Speculating on Private Information:

Buy the Rumor, Sell the News

Ohad Kadan

Roni Michaely

Pamela C. Moulton*

We test theoretical models of how investors should trade on short-lived private information. Our empirical identification rests on information leakage that occurs before analyst recommendations are publicly announced. Consistent with the theory, institutions, who likely possess a short-lived informational advantage, "buy the rumor and sell the news," buying before analyst upgrades and then selling when upgrades are announced. Placebo tests using earnings announcements confirm that these trading patterns are unique to instances where institutional investors have a short-lived informational advantage. Individuals, who are unlikely to be informed early, do not buy before or sell on upgrade announcements. The results are largely supportive of the theoretical predictions and provide the first empirical evidence of the "sell the news" behavior. The results also shed new light on how different investor types trade on analyst recommendations.

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* Kadan is at the Olin Business School, Washington University in St. Louis (kadan@wustl.edu); Michaely is at the Samuel Curtis Johnson School of Management, Cornell University (rm34@cornell.edu) and IDC; and Moulton is at the School of Hotel Administration, Cornell University (pmoulton@cornell.edu). We thank Yakov Amihud, David Brown, Markus Brunnermeier, Bidisha Chakrabarty, Ryan Davies, Thierry Foucault, Larry Glosten, Itay Goldstein, Michael Goldstein, Terry Hendershott, Jeff Hu, Paul Irvine, Pankaj Jain, Russell Jame, Ron Kaniel, Andrew Karolyi, Marc Lipson, Roger Loh, Tom McInish, Elizabeth Odders-White, Napoleon Overton, Mark Ready, Gideon Saar, Eric Sirri, David Smith, Elvira Sojli, Avanidhar Subrahmanyam, Sheridan Titman, Ruslan Tuneshev, and seminar participants at University of Adelaide, Babson College, Cornell University, Singapore Management University, Tsinghua University, University at Albany, University of Lugano, University of Memphis, University of Wisconsin at Madison, the 2013 IDC Summer Conference, the 2014 EFA meeting, the 2014 FMA meeting, the 2014 Multinational Finance Society symposium, and the UC Davis 2014 workshop on information and asset prices for helpful comments. We thank the New York Stock Exchange for providing data, Leonardo Madureira for sharing data with us, and Chris Vincent for research assistance.

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Abstract

We test theoretical models of how investors should trade on short-lived private information. Our empirical identification rests on information leakage that occurs before analyst recommendations are publicly announced. Consistent with the theory, institutions, who likely possess a short-lived informational advantage, “buy the rumor and sell the news,” buying before analyst upgrades and then selling when upgrades are announced. Placebo tests using earnings announcements confirm that these trading patterns are unique to instances where institutional investors have a short-lived informational advantage. Individuals, who are unlikely to be informed early, do not buy before or sell on upgrade announcements. The results are largely supportive of the theoretical predictions and provide the first empirical evidence of the “sell the news” behavior. The results also shed new light on how different investor types trade on analyst recommendations.

JEL classification: G14, G18, G23, G24

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1. Introduction

In today's financial markets, active portfolio managers are continuously engaged in the pursuit of informational advantages. Indeed, much of the asset management industry is focused on generating proprietary informational signals and then quickly exploiting these private signals either by trading or by disseminating them to clients. In this competitive and fast-paced environment, even a short-lived informational advantage may constitute a substantial edge. But what is the optimal way to trade on such short-lived pieces of private information? A Wall Street adage suggests that professional investors often follow a "buy the rumor and sell the news" strategy. That is, if an investor possesses a private, short-lived positive informational signal on an asset, she will buy the asset when the information is private, and then sell it when the signal is revealed publically.

This "buy the rumor and sell the news" strategy appears to be popular among professional money managers.[1] Moreover, this strategy rests on strong theoretical foundations (as discussed below). In this paper we test the empirical implications of theories describing optimal trade in the face of short-lived private information, and we provide the first formal evidence documenting the "sell the news" portion of the strategy.

Our analysis is primarily guided by two theoretical papers that describe how investors who possess a short-lived informational advantage are expected to trade. Hirshleifer, Subrahmanyam, and Titman (1994) offer a rational expectations model with risk-averse investors. In their model, an investor who gets an early positive signal about a risky asset's value finds it optimal to buy the asset. Once the signal is revealed to additional investors, the informational advantage is lost, and the "early-informed" investor sells a portion of the asset. Brunnermeier (2005) develops a model with risk-neutral investors. In his model an early-informed investor receives a noisy signal about a short-term component of value. At that time it is optimal for this investor to trade in the direction of the signal, before it becomes known to the public. When the signal is publically revealed, the

[1] A Google search shows more than seven million hits for the phrase "buy the rumor and sell the news" and over five million hits for the alternative phrase "buy the rumor and sell the fact." The term "rumor" in these phrases is interpreted broadly to include any information obtained before it is publicly announced, including very accurate information.

price tends to overshoot in the direction of the signal, and the early-informed investor finds it optimal, on average, to reverse some of her trade. Both models predict that the optimal way to exploit short-lived positive private information is to "buy the rumor and sell the news," with a mirror image of this strategy applying when the private information is negative.

While these theories offer several well-defined predictions about how short-lived private information should be traded upon, there is limited empirical evidence on how informed investors exploit short-lived information. There are two reasons for this. First, it is difficult to identify events a priori where one group of investors is likely to be informed while another group is not. Second, even when such a situation can be identified, detailed information about the trades of informed and less-informed investors is often unavailable. Thus, documenting the specific strategies of informed investors and testing theories associated with their trading patterns constitute a challenging task.[2]

To overcome these difficulties, we identify events for which short-lived differences in information across different classes of investors are plausible, and we analyze detailed data on trading patterns around these events. Specifically, we focus on sell-side analyst recommendation changes as times when information varies across investor classes because either (i) brokerages share information about their analysts' recommendations early with their institutional clients;[3] or (ii) sophisticated investors do their own research and reach similar conclusions before analysts release their recommendations. Institutional investors, who benefit from private information before recommendations are made public, are a plausible candidate to proxy for the early-informed investors in the models of Hirshleifer et al. (1994) and Brunnermeier (2005). Individual investors, who are unlikely to have information early and thus do not learn about analyst recommendation changes until they are publicly announced, are our proxy for late-informed investors. To examine

[2] The literature often focuses on insider trading as a proxy for informed trading; however, insiders are legally prevented from speculating on their firm's stock around releases of material information, unlike informed investors in general.

[3] Papers documenting evidence consistent with early information leakage around analyst recommendations include Irvine, Lipson, and Puckett (2007), Goldstein, Irvine, Kandel, and Wiener (2009), Juergens and Lindsey (2009), Christophe, Ferri, and Hsieh (2010), and Busse, Green, and Jegadeesh (2012). The practice of brokerages providing early information about their recommendations to their clients does not appear to be illegal during our sample period. See Section 2 for detailed discussion.

how such short-lived informational differences affect trading, we use a proprietary dataset that identifies all daily buy and sell volumes of institutions and individuals on the New York Stock Exchange (NYSE).[4] In addition, the NYSE dataset separately identifies program trades (orders to trade multiple stocks, as used in index arbitrage strategies, for example) from other institutional trades. This distinction is important because program trading is not typically motivated by specific news about one particular stock, and we use this feature to isolate the institutional trading that is more likely to have private information in advance of analyst recommendation changes.

The heart of our analysis focuses on the direction and timing of trades by the two types of investors: the early-informed (institutions) and the late-informed (individuals). We examine each investor group's abnormal trade imbalance, measured as their buy minus sell trade imbalance in excess of their typical trade imbalance, to test empirical predictions derived from Hirshleifer et al. (1994) and Brunnermeier (2005). Clearly, not all institutions possess short-lived information and possibly not all individuals are uninformed. For our analysis, we require only that institutions are more likely to possess information early, which is a reasonable assumption given the literature on institutional trading (e.g,, Hendershott, Livdan, and Schürhoff, 2014). The fact that not all institutions have an informational advantage simply adds noise to our analysis.

Both theoretical models predict that early-informed investors will buy stocks prior to positive information releases and reverse their positions when the information is released publicly. Hirshleifer et al. (1994) also predict that late-informed investors will trade in the direction of the information when it is released more broadly, but not before. Both models predict that early-informed investors' trading will be greater for information events with larger price changes on the day the information is made public. Indeed, both the early trading and the price change on the announcement date are driven by the strength of the underlying signal. The theories predict a mirror image of these trading patterns for negative information releases.

[4] It is important to note that individual trades are not simply the complement of institutional trades, because a third category, market makers (including specialists and non-designated market makers), also plays an active role in equity trading. In other words, it is not possible to back out individual trading from total trading and institutional trading.

Our results are generally supportive of these predictions. Institutions (the early-informed group) buy into a stock during the four days before it is upgraded and then sell a significant portion of the stock on the day of the upgrade. Thus, when it comes to upgrades, institutions appear to "buy the rumor and sell the news," pocketing short-term profits in line with the theoretical predictions. Moreover, as predicted by the theories, during the days preceding analyst upgrades institutions buy more of stocks that subsequently have bigger announcement-day price increases.[5] Institutions also sell significantly on the days before analyst downgrades and buy on the downgrade day, although the latter buying is only marginally significant in the overall sample of downgrades.

The speculative activity of institutions is more pronounced for small firms and, to a lesser extent, when the recommendations are issued by "star analysts," both cases where the recommendations likely carry more value. Moreover, both selling before and buying on the day of analyst downgrades are more pronounced for downgrades of stocks with high institutional ownership. This finding may be due to short-sale constraints that restrict institutions' ability to "sell the rumor and buy the news" surrounding analyst downgrades unless they already hold the affected stocks in their portfolios. Pontiff (2006) argues that high idiosyncratic volatility would deter speculators from engaging in risky arbitrage. In line with his prediction, we find that the speculative activity of institutions is less pronounced in highly volatile stocks.

Examining the behavior of individual investors, we find no abnormal buying by individuals prior to upgrades (nor selling prior to downgrades), in line with the theoretical predictions. Furthermore, we find significant net buying by individuals on the day of the upgrades, but we do not find significant selling on the day of downgrades. As with institutions, it may be that short-sale constraints limit the ability of individuals to sell stocks they do not own. These findings are largely consistent with the theoretical predictions of the models.

[5] It is widely documented that, on average, analyst recommendation changes are accompanied by abnormal short-term returns in the direction of the recommendation change (e.g., Womack, 1996; Loh and Stulz, 2011; and Kecskes, Michaely, and Womack, 2013).

Another implication of the Hirshleifer et al. (1994) and Brunnermeier (2005) models is that information events not associated with early information release to some investors do not induce the "buy the rumor, sell the news" pattern of trading. Rather, we should simply see trades in the direction of the news when it is publicly announced. To test this hypothesis we construct a sample of earnings announcement days. This sample captures significant information events that are unlikely to be associated with early information acquisition by institutions, since firms are prohibited from discussing material non-public information with analysts or investors in advance of earnings announcements. While in our main setting institutions are predicted to accumulate shares before recommendation changes become public and reverse their position on the announcement day, in this placebo sample the theory predicts no change in institutions' trading prior to the placebo day.

In line with the theoretical predictions, the results for this placebo sample are starkly different from those for recommendation changes. Most notably, the "buy the rumor, sell the news" pattern that institutions exhibit around analyst upgrades does not appear around the placebo positive events (earnings announcements accompanied by positive abnormal returns). Institutional investors exhibit no significant buying before the placebo positive events, and they significantly buy (rather than sell) on the day of placebo positive events. We thus find support for the theoretical predictions and conclude that the trading patterns we identify in our main tests are likely attributable to early-informed investors trading on private information before recommendation changes, in contrast to earnings announcements, where such early information is unlikely.

Our results offer an inside look at the way early-informed investors exploit their short-term informational advantage and contrast their behavior with that of late-informed investors. This allows us to corroborate the theoretical predictions describing how investors are expected to trade on short-lived information. Our unique data and the setting around analyst recommendations also allow us to offer the first formal piece of empirical evidence confirming the considerable anecdotal evidence of "buy the rumor, sell the news" trading strategies.

One aspect of our findings has been documented in earlier work: the "buy the rumor" behavior of early-informed investors. Using a dataset of institutional trades from Plexus, Irvine, Lipson, and Puckett (2007) find that institutions tend to buy before analysts initiate coverage with a buy recommendation, but they do not find evidence of institutional selling on the day the buy recommendation is announced. Our study benefits from the use of a dataset that captures all NYSE trading, with buy and sell volumes broken down by individual, institutional non-program, and institutional program trades. This allows us to test a broad range of theoretical predictions regarding the trading of early-informed and later-informed investors and find several new results, including the "sell the fact" behavior of institutions on recommendation-change days.

Furthermore, our analyses of individual trading provide evidence for additional theoretical implications that could not be tested using datasets containing only institutional trading. These and our analyses of institutional trading around placebo events provide new and informative counterfactuals to the trading of early-informed institutional investors, painting a more complete picture of the interaction of early- versus late-informed trading in a market.

Finally, our findings add to our understanding of the behavior of both sell-side analysts and investors. It is important to understand the identity of investors to whom analysts are talking, who is attentive to their outputs, and who trades based on their recommendations. This information has important academic and policy implications. For example, it is often argued that institutions are sophisticated and are able to undo any biases of sell-side analysts such as those related to investment banking (e.g., Lin and McNichols, 1998; Michaely and Womack, 1999). Individuals, on the other hand, are often portrayed as suffering from chronic naïveté, placing them on the losing sides of trades. Our results paint a more nuanced picture. It appears that on average active institutions profit from analyst recommendations via a contrarian strategy associated with early information acquisition that yields speculative short-term profits. And it is not individuals, but rather institutional program trades, that are on the other side of active institutional trades.

The remainder of the paper is organized as follows. In Section 2 we review the theoretical literature and develop our hypotheses. Section 3 describes our sample and data. Section 4 presents our results. Section 5 details robustness checks, and Section 6 concludes.

2. Theoretical Motivation and Hypothesis Development

Our empirical tests are guided by two theoretical models of the way investors benefit from short-lived informational advantages.[6] The first is Hirshleifer et al. (1994). They offer a two-stage rational expectations model with risk-averse investors of two types: "early-informed" and "late-informed." Early-informed investors learn information about a traded asset before other investors, and they can trade on their information at date 1. At date 2, the rest of the investors learn the information and can trade on it. Noisy liquidity demand in the model ensures that prices are not completely revealing, and the market is cleared by risk-neutral market makers.

