely reason for this change is insiders' acquisition of monopolistic power that tips the balance against liquidity traders.

These results suggest that it is not only important to debate the exact nature of analysts' informativeness but also the way such information can alter the balance between outsiders and insiders. Investors at large benefit from the analysts' presence because they restrain insiders' informational advantage.

The rest of the paper is organized as follows. Section 2 presents the theoretical background together with the sample of stocks dropped by financial analysts and the matching of the control stocks. Section 3 investigates the impact of the analysts' departure on liquidity. Section 4 looks at price discovery before and after the drop of the analysts. Section 5 looks at the competition between analysts and insiders and the trading profits realized by insiders. Section 6 concludes.

## Section 2. Theoretical Background and Data

Our research question is whether analysts restrain insiders' informational advantage. In Section 2.1 we present the theoretical background on this question and in Section 2.2 we discuss the data.

### 2.1 Theoretical Background

Information is fundamental in the trading process. Firm insiders, institutional shareholders and financial analysts (and their clients) can be considered as information-motivated traders with an important influence on liquidity and price discovery. Equally important is the competition between these different participants because this is closely linked to the quantity of information generated and the way it is disseminated.

While there is no ambiguity about firm insiders being informed, whether institutional shareholders and financial analysts are really "informed outsiders" remains an open question. Institutional shareholders' quantity and quality of information is likely to depend on ownership stake and long-term presence. Financial analysts' role is seen as gathering material information and offer independent insights on companies. If this role is properly fulfilled that would make them informed traders. The costs analysts incur are likely to be compensated by commissions and other soft dollars earned by the volume earned by affiliated brokerage operations (Irvine, 2001, Jackson, 2005). While some evidence shows that analysts' reports are informative (Hong et al., 2000, Frankel et al., 2006, amongst others), other evidence indicates that they are not because of different reasons (Easley et al. (1998), Michaely and Womack (1999), Agrawal and Chen (2008)). In particular, Piotroski and Roulstone (2004) argue that analysts' informational advantage is in acquiring industry-wide and market-wide information, rather than firm-specific.

Theoretical literature on insider trading focuses on how insiders' access to better information can influence firm prices. Fishman and Hagerty (1992) show that insiders' impact on stock prices hinges fundamentally on the relationship between insiders and informed outsiders. Although insider trades can increase the aggregate level of information, insiders can end up damaging stock price efficiency because they can crowd-out potential informed outsiders from acquiring information. This crowding-out effect is the essential feature of the competitive relationship between insiders and analysts. The presence of analysts decreases with the cost of acquiring information, the precision of insiders' information quality, and the presence of liquidity traders. Insiders influence positively (negatively) price efficiency when the cost of acquiring information is high (low), insider's information advantage is high (low), and liquidity traders are not active (active). Fishman and Hagerty conclude that "large (small) firms may be the ones for which insider trading is detrimental (beneficial) for stock price efficiency."

The quantity and quality of information produced by analysts should influence this relationship. The level of competition posed by analysts depends on their contribution to the price discovery process. Even if analysts' role is that of showcasing stocks to uninformed traders (Easley et al. (1998)) or are better placed to acquire and disseminate macro-level and industry-level information (Piotroski and Roulstone (2004)) rather than firm-specific information, they may still contribute to the price discovery process. Kelly and Ljungqvist (2008) estimate that the capitalized value of a publicly listed company from receiving sell-side research coverage averages around 110 basis points of its market value. This is the reduction of the stock's market capitalization from the departure of analysts. Thus sell-side coverage influences prices.

Another factor to consider is the number of analysts covering a stock. Brennan and Subrahmanyam (1995) find that analysts generate private information but competition between them gets information impounded quickly in prices and leads to lower information asymmetries. Hong et al. (2000), Frankel and Li (2004), and Barth and Hutton (2004) also assume that information asymmetries are reduced with higher analyst following. The relationship between the number of analysts, which proxies for competition among them, and analysts' informativeness can be positive or negative. If analysts just re-package publicly-available information, showcase stocks, misinform the market because of conflicts of interest, or they are partial substitutes then analysts' informativeness is negatively related with the number of analysts. In such cases, analysts cannot really restrain insiders' informational advantage.

Our sample and the time-series test are well-placed to investigate our hypothesis. First, sample (and control) firms are relatively small, providing us with a good experiment where insider trading should be beneficial to traders (Fishman and Hagerty (1992)). Since there is no crowding-out of the analysts behind the analysts' decision, termination of coverage provides the right environment to investigate the impact of monopolistic insiders on price discovery.

**2.2 Data**

We start by looking at the entire sample of all publicly traded companies on the NYSE, Nasdaq and AMEX that had coverage by at least one sell-side analyst for at least one full year over the period 1999-2003. We chose this period because it has an abnormally high level of analysts stopping coverage, possibly because of restructuring in different activities in investment banking. For example, Khorana, Mola, and Rau (2007) show that the annual average number of firms losing complete coverage over the period 1983-1998 is 8.32% of total firms that had coverage. In the period 1999-2003 this average rose to 14.82%, implying that the endogeneity reasons that can plague the decision to drop coverage may play a lesser role in the period under consideration in this paper.

We obtain this information from two sources: (a) I/B/E/S, and (b) FirstCall. We obtain the information from the Estimates files of these two sources. From the same sources we obtain the date of each analyst estimate for quarterly Earnings per Share (EPS) and from here we get the date of the last EPS estimate. We define loss of coverage as such when a stock loses all analysts' EPS estimates and no estimate appears during the subsequent 3 years. This leaves us with 976 stocks that lost coverage over the period 1999-2003. This sample contains stocks that lost coverage for different reasons, specifically: 418 firms that have been acquired by another firm, or firms that were subsequently delisted or went bankrupt at some point in the three years following the loss of coverage, and 558 firms that remained listed on their exchange and continued trading for at least two years following the analysts' departure. We keep only these 558 stocks because we want to investigate loss of coverage unrelated to any acquisition, delisting, or liquidation[4] and without any other confounding event that can make our tests and results unclear.

We start by looking at the number of analysts covering these stocks, their recommendations and estimates of quarterly Earnings per Share and the actual value of quarterly Earnings per Share.

[Insert Table 1]

Panel A of Table 1 shows the mean and median number of analysts following the sample stocks from event quarter -8 to event quarter 0 (the quarter for which we have the last analysts' EPS estimate). Both the mean and median statistics show the number of analysts decrease in the last five quarters. The median number of analysts is two about five quarters before the loss of coverage and the next-to-last analyst leaves about a year before the complete loss of coverage.[5] Panel B shows the mean, median and standard deviation of the analysts' recommendations (whether to "buy", "hold", or "sell"). Recommendations are ranked from 1 to 5, where 1 stands for a "Buy" and 5 stands for a "Sell". There is a slow process from a "Buy" towards a "Hold" recommendation over the nine quarters. The median recommendation stays at 2 for the entire period with the exception of the last two quarters, showing evidence of downgrading. However, there is no evidence of extreme downgrades and the median recommendation stays around the "Hold" level. This is evidence that the type of stocks considered in this paper do not suffer from extreme negative recommendations. The same picture emerges from Panel C that shows the analysts' estimates of the firms' quarterly Earnings per Share. Both the mean and median estimates decrease over the eight quarter before the last one. The median EPS estimate goes from $0.22 eights quarters before the departure of analysts to $0.07 in the last quarter for which we find an analyst's estimate. Panel D shows the firms' actual quarterly Earnings per Share from event quarter -8 to event quarter +4. The

[4] Consistent with Khorana, Mola and Rao (2007), we also remove certificates, shares of beneficial interest, units, ADRs, REITs, and closed-end funds.

[5] It should be noted that we match the sample firms with the control group over the period when the median number of analysts decreases from 2 to 1.

mean and median actual EPS are positive from event quarter -8 to event quarter -4 and then turn negative. Interestingly the mean reported EPS stays negative for 5 quarters while the median EPS stays negative for three quarters. After this period, actual EPS turns positive again.

All in all, this evidence shows that the sample stocks do not suffer from a permanent negative performance. One should also consider that over the same period the U.S. economy suffered from slow growth and a recession. This should have influenced the performance of small firms – the typical firm considered in this paper - more than large firms. Considering this evidence, one can reasonably conclude that analysts' stopped coverage may have been driven by factors exogenous to firms' performance.

### 2.2.1 Matching Sample

We match the sample firms with a control group to address two issues: first, any endogeneity that may exist in the analysts' decision to drop a stock, and, second, any market-wide change in liquidity over the same period. It is possible that sell-side analysts drop stocks that are performing badly, possibly leading to bankruptcy or delisting. For example, Khorana, Mola, and Rau (2007) find that the likelihood of coverage loss is related to firm size, performance, financial leverage and bankruptcy risk. In such a case liquidity can dry up because the market reacts negatively to the firm's bad performance, leading to lower traders' interest and hence lower liquidity. This may in turn lead to analysts fleeing the stock.

For each stock that loses complete coverage, we find a similar stock that has not lost coverage. We match on the basis of (a) industry, (b) sales, (c) market-to-book ratio, (d) z-scores, (e) returns on assets, (f) debt-to-equity ratio, (g) current ratio, (h) price, (i) volume, and (j) bid-ask spreads. In summary, we match on both firm characteristics and market microstructure variables. For sales, market capitalization, market-to-book ratio, returns on assets, debt-to-equity ratio, z-score and current ratio we use the year-end Center for Research in Security Prices (CRSP) preceding the last analyst report. The remaining microstructure matching variables are averages of daily values measured from event day -375 through event day -253 (hence, over the last six months before the last full year in which the stock has analyst' coverage).

We run two types of matching methodologies. The first one is based on propensity score matching. Matching stocks is a multi-dimensional problem and propensity score matching (as proposed by Rosenbaum and Rubin, 1983, Rosenbaum and Rubin, 1985, and Heckman, Ichimura, and Todd, 1997) is claimed to be the best methodology to solve such a problem.[6] In the case considered in this paper, the propensity score is the probability of all analysts dropping coverage of a stock conditional on y, in the following way:

$$p(y) = pr(D=1|y)$$

where $D$ is the event indicator under investigation, in our case D=1 if a firm loses coverage and 0 if coverage continues for a firm. The conditional probability is computed from a discrete choice model using a logit model.

The second matching technique is based on the traditional methodology of matching stocks using each variable one at a time. Following Bacidore and Sofianos (2002) and Huang and Stoll (1996), we find the matching stock that did not suffer any loss of coverage and that minimizes the equation

$$\sum_{i=1}^{8}\left(\frac{c_i^{\text{LOST COVERAGE}} - c_i^{\text{CONTINUE COVERAGE}}}{\left(c_i^{\text{LOST COVERAGE}} + c_i^{\text{CONTINUE COVERAGE}}\right)/2}\right)^2$$

where $c_i^{LOST\ COVERAGE}$ denotes the value of the *i*th matching variable for the stock that lost coverage, and $c_i^{CONTINUE\ COVERAGE}$ denotes the value of the *i*th matching variable for the stock that does not lose coverage. For each matching characteristic, *i*, the minimization is subject to the following constraint

$$\left|\frac{c_i^{\text{LOST COVERAGE}} - c_i^{\text{CONTINUE COVERAGE}}}{\left(c_i^{\text{LOST COVERAGE}} + c_i^{\text{CONTINUE COVERAGE}}\right)/2}\right| \langle 1$$

While the objective of traditional matching methodologies and propensity score matching is the same, the way the control group is chosen is different across the two methodologies. The traditional method finds matching firms by matching directly on each

[6] Using the propensity score is essentially using the conditional probability of a treatment assignment given a number of *ex ante* variables. This structure fits easily in our framework where we want to find the probability of a loss of complete coverage given a number of firm characteristics and market microstructure variables.

*ex ante* characteristic, whereas propensity score matching finds matches using the propensity score p(y). In this way, the propensity score method is better placed relative to traditional methods to balance the set of *ex ante* variables simultaneously rather than one by one, leading to unbiased estimates of the treatment impact.

We will use the control group found from the first matching methodology through propensity matching as our base case. All the results shown are those obtained from such matching. We also use the control group found from the second matching methodology as further robustness checks.[7]

[Insert Table 2]

Table 2 provides descriptive statistics for the sample and control stocks. In Panel A we provide market microstructure variables and Panel B we show firm characteristics of sample and control firms. Both sets of stocks have average share prices that are close to each other (sample is $11.21 and control is $11.21). The same applies to the average number of trades (sample is 109 and control is 111) and shares trading daily volume (sample is 10,520,000 and control is 10,240,000) during the sample period. The mean effective spread is about 2.56% for the sample stocks, and 2.83% for the control stocks, while the mean realized spread is 1.59% for the sample stocks, and 1.74% for the control stocks. Thus, the stated price of immediacy (i.e., the quoted spread) is $0.20 for a round-trip trade. The actual cost of immediacy is $0.06 to $0.07 (i.e., trades fill inside the quoted prices, on average).

The same picture emerges when we consider the firm characteristics of sample and control firms. The mean market capitalization of the sample firms is $160 million and $170 million for the control group. The median figures are $54 million and $59 million respectively. This evidence shows that the firms that suffer from complete loss of coverage tend to be small firms, with capitalization of less than $1 billion. The same can be said if we consider annual sales: the mean sales figure is $256 for sample firms and $281 for the control group. Looking at the Return on Assets, both sample and control firms have a median positive, but low, ROA (1.59% for sample firms and 2.52% for the control group). The mean ROA for sample firms is -0.89% and 0.95% for control firms.

[7] The results are not reproduced in the paper for the sake of brevity. Results can be obtained from the authors upon request.

While the ROA performance is low for sample firms, it is not very different from that of control firms. Looking at Long-Term debt, we find that both sample and control firms have higher than average debt with mean Long-Term Debt of 35% for sample firms and 32% for control firms. The sample and control firms also look similar when using the z-score as a measure of bankruptcy risk with a mean value of 3.18 for sample firms and 3.29 for control firms. Finally, the Current Ratio of sample firms looks very similar to that of the control group where the mean value is 2.80 for sample and 2.64 for control.

Turning to Panel C, we can see that sample and control firms are similar in their shareholders' base. We get data on institutional blockholders and insiders' holdings and volume transacted for the year before the analysts' departure. We find that insiders held, on average, 6.20% and 7.16% of outstanding shares in sample and control firms respectively. Institutional blockholders held on average 22.43% and 24.36% of sample and control firms. The same conclusion emerges when we look at volumes transacted by both institutional blockholders and insiders.

### 2.2.2 Last Analyst Report

An important aspect is the date of the last analyst report which becomes day 0 in our analysis. The date that we use is the one when the last estimate of the EPS estimate is recorded by either I/B/E/S and/or FirstCall. In practice, this is the date when the analyst's report is *communicated* to I/B/E/S and FirstCall. It is not necessarily the date when the analyst' report is *published*. It is possible that there is a difference between the report's *publication date* and its *communication date* to I/B/E/S and FirstCall. From an economic point of view, the important date is the one when the market gets to know the departure of analysts and hence the publication date is the most important. If, as it appears from the discussion we have held with research analysts, the publication date is ***before*** the communication date then we may see the change in liquidity occurring some time before the definition of day 0 in our paper.

We cannot find the information on the last analyst report for all the stocks on both I/B/E/S and FirstCall and hence we decide to use these two sources as complements. For the group of stocks for which we can get data in both I/B/E/S and FirstCall, we face an additional issue: for some stocks, I/B/E/S and FirstCall do not agree on the date of the last analyst report. In these cases, we decide to be conservative and use the latest date as reported by either I/B/E/S or FirstCall. This conservatism, however, has its own cost. If the correct last analyst report was really issued at the earlier date, then we may see an earlier impact on liquidity before the departure of the analysts.

