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HEDGE FUNDS AND SELL-SIDE RESEARCH: THE EFFECT OF HEDGE FUNDS' STOCK POSITIONS ON ANALYSTS' RECOMMENDATIONS

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ABSTRACT

This study examines whether sell-side research analysts help hedge fund managers by maintaining optimistic (or pessimistic) recommendations when hedge fund managers have large long (or short) positions and by delaying their recommendation revisions when hedge fund managers are unwinding their positions. The SEC and the financial press have raised concerns about pressure on analysts from institutional clients to express views in line with clients' positions in their recommendations. Of analysts' institutional clients, hedge fund managers are the most important to analysts because of the large commissions hedge funds generate. If these lucrative clients pressure analysts, I expect that it would be difficult for analysts to remain independent. My results reveal that, after controlling for future earnings surprises, analysts' recommendations are likely either Buy or Strong Buy when hedge funds have large long positions. I also find that those optimistic recommendations for stocks in which hedge funds have large long positions have negative future returns, indicating that those optimistic recommendations are overly optimistic.

I argue that the recommendations for stocks in which hedge funds have large long positions lead to negative returns because analysts do not downgrade their recommendations in a timely manner when their profitable clients sell these stocks. Consistent with this argument, further analysis shows that hedge fund managers start selling their stocks when analysts' recommendations are optimistic and that analysts downgrade their recommendations after hedge fund managers sell stocks. Cross-sectional analysis uncovers that compared to other analysts, analysts at top ten prime brokers such as Goldman Sachs, Bear Sterns, and Lehman Brothers are

almost 40% more likely to downgrade their recommendations in the quarters following stock sales by the 100 largest hedge funds.

TABLE OF CONTENTS

LIST OF TABLES

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1. Introduction

From 2000 to 2006, the number of hedge funds and their assets more than doubled to 8,661 and to $1.1 trillion, respectively (Sasseen and Borrus [2006]). The growth of hedge funds benefits sell-side analysts because actively trading hedge fund managers generate larger trading commissions than any other investors. Their trading volume accounts for 40 to 50 percent of the daily trading volume in the U.S. stock markets although the total assets of the funds represent just 5 percent of the U.S. assets under management (Abramowitz [2005]; Cox [2006]).[1] Since the Global Settlement in 2003, which prohibited any compensation to sell-side analysts from investment banking divisions, hedge fund trading commissions have been even more important to sell-side research departments because commissions are their only source of revenue.[2]

In addition to generating large commissions, the increase in the number of hedge funds has brought with it a structural change in the revenue sources of the Wall Street brokerage houses for which many analysts work. This change has arisen through the relationship between hedge funds and prime brokers – brokers who provide credit to funds, capital introduction services, and security lending services to hedge funds (SEC [2003]). The recent increase in the number of hedge funds has caused prime brokerage services to become one of the brokerage industry's main revenue sources.[3] As such, hedge fund managers do not just pay commissions but also pay interest and fees for other services to brokers.[4] Due to hedge funds' growing

[1] Vickers [2003] reports, for instance, that SAC Capital, one of the largest hedge funds in the U.S., accounts for as much as 3 percent of the New York Stock Exchange's average daily trading. A survey by Greenwich Associates [2006] places stock-trading commissions from the average hedge fund at $33 million a year while a mutual fund or equivalent investment manager pays $16 million (Onaran [2007]).

[2] The settlement enforced on April 2003 was intended to eliminate the pressure from a bank's investment banking division upon its research division.

[3] These services generate approximately $10 billion in annual revenue (O'Leary [2007]).

[4] According to Groysberg, Healy and Maber [2008], a broker's firm-wide profit is an important determinant of the compensation of the broker's analysts. Thus, the more a broker makes revenue from its prime brokerage services, the greater the bonus of the analysts who work for the broker would be.

importance to sell-side research analysts, several recent financial press articles claim that the whole sell-side research community caters to these lucrative clients (Onaran [2007]; Abramowitz [2005]; Schack [2006]).