Proposition 2 in Hirshleifer et al. (1994) shows that it is optimal for the early-informed investors to trade in the direction of their information when this information becomes available to them. When the information becomes available to the late-informed investors, it is then optimal for the early-informed to rebalance their positions and trade against their early information. Combining the two predictions produces "buy the rumor, sell the news" behavior for positive signals, with a mirror image of this strategy when the signal is negative.

Hirshleifer et al.'s (1994) Proposition 2 goes beyond just specifying the direction of trades, as it provides specific predictions regarding the amount of trade and how it is related to price changes on the day the information becomes available to the late-informed traders. Specifically, the amount of trading by the early-informed investors before the information is released more broadly is larger for more favorable information. That is, if the signal is more positive we expect to see the early-informed investors buying more before the signal becomes widely available. Empirically, since the signal is not observable, we expect that larger price changes when the information is released are preceded by more intensive "buying the rumor" by early-informed investors.[7] As for the late-informed investors, they naturally do not trade early. Instead they trade in the direction of the signal when it becomes available to them.

[6] Holden and Subrahmanyam (1996) show that short-term information becomes dominant in the presence of risk aversion.

[7] Another prediction of Hirshleifer et al.'s (1994) Proposition 2 is that there is a negative correlation between the price change on the day of the announcement and the trading on that day by the early-informed investors. This prediction, however, is directly attributable to the simplifying assumption in their model (made for tractability) that "informed traders are individually

The second theoretical model motivating our analysis is from Brunnermeier (2005), who develops a two-stage version of Kyle's (1985) model. Unlike in Hirshleifer et al. (1994), all agents in Brunnermeier's model are risk-neutral. In this model the value of the firm has short-term and long-term components. Some investors are informed about the long-term component, while an early-informed investor gets a noisy signal about the short-term component. The early-informed investor trades in the direction of the signal before it becomes known to the public. A key feature of the model is that even after the signal is revealed to the public, the early-informed investor possesses an informational advantage compared to the market maker. The reason is that the early-informed investor is the only one who knows how to disentangle the actual signal from the noise in his own early trading. The market maker instead attributes some of the early noise to the long-term value, mistaking the trade as coming from investors who are informed about the long-term component. As a result, the price (set by the market maker) overshoots on average in the direction of the signal. Consequently, the early-informed investor finds it optimal to trade against the signal when it becomes public. Like Hirshleifer et al.'s (1994) model, this model predicts "buy the rumor, sell the news" behavior. Furthermore, the more favorable the signal is, the stronger is the speculative trading activity before the information announcement (Propositions 1 and 2). Consequently, as in Hirshleifer et al. (1994), we expect a positive correlation between the pre-announcement trade of early-informed investors and the price change when the information is announced.

To transform the theoretical predictions into workable hypotheses in our empirical setting, we identify the early-informed investors in these models as institutional investors. One way that institutional investors may be informed early is that they receive information about stock recommendations from analysts (or salespeople who work at the same brokerage house with the analysts) a few days before the analyst recommendation becomes public, a practice known as

infinitesimal and fall on a continuum, so that no informed trader can affect the price" (page 1669). We do not pursue this prediction because institutional investors (the early-informed investors in our setting) are not infinitesimal. On the contrary, institutional trading would put upward (downward) pressure on prices when institutions buy (sell), which is likely to induce a positive correlation between institutional trade imbalance and contemporaneous stock prices.

"tipping" (e.g., Irvine et al., 2007).[8] Such early information leakage is not seen as illegal during our sample period (1999-2010). In an article about analysts sharing recommendations early, the Wall Street Journal notes that "securities laws require firms like Goldman to engage in 'fair dealing with clients,' and prohibit analysts from issuing opinions that are at odds with their true beliefs about a stock," but do not explicitly prohibit sharing recommendations early with select clients (Craig, 2009). Securities laws do bar selective disclosure by companies to analysts or investors, but "no law prevents investors from trading on non-public information they have legally purchased from other private entities. Trading would be illegal only if the information was passed through a breach of trust," according to securities lawyers (Mullins, Rothfeld, McGinty, and Strassburg, 2013). However, in 2012 the Securities and Exchange Commission (SEC) fined Goldman Sachs for not having adequate policies and procedures in place to address the "risk that the firm's analysts could share material, nonpublic information about upcoming research changes" in their internal meetings, the contents of which are subsequently communicated to select clients, suggesting that regulators are concerned about early information leakage (SEC, 2012). Our empirical design also works if institutional investors are not actually informed early about sell-side analysts' views per se, but rather do their own research and reach similar conclusions about stocks in the few days before analysts announce recommendation changes, inspiring them to trade as if they had received leaked information about upcoming recommendation changes. Such an alternative would also lead to institutional investors being early-informed and would be consistent with other evidence of institutions trading as if they are informed before news is released (e.g., Campbell, Ramadorai, and Schwartz, 2009, and Hendershott et al.2014).

We identify the late-informed investors in the models as individual investors. These investors are not known to acquire information early and thus receive the information about an analyst recommendation change only when the analyst's report is published.

We thus have the following testable hypotheses:

[8] Information about future recommendation changes may also be communicated through responses to analyst surveys conducted by institutional investors (e.g., Morgenson, 2014).

- **Hypothesis 1 (institutional trading direction):** Institutional investors will exhibit abnormal trading in the direction of the analyst recommendation change in the few days preceding the recommendation change and will exhibit abnormal trading against the recommendation change when it is publicly announced.
- **Hypothesis 2 (individual trading direction):** Individual investors will not exhibit abnormal trading before the recommendation change is announced and will exhibit abnormal trading in the direction of the recommendation change when it is announced.[9]

The prediction of both models that the amount of trading by the early-informed investors prior to the day of the information release is larger for more favorable information leads to the following testable hypothesis:

- **Hypothesis 3 (magnitude of trade for institutions):** The amount of abnormal trading of institutional investors preceding the recommendation change will be positively correlated with the price change on the day of the recommendation announcement.

Analyst recommendations are unusual in that because of early information leakage, different investors are informed about an analyst's views at different points in time. This practice does not appear to be illegal, as discussed above. In contrast, corporations must release material information such as quarterly earnings at the same time to all analysts and investors, whether institutions or individuals, especially since the enactment of Regulation Fair Disclosure (Reg FD) in August 2000. Our next hypothesis concerns such information events, which are characterized by stock price movements but are not associated with early release of information. These information events are likely to be associated with significant price changes, yet we do not expect such events to induce "buy the rumor, sell the news" trading activity by institutions, since they have no early informational advantage.

[9] This prediction comes from Hirshleifer et al. (1994) only; in Brunnermeier (2005) long-term traders (corresponding to individuals in our setting) do not trade based on the private signal when it becomes public. The reason is that, unlike in the Hirshleifer et al. model, the market maker learns the signal as well. Since the market maker is risk-neutral, she fully absorbs any risk and all the information related to the signal is correctly reflected into the price. This risk neutrality, however, is assumed for tractability only. If the market maker in Brunnermeier's model were risk averse, then the picture would change and the long-term traders would trade in the direction of the signal when it is publically revealed, in line with the Hirshleifer et al. (1994) prediction. We thank Markus Brunnermeier for clarifying this point for us.

- **Hypothesis 4 (other information events):** For informational events that are not associated with short-term informational advantages, institutions will not exhibit "buy the rumor, sell the news" trading activity. Rather, they will simply trade in the direction of the information when it becomes publicly available.

3. Data, Methodology, and Sample

In this section we detail our data sources, discuss how key variables are defined, and present descriptive statistics for our sample. We employ stock recommendation changes as events around which some investors have early information and others do not. Our analysis uses analyst stock recommendation data from the Thomson Financial Institutional Brokers Estimate (I/B/E/S) U.S. Detail File,[10] data on daily buy and sell transaction volume by trader type from the NYSE Consolidated Equity Audit Trail Data (CAUD) database, stock data from the Center for Research in Securities Prices (CRSP) database, and institutional holdings data from the Thomson Financial 13F quarterly holdings database. We also use information on analyst rankings from the Institutional Investor annual All-Star Analyst rankings. Our sample period is 1999 to mid-2010, and our sample includes all NYSE-listed domestic common stocks for which there are valid analyst recommendation changes in I/B/E/S, as defined in the next subsection.

3.1. Analyst recommendation changes

We define analyst recommendation changes based on the three-tier scale of buy, hold, and sell. We convert recommendations from the less common five-tier scale (e.g., strong buy, buy, hold, sell, strong sell) to the three-tier scale before identifying recommendation changes, so that our assessment of recommendation changes is not contaminated by the widespread change from five-tier to three-tier rating scales in 2002 prompted by the Global Analyst Research Settlement (Kadan, Madureira, Wang, and Zach, 2009). We define our recommendation changes as upgrades or downgrades within the three-tier scale for which the previous recommendation was issued by

[10] The data we use were pulled in early 2012 and so reflect the corrections Thomson made in 2007 in response to the findings of Ljungqvist, Malloy, and Marston (2009) that previous versions of the I/B/E/S database had been altered.

the same brokerage firm within the past year, to minimize the possibility of stale forecasts. We use the date and time stamps in I/B/E/S to identify the exact day of the recommendation change (the event day). To ensure that the recommendation date we consider is the relevant one in terms of the trading activity surrounding it, if a recommendation is released after 4:00 p.m. we designate the next trading day as the recommendation change day.

To separate the effect of analyst recommendation changes from firm-specific news (Altinkilic and Hansen, 2009), we apply two screens similar to Loh and Stulz (2011). First, we remove recommendation changes that occur on the same day as or the day following earnings announcements. Second, we remove recommendation changes on days when multiple analysts issue recommendations for the same firm, as clustering in recommendation changes may reflect the release of firm-specific news (Bradley, Jordan, and Ritter, 2008). Together these filters remove about 28% of the analyst recommendation changes in our sample period. As a robustness check, we also exclude recommendation changes when the same stock has other recommendation changes in the prior four days.

3.2. Investor-type trading volume and trade imbalance

We use proprietary data from the NYSE that allow us to precisely identify the trading activity of institutional investors (the early-informed) and individuals (the late-informed). The dataset is constructed from the NYSE's CAUD files, which are the result of matching trade reports to the underlying order data. CAUD contains information on all orders that execute on the NYSE, including both trades that are executed electronically and those that are executed manually (by floor brokers).

CAUD has two main advantages compared to other databases providing information on institutional trading. First is its coverage. CAUD covers a large portion of trading in NYSE stocks and is therefore likely to provide a representative picture of trading.[11] Second is the separate

[11] In the first half of our sample period, over 80% of trading in NYSE-listed stocks occurs on the NYSE and is therefore captured by CAUD. After the 2007 merger of NYSE with ARCA, our dataset includes trades on ARCA as well as on NYSE. We perform

identification of individual and institutional trading.[12] CAUD is one of the few databases that identify both individual and institutional trading; because of the presence of market makers, individual volume is not simply the complement of institutional volume. Moreover, CAUD separately identifies institutional program trading, which enables us to more precisely identify the early-informed traders. Since in this paper we are testing hypotheses related to institutional and individual trading behavior, these features of CAUD are crucial for us.

For each trade, CAUD shows the executed portion of the underlying buy and sell orders along with an account-type variable that identifies whether the trader who submitted an order is an institutional investor (and whether part of a program trade or not), an individual investor, or a market maker.[13] Providing the account type classification is mandatory for brokers, although it is not audited by the NYSE on an order-by-order basis.[14] Because CAUD reports the buyer and seller for each trade based on actual order data, the classification of buy and sell volume in our data set is exact, and thus we do not have to rely on trade classification algorithms.

We note that given the aggregation inherent in our dataset (summing across all traders within each type), institutional investors are a noisy proxy for early-informed investors. It is likely that analysts share their recommendations early with only a subset of their institutional investors, revealing information to their most valued institutional clients first and not revealing it to others (Goldstein, Irvine, Kandel, and Wiener, 2009; Nefedova, 2014), and they may share early information on just a subset of all recommendation changes. Similarly, only a subset of institutional investors is likely to be doing their own research and reaching parallel conclusions in the days before analysts announce their recommendation changes. Thus it is reasonable to assume

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robustness checks for the early versus latter part of the sample period, when more trading occurs off the NYSE. Our results hold for both sub-samples.

[12] Other papers use Trade and Quote (TAQ) data to identify large and small trades and then attribute large trades to institutions and small trades to individuals (e.g., Malmendier and Shantikumar, 2007). This categorization is less appropriate since the introduction of decimalization (trading in pennies rather than in sixteenths of a dollar) in 2000 and the growing use of computerized trading algorithms to break up institutional trades, both of which undermine the assumption that small trades are necessarily coming from individuals in recent years.

[13] The original CAUD dataset contains codes indicating more granular trader types within each of these categories, which are aggregated into these four categories in our dataset, limiting our ability to identify trader categories more narrowly.

[14] Kaniel, Saar, and Titman (2008) point out that any abnormal use of the individual investor designation by brokers in hopes of gaining advantages is likely to draw attention, preventing abuse of the system.

that our sample of early-informed institutions is contaminated by uninformed institutions. The presence of institutions that are not early-informed will add noise to our tests and would bias them against finding any differences between the group with early information (institutions) and the group without it (individuals). To the extent that we do find significant differences, they likely serve as a lower bound for the actual differences we would have observed had our proxy for the informed group been more precise. The NYSE dataset allows us to distinguish between the trades of institutions and individuals, but with one exception (described next) it does not enable us to distinguish further between types of institutions, nor does it allow us to identify a particular institution.[15]

Within the institutional category, we are able to separate institutional trading into program trades and non-program trades. The NYSE defines a program trade as the trading of a basket of at least 15 NYSE securities valued at $1 million or more. We exclude program trades from our measures of institutional trading in order to focus on the institutional investor trading that is more likely to be attentive to analyst recommendations and information about individual stocks.[16]

We construct daily measures of institutional and individual trading volume and trade imbalance for each stock, and we standardize the measures by the number of shares outstanding.[17] Specifically, we define Raw Trading Volume for stock *i*, investor type *x*, on day *t* as:

$$Raw\ Trading\ Volume_{i,x,t} = \frac{\left(SharesBought_{i,x,t} + SharesSold_{i,x,t}\right)}{SharesOutstanding_{i,t}} \quad (1)$$

where $SharesBought_{i,x,t}$ and $SharesSold_{i,x,t}$ are the number of shares of stock *i* bought and sold, respectively, by investor type *x* on day *t*, and $SharesOutstanding_{i,t}$ is the number of outstanding

[15] Analyzing changes in quarterly holdings, Klein, Saunders, and Wong (2014) and Swem (2014) find evidence consistent with hedge funds trading profitably on upcoming analyst recommendation changes, but no evidence that other types of investors do.