**Section 3 Loss of Coverage and Impact on Liquidity**

Liquidity should be influenced by the insiders' newly found monopolistic position following coverage termination. We investigate differences in liquidity between sample stocks and the control group and look at the equally-weighted and volume-weighted effective, realized spreads, price impact, and volume. The effective spread is measured as the product of an indicator variable that equals one for customer-initiated buy trades (negative one for customer initiated sell trades) times twice the difference between the trade price and the quote midpoint of the at the time of the trade. It estimates the round-trip immediacy cost paid by liquidity demanders. We use the Lee and Ready (1991) algorithm to infer buyer-initiated and seller-initiated trades.[8] The realized spread is measured as the product of an indicator variable that equals 1 (-1) for customer-initiated buy (sell) trades times twice the absolute difference between the trade price and the estimated post-trade value of the asset. We use the daily closing mid-quote for the post-trade value. Realized spreads measure the gross trading revenue earned by liquidity providers. The price impact measures the trades' information content and takes the form of the liquidity providers' losses to informed traders. We measure the price impact as the product of an indicator variable that equals 1 (-1) for customer-initiated buy (sell) trades times twice the absolute difference between the estimated post-trade value of the asset (represented by the end of the time price) and the mid-quote at the time of trade.

Spreads widen around coverage termination and stay permanently higher for the year after. Beginning at day 0, effective spreads increase from about 3.5% to about 4.7% 200 days after and then stay stable around this higher level.

[8] The Lee and Ready (LR) algorithm attempts to classify a trade as a buy or a sell by comparing the trade's execution price to prevailing quotes. Trades with trade prices above (below) the execution time midpoint are typed as buys (sells). To classify trades executing at the midpoint of the execution time quotes, the LR algorithm looks to prior trades. If the price of the prior trade is lower (higher) than the current trade's price, then the current trade is classified as a buy (sell). If the prior trade has the same execution price as the current trade, then the LR algorithm moves backwards in time until it finds a prior trade with a different price and follows similar logic. Our definition of effective spread is equivalent to defining the effective spread as 2|P-M| where P is the trade price and M is the quote midpoint.

[Insert Table 3]

We compute the weekly mean and median differences of the volume-weighted effective spreads for all stock pairs. Table 3 reports the differences in the mean (columns 2 and 5) and median (columns 3 and 6) in the year before and after termination. The differences in the means are tested using the (a) two sample t-test, and (b) Boehmer, Musumeci, and Poulsen (1991) *t*-test which is a difference in differences test.[9] Similarly, the weekly differences of the median effective spreads between the two groups are tested using the Wilcoxon test under the null hypothesis of either a zero difference or of a difference equal to that in the benchmark period (from week -51 to week -36).

There is evidence of statistically higher effective spreads for stocks that lost coverage versus their controls starting around event week -8 until 55 weeks after the analysts' departure. There may be various factors that explain why liquidity starts deteriorating before actual coverage termination. The last analyst report may not come as a surprise because analysts may have signaled their termination before the last report.[10] The fact that the impact starts showing up around week -8, which is a little shorter than a quarter, is consistent with this view. It is very unlikely that coverage termination occurs because of the deterioration of liquidity from week -8. Besides the reasons mentioned above, coverage termination is not a decision that is taken lightly or immediately following a few weeks of deteriorating liquidity. This evidence clearly suggests that the trading process is disrupted by coverage termination and that it does not return to its "normal" (or pre-analysts departure) level.

We next proceed to investigate whether higher spreads are due to higher adverse selection costs that should result from the insiders' monopolistic presence. We calculate the price impact for sample and control firms. We use weekly means and medians of the price impact for sample and control firms and compute weekly differences for each stock-pair (shown in Table 4).

[Insert Table 4]

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[9] In order to run the Boehmer, Musumeci, and Poulsen (1991) *test we use th*e period from week -51 to week -36 as the benchmark period. The test accounts for heterogeneity among the samples.

[10] From our conversation with analysts, we were told that analysts may state so in the next-to-last report and hence traders impound this information.

The price impact of sample stocks is very similar to that of control firms over the benchmark period but gets significantly larger after the analysts drop the stocks. Table 4 reports differences in the weekly mean (columns 2 and 5) and median (columns 3 and 6) price impacts between sample and control firms. We use both the t-statistic and the non-parametric Wilcoxon test under the null hypothesis of either a zero difference or of a difference equal to that in the benchmark period (from week -51 to week -36). Table 4 suggests that adverse selection costs increase after the analysts' departure.

We next look at volume and show daily cross-sectional averages of total volume for the sample and control firms in Figure 1. We also compute the mean and median weekly differences between sample and control total volumes. We do not show the results for the sake of brevity.[11]

[Insert Figure 1]

Figure 1 shows that total share volume holds stable before the analysts drop complete coverage and for few weeks after the last analyst report but then there is a significant decrease in volume transacted. The analysts' absence causes a gradual decrease of interest for the stock possibly because of strong fears of informed trading.

The stable volume in the months leading to coverage termination is important in itself because it shows that analysts do not drop the stocks because of lower commissions generated by volume. Existing literature has shown that this is an important factor in determining initiation and continuing coverage. The stability of volume in the year before analysts drop coverage is another confirmation that coverage termination in our sample is not driven by liquidity.

### 3.1 Institutional Shareholders and Insiders

What happens to institutional blockholders when analysts leave? This question is important for two reasons. First, it is important for our empirical methodology because an alternative explanation is that analysts' departure is not the "primitive" factor but rather caused by institutional selling. If institutional investors are the first to leave this signals something important to analysts. If analysts' are (indirectly) compensated through commissions generated by institutional volume, lower institutional presence will mean

[11] Results can be obtained on request.

lower volume in the future. Second, if institutional blockholders and analysts leave together then insiders' informational advantage can become larger. O'Brien and Bhushan (1990) find conflicting evidence on the simultaneity between the number of analysts following stocks and institutional holdings. They find clear evidence that institutional holdings in a specific year are positively influenced by the number of analysts following a stock in the previous year. The impact of previous-year institutional holdings on analysts following is sample-specific and does not hold through time.

We look at institutional holdings of the sample and control firms before and after the termination of coverage of the sample firms by the analysts. Data on institutional holdings and changes in holdings come from the 13F filings in the CDA Spectrum database distributed Thomson Financial. Figure 2 shows quarterly median percentage institutional holdings two years before and after the analyst's departure. There is a significant decrease in institutional holdings only after coverage termination. Table 5 reports quarterly mean and median measures of institutional holding positions (columns 2 and 3) and monthly mean and median percentage changes (columns 4 and 5) starting from quarter –7 to quarter 8. We use institutional holdings from month -12 to month –9 as the benchmark and use both the t-statistic and the non-parametric Wilcoxon test to investigate the significance of the difference.

[Insert Figure 2 and Table 5]

The results in both Table 5 and Figure 2 suggest that institutional shareholders do not leave before analysts. Institutional shareholders start "voting with their feet" and sell their shareholdings *after* coverage termination and such selling goes over a protracted period. Institutional holdings are 25.74% in quarter -7 and 24.56% in quarter -4 and the difference is not statistically significant. The average institutional holding is 23% in the quarter before coverage loss and decreases to 17% five quarters after the analysts' drop. From quarter 5 onwards institutional holdings level off. We find no change in the institutional holdings of control firms.

We can also look at the change of institutional holdings from quarter -7 to quarter -4 and link our evidence with that of O'Brien and Bhushan (1990) who used previous year institutional holdings as a determinant of analyst following. Institutional holdings over these 4 quarters for sample firms went from an average of 25.74% to 24.56%. The change is not statistically different from zero and it is too small to explain the decision of analysts to terminate coverage. Hence, we conclude that the departure of analysts is not caused by the departure of institutional shareholders.

How do insiders react to the change in analysts' coverage? We investigate insiders' reaction by looking at both insiders' holdings and insiders' volume using the Thomson Financial Filling Data Files. These files contain information on the individual insiders' daily trades and their resulting share holdings. Using this information we can calculate measures of total insiders' holdings as a percentage of shares outstanding and their volume of trading for weekly, monthly, and quarterly time intervals[12].

Quarterly figures of insiders' holdings and volume as a percentage of shares outstanding are presented in Figures 3, 4 and 5. Figure 3 (insiders' holdings) shows that insiders increase their (direct) holdings, going from 3.6% in quarter -7 to around 5.7% in quarter 8. Insiders in control firms have stable ownership over this period. This evidence shows that insiders in firms losing coverage exhibit an opposite reaction to institutions that sell partly their holdings. Figure 4 shows insider (unsigned) volume out of shares outstanding and suggests that insiders do not change their absolute trading intensity, even though there is more buying after coverage termination. When we consider insiders' volume out of total (share) volume traded we find that insiders' presence in the trading process increases. The results are shown in Figure 5. The reason is that while insiders do not decrease their trading intensity, the total share volume after coverage termination decreases with a subsequent increase in the presence of insiders in trading. This evidence will be considered very closely when we investigate the presence of informed traders in the trading process and the impact on adverse selection costs.

[12] To calculate insiders' information we rely on SEC Form 4 of the Thomson Financial Filing Data Files which reports information on the daily change in an insider's ownership position including whether the insider bough or sold shares, the amount of shares traded and the resulting number of shares owned after the trade. We estimate insiders' holdings by identifying the resulting positions of all insiders' trades that are reported up to two years before the drop of the analysts. We then follow the trades made by the insiders during the subsequent 4 years, i.e. up to the two years after coverage termination. For both volume and holdings we focus on trades related to direct ownership positions, i.e., equity positions held in the insider's name, or in the name of a broker, bank or nominee on behalf of the insiders. Indirect ownership positions and trades (equity held by members of the insiders' immediate family sharing the same household or investments partnerships) are excluded from the present analysis since not enough information is provided to determine whether it was an insider who initiated the trade and the exact number of shares. Hence allowing indirect trades could lead to over-counting.

[Insert Figures 3, 4, and 5]

### 3.2 Multivariate Analysis

We have shown that liquidity deteriorates permanently in univariate settings. We next determine whether these results are robust in a multivariate setting to control for other factors found to influence spreads. We compute the average weekly effective spread from all weekly observations and generate one observation per stock-week from week -49 through week +50. Then we proceed to compute the difference of effective spreads for each stock-pair each week. The regression is as follows:

$$\Delta ES_{jt} = \alpha + \beta_1 \text{Absence of Analyst} + \beta_2(\Delta \text{AdS Costs}_{jt}) + \beta_3(\Delta \text{Trading Volume}_{jt}) + \beta_4(\Delta \text{Price Volatility}_{jt}) + \beta_5(\Delta \text{Trade Price Inverse}_{jt}) + \beta_6(\Delta \text{Stock Returns}_{jt}) + \beta_7(\Delta \text{Institutional Shareholding}_{jt-1}) + \beta_8 \text{Weeks After Analysts Departure}_{jt} + \beta_9(\text{Weeks After Analysts Departure}_{jt})^2 + \varepsilon_{jt} \quad (1)$$

where $\Delta ES_{jt}$ is the weekly average difference between the effective spreads of the sample stock and its control that form stock pair j in week t, *Absence of Analysts* is a dummy variable that takes the value of 1 when the stock loses completely analysts' coverage and a value of zero otherwise, $\Delta AdS\ Costs_{jt}$ is the weekly average of the difference of adverse selection costs for each stock pair j in week t, $\Delta Trading\ Volume_{jt}$ is the difference in the weekly share volume for stock pair j in week t, $\Delta Price\ Volatility_{jt}$ is the difference in weekly price volatility for stock pair j in week t, *Trade Price Inverse*$_{jt}$ is the difference in the inverse of the trade prices for stock pair *j* in week *t*, $\Delta Stock\ Returns_{jt}$ is the difference in the weekly stock returns for stock pair *j* in week *t*, $\Delta Institutional\ Shareholding_j$ is the difference in the holdings of Institutional Shareholders for each stock pair *j* in the quarter before week *t*, *Weeks After Analysts Departure* is the number of weeks after the loss of complete coverage, and *Weeks After Analysts Departure*$^2$ is the squared term of the number of weeks after the loss of complete coverage. We include industry dummy variables and firm fixed effects in each regression. We have 558 stock pairs for 100 pair-week observations. There are some weeks where either the sample stock or its control do not trade leading to missing values and reducing our sample to 45,756 total observations. For some sample and control stocks we do not have data on institutional holdings, ending with 41,060 pair-week observations when using institutional holdings.

The main variable of interest is *Absence of Analysts Dummy*. If analysts contribute to the trading process then we should expect the coefficient estimate to have a positive sign after controlling for other variables found to influence trading costs. We also look at whether any deterioration in liquidity increases slowly after the loss of coverage (*Weeks After Analysts Departure*) and whether it takes place at a decreasing rate (*Weeks After Analysts Departure*$^2$). The variables *$\Delta$AdS Costs*$_{jt}$, *$\Delta$Trading Volume*$_{jt}$, *$\Delta$Price Volatility*$_{jt}$, *$\Delta$Trade Price Inverse*$_{jt}$, and *$\Delta$Stock Returns*$_{jt}$ have been used by existing literature to control for factors influencing trading costs. $\Delta$Institutional Shareholding$_{jt-1}$ controls for the impact of institutional shareholders.

[Insert Table 6]

Table 6 reports different results of the multivariate analysis. Column 1 reports the results of the basic model where we control for all microstructure variables. In column 2 we add the *$\Delta$Institutional Shareholding* as another control variable. In columns 3 and 4 we add *Weeks After Analysts Departure* and *Weeks After Analysts Departure*$^2$ to further investigate the time-series dynamics of liquidity after coverage termination.

The most important result is that the coefficient estimate for the *Absence of Analysts Dummy* variable is positive and statistical significant, meaning that coverage termination leads to higher spreads even after controlling for other variables. This result is also robust to the holdings of institutional investors. We also find that the departure of analysts does not lead to a one-time shock in spreads but they rather increase slowly over time. The coefficient estimate of *Weeks After Analysts Departure*$^2$ is negative and statistically significant, showing that such an increase takes place at a decreasing rate. This is consistent with the view that markets take some time to adjust to the absence of any coverage but eventually find the equilibrium level of liquidity without the contribution of analysts.

We next investigate whether there is something special about the loss of complete coverage. It can be argued that the same impact on liquidity is felt when a stock loses coverage by any analyst irrespective of whether complete coverage is lost or not. We also want to investigate any incremental impact on liquidity from the departure of the last analyst. We run the following estimation:

$$\Delta ES_{jt} = \alpha + \beta_1 \text{Absence of Analyst} + \beta_2 \text{Drop Dummy 1} + \beta_3 \text{Drop Dummy 2} + \beta_4(\Delta \text{AdS Costs}_{jt}) + \beta_5(\Delta \text{Trading Volume}_{jt}) + \beta_6(\Delta \text{Price Volatility}_{jt}) + \beta_7(\Delta \text{Trade Price Inverse}_{jt}) + \beta_8(\Delta \text{Stock Returns}_{jt}) + \beta_9(\Delta \text{Institutional Shareholding}_{j-1}) + \beta_{10} \text{Weeks After Analysts Departure}_{jt} + \beta_{11}(\text{Weeks After Analysts Departure}_{jt})^2 + \varepsilon_{jt} \quad (2)$$

where the variables have the same meaning as in (1) above while Drop Dummy 1 is a dummy variable that takes the value of 1 when a stock loses the second from last analyst and zero otherwise, and Drop Dummy 2 is a dummy variable that takes the value of 1 when a stock loses the next from last analyst and zero otherwise. Table 7 shows the results of our multivariate analysis.