In her testimony in 2001 before the House Subcommittee on Capital Markets, Insurance, and Government Sponsored Enterprises, Laura Unger, Acting Chairman of the SEC, warned of the pressure that analysts face from their institutional clients (Unger [2001]). She suggested that analysts would not downgrade the stocks their clients hold for fear of losing business.[5] If pressure from institutional investors exists, analysts would be especially susceptible to pressure from hedge fund managers because these managers are analysts' most lucrative clients. Also, since the Global Settlement, analysts are more likely to be susceptible to pressure because they make their livings through commission revenue. Motivated by concerns expressed by the SEC and the financial press about pressure from institutional investors and the growing importance of hedge funds to analysts, my study analyzes whether sell-side research analysts help hedge fund managers by maintaining optimistic (or pessimistic) recommendations when hedge fund managers have large long (or short) positions and by delaying their recommendation revisions when hedge fund managers are unwinding their positions.[6]

I first investigate the validity of Laura Unger's comment in her 2001 testimony that analysts are not likely to downgrade the stocks their clients hold. If it is difficult for analysts to downgrade stocks in which hedge funds have large long positions, then analysts' consensus recommendations for the stocks (e.g., buy, hold, sell) will likely be optimistic. I expect that only

[5] A survey by Boni and Womack [2003] supports Unger's testimony. Approximately 70 percent of the 92 investment professionals surveyed rated pressure from institutional investors as a main motivation for sell-side analysts to hold positive views on the stocks their clients hold. Stephen Hash, director of U.S. equity research for Lehman Brothers in 2000, also states, "That's the great irony of our business. Portfolio managers don't want us to downgrade stocks" (Sargent [2000]).

[6] According to Vickers [2003] and an anonymous article in *The* Economist [2006], some analysts admit that their hedge fund clients push them to reflect the funds' views on their reports.

Buy or Strong buy recommendations will remain in the market for these stocks. Likewise, analysts' consensus recommendations will more likely be pessimistic when hedge funds have large short positions. After controlling for future earnings surprises, I find that hedge fund net positions (their long positions minus their short positions) at a given quarter have a significant and positive association with analysts' consensus recommendations in the next quarter.[7]

Next, I analyze the association between consensus recommendations and future three-month and six-month returns after a consensus measuring window.[8] I do this to determine whether the optimistic (or pessimistic) consensus recommendations for firms in which hedge funds have large long (or short) positions are overly optimistic (or overly pessimistic). My expectation is that if analysts do not downgrade their recommendations in a timely manner due to pressure from hedge fund managers, overly optimistic consensus recommendations will lead to negative future returns. I find that the returns to the consensus recommendations are negative when hedge funds' long positions are high.[9] As an additional analysis, I collect firm-quarters with above-Buy recommendations, and check whether returns to the buy consensus recommendations vary depending on hedge funds' long positions. I find that three-month (or six-month) size-adjusted returns to the buy consensus are about 4% (6.6%) lower when hedge funds' long positions are in the top decile than when their long positions are in the bottom decile.

I conjecture that analysts' buy recommendations lead to negative returns because analysts hold their optimistic recommendations until hedge funds sell their stocks when facing bad news

[7] The holdings of institutional investors other than hedge funds, hereafter called other institutions, are also significantly associated with analysts' mean consensus recommendations, but the magnitude of the coefficient on other institutions in my model is significantly smaller than the coefficient on hedge funds' net positions.

[8] For example, if analysts' consensus recommendations are measured in the first quarter of 2004, I look at the association between the consensus recommendations and the returns after the first quarter.

[9] I do not find any evidence that hedge funds' short positions affect the returns to the consensus recommendations, suggesting that the pessimistic consensus recommendations that accompany large short positions are not overly pessimistic. In the empirical results section, I conjecture why hedge fund short positions do not lead to overly pessimistic recommendations.

about the stocks. For this conjecture to hold, two things should occur: hedge funds should sell their stocks while analysts' recommendations are optimistic (above-Buy) and analysts should downgrade their recommendations after hedge funds sell stocks. As expected, I find that hedge fund managers sell their stocks and increase their short positions when analysts' consensus recommendations are optimistic.[10] Further analysis reveals that hedge funds' position changes at a given quarter are positively associated with analysts' recommendation revisions in the next quarter. I do not find any evidence that analysts' recommendation revisions at a given quarter are significantly associated with the same quarters' hedge fund position changes.