[16] Program trades are often part of index arbitrage strategies or rule-based algorithms that trade a basket of stocks for reasons that are unrelated to analyst recommendations (Boehmer and Kelley, 2009).

[17] Standardizing by shares outstanding helps to make changes comparable across stocks, as in Irvine et al. (2007) and Hendershott et al. (2014). We replicate our tests with alternate variable definitions in our robustness checks.

shares of stock *i* on day *t*.[18] Similarly, we define Raw Trade Imbalance for stock *i*, investor type *x*, on day *t* as: [19]

$$Raw\ Trade\ Imbalance_{i,x,t} = \frac{SharesBought_{i,x,t} - SharesSold_{i,x,t}}{SharesOutstanding_{i,t}} \qquad (2)$$

To isolate the abnormal trading volume and abnormal trade imbalance surrounding analyst recommendation changes, we identify a benchmark period for each recommendation change. Our benchmark period is days -45 to -11 and +11 to +45 relative to the day of the analyst recommendation change. We calculate the Benchmark Trading Volume for stock *i*, investor type *x*, with analyst recommendation change on day *t* as the average Raw Trading Volume over days *t-45* to *t-11* and *t+11* to *t+45*. Similarly, we calculate the Benchmark Trade Imbalance for stock *i*, investor type *x*, with analyst recommendation change on day *t* as the average Raw Trade Imbalance over days *t-45* to *t-11* and *t+11* to *t+45*.

Our main variables of interest are the abnormal trading volume and abnormal trade imbalance for each investor type and recommendation change, defined as:

$$Abnormal\ Trading\ Volume_{i,x,t} = Raw\ Trading\ Volume_{i,x,t} - Benchmark\ Trading\ Volume_{i,x,t} \qquad (3)$$

and

$$Abnormal\ Trade\ Imbalance_{i,x,t} = Raw\ Trade\ Imbalance_{i,x,t} - Benchmark\ Trade\ Imbalance_{i,x,t} \qquad (4)$$

To calculate the benchmark period volume and imbalance, and thus the abnormal volume and imbalance for each recommendation change, we require at least 45 days of data before and after the recommendation change, reducing our sample from the eleven and a half years (January 1, 1999 to July 1, 2010) for which we have NYSE data to recommendation changes occurring between March 10, 1999 and April 22, 2010.

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[18] The actual trading volume for each trader type depends the extent to which traders trade with their own type versus other types of traders, since each trade consists of a buy and a sell. If all traders trade only with other trader types, trader-type volume equals (trader-type buys + trader-type sells), as we have defined it. At the other extreme, if traders trade only with their own type, trader-type volume equals (trader-type buys + trader-type sells)/2. Statistical inference is the same whichever volume approximation is used.

[19] Trade imbalance is sometimes referred to in the literature as "order imbalance." We use the term trade imbalance because we observe only executed trades, not all orders submitted, in our dataset.

3.4. Descriptive statistics

Panel A of Table 1 presents descriptive statistics for the stocks in our sample. Because our sample is restricted to firms with at least one analyst recommendation change, the stocks in our sample are large, with an average market capitalization $6.490 billion. The average number of analysts covering a firm in our sample is seven (with a median of six), and the average institutional holdings percentage is 66.6%. On average, daily institutional trading (excluding program trading) accounts for 0.378% of shares outstanding in our sample stocks, while individual trading accounts for 0.017%.[20] Clearly, institutional trading volume dwarfs that of individuals in these stocks on the NYSE, although individuals in aggregate trade over $2.044 trillion in our sample. As for trade imbalance, a priori it is not clear we should expect either group of investors to be net buyers or sellers, and indeed both groups' imbalances average near zero in our sample.

Panel B summarizes the distribution of analyst recommendation changes by year. Overall, there are about five percent more downgrades than upgrades in our sample: 15,907 downgrades versus 15,101 upgrades. This ratio is consistent with prior literature (e.g., Kecskés et al., 2013). Both analyst upgrades and analyst downgrades are accompanied by large average abnormal returns on the day they are announced.

[Table 1 here]

4. Empirical evidence on "buy the rumor, sell the news"

We begin by providing preliminary evidence documenting the trading volume of institutions and individuals around analyst recommendation changes in Section 4.1. In Section 4.2 we study the trade imbalances of these two groups, allowing us to directly test Hypotheses 1 and 2. In Section 4.3 we test Hypothesis 3 by evaluating how the magnitude of imbalances is related to the price changes associated with recommendation changes. In Section 4.4 we test Hypothesis 4 by examining trading around earnings announcements. In Section 4.5 we complete the picture by examining what types of traders act as counterparties to the early-informed institutions.

[20] Institutional program trades account for another 0.104% on average, and 0.067% is executed by market makers, including specialists.

4.1. Preliminary results: Institutional versus individual trading volume

Figures 1 and 2 provide a first look at institutional and individual trading volume surrounding analyst recommendation changes. Figure 1-A (2-A) shows the average Raw Trading Volume for institutions and individuals over the period from 45 days before to 45 days after an upgrade (downgrade); because the orders of magnitude for institutional and individual trading volumes are very different, we use separate scales for the two groups of investors (left vs. right axis). Figure 1-B (2-B) shows the average Abnormal Trading Volume in the days immediately surrounding an analyst upgrade (downgrade).

[Figure 1 here]

[Figure 2 here]

Both institutional and individual trading volumes appear to spike around analyst recommendation changes. Critically, in selecting these recommendation changes we have removed all earnings announcement dates and dates of clustered stock recommendations from multiple analysts. Thus the spike in volume around recommendation changes is likely associated with the recommendation change itself, not other news such as earnings announcements.

To determine the statistical significance of the volume patterns displayed in Figures 1 and 2, we conduct analyses of the following form:

$$Volume_{i,x,t+k} = \alpha + \varepsilon_{i,x,t+k} \,, \qquad (6)$$

where $Volume_{i,x,t+k}$ is the abnormal trading volume for investor-type x (institutions or individuals) in stock i with a recommendation change on day t. The variable k takes values in {-4, 0, 4}. When k = 0 we are focusing on the abnormal volume on the day of the recommendation change (day t); when k = -4 we are cumulating the abnormal volume over the four days prior to the recommendation change (days t-4 to t-1); and when k = 4 we are cumulating the abnormal volume over the four days following the recommendation change (days t+1 to t+4).[21] The coefficient of interest in this analysis is the intercept, α, which measures the abnormal volume related to the specific time period we are interested in (day of the recommendation change or four days preceding

[21] We examine four-day periods based on the prior literature and conversations with analysts regarding the typical wait for supervisory approval before analyst reports are published.

or following it). A positive intercept corresponds to a positive amount of abnormal volume. To adjust for potential cross-sectional correlation and idiosyncratic time-series persistence, we use standard errors double-clustered on stock and date in this and all subsequent analyses (Thompson, 2011).

Table 2 presents the regression results separately for upgrades (Panel A) and downgrades (Panel B). The results show clearly that volume is significantly higher on the recommendation change day (day 0) for both institutions and individuals and for upgrades and downgrades. We note that the day-0 abnormal volumes for the two groups of investors differ by an order of magnitude. For example, for upgrades the day-0 institutional abnormal volume is 31.683 basis points (column (2)), more than 30 times individual abnormal volume of 1.022 basis points (column (5)). On days -4 to -1 and +1 to +4, institutions exhibit abnormal volume on average, and individuals less so (columns (1) and (3) versus (4) and (6)), giving rise to significant differences between the two groups (last three columns).

[Table 2 here]

4.2. Direction and timing of trade

Figures 3 and 4 present the average buy-sell trade imbalances surrounding analyst recommendation changes. First consider Figure 3, which shows analyst upgrades. Panels A and B show that both institutional and individual trade imbalances are quite flat until a few days before the upgrades. Just prior to the information release (days -4 to -1), we see a notable increase in positive imbalance by institutions, which reverses to a negative imbalance on the day the upgrade is announced. That is, institutions are net buyers of stocks in the four days prior to upgrades, and are net sellers on the day of the upgrade (day 0). This pattern is consistent with the predictions of Hypothesis 1, that institutional investors trade in the direction of the recommendation change prior to and trade in the opposite direction on the day of its announcement, giving rise to "buy the rumor, sell the news" behavior.

The trade imbalances of individuals in Figure 3 tell a very different story. The abnormal imbalances of individual investors appear roughly flat before upgrades and then slightly positive on the day the upgrade is announced. This pattern is consistent with Hypothesis 2, that individuals trade in the direction of the recommendation change when it is announced, but not before.

Figure 4 suggests similar but less pronounced behavior for institutions around downgrades. Individual imbalances are also more muted around downgrades than upgrades.

[Figure 3 here]

[Figure 4 here]

To present formal tests of Hypotheses 1 and 2 we need to determine the statistical significance of the trade imbalance patterns displayed in Figures 3 and 4. We conduct analyses of the following form:

$$Imbalance_{i,x,t+k} = \alpha + \varepsilon_{i,x,t+k}\ , \qquad (7)$$

where $Imbalance_{i,x,t+k}$ is the abnormal trade imbalance for investor-type x (institutions or individuals) in stock i with a recommendation change on day t. The variable k takes values in {-4, 0, 4}, as in Equation (6). The coefficient of interest in this analysis is the intercept, α, which measures the abnormal trade imbalance related to the specific time period we are interested in (day of the recommendation change or four days preceding or following it). A positive (negative) intercept corresponds to excess buying (selling) activity relative to the benchmark period.

[Table 3 here]

Table 3 presents the regression results separately for upgrades (Panel A) and downgrades (Panel B). Consider Panel A first. The results for institutional investors show abnormal buying activity equal to 1.544 basis points of shares outstanding during the four days prior to an upgrade (column (1)), and then abnormal selling activity equal to 0.449 basis points of shares outstanding on the day of the upgrade (column (2)). These results are consistent with the prediction in Hypothesis 1 that institutions "buy the rumor and sell the news." The results in Panel B of Table 3 reveal that institutions are also significantly selling before downgrades, consistent with the "sell the rumor" part of our theoretical predictions. The subsequent buying on the day the downgrade is announced is significant but only at the 10% level (*t*-statistic of 1.8 corresponding to a p-value of 0.07).

Turning to individuals, Panels A and B of Table 3 mostly provide support for Hypothesis 2. First, the evidence indicates that individuals do not trade in the direction of information prior to recommend changes (upgrades or downgrades), consistent with Hypothesis 2. Second, the prediction that individuals should exhibit net buying on the day of upgrades is supported by column (5) of Panel A (*t*-statistic of 1.9 corresponding to a p-value of 0.06). On the other hand, selling on the day of downgrades is not supported (column (5) of Panel B). This non-result may be due to practical factors not considered by the theoretical models motivating our analysis. It is well known that trading on negative information is often harder compared to trading on positive information because of short-sale constraints. Individual investors can relatively easily respond to upgrades by buying the recommended stocks, but downgrades can only be traded upon if the individual already holds a particular stock or through a short sale. The two models we rely on assume that short sales are allowed and are not associated with any costs or constraints. Alternatively, it is possible that our statistical tests are not powerful enough to establish this result formally.

Across different recommendation changes, we would expect that early-informed investors would trade more strongly on analyst recommendation changes that have higher information content. One such case is when the analyst issuing the recommendation is an "all-star" analyst. Additionally, it is likely that the signal is more informative for small stocks, which are naturally covered by fewer analysts. Furthermore, we would expect that institutions would be more inclined to trade on analyst recommendations for stocks they already own, namely when institutional ownership is high. In particular, we expect that institutions would be more inclined to trade following downgrades when they already own the stock and thus no short selling is required or when other institutions hold it and it is easier to borrow for a short sale. Pontiff (2006) predicts that traders engaged in risky arbitrage will take smaller speculative positions when idiosyncratic risk is large. His intuition is that such traders are not fully hedged and so large idiosyncratic movements in price deter them from taking large positions. Applying this intuition to our situation, institutions may be less likely to "buy the rumor and sell the news" in stocks with higher idiosyncratic risk, proxied by volatility. To investigate these cross-sectional implications, we run regressions of the following form:

$$Imbalance_{i,t+k} = \alpha + \beta_1 AllStar_{i,t} + \beta_2 SmallFirm_{i,t} + \beta_3 LargeFirm_{i,t} + \beta_4 HighInst_{i,t} + \beta_5 LowInst_{i,t} + \beta_6 HighVolat_{i,t} + \beta_7 LowVolat_{i,t} + \varepsilon_{i,t+k}\ , \quad (8)$$

where $AllStar_{i,t}$ is an indicator variable that is equal to one if the analyst making the recommendation change is ranked as an all-star analyst by Institutional Investor in the prior year, else zero; $SmallFirm_{i,t}$ ($LargeFirm_{i,t}$) is an indicator variable that is equal to one if the firm is in the smallest (largest) firm-size quartile, else zero; $HighInst_{i,t}$ ($LowInst_{i,t}$) is an indicator variable that is equal to one if the firm is in the highest (lowest) institutional ownership percentage quartile as of the previous quarter-end, else zero; and $HighVolat_{i,t}$ ($LowVolat_{i,t}$) is an indicator variable that is equal to one if the firm is in the highest (lowest) return volatility quartile as of the previous quarter-end, else zero. As in prior equations, the variable k takes values in {-4, 0, 4}.[22]

[Table 4 here]

The regression results in Panel A of Table 4 show that the "buy the rumor, sell the news" trading of institutions around analyst upgrades is stronger for small firms and stocks with high institutional ownership (Panel A, columns (1) and (2)). These results are consistent with the intuition that institutions will engage in more speculative trading around upgrades with higher information content. The "sell the news" trading activity is weaker for stocks with high volatility (positive coefficient for high volatility stocks on day of recommendation change), supporting the Pontiff (2006) conjecture that speculators are less likely to engage in risky arbitrage in more volatile stocks; the negative coefficient for day -4 to -1 in column (1) is weaker (*t*-statistic of 1.7 corresponding to p-value of 0.089). The results also provide evidence that institutions are more likely to "buy the rumor" when the analyst issuing the recommendation is an all-star analyst, but the statistical significance is weak (*t*-statistic of 1.9). Panel B shows that the corresponding "sell the rumor, buy the news" pattern of trading around analyst downgrades is significant for stocks

[22] The results of similar regressions including additional cross-sectional explanatory variables are discussed in Section 5.

with the highest institutional ownership (Panel B, columns (1) and (2)).[23] This result is consistent with institutions finding it easier to trade on downgrades when they already hold the stock or when it is widely held by institutions, making it easier to borrow for a short sale. The Pontiff (2006) prediction is more fully supported in the case of downgrades, with high-volatility stocks showing a significant positive coefficient before and negative coefficient the day of downgrades, suggesting that the sell the rumor, buy the news trading pattern is indeed weaker for more volatile stocks.