[Insert Table 7]

Our main interest is the coefficient estimates of the *Absence of Analyst Dummy*, the *Drop Dummy 1*, and the *Drop Dummy 2*. The results show that neither the coefficient estimate of *Drop Dummy 1* nor that of *Drop Dummy 2* is statistically significant. Even when the number of analysts covering a stock is small, as is our case, and the impact of a departure of an analyst should be high, we see that liquidity does not suffer in a significant way when one analysts leaves as long as coverage continues. What really matters is coverage termination.

The results presented so far suggest that there is a statistically and economically significant impact of analysts' departure on the trading process. These results suggest that analysts do something more fundamental than adding noise to the trading process.

**Section 4. Price Discovery and Efficiency**

The next question deals with price efficiency in an environment where insiders are not restrained by analysts. Does price discovery become more or less efficient? Information, whether private or public, is generated continuously. How much of this information gets impounded in prices and how fast is a crucial question.

If analysts contribute to information generation then we should expect learning about the stock's true price becomes more complicated after their departure. If analysts' contribution is negligible then we should not find any incremental difficulty in price discovery.

We first look at intraday price volatility, measured as the standard deviation of intraday returns using the changes in natural log of midquotes.

[Insert Figure 6.]

Figure 6 shows that while price volatility of control firms is stable over the two year period, sample stocks experience a doubling of intraday volatility after coverage termination.

We use two methodologies to investigate price discovery. The first approach is finding the volatility of trade prices around true prices. One possible proxy for the true price is the midpoint between the bid and ask prices. Although existing literature has used such an approach, there remain many reasons that cast doubt on this proxy. Goettler, Parlour, and Rajan (2005) show that conditioning on trading the midpoint is not a good proxy. Our methodology is based on this insight and we get an estimate of the true price using a Kalman Filtering approach. We then compare the price volatility around the true price before and after the departure of analysts.

Consistent with Madhavan et al. (1997), the trade price discovery process as follows

$$p_{t,i} = m_t + s_{t,i} + \varepsilon_{t,i} \qquad \varepsilon_{t,i} \sim N(0, \sigma_\varepsilon^2) \;\; i=1,\ldots, N_t \qquad (3)$$

$$m_{t,i} = m_{t-1} + \nu_t + \zeta_t \qquad \zeta_{t,i} \sim N(0, \sigma_\zeta^2) \;\; i=1,\ldots, n \qquad (4)$$

where $p_{t,i}$ is the transaction price at time t for trade i, $s_{t,i}$ is the half-spread and $\varepsilon_{t,i}$ is the pricing error in the transaction price, $m_{t,i}$ is the fundamental (true) price, $\nu_t$ is the price-relevant information released by the order flow, and $\zeta_t$ is the disturbances generated by the information coming from other sources besides the volume transacted. The disturbances $\varepsilon_{t,i}$ and $\zeta_t$ are normally distributed and independent of each other.

In our methodology we assume that spreads have one component - adverse selection - while the inventory component and order processing component are not explicitly modeled. Additional structure is needed to calculate the "system-wide" price: (i) the information impounded from the order flow, and (ii) the factors affecting the spreads must be specifically modeled. We specify the half-spread at time *t* on the *i*-th trade through the following process:

$$s_{t,i} = d_{t,i} \left(\tau'_t \Pi + \varkappa'_x \Omega\right) \qquad x = x_{t,i}$$

where

$$d_{t,i} = \begin{cases} 1 \text{ if trade is buyer-initiated} d \\ -1 \text{ if trade is seller-initiated} \end{cases}$$

and $(\tau'_t\Pi + \xi'_x\Omega)$ is a cubic spline regression with parameter vectors $\Pi$ and $\Omega$. The explanatory variables $\tau'_t$ and $\varkappa'_x$ are vectors based on the time-of-day effect $\tau$ and the trade size $x_{t,i}$ respectively.

Following Copeland (1976) and Easley and O'Hara (1987 and 1992) we assume that the order flow, the trade size, the order persistency and the time interval between successive trades are factors that signal information about the true value of the security. We follow Hasbrouck (1991) and assume that the order flow is serially correlated because of order fragmentation and price stickiness. If we allow the vector $q_{j,t} = (q_{1,t},\ldots,q_{S,t})$ to contain the lagged trade volumes multiplied by the binary variable $d_{t,i}$, we allow for serial correlation in the following way:

$$q_{j,t} - E(q_{j,t} \mid q_{j-1,t}, q_{j-2,t}, q_{j-3,t} \ldots) = q_{j,t} - \Theta_1 q_{j-1,t} - \Theta_2 q_{j-2,t} - \Theta_3 q_{j-3,t} \ldots \quad (5)$$

With this structure, we model the information contained in the order flow as follows

$$vt = q_t \lambda = \sum_{j=1}^{S} \lambda_j q_{j,t} \quad (6)$$

where, $q_{j,t} = \sum_{i=1}^{N_{t-j}} d_{t-j}, x_{t-j}$ and $\lambda = (\lambda_1,\ldots,\lambda_2)$ is a fixed unknown vector of coefficients.

We write the model in (3) and (4) in a state space framework with the following transition and measurement equations:

$$\alpha_t = \Omega_t \alpha_{t-1} + \Pi_t \gamma_\varkappa + \beta_t \eta_t \qquad \eta_t \sim N(0, \sigma_\eta^2) \quad i=1,\ldots, n \quad (7)$$

$$p_{t,i} = \Phi_{t,i} \alpha_t + X_{t,i} \gamma_\omega + \varepsilon_{t,i} \qquad \varepsilon_{t,i} \sim N(0, \sigma_\varepsilon^2) \quad i=1,\ldots, N_t \quad (8)$$

where $\alpha_t$ is the m×1 state vector which follows a vector autoregressive process with transition matrix $\Omega_t$, explanatory matrix $\Pi_t$ and selection matrix $\beta_t$ for the disturbance term $\eta_t$. The parameter vectors $\gamma_\varkappa$ and $\gamma_\omega$ allow the inclusion of the fixed effects in the model. The matrices $\Omega_t$, $\Pi_t$, $\beta_t$, and the vectors $\Phi_{t,i}$, $X_{t,i}$ are assumed to be deterministic and known.

The time-of-day effect on spreads and the trade size effect are modeled as regression spline functions with a number of knots determined using the Akaike Information Criterion (AIC) to obtain fit and parsimony in the model. Following Koopman and Lai (1999), the model used has four knots for the time spline and three knots for the size spline. The volume effect $\nu_t$ is modeled through $\Pi_t\ \gamma_{\varkappa}$ while the regression effect $X_{t,i}\ \gamma_{\omega}$ models the spread. The state vector is the scalar $m_t$ and modeled as a nonstationary process with the initial state requiring a diffuse prior condition

$$\alpha_1 \sim N(0, \kappa)$$

where κ is assumed to have a value of $10^6$.

The Kalman filter uses the past vector observations of $p_1,... p_t$ to evaluate the minimum mean squared linear estimator of the state vector $\alpha_{t+1}$ with $\alpha_{t+1} = E(\alpha_{t+1} \mid p_1,... p_t)$ and variance matrix by $Y_{t+1} = var(\alpha_{t+1} \mid p_1,... p_t)$. In this way, the Kalman filter runs to evaluate one-step and multi-step predictions of the state vector. It will also obtain one-step ahead prediction errors together with their variances.

Harvey (1993) and Koopman and Lai (1999) show that some of the elements of these matrices and vectors may be unknown. These elements are collected in the vector $\varpi$ and estimated by maximum likelihood

$$\text{LogL}(\varpi)=\text{constant} - \frac{1}{2}\sum_{t=t_0}^{n}\ \sum_{i=1}^{y_t} \log Z_{t,i} + \frac{j_{t,i}^2}{Z_{t,i}}$$

The disturbances in the model are normally distributed while the variance of $\eta_t$ can be expressed as a ratio of the variance of $\varepsilon_t$, giving us the signal-to-noise ratio, given by $\Psi = \sigma_\eta^2 / \sigma^2_\varepsilon$ and $\psi$ is estimated by numerically optimizing the likelihood function.

Following the calculation of the true "system-wide" price, we measure the price volatility around the fundamental price calculated from the state space model. This volatility measures traders' learning. If analysts do not influence the learning process we should find no impact on this volatility measure after coverage termination.

Denoting $\sigma_\xi^2$ and $\sigma_\omega^2$ as the variance of the price discovery process before the departure of analysts and after their departure respectively, we can calculate $Var[\ln(m_t)-\ln(p_t^{BEFORE}]$ and $Var[\ln(m_t)-\ln(p_t^{AFTER})]$.

The conventional variance ratio, given by $\sigma_\omega^2/\sigma_\xi^2$ is defined as:

$$\Lambda = \frac{Var\left[\ln(m_t) - \ln\left(p_t^{AFTER}\right)\right]}{Var\left[\ln(m_t) - \ln\left(p_t^{BEFORE}\right)\right]}$$

Ronen (1997) shows that cross-stock correlations, serial correlation and heteroscedasticity in the return series can severely bias variance ratios. The Generalized Method of Moments (GMM) can deal effectively with these problems.[13]

We use the Lagrange Multiplier to test the null hypothesis of unity variance ratios for individual securities while we employ the Wald statistic $T\left(\hat{\Lambda}-1\right)' \sum_{\Lambda}^{-1}(\Lambda-1) \sim \chi^2(N)$ to test the null hypothesis that the variance ratios are jointly equal to unity.

[Insert Table 8]

Table 8 reports the results of variance ratios for each of the four quarters after coverage termination. The results show that there is a significantly increase in price volatility around the true market price and this increases monotonically with time. The results in Panel B and Panel C show that the biggest increase in variance ratios occurs for stocks with above-median insiders' holdings.

The second methodology we use is the one proposed in Hasbrouck (1993) and estimate the dispersion of differences between trading prices and the stock's true price. This is done through a vector autoregression model separating the variability of the random walk component of price changes (the efficient price) from the stationary component of price changes (the pricing errors). In this way we will be distinguishing between informed and uninformed trading.

Hasbrouck (1993) uses the following decomposition of the (log) of transaction prices, $p_t$, in a random walk component, $m_t$, and a transitory pricing error, $s_t$, as follows:

$p_t = m_t + s_t$

The $m_t$ component can be understood as the stock's true (efficient) price and its innovations occur due to the arrival of public and private information. The $s_t$ component is the pricing error as it measures (temporary) deviations from the true price. It is assumed to follow a zero-mean covariance-stationary process. The pricing error's

[13] This methodology has been used by Madhavan and Panchapagesan (2000) in another context.

standard deviation, $\sigma_s$, is a measure of the (inverse) informational efficiency. We will refer to the estimate of $\sigma_s$ as Var(s).

We follow Hasbrouck (1993) and Boehmer and Kelly (2007) and estimate Var(s) from a vector moving average representation of the VAR system with five lags. We use all price observations and eliminate (a) all observations where the change in price is larger than 40%, and (b) overnight price changes. We estimate the monthly means of Var(s) and then run the following regression:

$$Var(s)_{jt} = \alpha + \beta_1 Insiders\ Holdingsj_{t-1} + \beta_2 Insiders\ Holdings_{jt-1} * Absence\ of\ Analysts + \beta_3 Presence\ of\ Analyst_{jt} + \beta_4 Institutional\ Holdings_{jt-1} + \beta_5 Effective\ Spread_{jt} + \beta_6 Trade\ Price_{jt} + \beta_7 Var(Trade\ Price)_{jt} + \beta_8 Market\ Capitalization_{jt} + \beta_9 Var(s)_{jt-1} + \varepsilon_{jt} \quad (9)$$

where for each stock j and month t we compute the mean of *(log) Var(s)*, *Insiders Holdingsj*$_{t-1}$ is the level of Insiders Holdings of outstanding shares, *Insiders Holdings*$_{jt-1}$**Absence of Analysts* is the interaction between Insiders Holdings and a dummy variable (Absence of Analysts) that takes the value of 1 after coverage termination and 0 otherwise, *Presence of Analyst*$_{jt}$ is a dummy variable that takes the value of 1 before coverage termination and 0 after, *Institutional Holdings*$_{jt-1}$ is the level of holdings of Institutional Shareholders in the previous-quarter, *Effective Spread*$_{jt}$ is the monthly mean of intraday volume-weighted effective spread, *Trade Price*$_{jt}$ is the monthly mean of closing trade prices (in logs), *Var(Trade Price)*$_{jt}$ is the standard deviation of intraday trade prices during month t (in logs), *Market Capitalization*$_{jt}$ is the market capitalization during month t (in logs), and *Var(s)*$_{jt-1}$ is the lagged value of (log) Var(s). We run the regression both on the sample of firms that lost coverage and also for the stock-pairs where for the (log) Var(s) and independent variables we take the difference between sample and control firms. The results are shown in Table 9. Columns (1) and (2) show the results for the 558 stocks that lost coverage. Columns (3) and (4) show the results for stock-pairs.

[Insert Table 9]

The results shown for all specifications indicate that insiders have an adverse impact on price efficiency but such an impact is not statistically significant. Insiders' impact becomes larger and statistically significant after coverage termination. The coefficient of the variable *Insiders Holdings*$_{jt-1}$**Absence of Analysts* is positive and carries statistical significance for all specifications shown in columns (3) and (4). On the other hand, the coefficient of the variable *Presence of Analyst*$_{jt}$ is negative and carries significance at the 10% level, indicating that research coverage adds information that is useful for traders. Finally, we find that Institutional Holdings improve price efficiency similar to Boehmer and Kelly (2007). We interpret these results as evidence that analysts restrain the informational advantage of insiders and they seem to "neutralize" any adverse impact that insiders may have on price efficiency. Once coverage is terminated insiders' adverse impact is unrestrained and generates a significant impact on price efficiency.

## Section 5. Adverse Selection Costs

After finding that analysts' departure leads to a permanent increase in spreads and less efficient price discovery we next address two questions. First, what happens to adverse selection costs? Second, if we find that adverse selection costs are influenced by the analysts' departure then we need to ask through which channel is this influence taking place? These questions are closely related to the restraining role of analysts on insiders. We conjecture that since information production changes after coverage is terminated this should influence the presence of liquidity-motivated and information-motivated traders.

Brennan and Subrahmanyam (1995) hold that analysts unearth new private information, thus becoming informed outsiders, and that competition between them leads to trade-related information getting impounded in prices. In the case of long-lived information, Holden and Subrahmanyam (1992) show that information-motivated traders trade very aggressively and the price will reflect the traders' private information very rapidly leading to a deeper market. An important insight of Holden and Subrahmanyam (1992) is that the impact of informed traders on price informativeness is non-linear: it is greatest the smaller the number of informed traders. The sample of stocks considered in this paper is well placed to analyze such an effect since they have very limited analysts' following.

If this view is correct, then we should find that when coverage is terminated the presence of outside informed traders diminishes with a direct impact on the informational advantage of insiders.

Two factors should be considered to see whether insiders' informational advantage really increases after coverage termination. First, analysts' reports should contain trade-relevant information, making them informed traders. Michaely and Womack (1999), Agrawal and Chen (2008), Easley et al. (1998), Roulstone (2003), and Piotroski and Roulstone (2004) suggest otherwise. In the case that analysts re-package public information or add noisy information then we should expect that insiders' informational advantage does not change after coverage termination because analysts were not doing any activity that restrained insiders' advantage in the first place. Second, we must consider the role of other potential outside informed traders, namely institutional blockholders. Institutional blockholders may replace analysts in information acquisition once coverage terminates. We find that institutional blockholders' presence decreases significantly after the departure of analysts and hence blockholders' importance decreases, not increases, after coverage termination.

But is insiders' informational advantage beneficial or detrimental to the trading process? Fishman and Hagerty (1992) show that this depends on (i) market conditions, and (ii) the outsider's cost of acquiring information. In their model, insider trading should produce a beneficial impact when the outsider's cost of acquiring information is high, insider's informational advantage is high, and the stock is not actively traded by liquidity traders. The environment considered here is very close to the conditions indicated by Fishman and Hagerty (1992) to be congenial for insiders to contribute positively to the trading process.

We investigate this question by looking at the impact of insiders' holdings and volume on measures of adverse selection. If insiders' informational advantage does not increase, or is not seen as a threat to traders, then it should not have any impact on adverse selection costs after the departure of analysts.

We have two measures of adverse selection costs. First, we use the Glosten and Harris (1988) methodology, and, second, the Madhavan and Smidt (1991) methodology. To measure adverse selection costs we estimate $\lambda$, which is the inverse of market depth using the different procedures as proposed by Glosten and Harris (1988) and Madhavan and Smidt (1991). In Glosten and Harris (1988) $\lambda$ is estimated in the following way:

$$\Delta p_t = \lambda q_t + \psi\left[D_t - D_{t-1}\right] + y_t$$

where $\Delta p_t$ is the price change at transaction t, $q_t$ is the signed trade size, $D_t$ is a dummy variable to indicate the trade direction and takes the value of +1 for a buy-initiated trade and -1 for a sell-initiated trade, $\psi$ is the fixed-cost component of providing liquidity and $y_t$ is the error term which is assumed to be i.i.d.

In Madhavan and Smidt (1991) $\lambda$ is estimated in the following way:

$$\Delta p_t = \lambda q_t + \frac{\psi}{\pi} D_t - \psi D_{t-1} + \eta_t$$

where the variables $\Delta p_t$, $q_t$, $D_t$, have the same meaning as before, $\pi$ is the Bayesian weight, and $\eta_t$ is the error term which is assumed to be MA(1).

The regression specification is as follows:

Adverse Selection $Costs_{jt}$ = $\alpha$ + $\beta_1$Insiders $Holdings_{jt}$ + $\beta_2$Insiders $Holdings_{jt}$ x Absence of $Analysts_j$ + $\beta_3$Institutional $Shareholding_{jt}$ + $\beta_4$Presence of $Analyst_j$ + $\beta_5$ Price $Volatility_{jt}$ + $\beta_6$Trade Price $Inverse_{jt}$ + $\beta_7$ Share $Volume_{jt}$ + $\varepsilon_{jt}$ (3)

where Adverse Selection $Costs_{jt}$ is the weekly average adverse selection costs for sample stock j in week t. The independent variables are: *Insiders $Holdings_{jt}$* are the (log of) holdings of all insiders in week t; *Insiders $Holdings_{jt}$ x Absence of Analysts* is the interactive variable where the (log of) holdings of all insiders in week t are interacted with a dummy variable (*Absence of Analysts*) that takes the value of 1 after coverage termination and 0 otherwise; *Institutional $Shareholding_{jt}$* are the (log of) holdings of all institutional blockholders in each quarter; *Presence of $Analyst_j$* is a dummy variable that takes the value of 1 before the complete departure of analysts and 0 otherwise; *Price $Volatility_{jt}$* is the weekly price volatility, *Trade Price $Inverse_{jt}$* is the inverse of the weekly average trade price, and *Share $Volume_{jt}$* is the (log of) weekly share volume. We include industry dummy variables and firm fixed effects.

To investigate the impact of the volume transacted by insiders on adverse selection costs we also run the following regression:

Adverse Selection $Costs_{jt}$ = $\alpha$ + $\beta_1$Insiders $Holdings_{jt}$ + $\beta_2$Insiders $Volume_{jt}$ + $\beta_3$Insiders $Volume_{jt}$ x Absence of $Analysts_j$ + $\beta_4$Institutional $Shareholding_{jt}$ + $\beta_5$Presence of $Analyst_j$ + $\beta_6$ Price $Volatility_{jt}$ + $\beta_7$Trade Price $Inverse_{jt}$ + $\beta_8$ Share $Volume_{jt}$ + $\varepsilon_{jt}$ (4)

where the variables in (4) have the same meaning as in (3) and *Insiders $Volume_{jt}$* are the (log of) share volume of all insiders for each month; *Insiders $Volume_{jt}$ x Absence* *of Analysts* is the interactive variable of the (log of) monthly share volume of all insiders interacted with a dummy variable (*Absence of Analysts*) that takes the value of 1 after the departure of analysts and 0 otherwise.

We apply two different methodologies. The first one uses the time-series dimension of the sample of stocks dropped by analysts and investigates the impact of the coverage termination. Although this approach has certain advantages, it has the drawback that coverage termination is assumed to be completely exogenous. Although we present evidence that analyst termination in our sample period may be driven by reasons other than crowding out of insiders or firms' performance we need to still take the possibility of endogeneity in our tests. Hence, we use the second approach where we use a simultaneous set of equations, similar to that of Brennan and Subrahmanyam (1995). We do not report the results obtained from this methodology since the results are similar to those obtained from the first methodology. Results can be obtained from the authors on request.

The results are shown in Table 10.

[Insert Table 10]

The results in Table 10 show that insiders' holdings increase adverse selection costs although the significance of the coefficient estimate is significant only at the 10% level. This result is not very different is spirit than that found by Glosten and Harris (1988) although we find a larger impact from insiders. Importantly insiders' holdings after coverage termination strongly influence adverse selection costs. The coefficient estimates of the variable Insiders Holdings x Absence of Analysts have both statistical and economic significance. This result suggests that insiders' informational advantage is detrimental to the trading process and become more so when no analysts are present to restrain that advantage. Traders take into consideration the insiders' new role as informational monopolists and adjust appropriately.

There are two additional important results in this regard. First, the coefficient estimate of the dummy variable that denotes the presence of analysts is negative and statistically significant, meaning that the presence of sell-side analyst reduces adverse selection costs. This result is consistent with Brennan and Subrahmanyam (1995). Second, institutional investors also have a negative impact on adverse selection costs although the coefficient estimates carry weak statistical significance when using the Glosten and Harris methodology and no significance when using the Madhavan and Smidt methodology. The control variables have the expected signs and carry statistical significance.

We further investigate insiders' impact on adverse selection costs by looking at insiders' volume. The results show that insiders' volume has a very weak impact on adverse selection costs when we use the Glosten and Harris methodology and no significant impact when we use the Madhavan and Smidt methodology. Insiders volume's impact on adverse selection becomes significant only after coverage is terminated.

So far we have found evidence that analysts' presence restrain insiders' informational advantage. This is not consistent with the view that analysts just re-package available public information. It is more consistent with the view that analysts' reports contain trade-related information. This result calls for an investigation of the way analysts generate information. Analysts may unearth new information, or, in the words of Easley et al. (1998) "…the creation of new private information…". Unearthing new information is not the only way analysts can influence stocks' information structure. Analysts can compete with insiders for existing price-sensitive information. If analysts' activity leads to this existing private information to become publicly known then they will be influencing the information structure. Without the analysts' presence, this price-sensitive information would have either remained private or would have become impounded slower in prices.

We investigate this question using the Probability of Informed Trading (PIN) measure proposed by Easley et al. (1996). The PIN measure is best placed to provide answers on the (a) stock's information structure, (b) liquidity-motivated traders, and (c) informed-motivated traders. The measure contains five basic parameters: the probability of arrival of new information ($\alpha$), the probability that the new information is negative ($\delta$), the arrival rate of informed traders ($\mu$), and the arrival rates of liquidity-based sellers and buyers ($\varepsilon_s$ and $\varepsilon_b$). Using this notation, the probability of informed-based orders can be written as:

$$\text{PIN} = \frac{\alpha\mu}{\alpha\mu + \varepsilon_s + \varepsilon_b}$$

We measure the PIN measure for sample and control firms together with the estimates of the different components α, μ, and ε. The maximum likelihood estimation converges for 422 stock pairs. Consistent with Easley et al. (1998), we use a logit transformation to restrict the two probability parameters α and δ to [0,1] and use a logarithmic transformation to restrict the parameters μ and ε to [0, ∞]. The results are shown in Table 11.

[Insert Table 11]

Panel A of Table 11 shows the means of the estimated parameters for the sample stocks and the control group from event week -52 to event week -12 while Panel B shows the estimated parameters from event week + 4 to event week + 52. We stop our analysis for the pre-departure period at week -12 to avoid the last quarter where liquidity may suffer before coverage is effectively terminated.

We first start by looking at whether there are any systematic differences in the parameter estimates of sample and control over the period that goes from event week -52 to event week -12. We use the Wilcoxon Signed Rank test for this purpose. The test statistics are shown in Panel A. The PIN estimate is 0.164 for the sample stocks and 0.157 for the control stocks. The difference of PIN and of the individual estimates, α, δ, μ, and ε is not statistically significant, showing that there are no differences between sample and control firms.

Turning to Panel B, we see that the parameters for the sample stocks change after coverage termination. We use two types of Wilcoxon Signed Rank tests. The first one to test whether there is a statistical difference between the sample stocks' parameters in the pre-departure period and in the post-departure period. The second to test whether the sample stocks' parameters in the post-departure period are different than those of the control group in the same period.

We first consider the change in the α parameter, which shows the probability of the occurrence of a private information event. Using the Easley et al. (1998) framework, analysts can either unearth new private information or show abilities in turning any private information into the public domain. There is a statistically significant increase in α, from 0.260 in the pre-period to 0.294 in the post-period. The results for α are consistent with the view that analysts are able to make private information available to all traders in the market. This is beneficial to the trading process even if they do not generate new information.

We turn next to the $\delta$ parameter, which provides the probability of bad news. The results show that there is an increase in this parameter but it carries very weak significance.

Finally, we look at the parameters of the presence of liquidity traders, $\varepsilon$, and the presence of informed traders, $\mu$. The presence of liquidity traders in the sample stocks diminishes significantly, going from 15.15 in the pre-departure period to 10.51 in the post-departure period. At the same time, the presence of informed traders increases from 22.27 in the pre-departure period to 26.91 in the post-departure period (significant at the 5% level). This result is consistent with Figure 5 that shows insiders' volume out of total volume transacted increasing substantially after coverage termination.

We also look at sub-samples formed on insiders' presence. Panel C shows the sample firms with an above-median presence of insiders and Panel D with below-median presence of insiders. The former have higher PIN measures before and after coverage termination relative to the latter. An interesting result in the $\alpha$ parameter which increases in both sub-samples but the biggest increase is experienced by stocks that have high insiders holdings.

The interpretation of these results reveals a somewhat complex picture of the analysts' role. First, although analysts do not generate new private information, they do contribute to the trading process by turning private information into public information. This means that analysts and their clients have early notification of the occurrence of events on which they can trade. This information, without the presence of analysts, would have either remained private or would have been impounded in prices with a much slower intensity. Liquidity traders are benefiting from the presence of analysts in a different way than just the showcasing role. In essence, with the presence of analysts prices should be more informative because analysts and their clients compete on the early notification of private information. Once this competition disappears, liquidity traders are harmed. The trading process is slower in reflecting available information and the presence of informed traders increases. As a result, liquidity traders leave the stock with a consequent impact on stock's liquidity.

### 5.1 Insiders Price Impact

We next investigate the price impact of insiders' trades during the period around coverage termination. To better capture the insiders' effect on prices and to control for the possible splitting of insiders' orders we look at the entire sequence of individual trades per insider. We use the methodology proposed by Chan and Lakonishok (1995) when investigating the price impact of institutional trades. We define an insiders' trading buy (sell) package as the series of successive purchases (sales) of the same stock with a break of less than 5 days between successive trades. Our unit of analysis is the individual insiders' buy and sell packages. The time period we analyze encompasses four quarters before and four quarters after the analysts drop date.[14] Table 12 Panels A and B report summary statistics for the insiders' packages for the pooled sample of companies that lost complete coverage.

[Insert Table 12]

The table shows the mean and median size of the packages both in dollar volume (Panel A) and shares traded (Panel B) and the percentage of packages that last (a) one day, (b) between two to three days, and (c) more than three days. Panel A shows that during the period before the analysts stop coverage, insiders trade similar packages in dollar amounts. In addition, Panel A shows that although most packages appear to last one day (88% of all packages before the drop and 89% after), more than 20 % of all dollar volume packages take longer than one day to execute. Panel B reports similar statistics for the total shares traded. The mean and median statistics of shares traded suggest that insiders' packages are significantly larger after the drop than before the drop. In conclusion, the results describe a picture of active insiders, whose participation either stays stable of increases after coverage is terminated.

Panels C and D of Table 12 report the price impact of insiders' packages by looking at returns before, during and after the insiders' packages are executed. We look at return windows of 5 and 20 days before the initiation and after the completion of each insiders' trade package respectively. All results compare mean and median measures of package returns before and after the drop of analysts. Panel C reports raw returns whereas

[14] We excluded from the analysis the quarter before and the quarter after the analysts drop to avoid overlapping periods and possible distortion of the results.

Panel D looks at excess returns which adjust for the market-wide stock price movements by subtracting the returns of the matching firm. Both Panels C and D report cross-sectional mean and median measures of dollar-volume weighted returns for each company (principal-weighted average within the company). The results for the periods of 20 and 5 days preceding the packages suggest that insiders follow a contrarian strategy in their investments, in the sense that decreases in the stock price trigger insider buys, and to a lesser extent, increases in prices trigger sells. This behavior is consistent with existing literature (Lakonishok and Lee, 2001, and Piotroski and Roulstone, 2005).

We find evidence that the price impact of insiders' packages is larger after coverage termination. For buy packages, there is an average excess return during the package execution period of 2.81% (median value of 1.31%) which is both statistically and economically larger than for similar buy packages in the period before termination. In a similar manner, though not statistically significant, sell packages appear to have a larger negative impact on prices during their execution period, with both larger raw and excess returns. For the post-execution periods of 5 and 20 days, we see from both the mean and median excess return measures (Panel D) that insiders' packages almost always have a larger impact on prices during the post-termination period. The lack of price reversal in stock prices after the package ends for the post-termination period suggests that insiders have predictive ability with respect to short-term price movements that can lead to significant profits. Such a superior performance, however, appears to be present predominantly in the period after termination. Insiders' trades become more profitable after coverage termination consistent with the view that insiders find themselves relatively unconstrained without the presence of analysts and this helps them to use better their informational advantage, lending further support to the evidence shown above.

## Conclusions

This paper investigates the role of analysts in restraining insiders' informational advantage and its impact on liquidity and price discovery. We use a quasi-natural experiment of stocks that lose ***completely*** all research coverage without suffering any subsequent delisting or bankruptcy. For the period 1999-2003 we found 558 of such instances. We use a matching firm approach to address endogeneity issues.

We look at three related issues around and after coverage termination to investigate how informed outsiders impact insiders' informational advantage: (a) liquidity changes, (b) the changes in the equilibrium between informed and uninformed traders, and (c) price discovery changes.