4.3. Magnitude of institutional trading

We now turn to examine Hypothesis 3, which involves the link between institutional trade imbalances and stock returns. We consider the following specifications:

$$Imbalance_{i,t-4} = \alpha + \beta Return_{i,t} + \varepsilon_{i,t-4}\,, \quad (9)$$

where $Imbalance_{i,t-4}$ cumulates over the four days prior to the analyst recommendation change and $Return_{i,t}$ is the abnormal return for stock *i* on the day of the analyst recommendation change, measured as the stock return minus the CRSP equal-weighted market return.

We have already seen that institutions tend to buy prior to upgrades (Table 3). Our focus here will be on the coefficient β, which measures whether the buying activity of institutions is stronger for stocks that experience higher abnormal returns on the day of the upgrade. This approach allows us to test Hypothesis 3, which predicts that the trade imbalance of institutions prior to the recommendation change is positively correlated with the price change on the recommendation change day.

[Table 5 here]

Panel A of Table 5 presents the analysis for upgrades. As in Table 3, the intercept in this regression is positive (1.627 basis points) and significant (*t*-statistic of 5.6), indicating that institutions net buy stocks in the four days before they are upgraded. In addition, the coefficient on *Return* is positive (21.48 basis points) and significant (*t*-statistic of 3.7). Thus, institutions appear to be buying even more of the about-to-be-upgraded stocks whose prices rise more on the day of the upgrade. This is consistent with the idea underlying Hypothesis 3 that both the

[23] The F-value for the test of differences across levels of institutional ownership in Column (1) is 3.09, with a p-value of 0.029. The corresponding F-value in Column (2) is 2.84, with a p-value of 0.045.

institutional buying and the subsequent change in price are driven by the same signal. A similar picture emerges for downgrades, with the positive coefficient on *Return* indicating that institutions net sell more of the about-to-be-downgraded stocks that have the largest negative returns on the day the downgrades are announced.

4.4. Information events without early information leakage

The final prediction we test is that information events that are not accompanied by early information release to some investors should not induce "buy the rumor, sell the news" trading patterns (Hypothesis 4). If such events do induce the buy/sell trading pattern, it would suggest that the trading pattern is not due to early-informed trading. For example, it may be that institutional investors always buy before and sell on days with large positive returns, and analyst upgrades are simply one cause of large positive returns. A related concern is that there may be omitted variables related to the behavior of individuals and institutions, which drive the differences in their trading behavior irrespective of whether they are early-informed or late-informed. To address these concerns, we conduct a placebo test to examine the trading behavior of institutions and individuals around earnings announcements. Earnings announcements are ideal placebo events for our study because they generally lead to large returns but information leakage is unlikely: Insider trading laws and regulations (e.g., Reg FD) prevent companies from revealing material non-public information to analysts and investors prior to an earnings announcement.

We construct the placebo sample as follows. For each analyst recommendation change in our sample, we identify a placebo event defined as the earnings announcement date for the same stock that has the closest abnormal return to that of the analyst recommendation change (day 0).[24] We exclude from consideration the nine-day periods (days *t-4* to *t+4*) surrounding all actual analyst recommendation change dates for that stock, to avoid overlap with analyst recommendation changes. Placebo events are chosen without replacement, so there are no duplicates in the placebo event set. Because of the limited number of earnings announcements for

[24] We define "closest abnormal return" as the return that has the same sign as and minimum absolute distance from the day-0 abnormal return of the actual analyst recommendation change.

each stock, our placebo sample is somewhat smaller than the recommendation change sample (25,931 placebo events versus 31,008 recommendation changes). Figure 5 shows the average abnormal return for the period surrounding the actual recommendation change dates and the placebo event dates. The average absolute difference between actual and placebo day-0 abnormal returns is 68 basis points, with earnings announcements generally having higher abnormal returns than analyst recommendation changes.

[Figure 5 here]

Figure 6 graphically examines institutional and individual investor trading volume surrounding placebo events compared to analyst recommendation changes.

[Figure 6 here]

The top two graphs in Figure 6 show that institutional and individual investor volume is on average higher surrounding the placebo events than it is around the analyst recommendation changes. To determine the statistical significance of the volume patterns surrounding the placebo events, we employ regression analyses identical to those in Equation (6) and Table 2 except that we now perform the analyses on the placebo event sample. Table 6 presents the results.

[Table 6 here]

The variable of interest in these regressions is the intercept, which measures the abnormal volume in the days preceding, day of, and days following the placebo event (earnings announcement day with price movements of similar magnitude). Institutional and individual abnormal trading volume is significantly higher surrounding the placebo events, reflecting the importance of earnings announcements as a source of information as well as the predictability of their timing. All investors know (or can find out) when a firm is expected to announce its earnings each quarter, and volume is typically higher in advance of the announcements as well as on the day of and after.

Figure 7 provides a first look at institutional and individual investor trade imbalances surrounding placebo events compared to analyst recommendation changes.

[Figure 7 here]

Institutional trade imbalances display dramatically different patterns surrounding the placebo events compared to analyst recommendation changes. Most notably, the contrarian behavior of institutions (selling on upgrades, buying on downgrades) that appears on the day of recommendation changes is reversed for the placebo events: On average institutional investors appear to net buy on day 0 for placebo upgrades (earnings announcements with positive abnormal returns) and net sell on day 0 for placebo downgrades (earnings announcements with negative abnormal returns). Table 7 presents the results of regression analyses for abnormal trade imbalances, analogous to those in Equation (7) and Table 3 except now using the placebo sample.

[Table 7 here]

The results in Table 7 support Hypothesis 4. On earnings announcement days with large abnormal returns, institutions generally trade in the direction of the information when it is released, rather than exhibiting "buy the rumor, sell the news" behavior associated with early information acquisition. Institutional investors are net buyers rather than sellers on the day of the placebo upgrade (column (2) of Panel A), and they are net sellers on placebo downgrade days (column (2) of Panel B), in contrast to their buying on actual downgrade days (Table 3). Institutions do not demonstrate significant buying prior to the placebo upgrades (column (1) of Panel A), nor do they exhibit significant net selling prior to placebo downgrades (column (1) of Panel B). These differences between actual and placebo recommendation changes are significant (see bottom row in each panel, which tests the differences between the results for recommendation changes in Table 3 and the placebo sample presented above in Table 7).

Overall, these placebo tests show that institutions trade differently around information events when they do not possess short-lived private information. Most notably, the imbalance patterns show that the "buy the rumor, sell the news" behavior of institutions is related specifically to analyst recommendation changes, not events such as earnings announcements where early private information is less likely.

Taken together, these results lend further support to the predictions of Hirshleifer et al. (1994) and Brunnermeier (2005) that investors trade differently when they have a short-term informational advantage than when they do not. Before the information is revealed, early-informed investors buy stocks in which they have a positive informational advantage. Once the information is revealed, they reverse their position in those stocks. And the late-informed investors do not change their trading patterns before the information event. From these findings it is not clear who trades with the institutions before the information release. We address this question next.

4.5. Who is on the other side?

For every buyer there is a seller, and in aggregate the number of shares bought equals the number of shares sold. Thus a natural question is: Who stands on the other side of the trading activity we document around analyst recommendation changes? In particular, when institutions are buying a stock a few days before an upgrade, some other traders must be selling to them. And when institutions are selling to take profits on the day of an upgrade, other traders must be buying. From the results so far it does not appear that individuals are the main counterparties of institutions in their trades around analyst recommendation changes. Even when individual trade imbalances are of the opposite sign than institutional imbalances, they are much smaller in magnitude.[25]

The other candidates for being "counterparties" are program traders and market makers. Program traders are institutions trading baskets of securities. In our main analysis, we separate active institutional investors from program traders because the latter are not likely to be trading on analysts' recommendations on individual stocks. The market maker category includes specialists and non-designated market makers.

Panel A of Table 8 reports results on the abnormal trade imbalances of program traders and market makers around upgrades. The results for program trades are striking (columns (1) through (3)). The intercept on days -4 to -1 is negative and significant, whereas the intercept on day 0 is positive and significant. Comparing these results to the institutional trades in Panel A of Table 3, we find that the intercepts have similar magnitudes but opposite signs. The abnormal imbalance of program traders forms nearly a mirror image to that of institutional investors before and on the day of upgrades. In contrast, the analogous analysis for market makers shows no significant intercepts (columns (4) through (6)). A similar picture emerges from the analysis of program trade

[25] Kaniel et al. (2008) find patterns of individual trading consistent with risk-averse individuals providing liquidity to institutions, but individual trade imbalances are too small to account for the entire story.

and market maker imbalances around downgrades in Panel B. Thus, program traders (and not market makers) emerge as the de-facto counterparties of institutions when institutions "buy the rumor and sell the news" around analyst upgrades, serving the role of liquidity providers around these events.[26]

[Table 8 here]

It is natural to ask what drives this result. Namely, what would induce program traders to trade against active institutional investors around analyst recommendation changes? Unfortunately, we do not have a clear answer to this question. Program traders comprise a variety of traders including index arbitragers, quantitative hedge funds, and other traders who trade baskets of securities based on a wide variety of quantitative models. Our dataset pools all of these traders together under the program trader category, so it does not allow us to determine the motives of these traders. Thus this question remains open for now.

5. Robustness Checks

We conduct several additional tests to confirm the robustness of our results (results from robustness checks are available on request). Excluding recommendation changes when the same stock has other recommendation changes in the prior four days yields identical inference. Excluding from our sample all recommendation changes announced after 4:00 p.m. does not alter our results. Our results hold when our sample is divided into sub-periods for before versus after 2007, when Regulation NMS and the NYSE's Hybrid market structure were implemented (Hendershott and Moulton, 2011). Results are qualitatively similar for three- and five-day periods surrounding analyst recommendation changes and for three alternative measures of trade imbalance: unscaled dollar imbalance, dollar imbalance scaled by lagged market capitalization, and imbalance scaled by daily volume. Constructing the placebo sample based simply on

[26] Our finding that program traders are trading opposite early-informed institutions is consistent with Hendershott and Seasholes' (2009) finding that program traders are adversely selected at the market level. The opposite trading patterns of program and non-program institutional traders may also explain why Busse et al. (2012) do not find evidence of institutions buying before or selling on analyst upgrades. Their Plexus/Abel Noser dataset of self-reported institutional trades does not distinguish between program and non-program trades.

stock/days with similar price changes instead of earnings announcement stock/days with similar price changes yields identical inference.

In multivariate regressions akin to those in Equation (8), we also test a number of other characteristics of recommendation changes, including the firm's book-to-market ratio, stock turnover, the number of analysts covering the firm, and whether the recommendation change is accompanied by an earnings forecast, issued by one of the 10 largest brokerages, issued by a brokerage firm that has an underwriting relationship with the firm, or occurs after the Global Settlement of 2002. None of these variables are found to be significantly related to the strength of the "buy the rumor, sell the news" trading activity of institutions.

In our study we focus on analyst recommendation changes and so exclude initiations of analyst coverage. Thus our results are not directly comparable to those of Irvine et al. (2007), who focus on analyst coverage initiations only. To reconcile our results with those of Irvine et al., we repeat our analysis for analyst initial recommendations. Using the methodology of Irvine et al., we identify 6,889 analyst coverage initiations for NYSE stocks during our sample period. We find that institutions are significant net buyers in the days prior to an analyst's initial positive recommendation, consistent with Irvine et al. and our findings for analyst recommendation changes. Also consistent with Irvine et al., but in contrast to our findings for analyst recommendation changes, we find no significant net selling by institutions on the day the initial recommendation is announced. Thus, while institutions appear to be contrarians when it comes to positive recommendation *changes*, this behavior is not observed for positive *initiations*. The differential response of institutions to the announcement of initial positive recommendations versus upgrades may be attributable to the magnitude of the price effects. Hirshleifer et al. (1994) predict that the magnitude of early-informed buying before and selling the day of the announcement are positively related to the strength of the signal, and in our samples the average abnormal return is higher on the day of an analyst upgrade than on the day of a positive analyst initiation.

6. Conclusion

In this paper we study how informed investors trade when they have short-lived private information. Our empirical tests are guided by the theoretical work of Hirshleifer et al. (1994) and Brunnermeier (2005), who predict that early-informed investors will follow a "buy the rumor, sell the news" trading strategy. Our empirical approach is to identify likely early-informed investors by relying on analysts' practice of giving early information to institutional clients on the days before they issue a recommendation or institutions' skill at reaching similar conclusions from their own research a few days before analyst recommendation changes are announced. We study how different types of investors trade around analyst recommendation changes, using a unique dataset that captures all NYSE trading by institutions and individuals from 1999 to mid-2010. As a counterfactual, we also conduct a similar analysis around earnings announcements events, where early release of information is much less likely.

To our knowledge, this is the first study to analyze the differences in trading activity between early- and late-informed investors. Consistent with the theoretical predictions, we find that institutions (who likely receive information early) are significant net buyers before upgrades, and they buy more of stocks that ultimately have the biggest returns when analyst recommendation changes are announced. On the day of the upgrade, institutions trade in the opposite direction, selling upgraded stocks, as predicted by the models but not previously documented empirically. Both selling before and buying the day of analyst downgrades are significant for downgrades of stocks with very high institutional ownership, where the effects of short-sale constraints may be less binding. In contrast, individuals, who are unlikely to be informed early, do not exhibit abnormal trade imbalances before upgrades or downgrades. Our placebo test reveals that institutions do not "buy the rumor and sell the news" around earnings announcements, which are characterized by large price moves but no early information acquisition. Finally, we find that program traders are the de-facto counterparties to institutional investors, buying and selling shares in a near mirror image of institutional investors' trading pattern surrounding analyst upgrades.