We first find that analysts' departure has a significantly permanent (negative) impact on liquidity in the year following departure. Institutional blockholders, another group of potentially informed outsiders, leave the stock after the last analysts' report and not before. Using both a kalman filtering methodology and the Hasbrouck (1993) methodology we find that the departure of analysts makes the price discovery process less efficient and the volatility around the stock's true price larger. We investigate whether these results are driven by the restraining role of analysts on insiders. Information generation and dissemination are crucial in trading and we find that the equilibrium between informed and uninformed traders that existed prior to the analysts' departure changes. We find (i) a positive relationship between insiders' holdings and adverse selection costs, and (ii) adverse selection costs become more sensitive to insiders' holdings and volume following the analysts' departure. Using the PIN methodology proposed by Easley et al. (1996) we find that the probability of trading with an informed trader increases after the departure of analysts. We find evidence that the role of the analysts is not that of unearthing new (private) information but rather making public existing private information. This result indicates that analysts compete with insiders for the pool of existing private information.

Our results shed light on how analysts influence trading dynamics by restraining insiders. The most likely reason for this change is insiders' acquisition of monopolistic power that tips the balance against liquidity traders.

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**Table 1**

**Analysts' Coverage and Firm Performance**

The Table shows number of analysts, recommendations, estimates and actual firm performance two years before coverage termination. Quarter 0 is the last quarter for which analysts issue a report. Panel A shows the median and mean number of analysts following the 558 stocks in the sample. Panel B shows the mean, median and standard deviation of analysts' recommendations (buy, sell or hold). Recommendations are ranked from 1 to 5, where 1 stands for a "Buy" and 5 stands for a "Sell". Panel C shows analysts' estimates of quarterly Earnings per Share. Panel D shows the firms' actual quarterly EPS. In Panel D we show the actual EPS from quarter -8 to quarter +4.

**Panel A: Number of Analysts per Quarter**

| Quarter | Number of Analysts | | Quarter | Number of Analysts | |
|---|---|---|---|---|---|
| | Mean | Median | | Mean | Median |
| -8 | 2.06 | 2 | -3 | 2.01 | 1 |
| -7 | 2.21 | 2 | -2 | 1.96 | 1 |
| -6 | 2.22 | 2 | -1 | 1.71 | 1 |
| -5 | 2.12 | 2 | 0 | 1.57 | 1 |
| -4 | 2.04 | 1 | | | |

**Panel B: Recommendations Made by Analysts**

| Quarter | Mean | Median | Std. Deviation |
|---|---|---|---|
| -8 | 1.9809 | 2 | 0.8884 |
| -7 | 2.0743 | 2 | 0.8865 |
| -6 | 2.0413 | 2 | 0.8608 |
| -5 | 2.0482 | 2 | 0.8558 |
| -4 | 2.1193 | 2 | 0.9013 |
| -3 | 2.1654 | 2 | 0.8948 |
| -2 | 2.2835 | 2 | 0.8907 |
| -1 | 2.3421 | 3 | 0.9112 |
| 0 | 2.5062 | 3 | 0.9163 |

**Panel C: Estimates of Earnings per Share Made by Analysts**

| Quarter | Mean | Median | Std. Deviation |
|---|---|---|---|
| -8 | 0.4990 | 0.22 | 0.3878 |
| -7 | 0.2454 | 0.23 | 0.2486 |
| -6 | 0.3541 | 0.20 | 0.3051 |
| -5 | 0.1003 | 0.17 | 0.1514 |
| -4 | 0.1509 | 0.15 | 0.1368 |
| -3 | 0.0382 | 0.12 | 0.1047 |
| -2 | 0.0467 | 0.11 | 0.1157 |
| -1 | 0.0388 | 0.09 | 0.0911 |
| 0 | 0.0088 | 0.07 | 0.0794 |

**Panel D: Actual Earnings per Share Reported by Firms**

| Quarter | Mean | Median | Std. Deviation |
|---|---|---|---|
| -8 | 0.3929 | 0.13 | 0.3307 |
| -7 | 0.2379 | 0.11 | 0.2634 |
| -6 | 0.1792 | 0.10 | 0.1708 |
| -5 | 0.1409 | 0.07 | 0.2157 |
| -4 | 0.0898 | 0.03 | 0.0823 |
| -3 | 0.0406 | 0 | 0.1226 |
| -2 | -0.0598 | -0.04 | -0.1624 |
| -1 | -0.0916 | -0.06 | -0.2224 |
| 0 | -0.1257 | -0.02 | -0.3145 |
| 1 | -0.1684 | 0.04 | -0.1399 |
| 2 | -0.0958 | 0.06 | -0.1084 |
| 3 | 0.0244 | 0.12 | 0.0489 |
| 4 | 0.0949 | 0.18 | 0.1794 |

**Table 2**
**Descriptive Characteristics of the Sample and Control Groups**

The table reports trading and liquidity characteristics for the sample of companies that lost analysts' coverage and the control group. The characteristics are calculated over the benchmark time period, that is the last quarter of the year before the drop of the analysts (i.e. from day -325 to day -251 before the drop). We report average daily measures per company per day. The variables are: stock mid-quote prices ($), daily number of trades, the intraday effective spreads calculated both as daily simple average and as weighted with respected to trade volume, the daily volume in $1000, the daily volume in 1000 shares, daily return in percentages and daily return volatility in percentages.

| | Mean | Std.Dev | Median | Min | Max |
|---|---|---|---|---|---|
| **Panel A: Market Microstrcuture Variables** | | | | | |
| Mid-Quote Price ($) - Sample | 11.21 | 0.09 | 7.69 | 0.40 | 322.00 |
| Mid-Quote Price ($) – Control | 12.37 | 0.08 | 8.95 | 0.19 | 121.10 |
| Number of Trades - Sample | 109 | 3.94 | 27 | 1 | 55630 |
| Number of Trades – Control | 111 | 3.80 | 22 | 1 | 48260 |
| Effective Spreads (%) - Sample | 2.56 | 0.01 | 1.87 | 0.00 | 28.57 |
| Effective Spreads (%) – Control | 2.83 | 0.02 | 1.89 | 0.00 | 29.89 |
| Volume-Weighted Effective Spreads (%) – Sample | 2.56 | 0.01 | 1.83 | 0.00 | 28.57 |
| Volume-Weighted Effective Spreads (%) – Control | 2.82 | 0.02 | 1.86 | 0.00 | 29.89 |
| Volume ($1000) – Sample | 1,273 | 42 | 194 | 0.07 | 707,100 |
| Volume ($1000) – Control | 2,000 | 75 | 159 | 0.06 | 912,600 |
| Volume (1000 Shares) – Sample | 105.2 | 2.2 | 26 | 0.1 | 25,710.0 |
| Volume (1000 Shares) – Control | 102.4 | 2.3 | 22.7 | 0.1 | 25,980.0 |
| Returns (%) – Sample | -0.17 | 0.04 | 0.00 | -152 | 155 |
| Returns (%) – Control | -0.07 | 0.05 | 0.00 | -275 | 341 |
| Volatility (%) - Sample | 1.20 | 0.01 | 0.62 | 0.00 | 72.31 |
| Volatility (%) - Control | 1.19 | 0.02 | 0.63 | 0.00 | 112.90 |

| | Mean | Std.Dev | Median | Min | Max |
|---|---|---|---|---|---|
| **Panel B: Firm Characteristics** | | | | | |
| Market Capitalization ($MM) – Sample | 198.85 | 272.62 | 76.43 | 45.60 | 3,170.20 |
| Market Capitalization ($MM) – Control | 210.04 | 329.75 | 79.78 | 48.11 | 5,891.97 |
| Sales ($MM) - Sample | 275.71 | 560.37 | 65.27 | 0 | 2,223 |
| Sales ($MM) – Control | 295.38 | 675.89 | 69.89 | 0 | 3,020 |
| Book Leverage (%) - Sample | 34.68 | 28.06 | 30.23 | 0 | 98.22 |
| Book Leverage (%) – Control | 32.21 | 27.55 | 28.03 | 0 | 97.21 |
| Z score – Sample | 3.18 | 6.18 | 2.78 | 0.0192 | 12.038 |
| Z score - Control | 3.29 | 5.91 | 2.92 | 0.0481 | 15.214 |
| Return on Assets (%) - Sample | -0.49 | 5.75 | 1.59 | -19.82 | 38.71 |
| Return on Assets (%) – Control | 0.65 | 4.90 | 2.52 | -13.95 | 50.78 |
| Current Ratio – Sample | 2.80 | 3.31 | 1.91 | 0.06 | 30.47 |
| Current Ratio – Control | 2.64 | 2.64 | 1.82 | 0.08 | 26.95 |

| | Mean | Std.Dev | Median | Min | Max |
|---|---|---|---|---|---|
| **Panel C: Institutions and Insiders** | | | | | |
| Institutional Holdings (%) - Sample | 22.43 | 12.98 | 20.76 | 3.59 | 51.85 |
| Institutional Holdings (%) - Control | 24.36 | 15.96 | 21.98 | 2.65 | 62.33 |
| Institutional Volume/Turnover (%) - Sample | 4.76 | 3.55 | 3.99 | 0.45 | 13.89 |
| Institutional Volume/Turnover (%) - Control | 5.33 | 4.82 | 3.61 | 0.21 | 18.23 |
| Insider Holdings (%) - Sample | 6.20 | 6.35 | 3.57 | 0.04 | 26.54 |
| Insider Holdings (%) - Control | 7.16 | 6.72 | 4.85 | 0.27 | 28.65 |
| Insider Volume/Turnover (%) - Sample | 2.42 | 3.15 | 0.96 | 0.05 | 14.30 |
| Insider Volume/Turnover (%) - Control | 3.27 | 4.72 | 1.03 | 0.04 | 20.70 |

## Table 3

**Difference in Volume-Weighted Effective Spreads Between Sample and Control Firms**

The table shows differences in percentage weighted effective spreads between the sample of companies that lost analysts' coverage and the control group. Control stocks are selected based on market capitalization, share price, trading volume, and stock price volatility. Sample stocks lost analysts' coverage on week 0. The table reports differences in the mean (columns 2 and 5) and median (columns 3 and 6) weekly effective spreads of the treatment and control groups for the 55 weeks before the lost of analysts (negative weeks) to 55 weeks after (positive weeks). The statistical test for the mean difference being positive is conducted using the two sample t-test and the Boehmer, Musumeci, and Poulsen (1991) *t*-statistic with the period -55 to -36 as the benchmark period**.** We use the Wilcoxon test to examine the differences in medians both with and without a benchmark period. An *asterisk* denotes significant differences of the simple tests at the 1% significance level whereas a pound sign denotes significant differences accounting for the benchmark period at the 1% significance.

| Event Time (weeks) | Difference in Percentage Points | | Event Time (weeks) | Difference in Percentage Points | |
|---|---|---|---|---|---|
| | Mean | Median | | Mean | Median |
| -55 to -36 | -0.15 | 0.04 | 1 | 0.45# | 0.89*# |
| -35 | 0.03 | 0.12 | 2 | 0.39 | 0.63*# |
| -34 | 0.14 | 0.14 | 3 | 0.42# | 0.91*# |
| -33 | -0.09 | 0.11 | 4 | 0.60*# | 0.58*# |
| -32 | -0.14 | 0.21 | 5 | 0.38 | 0.64*# |
| -31 | -0.10 | 0.02 | 6 | 0.50# | 0.91*# |
| -30 | -0.12 | -0.02 | 7 | 0.50# | 0.92*# |
| -29 | -0.05 | -0.03 | 8 | 0.59*# | 0.80*# |
| -28 | 0.01 | 0.10 | 9 | 0.67*# | 0.83*# |
| -27 | 0.00 | 0.18 | 10 | 0.59*# | 0.95*# |
| -26 | 0.13 | 0.27 | 11 | 0.78*# | 1.16*# |
| -25 | -0.04 | 0.41 | 12 | 0.84*# | 0.91*# |
| -24 | 0.03 | 0.35 | 13 | 0.82*# | 1.09*# |
| -23 | -0.02 | 0.35 | 14 | 0.86*# | 1.28*# |
| -22 | -0.06 | 0.32 | 15 | 0.76*# | 1.08*# |
| -21 | 0.09 | 0.27 | 16 | 0.65*# | 1.08*# |
| -20 | 0.16 | 0.42 | 17 | 0.95*# | 1.23*# |
| -19 | 0.06 | 0.36 | 18 | 0.80*# | 1.22*# |
| -18 | 0.06 | 0.42 | 19 | 0.72*# | 1.20*# |
| -17 | 0.20 | 0.29 | 20 | 0.99*# | 1.25*# |
| -16 | 0.21 | 0.46 | 21 | 1.02*# | 1.40*# |
| -15 | 0.18 | 0.35 | 22 | 0.80*# | 1.38*# |
| -14 | 0.20 | 0.49 | 23 | 0.82*# | 1.19*# |
| -13 | 0.25 | 0.50 | 24 | 1.00*# | 1.32*# |
| -12 | 0.20 | 0.49 | 25 | 0.89*# | 1.20*# |
| -11 | 0.13 | 0.45 | 26 | 1.01*# | 1.44*# |
| -10 | 0.38 | 0.50 | 27 | 0.96*# | 1.46*# |
| -9 | 0.36 | 0.65*# | 28 | 0.94*# | 1.53*# |
| -8 | 0.24 | 0.78*# | 29 | 1.03*# | 1.43*# |
| -7 | 0.49*# | 0.71*# | 30 | 1.21*# | 1.30*# |
| -6 | 0.43# | 0.66*# | 31 | 0.95*# | 1.33*# |
| -5 | 0.31 | 0.75*# | 32 | 1.06*# | 1.43*# |
| -4 | 0.44# | 0.74*# | 33 | 1.18*# | 1.34*# |
| -3 | 0.45# | 0.71*# | 34 | 1.02*# | 1.53*# |
| -2 | 0.52*# | 0.71*# | 35 | 1.23*# | 1.46*# |
| -1 | 0.51*# | 0.86*# | 45 | 1.24*# | 1.63*# |
| 0 | 0.44# | 0.85*# | 55 | 1.45*# | 1.81*# |

## Table 4

**Differences in Volume-Weighted Price Impact Between the Sample and Control Firms**

The table shows differences in percentage weighted price impact between the sample of companies that lost analysts' coverage and the control group. Control stocks are selected based on market capitalization, share price, trading volume, and stock price volatility. Sample stocks lost analysts' coverage on week 0. The table reports differences in the mean (columns 2 and 5) and median (columns 3 and 6) weekly differences of price impact measures between the treatment and control groups for the 51 weeks before the lost of analysts (negative weeks) to 55 weeks after (positive weeks). The statistical test for the mean difference being positive is conducted using both the two sample t-test and the Boehmer, Musumeci, and Poulsen (1991) *t*-statistic with the period -51 to -36 as the benchmark period**.** We use the Wilcoxon test to examine the differences in medians both with and without a benchmark period. An *asterisk* denotes significant differences of the simple tests at the 5% significance level whereas a pound sign denotes significant differences accounting for the benchmark period at the 5% significance.