In addition to shedding new light on important models of asymmetric information, our empirical results provide insight into the important issue of who trades and who benefits from analyst recommendations. We find that the majority of the trades around recommendation changes are done by institutions. Moreover, we find that institutions accumulate shares before upgrades and unload shares when the upgrade is announced. Abstracting from transaction costs, institutions are also the ones who profit from analysts' recommendations in the short run. For the most part, individuals do not trade as much around analyst recommendation changes, but at least they do not seem to lose from these events. In aggregate, there appears to be a transfer of wealth among institutional traders, from program traders to institutions that are informed early.[27]

We concentrate on one type of informational event (analyst recommendation changes) due to information availability, but the implications of our analysis are likely to be relevant to other situations where some investors have short-lived informational advantages. For example, until recently BlackRock regularly gathered nonpublic views from analysts through a survey to gain a short-term informational advantage. Because of public pressure, BlackRock agreed to stop gathering this information (Morgenson, 2014). There is also evidence of possible informed trading ahead of macroeconomic news announcements (Lucca and Moench, 2015; Bernile, Hu, and Tang, 2014). Recent press reports reveal that a number of high-speed traders pay for faster news feeds, giving them a few-second (or few-millisecond) advantage over investors who wait to receive news releases through conventional media outlets (e.g., Mullins et al., 2013; Paterson, 2014; analyzed empirically by Hu, Pan, and Wang, 2013). Some news vendors have stopped selling direct access to high-speed traders, while regulators are investigating the practice and what it means for market fairness. Our findings may be relevant to these situations as well, where the timescale is smaller but the underlying principle of early- versus later-informed investors is the same.

[27] Our ability to assess profitability is limited by the aggregate nature of our data and the fact that we do not see trades in other markets that may be part of a larger strategy, such as index arbitrage involving futures as well as cash equities.

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Table 1: Descriptive statistics

The sample consists of all domestic common stocks that were traded on the NYSE and had analyst recommendation changes between March 8, 1999 and April 22, 2010. Panel A presents descriptive statistics for the 2,122 stocks in the sample. *Market capitalization* is calculated annually from CRSP; Number of analysts covering (*# Analysts covering*) is calculated annually from I/B/E/S; *Institutional holdings* are calculated quarterly as the percentage of shares held by institutional owners from Thompson 13F database; *Raw Trading Volume* and *Raw Trade Imbalance* are calculated daily from CAUD data files and scaled by shares outstanding. All variables in Panel A are averaged for each stock over the sample period, and across-stock statistics are reported in Panel A. Panel B reports separately for *Upgrades* and *Downgrades* number of analyst recommendation changes in the sample year-by-year and the average abnormal return on the recommendation-change day *(Avg Return)*, with Upgrades and Downgrades determined based on a three-tier scale (buy/hold/sell). The total number of recommendation changes in the sample is 31,008 (15,101 upgrades + 15,907 downgrades).

Panel A: Firms in sample

	Mean	Median	Std Dev
Market capitalization ($bn)	6.490	1.532	19.277
# Analysts covering	7.1	6.0	4.7
Institutional holdings (%)	66.6	69.4	22.6
Raw Trading Volume (%)			
Institutional	0.378	0.322	0.262
Individual	0.017	0.010	0.024
Raw Trade Imbalance (%)			
Institutional	0.002	0.002	0.023
Individual	-0.002	-0.002	0.012
Number of firms	2,122		

Panel B: Recommendation changes by year

	Upgrades		Downgrades	
	# Upgrades	Avg Return (%)	# Downgrades	Avg Return (%)
1999	1,151	1.33	1,106	-1.70
2000	386	1.39	598	-1.62
2001	795	1.25	1,050	-1.72
2002	1,194	1.48	2,124	-1.56
2003	1,667	1.99	1,871	-1.63
2004	1,414	1.73	1,437	-1.65
2005	1,328	1.92	1,077	-1.68
2006	1,157	1.96	1,189	-1.62
2007	1,774	2.02	1,476	-1.81
2008	2,016	2.42	1,981	-2.77
2009	1,735	2.72	1,607	-2.08
2010	484	2.00	391	-1.12
Total	15,101	1.96	15,907	-1.83

Table 2: Analysis of abnormal volume surrounding analyst recommendation changes

This table presents univariate analyses of abnormal trading volumes in the days surrounding analyst upgrades (Panel A) and downgrades (Panel B). The dependent variable is abnormal trading volume for institutional (three left columns) or individual (three center columns) traders. Abnormal volume per day is defined as daily shares bought plus shares sold, scaled by shares outstanding, minus average daily shares bought plus shares sold, scaled by shares outstanding, during the benchmark period (days *t-45* to *t-11* and days *t+11* to *t+45* relative to the day of the analyst recommendation change). *Day 0* is the day the analyst recommendation change is released if before 4:00 pm on a trading day, else the next trading day. *Day -4 to -1* (*Day +1 to +4*) reflects days -4 to -1 (+1 to +4), with abnormal volume calculated as the sum of the daily abnormal volumes over the four days. Parameter estimates are reported in basis points, and *t* -statistics (in parentheses below parameter estimates) are based on standard errors that are double-clustered on stock and date.

Panel A: Analyst upgrades

Dependent Variable	Institutional Volume			Individual Volume			Institutional - Individual Difference		
	(1)	(2)	(3)	(4)	(5)	(6)			
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	42.724	31.683	28.365	0.467	1.022	0.898	42.257	30.661	27.467
	(18.2)	*(15.0)*	*(12.9)*	*(1.9)*	*(8.0)*	*(3.9)*	*(18.5)*	*(15.0)*	*(12.8)*
# Observations	15,101	15,101	15,101	15,101	15,101	15,101			

Panel B: Analyst downgrades

Dependent Variable	Institutional Volume			Individual Volume			Institutional - Individual Difference		
	(1)	(2)	(3)	(4)	(5)	(6)			
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	47.618	37.624	37.433	0.581	1.369	1.725	47.037	36.255	35.708
	(16.3)	*(23.1)*	*(16.9)*	*(1.7)*	*(7.6)*	*(4.3)*	*(16.7)*	*(23.1)*	*(16.9)*
# Observations	15,907	15,907	15,907	15,907	15,907	15,907			

Table 3: Analysis of abnormal trade imbalance surrounding analyst recommendation changes

This table presents univariate analyses of abnormal trade imbalances in the days surrounding analyst upgrades (Panel A) and downgrades (Panel B). The dependent variable is abnormal trade imbalance for institutional (three left columns) or individual (three center columns) traders. Abnormal imbalance per day is defined as shares bought minus sold, scaled by shares outstanding, minus average daily shares bought minus shares sold, scaled by shares outstanding, during the benchmark period (days *t-45* to *t-11* and days *t+11* to *t+45* relative to the day of the analyst recommendation change). *Day 0* is the day the analyst recommendation change is released if before 4:00 pm on a trading day, else the next trading day. *Day -4 to -1* (*Day +1 to +4*) reflects days -4 to -1 (+1 to +4), with abnormal imbalance calculated as the sum of the daily abnormal imbalances over the four days. Parameter estimates are reported in basis points, and *t*-statistics (in parentheses below parameter estimates) are based on standard errors that are double-clustered on stock and date.

Panel A: Analyst upgrades

Dependent Variable	Institutional Trade Imbalance			Individual Trade Imbalance			Institutional - Individual Difference		
	(1)	(2)	(3)	(4)	(5)	(6)			
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	1.544	-0.449	0.360	-0.083	0.078	0.126	1.626	-0.527	0.234
	(5.8)	*(-3.6)*	*(1.4)*	*(-0.9)*	*(1.9)*	*(1.6)*	*(5.8)*	*(-4.0)*	*(1.3)*
# Observations	15,101	15,101	15,101	15,101	15,101	15,101			

Panel B: Analyst downgrades

Dependent Variable	Institutional Trade Imbalance			Individual Trade Imbalance			Institutional - Individual Difference		
	(1)	(2)	(3)	(4)	(5)	(6)			
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	-1.345	0.293	0.470	0.144	-0.008	-0.129	-1.489	0.301	0.599
	(-4.1)	*(1.8)*	*(1.5)*	*(1.2)*	*(-0.1)*	*(-1.0)*	*(-4.3)*	*(1.7)*	*(1.7)*
# Observations	15,907	15,907	15,907	15,907	15,907	15,907			

Table 4: Multivariate regressions of institutional abnormal trade imbalances surrounding analyst recommendation changes

This table presents multivariate analyses of abnormal trade imbalances in the days surrounding analyst upgrades (Panel A) and downgrades (Panel B). The dependent variable is abnormal trade imbalance for institutional traders. Abnormal imbalance per day is defined as shares bought minus sold, scaled by shares outstanding, minus average daily shares bought minus shares sold, scaled by shares outstanding, during the benchmark period (days *t-45* to *t-11* and days *t+11* to *t+45* relative to the day of the analyst recommendation change). *Day 0* is the day the analyst recommendation change is released if before 4:00 pm on a trading day, else the next trading day. *Day -4 to -1* (*Day +1 to +4*) reflects days -4 to -1 (+1 to +4), with abnormal imbalance calculated as the sum of the daily abnormal imbalances over the four days. *All-star analyst* is an indicator variable that is equal to one if the analyst making the recommendation change is ranked as an all-star analyst by Institutional Investor in the prior year, else zero; *Small firm (Large firm)* is an indicator variable that is equal to one if the firm is in the smallest (largest) firm-size quartile, else zero; *High institutional ownership (Low institutional ownership)* is an indicator variable that is equal to one if the firm is in the highest (lowest) insitutional ownership percentage quartile as of the previous quarter-end, else zero; and *High volatility* (*Low volatility*) is an indicator variable that is equal to one if the firm is in the highest (lowest) volatility quartile as of the previous quarter-end, else zero. Parameter estimates are reported in basis points, and *t*-statistics (in parentheses below parameter estimates) are based on standard errors that are double-clustered on stock and date.

Panel A: Analyst upgrades			
Dependent Variable	Institutional Trade Imbalance		
	(1) Day -4 to -1	(2) Day 0	(3) Day +1 to +4
Intercept	1.931	-0.620	0.773
	(3.6)	*(-2.5)*	*(1.6)*
All-star analyst	1.429	0.200	1.353
	(1.9)	*(0.6)*	*(2.0)*
Small firm	1.853	-1.038	-1.242
	(2.3)	*(-2.8)*	*(-1.8)*
Large firm	-1.486	0.359	-0.741
	(-2.4)	*(1.2)*	*(-1.3)*
High institutional ownership	1.770	-0.955	0.849
	(2.7)	*(-3.1)*	*(1.4)*
Low institutional ownership	-0.385	-0.432	-0.993
	(-0.5)	*(-1.3)*	*(-1.6)*
High volatility	-1.158	0.577	1.426
	(-1.7)	*(1.9)*	*(2.4)*
Low volatility	-0.038	0.121	0.287
	(-0.1)	*(0.4)*	*(0.5)*
# Observations	15,101	15,101	15,101

Panel B: Analyst downgrades			
Dependent Variable	Institutional Trade Imbalance		
	(1)	(2)	(3)
	Day -4 to -1	Day 0	Day +1 to +4
Intercept	-1.562	0.612	1.402
	(-2.4)	*(1.8)*	*(2.1)*
All-star analyst	-0.907	-0.701	-2.475
	(-1.0)	*(-1.5)*	*(-2.7)*
Small firm	-2.427	0.788	-1.116
	(-2.6)	*(1.7)*	*(-1.2)*
Large firm	0.840	-0.238	-0.387
	(1.1)	*(-0.6)*	*(-0.5)*
High institutional ownership	-2.563	1.309	-0.029
	(-3.1)	*(3.2)*	*(0.0)*
Low institutional ownership	1.578	0.644	0.236
	(1.9)	*(1.5)*	*(0.3)*
High volatility	1.717	-1.231	-1.548
	(2.1)	*(-3.0)*	*(-1.9)*
Low volatility	-1.199	0.023	0.762
	(-1.4)	*(0.1)*	*(0.9)*
# Observations	15,907	15,907	15,907

Table 5: Regressions of institutional abnormal trade imbalances on returns

This table presents regression analyses of abnormal trade imbalances in the days prior to analyst upgrades (Panel A) and downgrades (Panel B). The dependent variable is abnormal trade imbalance for institutional traders. Abnormal imbalance per day is defined as shares bought minus sold, scaled by shares outstanding, minus average daily shares bought minus shares sold, scaled by shares outstanding, during the benchmark period (days *t-45* to *t-11* and days *t+11* to *t+45* relative to the day of the analyst recommendation change). *Day 0* is the day the analyst recommendation change is released if before 4:00 pm on a trading day, else the next trading day. *Day -4 to -1* reflects days -4 to -1, with abnormal imbalance calculated as the sum of the daily abnormal imbalances over the four days. *Return day 0* is the abnormal return for the stock on the day of the analyst recommendation change. Parameter estimates are reported in basis points, and *t*-statistics (in parentheses below parameter estimates) are based on standard errors that are double-clustered on stock and date.

Panel A: Analyst upgrades

Dependent Variable	Institutional Trade Imbalance
	Day -4 to -1
Intercept	1.627
	(5.6)
Return day 0	21.480
	(3.7)
# Observations	15,101

Panel B: Analyst downgrades

Dependent Variable	Institutional Trade Imbalance
	Day -4 to -1
Intercept	-1.021
	(-2.9)
Return day 0	17.748
	(2.8)
# Observations	15,907

Table 6: Analysis of abnormal volume surrounding placebo dates

This table presents univariate analyses of abnormal trading volumes in the days surrounding earnings announcement days with returns similar to upgrade days (Panel A) and downgrade days (Panel B). The dependent variable is abnormal trading volume for institutional (three left columns) or individual (three center columns) traders. Abnormal volume per day is defined as daily shares bought plus shares sold, scaled by shares outstanding, minus average daily shares bought plus shares sold, scaled by shares outstanding, during the benchmark period (days *t-45* to *t-11* and days *t+11* to *t+45* relative to the day of the analyst recommendation change). *Day 0* is the day the earnings announcement is released if the announcement is made before 4:00 pm on a trading day, else the next trading day. *Day -4 to -1* (*Day +1 to +4*) reflects days -4 to -1 (+1 to +4), with abnormal volume calculated as the sum of the daily abnormal volumes over the four days. Parameter estimates are reported in basis points, and *t*-statistics (in parentheses below parameter estimates) are based on standard errors that are double-clustered on stock and date.

Panel A: Placebo positive-return days

Dependent Variable	Institutional Volume			Individual Volume			Institutional - Individual Difference		
	(1)	(2)	(3)	(4)	(5)	(6)			
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	112.535	98.782	149.621	2.861	2.759	4.313	109.674	96.022	145.308
	(16.8)	*(23.7)*	*(20.7)*	*(10.0)*	*(16.0)*	*(14.6)*	*(16.7)*	*(23.5)*	*(20.5)*
# Observations	12,444	12,444	12,444	12,444	12,444	12,444			
	Actual - Placebo Difference								
Actual - Placebo	-69.811	-67.099	-121.256	-2.394	-1.737	-3.415			
	(-10.2)	*(-15.1)*	*(-16.6)*	*(-6.3)*	*(-8.3)*	*(-9.2)*			

Panel B: Placebo negative-return days

Dependent Variable	Institutional Volume			Individual Volume			Institutional - Individual Difference		
	(1)	(2)	(3)	(4)	(5)	(6)			
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	109.543	104.358	164.091	2.773	2.660	4.817	106.770	101.698	159.274
	(18.2)	*(25.0)*	*(24.0)*	*(10.3)*	*(17.8)*	*(12.7)*	*(18.1)*	*(24.8)*	*(23.8)*
# Observations	13,487	13,487	13,487	13,487	13,487	13,487			
	Actual - Placebo Difference								
Actual - Placebo	-61.926	-66.734	-126.657	-2.192	-1.291	-3.091			
	(-9.5)	*(-16.2)*	*(-18.1)*	*(-4.9)*	*(-5.4)*	*(-5.5)*			

Table 7: Analysis of abnormal trade imbalance surrounding placebo dates

This table presents univariate analyses of abnormal trade imbalances in the days surrounding earnings announcements with returns similar to upgrade days (Panel A) and downgrade days (Panel B). The dependent variable is abnormal trade imbalance for institutional (three left columns) or individual (three center columns) traders. Abnormal imbalance per day is defined as shares bought minus sold, scaled by shares outstanding, minus average daily shares bought minus shares sold, scaled by shares outstanding, during the benchmark period (days *t-45* to *t-11* and days *t+11* to *t+45* relative to the day of the analyst recommendation change). *Day 0* is the day the earnings announcement is released if the announcement is made before 4:00 pm on a trading day, else the next trading day. *Day -4 to -1* (*Day +1 to +4*) reflects days -4 to -1 (+1 to +4), with abnormal imbalance calculated as the sum of the daily abnormal imbalances over the four days. Parameter estimates are reported in basis points, and *t*-statistics (in parentheses below parameter estimates) are based on standard errors that are double-clustered on stock and date.

Panel A: Placebo positive-return days

Dependent Variable	Institutional Trade Imbalance			Individual Trade Imbalance			Institutional - Individual Difference		
	(1)	(2)	(3)	(4)	(5)	(6)			
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	-0.413	0.848	1.974	0.036	-0.115	-0.266	-0.449	0.963	2.240
	(-0.9)	*(3.2)*	*(4.0)*	*(0.3)*	*(-1.3)*	*(-1.8)*	*(-1.0)*	*(3.5)*	*(4.4)*
# Observations	12,444	12,444	12,444	12,444	12,444	12,444			
	Actual - Placebo Difference								
Actual - Placebo	1.956	-1.297	-1.613	-0.119	0.192	0.392			
	(4.0)	*(-4.7)*	*(-3.1)*	*(-0.8)*	*(2.1)*	*(2.4)*			

Panel B: Placebo negative-return days

Dependent Variable	Institutional Trade Imbalance			Individual Trade Imbalance			Institutional - Individual Difference		
	(1)	(2)	(3)	(4)	(5)	(6)			
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	0.574	-0.973	0.803	0.064	-0.050	-0.207	0.510	-0.923	1.011
	(1.4)	*(-3.8)*	*(1.7)*	*(0.5)*	*(-0.8)*	*(-1.3)*	*(1.2)*	*(-3.5)*	*(2.0)*
# Observations	13,487	13,487	13,487	13,487	13,487	13,487			
	Actual - Placebo Difference								
Actual - Placebo	-1.920	1.266	-0.334	0.080	0.042	0.078			
	(-3.7)	*(4.3)*	*(-0.6)*	*(0.5)*	*(0.5)*	*(0.4)*			

Table 8: Univariate regressions of abnormal program trade and market maker imbalance surrounding analyst recommendation changes

This table presents univariate analyses of abnormal trade imbalances in the days surrounding analyst upgrades (Panel A) and downgrades (Panel B). The dependent variable is abnormal trade imbalance for institutional program trades (three left columns) and market makers (three right columns). Abnormal imbalance per day is defined as shares bought minus sold, scaled by shares outstanding, minus average daily shares bought minus shares sold, scaled by shares outstanding, during the benchmark period (days *t-45* to *t-11* and days *t+11* to *t+45* relative to the day of the analyst recommendation change). *Day 0* is the day the analyst recommendation change is released if before 4:00 pm on a trading day, else the next trading day. *Day -4 to -1* (*Day +1 to +4*) reflects days -4 to -1 (+1 to +4), with abnormal imbalance calculated as the sum of the daily abnormal imbalances over the four days. Parameter estimates are reported in basis points, and *t*-statistics (in parentheses below parameter estimates) are based on standard errors that are double-clustered on stock and date.

Panel A: Analyst upgrades						
Dependent Variable	Program Trade Imbalance			Market Maker Imbalance		
	(1)	(2)	(3)	(4)	(5)	(6)
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	-1.200	0.512	-0.732	-0.261	-0.140	0.246
	(-5.9)	*(5.5)*	*(-3.3)*	*(-1.5)*	*(-1.6)*	*(1.5)*
# Observations	15,101	15,101	15,101	15,101	15,101	15,101

Panel B: Analyst downgrades						
Dependent Variable	Program Trade Imbalance			Market Maker Imbalance		
	(1)	(2)	(3)	(4)	(5)	(6)
	Day -4 to -1	Day 0	Day +1 to +4	Day -4 to -1	Day 0	Day +1 to +4
Intercept	0.888	-0.198	0.020	0.313	-0.087	-0.361
	(4.4)	*(-2.0)*	*(0.1)*	*(1.4)*	*(-0.7)*	*(-1.6)*
# Observations	15,907	15,907	15,907	15,907	15,907	15,907

Figure 1: Volume surrounding analyst upgrades

Daily *Raw Trading Volume* for each stock is defined as trader-type volume scaled by shares outstanding in thousands. Daily *Abnormal Trading Volume* for each stock is equal to Raw Trading Volume minus trader-type Benchmark Trading Volume, measured over the period from -45 to -11 and +11 to +45 days relative to each analyst recommendation change. Graphs depict averages across 15,101 analyst upgrades from March 10, 1999 to April 22, 2010.

Figure 1-A: Upgrades -45 days to +45 days

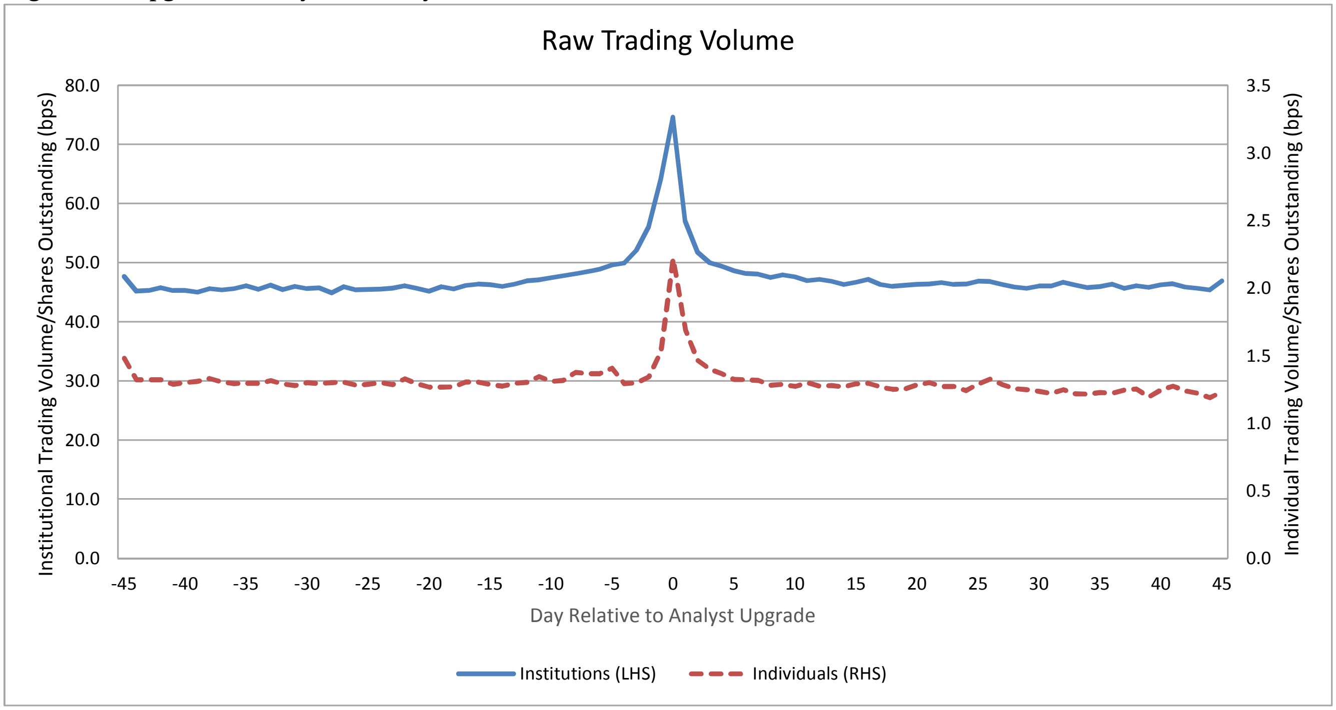


Figure 1-B: Upgrades -5 days to +5 days

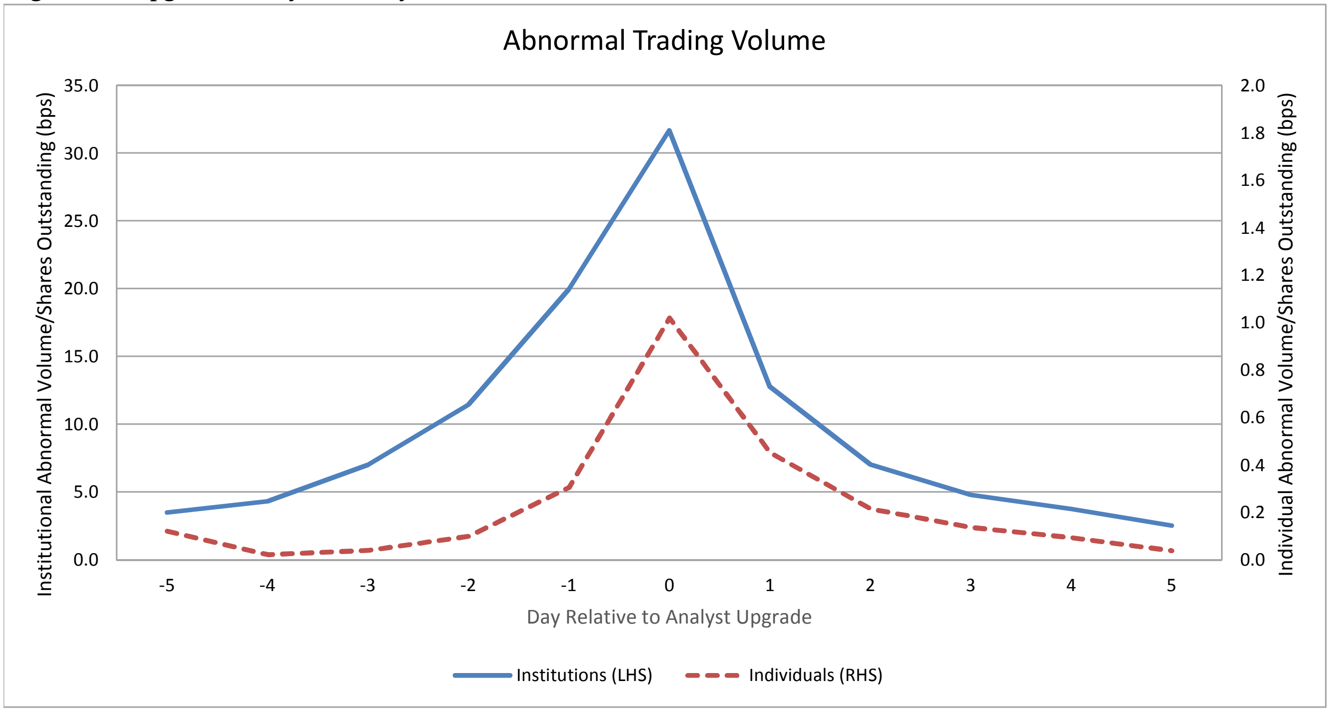


Figure 2: Volume surrounding analyst downgrades

Daily *Raw Trading Volume* for each stock is defined as trader-type volume scaled by shares outstanding in thousands. Daily *Abnormal Trading Volume* for each stock is equal to Raw Trading Volume minus trader-type Benchmark Trading Volume, measured over the period from -45 to -11 and +11 to +45 days relative to each analyst recommendation change. Graphs depict averages across 15,907 analyst downgrades from March 10, 1999 to April 22, 2010.