| Event Time (weeks) | Difference in Percentage Points | | Event Time (weeks) | Difference in Percentage Points | |
|---|---|---|---|---|---|
| | Mean | Median | | Mean | Median |
| -51 to -36 | -0.05 | 0.00 | 1 | -0.03 | 0.00 |
| -35 | 0.15 | 0.07 | 2 | -0.10 | 0.09 |
| -34 | -0.10 | -0.04 | 3 | 0.19# | 0.20# |
| -33 | -0.17 | -0.03 | 4 | 0.20# | 0.10# |
| -32 | -0.05 | 0.03 | 5 | 0.25# | 0.28*# |
| -31 | -0.05 | 0.06 | 6 | -0.03 | 0.18# |
| -30 | -0.11 | 0.11 | 7 | 0.40*# | 0.31*# |
| -29 | 0.07 | 0.01 | 8 | 0.30# | 0.29*# |
| -28 | -0.16 | -0.03 | 9 | 0.07 | 0.15# |
| -27 | 0.23*# | 0.23*# | 10 | 0.41*# | 0.32*# |
| -26 | 0.02 | 0.08 | 11 | 0.53*# | 0.26*# |
| -25 | 0.01 | 0.02 | 12 | 0.64*# | 0.32*# |
| -24 | -0.15 | 0.04 | 13 | 0.15 | 0.21*# |
| -23 | 0.16 | 0.05 | 14 | 0.23*# | 0.18*# |
| -22 | -0.26 | -0.05 | 15 | 0.01 | 0.29# |
| -21 | 0.01 | -0.02 | 16 | 0.30*# | 0.27*# |
| -20 | 0.15 | 0.00 | 17 | 0.29*# | 0.12# |
| -19 | -0.08 | 0.07 | 18 | 0.28*# | 0.23*# |
| -18 | -0.12 | 0.00 | 19 | 0.09 | 0.18# |
| -17 | 0.37*# | 0.21*# | 20 | 0.24# | 0.22# |
| -16 | -0.29 | -0.04 | 21 | 0.12 | 0.18*# |
| -15 | -0.06 | 0.11 | 22 | 0.25# | 0.22# |
| -14 | -0.06 | -0.01 | 23 | 0.72*# | 0.23*# |
| -13 | -0.32 | 0.04 | 24 | 0.59*# | 0.31*# |
| -12 | -0.13 | 0.07 | 25 | 0.11 | 0.17 |
| -11 | 0.06 | 0.19 | 26 | 0.21# | 0.23*# |
| -10 | -0.38*# | 0.07 | 27 | 0.62*# | 0.24*# |
| -9 | -0.02 | 0.10 | 28 | 0.38*# | 0.36*# |
| -8 | -0.14 | 0.13 | 29 | 0.07 | 0.23*# |
| -7 | 0.15 | 0.02 | 30 | 0.58*# | 0.38*# |
| -6 | -0.40*# | 0.03 | 31 | 0.62*# | 0.24*# |
| -5 | -0.33 | 0.23 | 32 | 0.58*# | 0.34*# |
| -4 | -0.12 | 0.13 | 33 | 0.44*# | 0.31*# |
| -3 | 0.03 | 0.08 | 34 | 0.37*# | 0.28*# |
| -2 | 0.46*# | 0.35*# | 35 | 0.98*# | 0.44*# |
| -1 | 0.11 | 0.18# | 45 | 0.71*# | 0.32*# |
| 0 | -0.08 | 0.09 | 55 | 0.86*# | 0.36*# |

## Table 5
## Institutional Holdings for Companies that Lost Analysts' Coverage

The table reports mean and median values for institutional holding positions for our sample of 558 companies that lost coverage and the control group. We report quarterly results for the period of two year before to two year after coverage termination. The table shows cross-sectional quarterly statistics (means and medians) for % institutional holdings of shares outstanding, and change in % of institutional holdings with respect to shares outstanding. We compare each statistic with quarter -3 which is our benchmark period**.** We use both the t-statistic and the non-parametric Wilcoxon test to under the null hypothesis of no difference with quarter -3. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

| | Institutional Holdings (%) | | | |
|---|---|---|---|---|
| | Sample Firms | | Control Firms | |
| Quarterly Period | Mean | Median | Mean | Median |
| -7 | 25.74 | 22.21 | 27.07 | 21.37 |
| -6 | 25.74 | 22.54 | 27.13 | 20.71 |
| -5 | 24.92 | 21.99 | 26.66 | 20.09 |
| -4 | 24.56 | 20.76 | 27.16 | 21.98 |
| -3 | 23.82 | 19.83 | 26.88 | 20.74 |
| -2 | 23.69 | 20.43 | 26.79 | 21.22 |
| -1 | 23.05 | 19.71 | 26.87 | 19.99 |
| 0 | 21.85* | 17.84* | 26.62 | 20.61 |
| 1 | 20.21*** | 16.46*** | 27.02 | 20.19 |
| 2 | 18.58*** | 14.40*** | 27.08 | 20.48 |
| 3 | 18.66*** | 13.49*** | 26.85 | 19.74 |
| 4 | 17.29*** | 11.81*** | 27.42 | 20.09 |
| 5 | 17.66*** | 11.70*** | 28.50 | 20.25 |
| 6 | 17.78*** | 11.39*** | 28.97 | 20.60 |
| 7 | 17.27*** | 10.84*** | 28.96 | 20.51 |
| 8 | 16.88** | 10.54*** | 29.33 | 21.30 |

## Table 6
**Differences in Volume-Weighted Effective Spreads Between Sample and Control Stocks**

The dependent variable is the difference of the percentage effective spreads of a stock that has lost complete coverage and its control. The estimates shown are obtained from a fixed effects (at the firm level) regression model. *Absence of Analysts* is a dummy variable that takes the value of 1 when the stock loses coverage and the value of zero otherwise, *ΔAdS Costs*$_{jt}$ is the weekly average difference of adverse selection costs of stock pair j in week t, *ΔTrading Volume*$_{jt}$ is the difference of the weekly share volume for stock pair j in week t, *ΔPrice Volatility*$_{jt}$ is the difference of weekly price volatility for stock pair j in week t, *Trade Price Inverse*$_{jt}$ is the difference in the inverse of the trade prices for stock pair *j i*n week *t*, *ΔStock Returns*$_{jt}$ is the difference in weekly stock returns for stock pair *j i*n week *t*, *ΔInstitutional Shareholding*$_j$ is the difference in the holdings of Institutional Shareholdings in each quarter, *Weeks After Analysts Departure* is the number of weeks after the loss of coverage, and *Weeks After Analysts Departure*$^2$ is the squared term of the number of weeks after the loss of complete coverage. Industry dummy variables and firm fixed effects are included in each regression. Asterisks (*, ** and ***) indicate statistical significance (at the 10%, 5% and 1% level respectively).

| | **(1)** | **(2)** | **(3)** | **(4)** |
|---|---|---|---|---|
| Absence of Analyst | 0.6847*** | 0.5826*** | 0.4318*** | 0.3129*** |
| | (5.30) | (3.71) | (2.95) | (2.86) |
| Adverse Selection Costs | 0.4619*** | 0.3910** | 0.3876* | 0.3711* |
| | (2.89) | (1.97) | (1.89) | (1.84) |
| Trading Volume | -0.0725** | -0.0518*** | -0.0585*** | -0.0564*** |
| (x 1,000,000) | (-7.30) | (-5.54) | (-4.19) | (-4.10) |
| Price Volatility | 0.0071*** | 0.0062*** | 0.0052*** | 0.0049*** |
| | (3.76) | (3.08) | (2.92) | (2.84) |
| Trade Price Inverse | 2.7211*** | 1.7680** | 1.5741** | 1.5011** |
| (x $10^5$) | (4.18) | (2.42) | (2.24) | (2.38) |
| Stock Returns | -0.0005*** | -0.0005*** | -0.0004*** | -0.0004*** |
| | (4.66) | (-3.44) | (-2.95) | (-2.91) |
| Institutional Shareholdings | | -0.0195*** | -0.0172*** | -0.0180*** |
| | | (-3.25) | (-3.10) | (-3.07) |
| Weeks After Analysts' | | | 0.0341** | 0.0322** |
| Departure | | | (2.26) | (2.29) |
| Weeks After Analysts' | | | | -0.0003** |
| Departure$^2$ (x1,000) | | | | (-2.36) |
| Intercept | 0.0422*** | 0.0346*** | 0.0311*** | 0.0308*** |
| | (10.18) | (7.94) | (6.10) | (5.92) |
| Industry Dummies | Yes | Yes | Yes | Yes |
| Fixed Effects | Stock-Pair | Stock-Pair | Stock-Pair | Stock-Pair |
| No. of Obs. | 45,756 | 41,060 | 41,060 | 41,060 |
| $R^2$ | 0.1282 | 0.1295 | 0.1310 | 0.1318 |

**Table 7**
**Differences in Volume-Weighted Effective Spreads Between Sample and Control Stocks**

The dependent variable is the difference in the percentage effective spreads of a stock that has lost complete coverage and its control. The estimates shown are obtained from a fixed effects (at the firm level) regression model. *Absence of Analysts* is a dummy variable that takes the value of 1 when the stock loses coverage and the value of zero otherwise, Drop Dummy 1 is a dummy variable that takes the value of 1 when a stock loses the second from last analyst and zero otherwise, and Drop Dummy 2 is a dummy variable that takes the value of 1 when a stock loses the next from last analyst and zero otherwise, *ΔAdS* $Costs_{jt}$ is the weekly average difference of adverse selection costs of stock pair j in week t, *ΔTrading* $Volume_{jt}$ is the difference of the weekly share volume for stock pair j in week t, *ΔPrice* $Volatility_{jt}$ is the difference of weekly price volatility for stock pair j in week t, *Trade Price Inverse*$_{jt}$ is the difference in the inverse of the trade prices for stock pair *j* in week *t*, *ΔStock* $Returns_{jt}$ is the difference in weekly stock returns for stock pair *j* in week *t*, *ΔInstitutional* $Shareholding_j$ is the difference in the holdings of Institutional Shareholdings in each quarter, *Weeks After Analysts Departure* is the number of weeks after the loss of coverage, and *Weeks After Analysts Departure*$^2$ is the squared term of the number of weeks after the loss of complete coverage. Industry dummy variables and firm fixed effects are included in each regression. Asterisks (*, ** and ***) indicate statistical significance (at the 10%, 5% and 1% level respectively).

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Absence of Analyst | 0.0061*** | 0.0050*** | 0.0039** | 0.0028*** |
| | (5.11) | (3.22) | (2.52) | (2.46) |
| Drop Dummy 1 | 0.0002 | 0.0002 | 0.0002 | 0.0001 |
| | (0.91) | (0.88) | (0.87) | (0.80) |
| Drop Dummy 2 | 0.0012 | 0.0011 | 0.0010 | 0.0009 |
| | (1.48) | (1.44) | (1.37) | (1.28) |
| Adverse Selection Costs | 0.4322*** | 0.4155** | 0.3916* | 0.3410* |
| | (2.81) | (1.99) | (1.85) | (1.80) |
| Trading Volume | -0.0070** | -0.0054*** | -0.0060*** | -0.0049*** |
| (x 1,000,000) | (-7.15) | (-5.68) | (-4.29) | (-3.90) |
| Price Volatility | 0.0018*** | 0.0015*** | 0.0013*** | 0.0010** |
| | (3.79) | (2.88) | (2.81) | (2.50) |
| Trade Price Inverse | 2.6920*** | 1.7042** | 1.3129** | 1.4221** |
| ($x10^6$) | (4.05) | (2.28) | (2.16) | (2.10) |
| Stock Returns | -0.0009*** | -0.0008*** | -0.0007** | -0.0006** |
| | (4.50) | (-3.71) | (-2.45) | (-2.31) |
| Institutional Shareholdings | | -0.0005*** | -0.0005*** | -0.0004** |
| | | (-3.02) | (-2.90) | (-2.57) |
| Weeks After Analysts' | | | 0.0001** | 0.0001** |
| Departure | | | (2.21) | (2.02) |
| Weeks After Analysts' | | | | -0.0025** |
| $Departure^2$ (x1,000) | | | | (-2.19) |
| Intercept | 0.0381*** | 0.0351*** | 0.0278*** | 0.0291*** |
| | (9.94) | (7.16) | (5.85) | (5.42) |
| Industry Dummies | Yes | Yes | Yes | Yes |
| Fixed Effects | Stock-Pair | Stock-Pair | Stock-Pair | Stock-Pair |
| No. of Obs. | 45,756 | 41,060 | 41,060 | 41,060 |
| $R^2$ | 0.1285 | 0.1289 | 0.1297 | 0.1298 |

## Table 8
## Variance Ratios in the Year After Coverage Termination

The table shows the Variance Ratios for the sample firms that lost coverage and their controls. First we calculate the true price using a Kalman Filtering technique. Second, we measure the volatility of the trading price around the true price. Denoting $\sigma_{\xi}^2$ and $\sigma_{\omega}^2$ as the variance of the price discovery process before and after the departure of analysts respectively, we have $Var[\ln(m_t)-\ln(p_t^{AFTER})]$ and $Var[\ln(m_t)-\ln(p_t^{BEFORE})]$ as the variance of the pricing errors before and after the departure of analysts, where $m_t$ is the true price and $p_t^{BEFORE}$ and $p_t^{AFTER}$ are the trading price process before and after the departure of analysts. We employ a Generalized Method of Moment to estimate $\Lambda = \frac{Var[\ln(m_t) - \ln(p_t^{AFTER})]}{Var[\ln(m_t) - \ln(p_t^{BEFORE})]}$. The Lagrange Multiplier test the null hypothesis of unity variance ratios for individual securities while we employ the Wald statistic (in brackets) to test the null hypothesis that the variance ratios are jointly equal to unity. Panel A reports the variance ratios for the sample stocks and for the control group. Panel B reports the variance ratios of sample stocks with above-median insiders' holdings. Panel C reports the variance ratios of sample stocks with below-median insiders' holdings. We divide the year following the departure of analysts into 4 periods: Period 1 is from day 0 to day +60 (first quarter after coverage termination); Period 2 is from day +61 to day +120 (second quarter after coverage termination); Period 3 is from day +121 to day +180 (third quarter after coverage termination); Period 4 is from day +181 to day +250 (fourth quarter after coverage termination). Asterisks (*, and **) indicate statistical significance (at the 5% and 1% level respectively).

| | **Period 1** | **Period 2** | **Period 3** | **Period 4** |
|---|---|---|---|---|
| **Panel A: Entire Sample** | | | | |
| **Sample Stocks** | | | | |
| Variance Ratios | 1.251** | 1.327** | 1.389** | 1.3902** |
| | (4.7611) | (5.4901) | (6.176) | (6.255) |
| **Control Stocks** | | | | |
| Variance Ratios | 1.049 | 0.988 | 1.021 | 1.026 |
| | (0.918) | (0.924) | (1.020) | (1.038) |
| **Panel B: Sample Stocks With High Insiders' Holdings** | | | | |
| Variance Ratios | 1.342** | 1.391** | 1.442** | 1.439** |
| | (5.8021) | (6.211) | (7.028) | (6.871) |
| **Panel C: Sample Stocks With Low Insiders' Holdings** | | | | |
| Variance Ratios | 1.2186** | 1.2781** | 1.3792** | 1.3711** |
| | (4.218) | (4.916) | (5.872) | (6.011) |

## Table 9
**Impact of Insiders, Research Coverage and Institutional Blockholders on Pricing Errors**

The dependent variable is the estimate of pricing errors obtained using the Hasbrouck (1993) methodology where for each stock (stock-pair) *j* and month *t* we compute the mean of *(log) Var(s)*. *Insiders Holdings*$_{jt-1}$ is the level of Insiders Holdings of outstanding shares, *Insiders Holdings*$_{jt-1}$**Absence of Analysts* is the interaction between Insiders Holdings and a dummy variable (Absence of Analysts) that takes the value of 1 after coverage termination and 0 otherwise, *Presence of Analyst*$_{jt}$ is a dummy variable that takes the value of 1 before coverage termination and 0 after, *Institutional Holdings*$_{jt-1}$ is the level of holdings of Institutional Shareholders in the previous-quarter, *Effective Spread*$_{jt}$ is the monthly mean of intraday volume-weighted effective spread, *Trade Price*$_{jt}$ is the monthly mean of closing trade prices (in logs), *Var(Trade Price)*$_{jt}$ is the standard deviation of intraday trade prices during month t (in logs), *Market Capitalization*$_{jt}$ is the market capitalization during month t (in logs), and *Var(s)*$_{jt-1}$ is the lagged value of (log) Var(s). Columns (1) and (2) show the results for the 558 stocks that lost coverage. Columns (3) and (4) show the results for each stock pair using the difference of *(log) Var(s)* between sample and control firms. The independent variables in columns (3) and (4) are measured as the difference between sample and control firms. The estimates shown are obtained from a fixed effects (at the firm level) regression model. Asterisks (*, ** and ***) indicate statistical significance (at the 10%, 5% and 1% level respectively).