Figure 2-A: Downgrades -45 days to +45 days

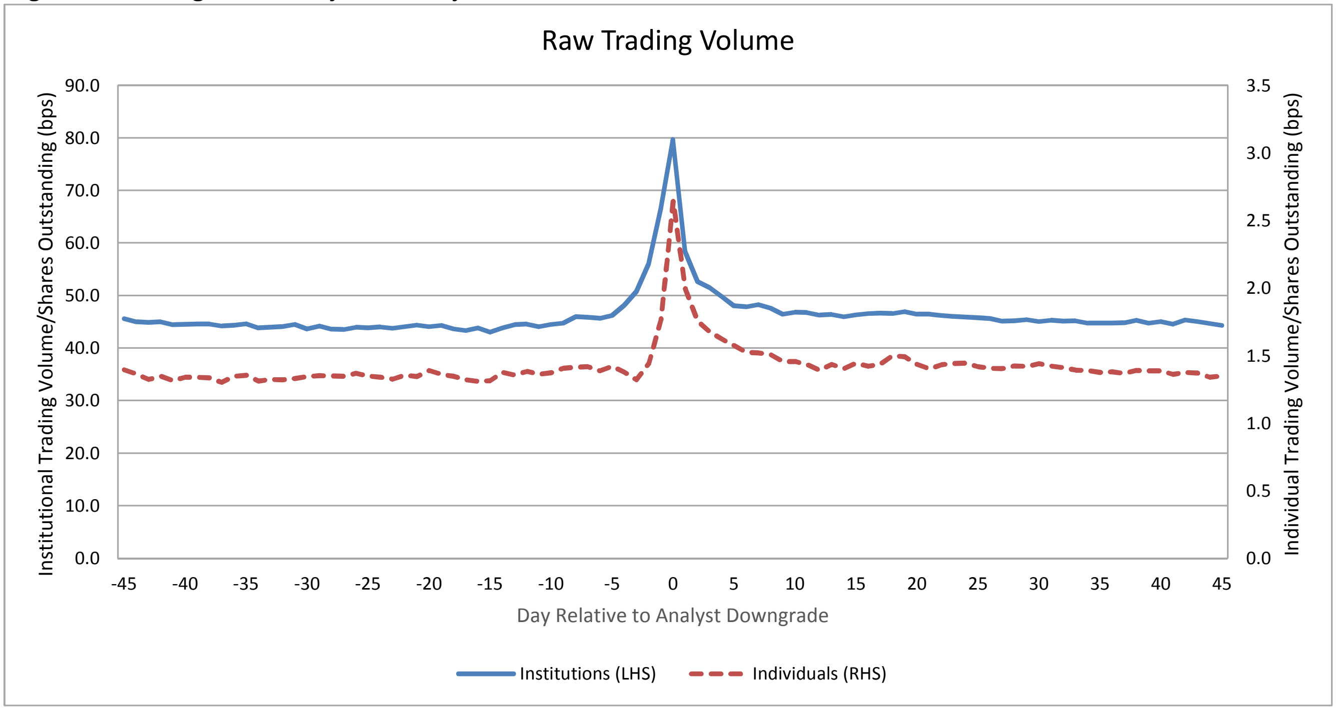


Figure 2-B: Downgrades -5 days to +5 days

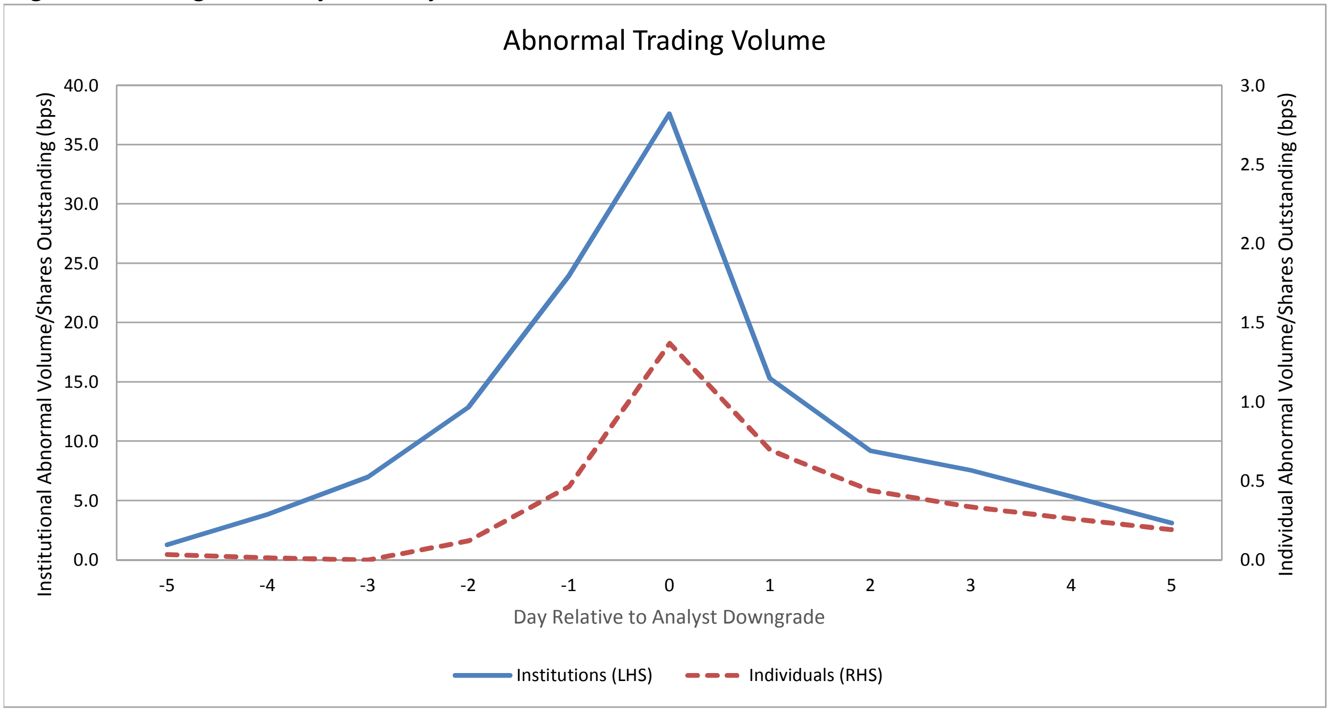


Figure 3: Imbalance surrounding analyst upgrades

Daily *Raw Trade Imbalance* for each stock is defined as trader-type shares bought minus sold, scaled by shares outstanding in thousands. Daily *Abnormal Trade Imbalance* for each stock is equal to Raw Trade Imbalance minus trader-type Benchmark Trade Imbalance, measured over the period from -45 to -11 and +11 to +45 days relative to each analyst recommendation change. Graphs depict averages across 15,101 analyst upgrades from March 10, 1999 to April 22, 2010.

Figure 3-A: Upgrades -45 days to +45 days

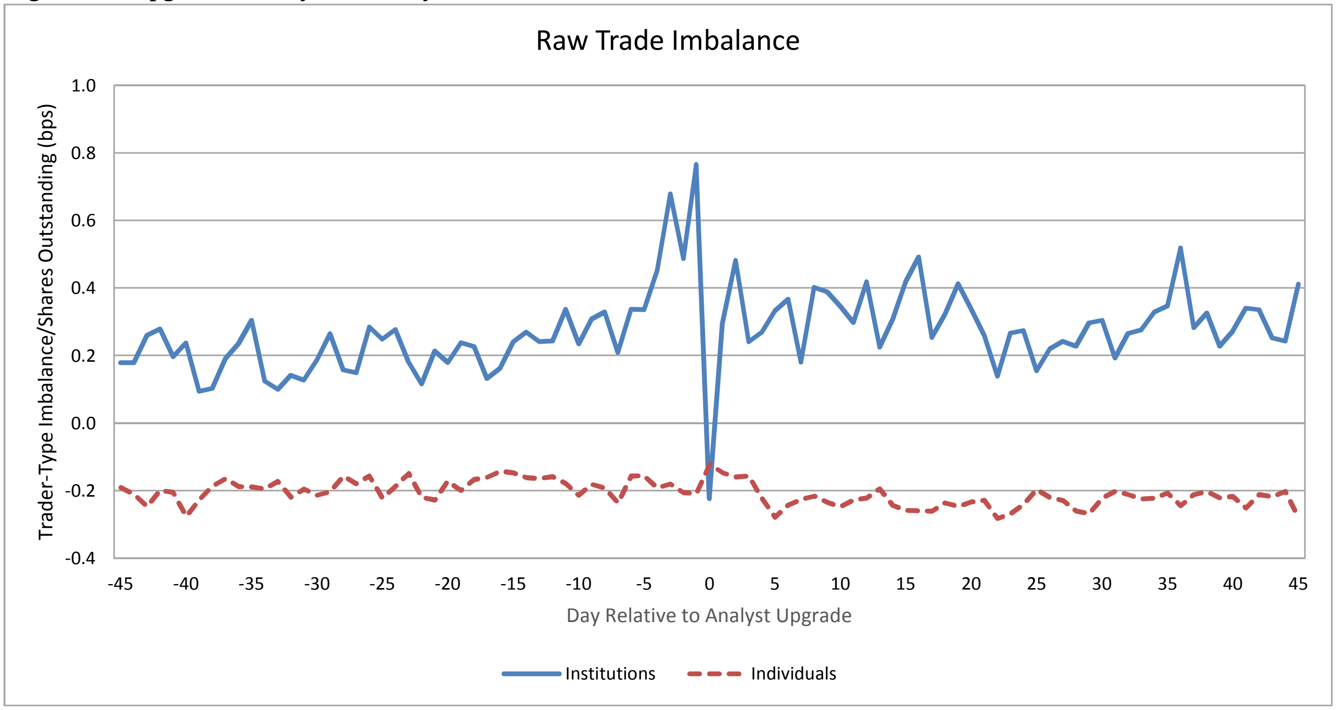


Figure 3-B: Upgrades -5 days to +5 days

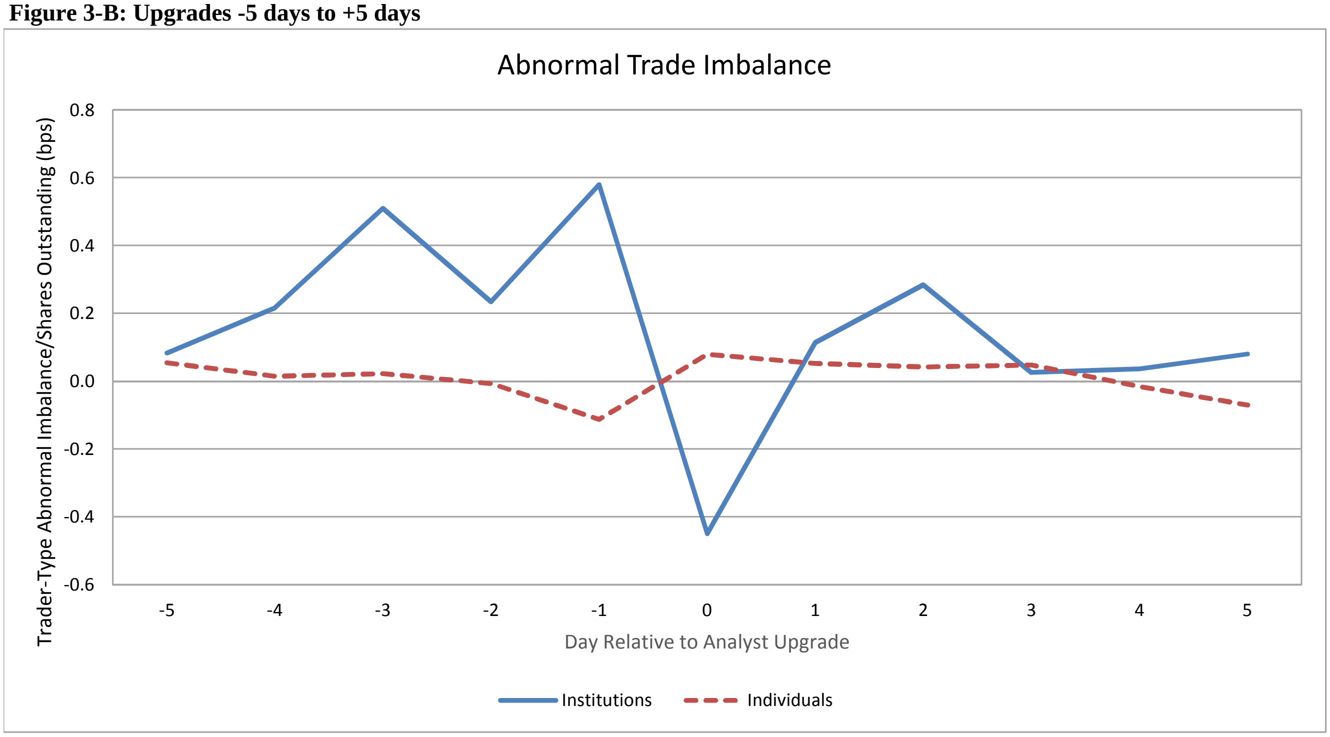


Figure 4: Imbalance surrounding analyst downgrades

Daily *Raw Trade Imbalance* for each stock is defined as trader-type shares bought minus sold, scaled by shares outstanding in thousands. Daily *Abnormal Trade Imbalance* for each stock is equal to Raw Trade Imbalance minus trader-type Benchmark Trade Imbalance, measured over the period from -45 to -11 and +11 to +45 days relative to each analyst recommendation change. Graphs depict averages across 15,907 analyst downgrades from March 10, 1999 to April 22, 2010.

Figure 4-A: Downgrades -45 days to +45 days

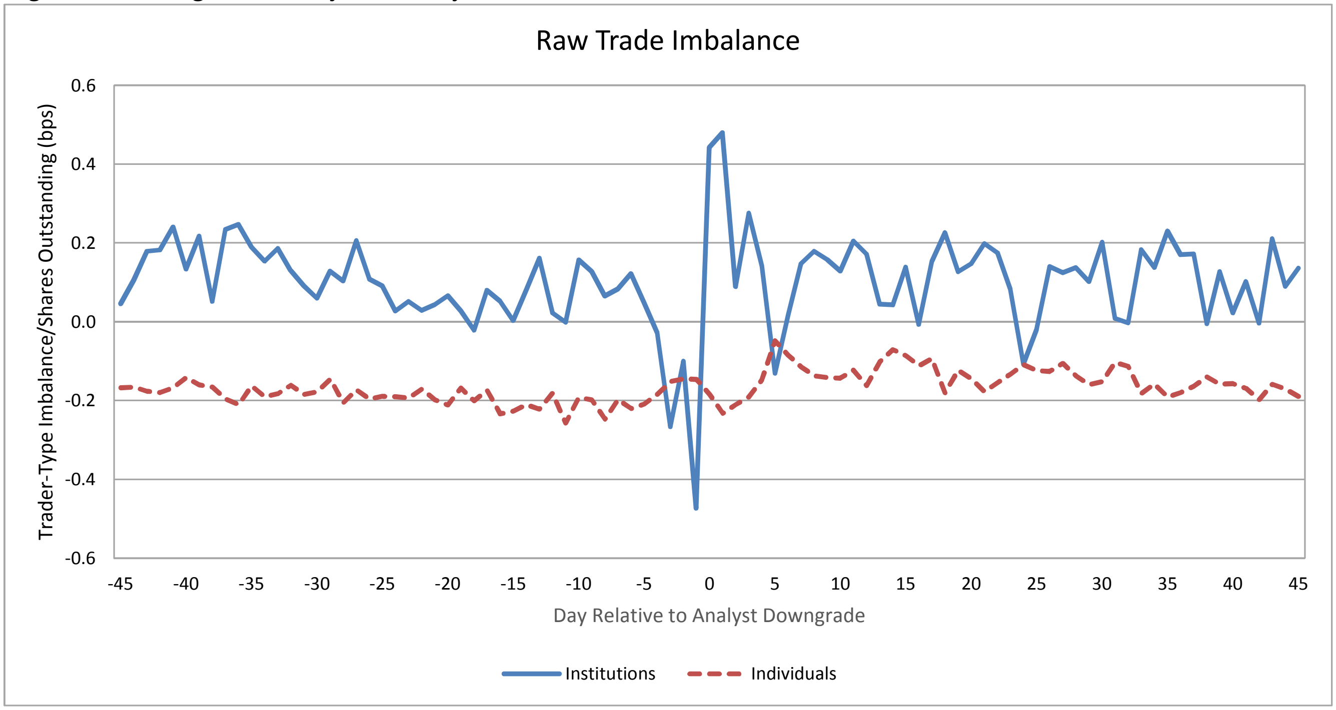


Figure 4-B: Downgrades -5 days to +5 days

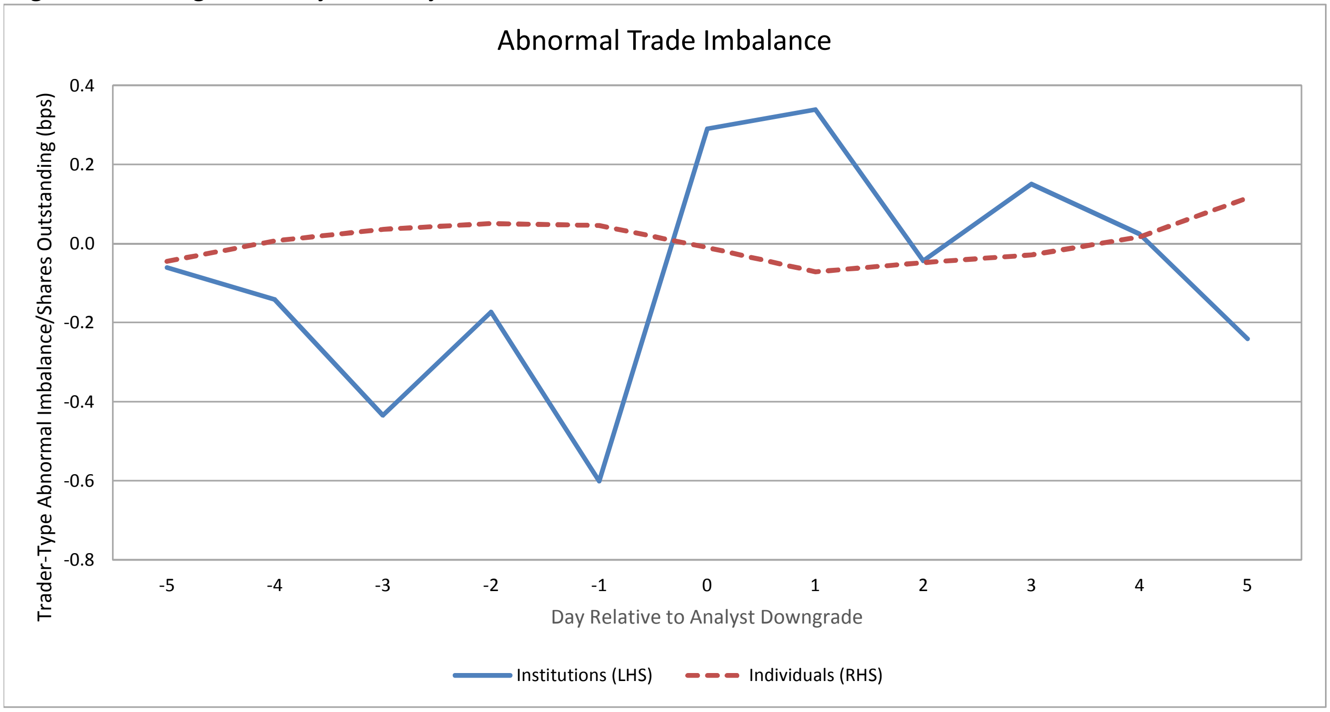
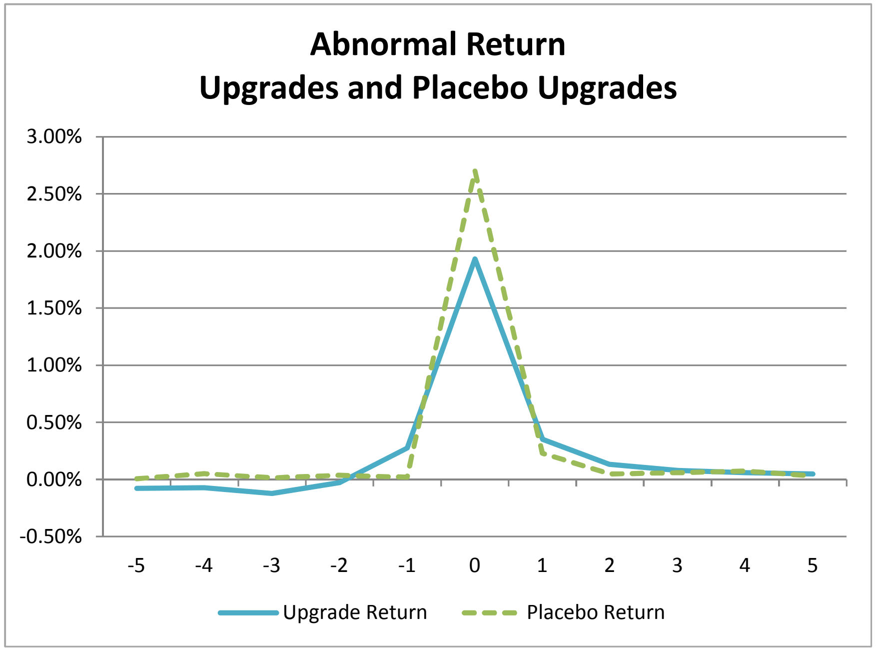


Figure 5: Abnormal returns surrounding analyst recommendation changes and placebo events (earnings announcements)

Graphs depict average abnormal returns across analyst upgrades and placebo upgrades (left graph) and analyst downgrades and placebo downgrades (right graph) from March 10, 1999 to April 22, 2010. For each analyst recommendation change, the placebo event is defined as the earnings announcement day on which the same stock has the closest abnormal return to the stock's abnormal return on the day of the analyst recommendation change. Days within *t-4* to *t+4* of analyst recommendation changes are excluded, and placebo events are chosen without replacement.



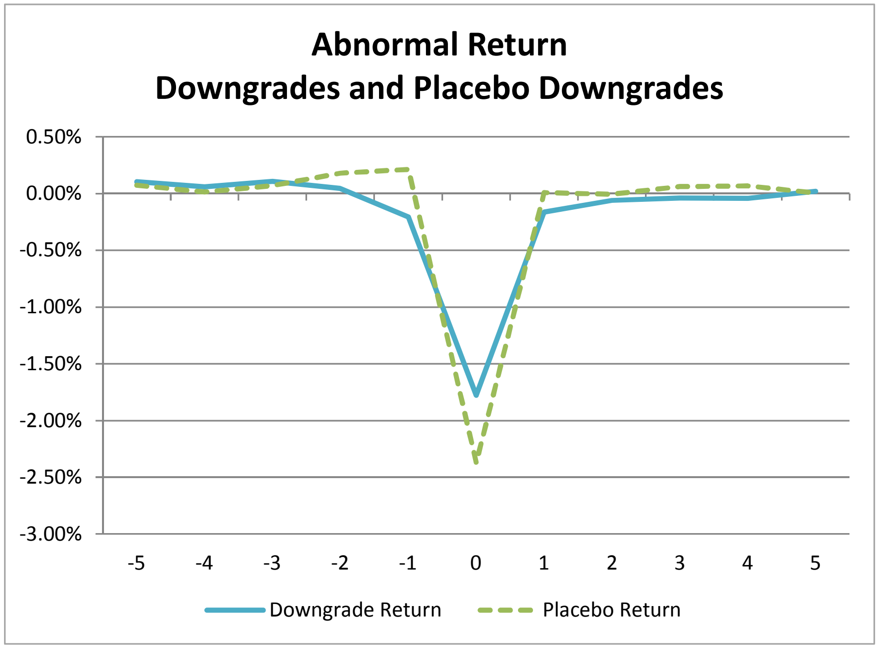


Figure 6: Abnormal trading volume surrounding analyst recommendation changes and placebo events (earnings announcements)

Graphs depict average *Abnormal Trading Volume* for institutional investors (top graphs) and individual investors (bottom graphs) across analyst upgrades and placebo upgrades (left graphs) and analyst downgrades and placebo downgrades (right graphs) from March 10, 1999 to April 22, 2010. For each analyst recommendation change, the placebo event is defined as the earnings announcement day on which the same stock has the closest abnormal return to the stock's abnormal return on the day of the analyst recommendation change. Days within *t-4* to *t+4* of analyst recommendation changes are excluded, and placebo events are chosen without replacement. Daily *Abnormal Trading Volume* for each stock is equal to Raw Trading Volume minus trader-type Benchmark Trading Volume, measured over the period from -45 to -11 and +11 to +45 days relative to each analyst recommendation change or placebo event.

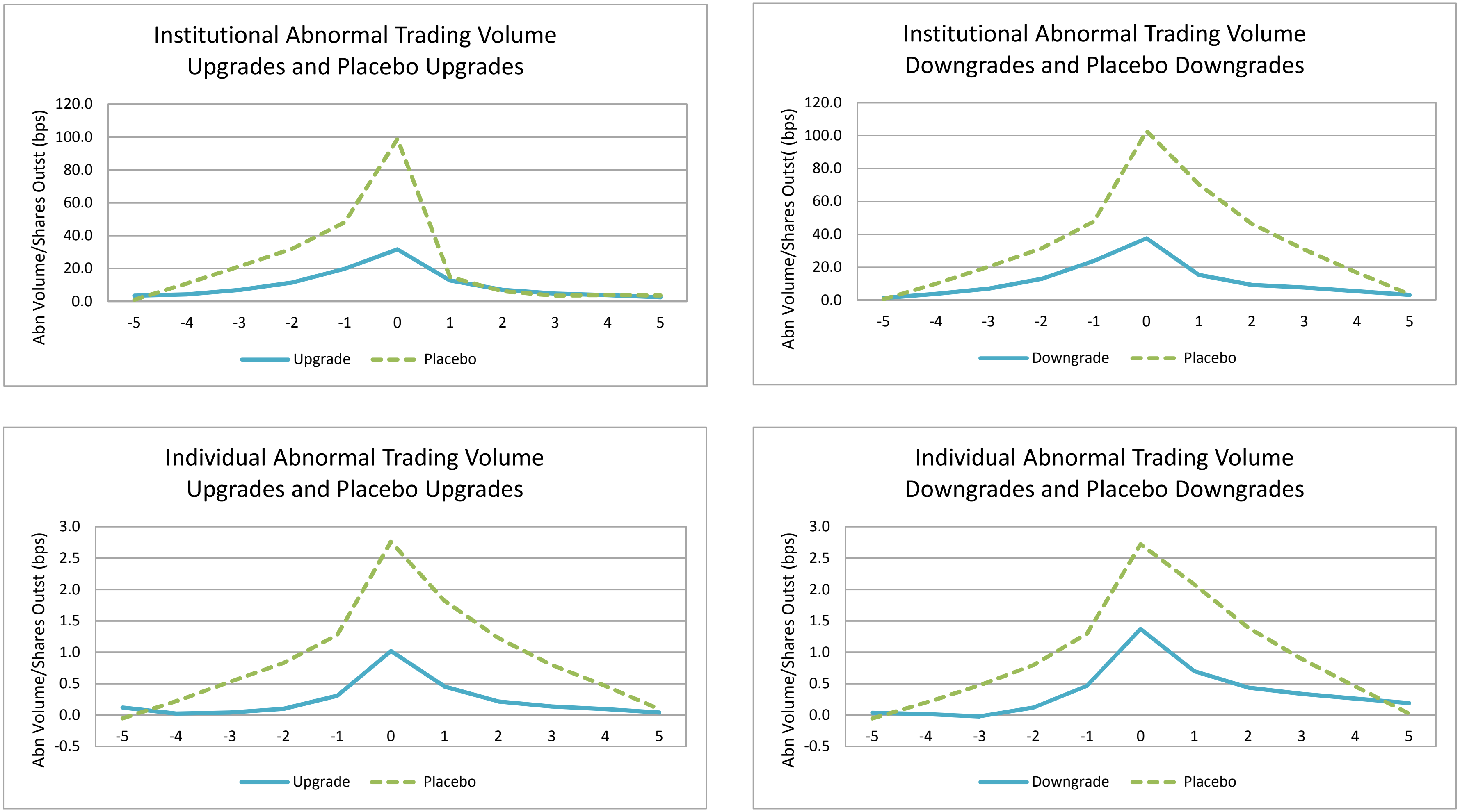


Figure 7: Abnormal trade imbalance surrounding analyst recommendation changes and placebo events (earnings announcements)

Graphs depict average *Abnormal Trade Imbalance* for institutional investors (top graphs) and individual investors (bottom graphs) across analyst upgrades and placebo upgrades (left graphs) and analyst downgrades and placebo downgrades (right graphs) from March 10, 1999 to April 22, 2010. For each analyst recommendation change, the placebo event is defined as the earnings announcement day on which the same stock has the closest abnormal return to the stock's abnormal return on the day of the analyst recommendation change. Days within *t-4* to *t+4* of analyst recommendation changes are excluded, and placebo events are chosen without replacement. Daily *Abnormal Trade Imbalance* for each stock is equal to Raw Trade Imbalance minus trader-type Benchmark Trade Imbalance, measured over the period from -45 to -11 and +11 to +45 days relative to each analyst recommendation change or placebo event.