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Insiders Holdings | 0.0892 | 0.0854 | 0.0619 | 0.0552 |
| | (1.62) | (1.56) | (1.48) | (1.38) |
| Insiders Holdings*Absence of Analysts | | 0.1124** | | 0.0927* |
| | | (1.98) | | (1.91) |
| Presence of Analyst | -0.0228* | -0.0216* | -0.0187* | -0.0179* |
| | (-1.92) | (-1.84) | (-1.84) | (-1.80) |
| Institutional Holdings | -0.1287** | -0.1128** | -0.1015* | -0.0997* |
| | (-2.05) | (-1.96) | (-1.94) | (-1.90) |
| Effective Spread | 1.8240** | 1.7167** | 1.4115** | 1.3954** |
| | (2.15) | (2.10) | (2.05) | (1.98) |
| Trade Price | -0.1967** | -0.1915** | -0.1558** | -0.1507** |
| | (-2.35) | (-2.29) | (2.11) | (2.02) |
| Var(Trade Price) | 0.0497* | 0.0481* | 0.0322** | 0.0317** |
| | (1.92) | (1.90) | (1.97) | (1.97) |
| Market Capitalization | -0.0771*** | -0.0750*** | -0.0528* | -0.0512* |
| | (3.01) | (2.89) | (-1.90) | (-1.84) |
| Var(s)$_{jt-1}$ | 0.5205** | 0.5182** | 0.4517** | 0.4487** |
| | (2.55) | (2.42) | (2.06) | (1.97) |
| Intercept | 3.7182*** | 3.4116*** | 4.816*** | 4.472*** |
| | (3.59) | (3.18) | (4.57) | (4.18) |
| Industry Dummy Variables | YES | YES | YES | YES |
| Fixed Effects | Firm | Firm | Firm | Firm |
| No. of Obs. | 11,683 | 11,683 | 10,295 | 10,295 |
| $R^2$ | 0.5021 | 0.5106 | 0.2681 | 0.2705 |

## Table 10
### Multivariate Analysis of Adverse Selection Costs

The dependent variable is adverse selection costs measured using the Glosten and Harris (1988) methodology in columns (1) and (3) and the Madhavan and Smidt (1991) methodology in columns (2) and (4). The independent variables are the following: *Insiders Holdings* are the (log of) holdings of all insiders in month t; *Insiders Holdings x Absence of Analysts* is the interactive variable where the (log of) holdings of all insiders in month t are interacted with a dummy variable (Absence of Analysts) that takes the value of 1 after the departure of analysts and 0 otherwise; *Insiders Volume* are the (log of) share volume of all insiders in month t; *Insiders Volume x Absence of Analysts* is the interactive variable of the (log of) share volume of all insiders in month t interacted with a dummy variable (Absence of Analysts) that takes the value of 1 after the departure of analysts and 0 otherwise; *Institutional Shareholding* are the (log of) holdings of all institutional blockholders in month t; *Presence of Analyst* is a dummy variable that takes the value of 1 before the complete departure of analysts and 0 otherwise; *Price Volatility* is the weekly price volatility, *Trade Price Inverse* is the inverse of the weekly average trade price, and *Share Volume* is the weekly share volume. The estimates shown are obtained from a fixed effects (at the firm level) regression model. Asterisks (*, ** and ***) indicate statistical significance (at the 10%, 5% and 1% level respectively).

| | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| Insiders Holdings | 0.295* | 0.2491* | 0.3051* | 0.2624* |
| | (1.89) | (1.80) | (1.93) | (1.80) |
| Insiders Holdings x Absence of Analysts | 0.4812** | 0.3509* | | |
| | (2.35) | (1.92) | | |
| Insiders Volume | | | 0.3109* | 0.2016 |
| | | | (1.72) | (1.62) |
| Insiders Volume x Absence of Analysts | | | 0.4028** | 0.3268* |
| | | | (2.08) | (1.90) |
| Institutional Shareholding | -0.1950* | -0.1411 | -0.175* | -0.1501 |
| | (-1.80) | (-1.60) | (-1.78) | (-1.52) |
| Presence of Analyst | -0.0199** | -0.0184** | -0.0121* | -0.0178** |
| | (-2.45) | (-2.05) | (1.89) | (1.99) |
| Price Volatility | 0.1201*** | 0.0952** | 0.1389*** | 0.1534** |
| | (6.21) | (2.48) | (7.15) | (8.15) |
| Trade Price Inverse | 0.1085*** | 0.1012*** | 0.1002*** | 0.1049*** |
| | (3.19) | (2.75) | (3.52) | (4.48) |
| Share Volume | -0.8711*** | -0.6083*** | -0.7084*** | -0.8101*** |
| | (-4.25) | (-3.44) | (-4.73) | (-5.02) |
| Intercept | -2.1426*** | 1.9822*** | -3.7012*** | 2.9512*** |
| | (-7.01) | (5.40) | (-8.92) | (7.08) |
| Industry Dummy Variables | YES | YES | YES | YES |
| Fixed Effects | Firm | Firm | Firm | Firm |
| No. of Obs. | 42,190 | 42,190 | 42,190 | 42,190 |
| $R^2$ | 0.1802 | 0.1455 | 0.1618 | 0.1409 |

## Table 11
## Parameter Estimates of the PIN Methodology

This table provides the mean parameter estimates of the PIN estimation for the sample stocks that lost coverage and the control group. The PIN is estimated using the maximum likelihood approach proposed by Easley et al. (1996). Panel A shows the parameter estimates for the period from week -52 to week -12. Panel B shows the parameter estimates from week +4 to week +52. We also show different Wilcoxon Sign Rank tests. In Panel A the Wilcoxon test investigates whether there are differences in parameter estimates of sample and control stocks over the period from week -52 to week -12. In Panels B, C and D we report Wilcoxon Test 1 and 2. The first one tests whether there is a statistical difference between the sample stocks' parameters in the pre-departure period and in the post departure period. The second one tests whether the sample stocks' parameter estimates in the post-departure period are different than those of the control group for the same period. In Panels C and D the Wilcoxon tests investigates differences of parameter estimates for sample stocks before and after coverage termination.

| | **μ** | **ε** | **α** | **δ** | **PIN** |
|---|---|---|---|---|---|
| **Panel A: Pre-Departure of Analysts** | | | | | |
| **Sample Stocks** | | | | | |
| Mean | 22.270 | 15.150 | 0.260 | 0.401 | 0.164 |
| STD | 21.797 | 14.225 | 0.133 | 0.307 | 0.072 |
| **Control Stocks** | | | | | |
| Mean | 23.384 | 17.360 | 0.277 | 0.387 | 0.157 |
| STD | 22.566 | 12.303 | 0.127 | 0.242 | 0.059 |
| Wilcoxon Test | 1.38 | 1.15 | 1.22 | -1.41 | -1.08 |
| **Panel B: Post-Departure of Analysts** | | | | | |
| **Sample Stocks** | | | | | |
| Mean | 26.910 | 10.510 | 0.294 | 0.428 | 0.274 |
| STD | 29.552 | 11.686 | 0.183 | 0.325 | 0.108 |
| **Control Stocks** | | | | | |
| Mean | 22.901 | 18.020 | 0.269 | 0.397 | 0.149 |
| STD | 22.471 | 11.917 | 0.138 | 0.207 | 0.062 |
| Wilcoxon Test 1 | 2.08 | -3.18 | 2.15 | 1.82 | 4.24 |
| Wilcoxon Test 2 | 2.01 | -4.07 | 2.91 | 1.92 | 5.09 |
| **Panel C: Sample Stocks With High Insiders Presence** | | | | | |
| **Before Coverage Termination** | | | | | |
| Mean | 27.182 | 13.744 | 0.272 | 0.391 | 0.212 |
| STD | 26.102 | 14.105 | 0.265 | 0.317 | 0.158 |
| **After Coverage Termination** | | | | | |
| Mean | 30.981 | 10.012 | 0.319 | 0.416 | 0.291 |
| STD | 35.711 | 12.427 | 0.382 | 0.365 | 0.192 |
| Wilcoxon Test 1 | 2.44 | -2.15 | 2.08 | 1.78 | 3.75 |
| **Panel D: Sample Stocks With Low Insiders Presence** | | | | | |
| **Before Coverage Termination** | | | | | |
| Mean | 18.720 | 17.061 | 0.251 | 0.448 | 0.138 |
| STD | 20.092 | 19.018 | 0.249 | 0.422 | 0.095 |
| **After Coverage Termination** | | | | | |
| Mean | 22.405 | 14.771 | 0.271 | 0.472 | 0.214 |
| STD | 26.821 | 16.002 | 0.262 | 0.455 | 0.151 |
| Wilcoxon Test 1 | 2.95 | -3.01 | 1.86 | 1.85 | 3.75 |

## Table 12
## Insiders' Trading Packages and Price Impact

The Table reports summary statistics of insiders' trading package sizes (Panels A and B) before and after the drop of analysts, and return measures around the trading packages (Panel C and D) for the sample set of companies that lost analysts coverage. Insiders' trading buy (sell) packages are defined for each insider as a series of successive purchases (sales) of the same stock with a break of less than 5 days between successive trades, similar in definition to Chen and Lakonishok (1995). Panel A reports the total number of all packages before and after the drop of analysts in dollar volume in parentheses. It also reports the percent completed in each of the indicated number of trading days (1 day, 2 to 3 days and greater than 3 day packages) and the mean and median of the trading package in dollar volume. Panel B reports the same characteristics in shares-volume traded instead of dollar-volume traded packages. Panels C and D report the price impact of insiders' packages by looking at returns before, during, and after the package is executed. Panel C looks at raw returns of buy and sell packages and reports the raw returns during the periods of 20 and 5 days before the trade, during the trade period, and the periods of 5 and 20 days after the trade. All results compare mean and median measures of returns before and after the drop of analysts. Panel D looks at excess returns by adjusting the raw returns for a company matching benchmark. Asterisks (*, ** and ***) indicate statistical significance (at the 10%, 5% and 1% level respectively).

**Panel A: Summary Statistics of Insider Packages: Dollars**

| | Total | | 1 Day | | 2-3 Days | | >3 Days | |
|---|---|---|---|---|---|---|---|---|
| Before Drop | 2072 ($146.6 Million) | | 87.8 (74.2) | | 9.7 (16.4) | | 2.5 (9.4) | |
| After Drop | 1836 ($144.3 Million) | | 88.8 (81.1) | | 8.0 (6.7) | | 3.2 (12.2) | |
| | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| Before Drop | 70740 | 13490 | 59870 | 10950 | 120400 | 47310 | 256300 | 143400 |
| After Drop | 78610 | 11250 | 71790 | 9832 | 65960 | 24500 | 298400 | 127500 |

**Panel B: Summary Statistics of Insider Packages: Shares**

| | Total | | 1 Day | | 2-3 Days | | >3 Days | |
|---|---|---|---|---|---|---|---|---|
| Before Drop | 2437 (27.5 Million Shares) | | 89.4 (77.8) | | 8.7 (14.7) | | 1.9 (7.5) | |
| After Drop | 2155 (41.9 Million Shares) | | 90.1 (81.1) | | 7.1 (7.6) | | 2.8 (11.3) | |
| | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** | **Mean** | **Median** |
| Before Drop | 11280 | 2142 | 9822 | 2000 | 19040 | 8043 | 44840 | 23100 |
| After Drop | 19450 | 3000 | 17500 | 2500 | 20820 | 7550 | 77960 | 41300 |

**Panel C: Raw Returns of Insiders Trade Packages**

| Principal-weighted Average within Company | Performance 20 Days Before Package | | Performance 5 Days Before Package | | Performance During Package | | Performance 5 Days After Package | | Performance 20 Days After Package | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | Before | After | Before | After | Before | After | Before | After |
| **Buys** | | | | | | | | | | |
| Cross-Sectional Mean | -10.14 | -3.12* | -2.39 | -3.09 | 0.30 | -0.23 | -0.69 | 2.15 | -3.34 | -5.69 |
| Cross-Sectional Median | -5.58 | -2.57** | -1.24 | -1.17 | -0.11 | 0.21* | -0.08 | 0.40** | -1.07 | 0.68** |
| Standard Deviation | 25.00 | 58.69 | 19.03 | 42.81 | 24.28 | 34.74 | 21.9 | 47.28 | 24.28 | 84.19 |
| **Sell** | | | | | | | | | | |
| Cross-Sectional Mean | -0.21 | -1.95 | -0.98 | -6.85 | -1.67 | -1.09 | -1.45 | -5.78* | -5.80 | -3.90 |
| Cross-Sectional Median | -0.19 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | -0.88 | 0.00 | -4.70 | -0.23 |
| Standard Deviation | 20.83 | 99.76 | 13.76 | 66.11 | 17.51 | 37.2 | 12.83 | 44.00 | 21.78 | 22.93 |

**Panel D: Excess Returns of Insiders Trade Packages**

| Principal-weighted Average within Company | Performance 20 Days Before Package | | Performance 5 Days Before Package | | Performance During Package | | Performance 5 Days After Package | | Performance 20 Days After Package | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Before | After | Before | After | Before | After | Before | After | Before | After |
| **Buys** | | | | | | | | | | |
| Cross-Sectional Mean | -8.66 | -3.59** | -3.13 | -1.42 | 0.54 | 2.87* | -0.94 | 1.05* | -2.12 | 0.62 |
| Cross-Sectional Median | -5.14 | -3.47** | -1.41 | -0.93 | 0.12 | 1.31* | 0.00 | 0.72 | -1.26 | 0.56* |
| Standard Deviation | 23.59 | 27.04 | 13.56 | 16.28 | 14.99 | 13.98 | 0.17 | 16.26 | 23.73 | 25.19 |
| **Sell** | | | | | | | | | | |
| Cross-Sectional Mean | 2.26 | -2.03 | 0.77 | -0.16 | -2.06 | -2.24 | 0.22 | -2.20* | -3.50 | -6.62 |
| Cross-Sectional Median | 1.47 | -1.25* | -0.04 | -0.53 | 0.15 | -0.02 | 0.00 | -1.37 | -4.35 | -3.42 |
| Standard Deviation | 26.18 | 31.75 | 16.24 | 19.08 | 13.60 | 17.94 | 15.32 | 18.84 | 26.40 | 20.20 |

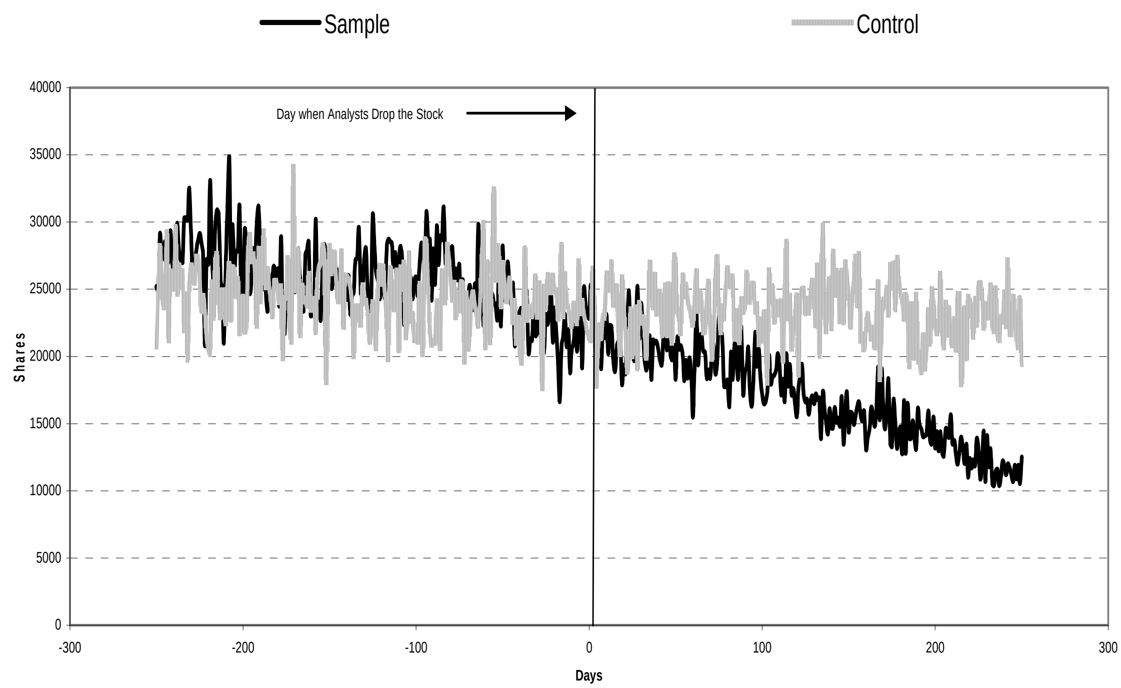


**Figure 1. Median daily share volume for sample firms and control firms from day -250 to day +250**

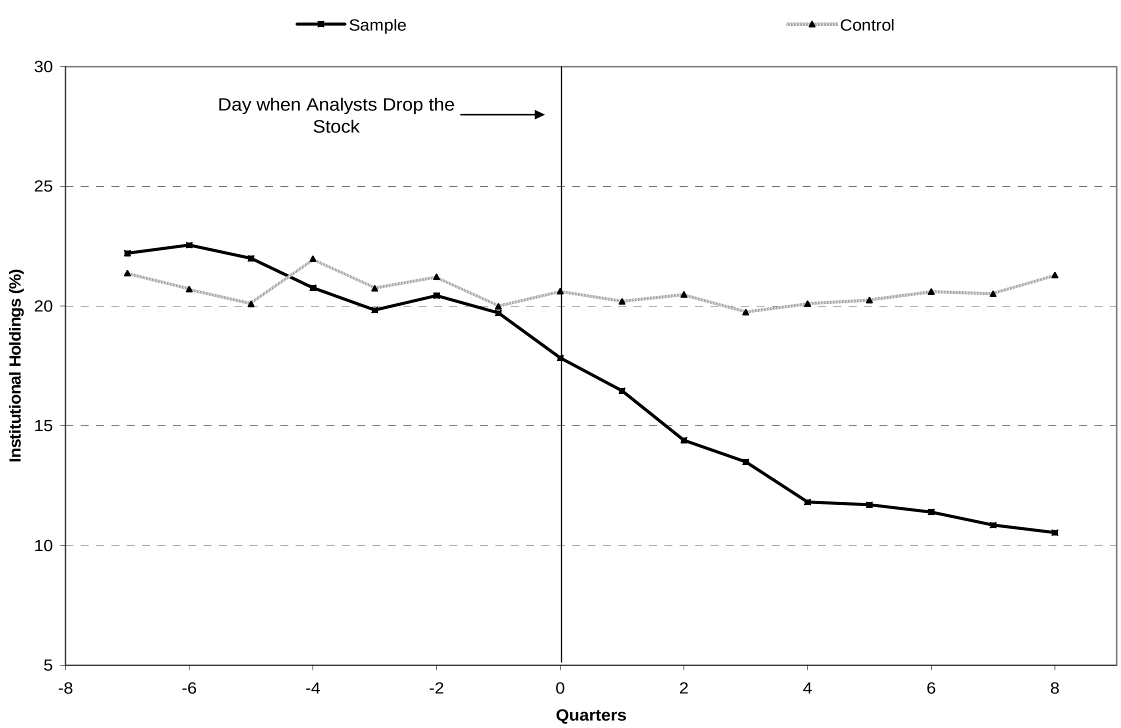


**Figure 2. Median Percentage Institutional Holdings for sample and control firms from quarter -7 to quarter +8**

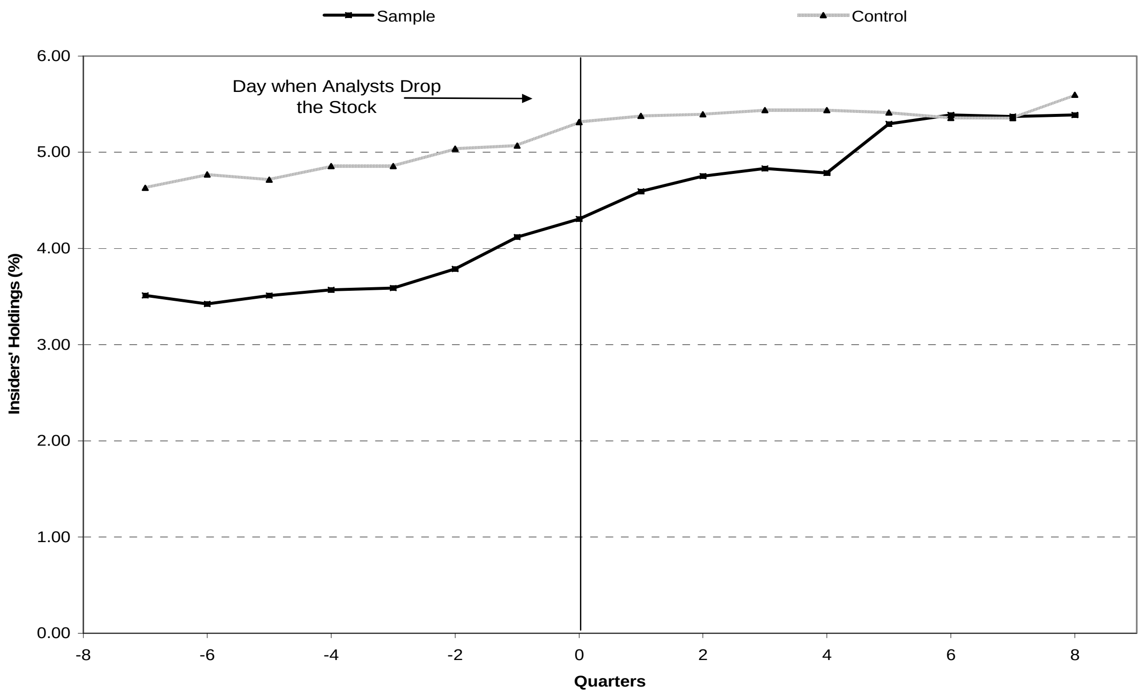


**Figure 3. Median Percentage Insiders Holdings for sample and control firms from quarter -7 to quarter +8**

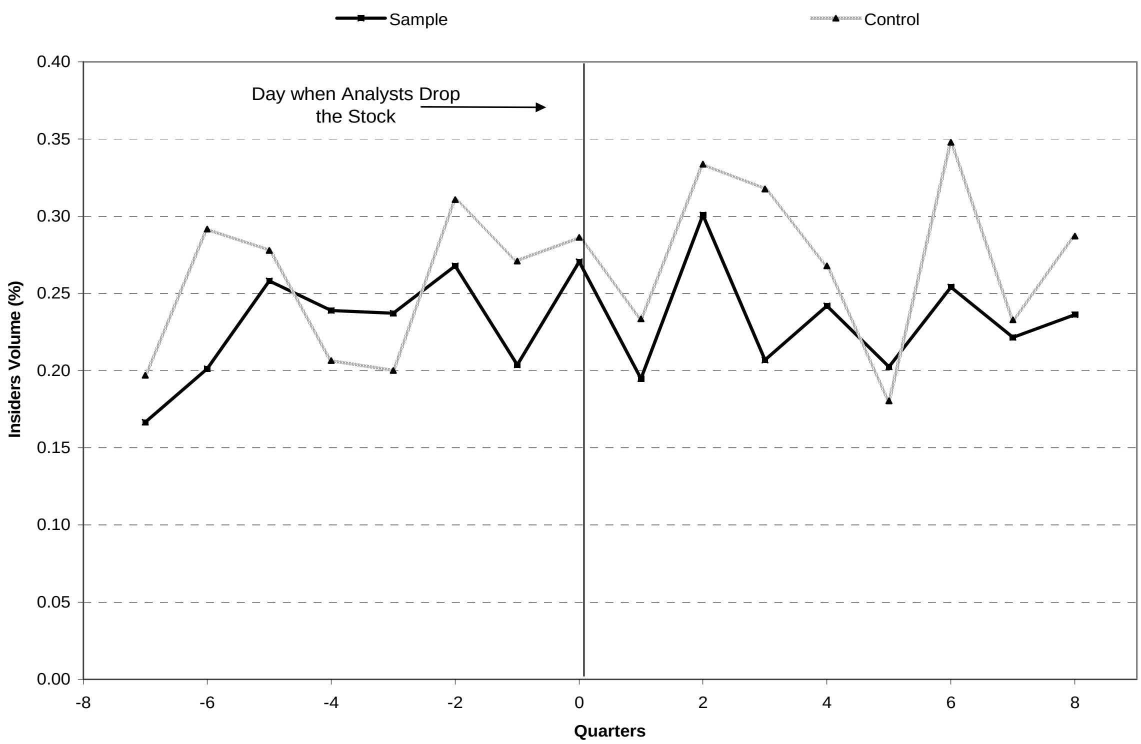


**Figure 4. Median Percentage Insiders Volume for sample and control firms from quarter -7 to quarter +8**

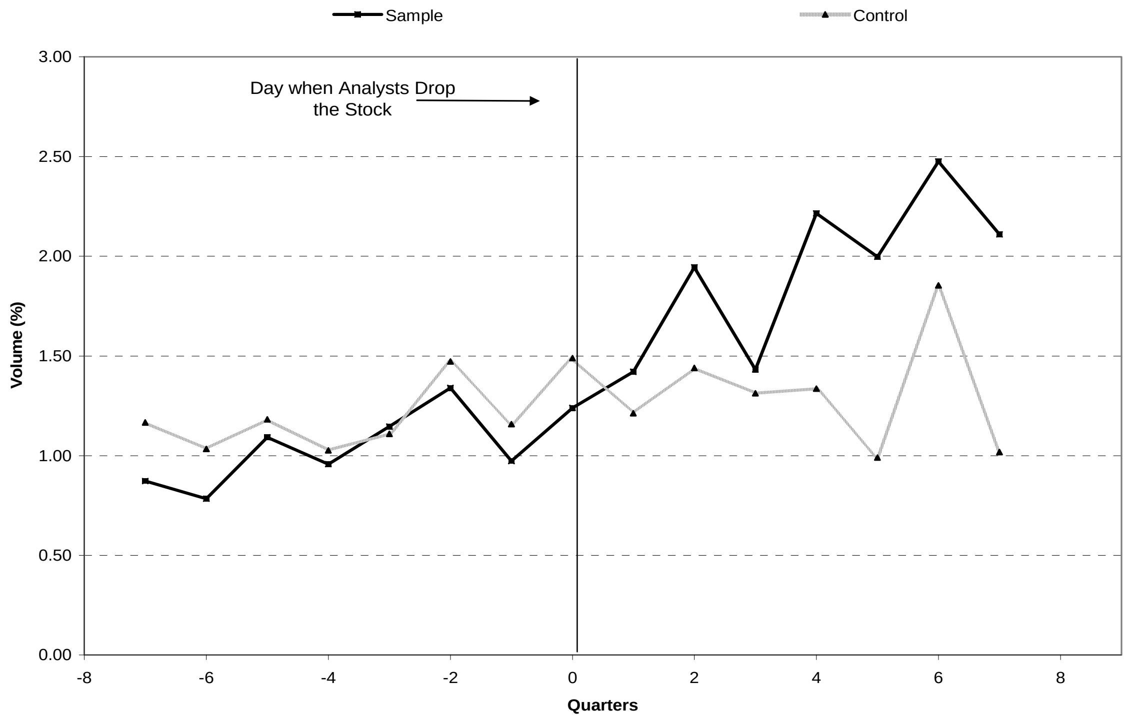


**Figure 5. Median Percentage Insiders Volume out of total share volume traded for sample and control firms from quarter -7 to quarter +8**

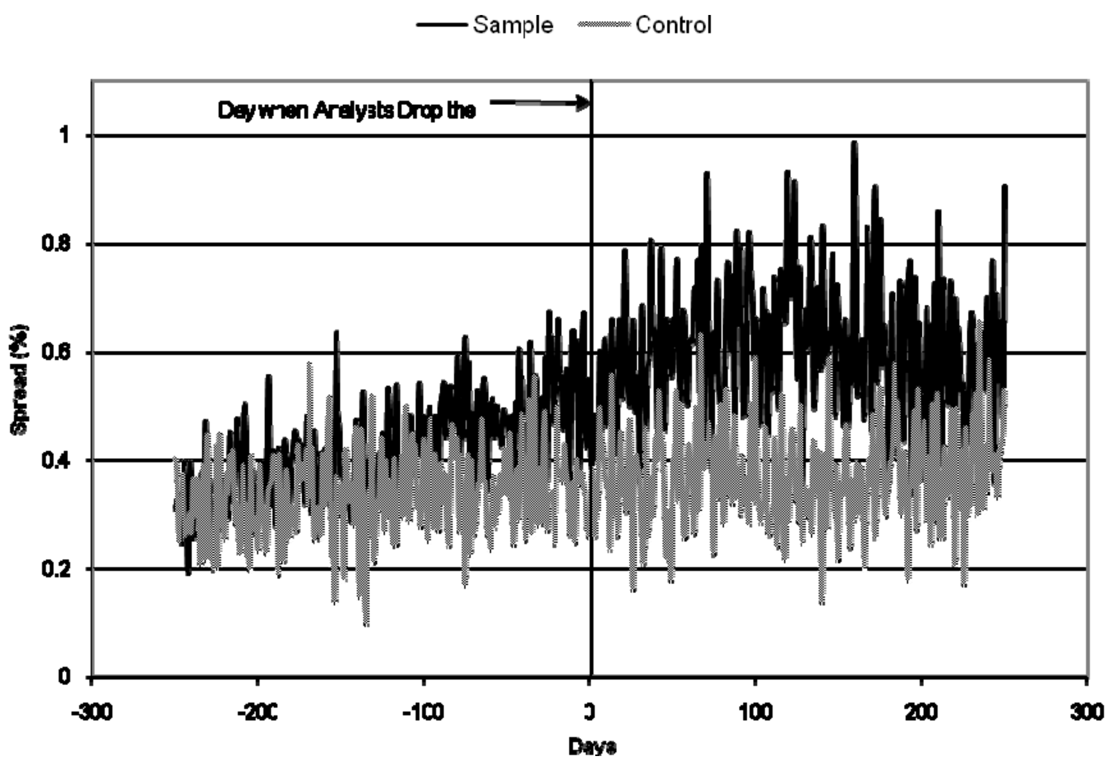


**Figure 6. Intraday price volatility for sample firms and control firms from day -250 to day +250**