However, two alternative explanations to the pressuring scenario discussed above might exist. Hedge fund managers are considered the most sophisticated investors in the market. Thus, one alternative explanation is that analysts infer information from hedge funds' position changes and revise their recommendations accordingly, hereafter called the signaling scenario. Second, while analysts and hedge fund managers can chase after the same information, hedge funds might acquire it earlier than analysts and trade before analysts revise their recommendations; this explanation will hereafter be called the superiority scenario. If analysts are rational, they would follow hedge funds' position changes only when hedge funds' position changes are related to future returns. I check whether hedge fund position changes are positively related to future returns, and I do not find evidence for this relationship. Also, if the change in hedge funds' positions has provided a valid signal historically, other market participants would follow the signal as analysts do. Yet I do not find any evidence that other institutional investors follow the changes in hedge funds' positions. These two results show that the signaling scenario is an

[10] In the main analysis discussed earlier, I examine the association between hedge funds' net positions at a given quarter and analysts' consensus recommendations in the next quarter. In examining hedge funds' trades when analysts' recommendations are optimistic, I use the same quarter variables. That is, when analysts' recommendations are optimistic at a given quarter, I investigate how hedge fund managers trade in the same quarter.

unlikely explanation for my findings. To address the superiority scenario, I investigate whether analysts' recommendation revisions are related to future returns to examine analysts' ability to find mispriced securities. Analysts' recommendation revisions have a positive and significant association with future returns, indicating that analysts are able to find mispriced securities. Further analysis reveals that it is more experienced senior analysts who downgrade their recommendations after the sales of hedge funds. Less experienced junior analysts are more likely to downgrade their recommendations in the same quarters that hedge fund managers sell stocks. Since I find that hedge funds' position changes are not related to future returns, it is hard to believe that hedge fund managers are smarter than those more experienced senior analysts, suggesting that the superiority scenario is an unlikely explanation for my study's findings.

I also investigate whether changes in hedge funds' positions are associated with changes in earnings forecasts. Since earnings forecasts are inputs to analysts' valuation model, which produces analysts' recommendations, recommendation revisions that follow changes in hedge funds' positions for information reasons should be accompanied by changes in analysts' earnings forecasts. However, I do not find any evidence that hedge funds' stock positions or the change in their positions affect analysts' earnings forecasts, which makes signaling and superiority scenarios even less likely.

Finally, analysts who work for top 10 prime brokers have more incentives to help hedge fund managers than any other analysts because those hedge fund clients pay not only commissions but also fees for prime brokerage services such as interests for loans.[11] Also, the top 100 largest hedge funds are more important clients to analysts because they generate more trading commissions than any other hedge funds due to their size. I find that analysts at the top

[11] Those top 10 prime brokers are JPMorgan, Deutsche Bank, Goldman Sachs, Morgan Stanley, Merrill Lynch, CSFB, UBS, Lehman Brothers, Citigroup and Bear Stearns.

10 prime brokers are almost 40% more likely to downgrade their recommendations after the top 100 hedge funds' stock sales than other analysts. Since the change in the top 100 hedge funds' stock positions does not predict future returns at all, this cross-sectional analysis further supports my pressuring scenario.

My study adds to existing literature on sell-side analysts by examining the interaction between analysts and their most important clients, hedge funds. Prior research has examined the association between analysts and institutional investors in general. For example, Irvine, Lipson and Puckett [2007] find that analysts privilege their institutional clients with their newly initiated recommendations, giving institutional investors recommendations four or five days before making them publicly available. Ljungqvist, Marston, Starks, Wei and Yan [2007] examine the influence of institutional investors in general on sell-side research and document that analyst recommendations are less optimistic when institutional ownership of stocks is high. However, separating hedge fund clients from other clients is important in that the actions and motives of analysts might differ when they deal with their most lucrative clients.[12] Ljungqvist, Marston, Starks, Wei and Yan [2007] argue that institutional investors in general like unbiased research and because their commission is a source of sell-side research departments' revenues, the presence of institutional investors in stocks moderates analysts' conflict of interests that results from pressure on research divisions from other departments, such as investment banking divisions. The present study makes a contribution to existing research by showing that one group of analysts' institutional clients can actually create a conflict of interests for analysts rather

[12] Richard S. Drake, director of equity research at ABN Amro, expresses his view on the relationship between hedge funds and analysts: "[Wall Street] caters to the hedge funds and the high-turnover funds. It doesn't even cater to long-term-oriented institutions like us. We typically own a stock anywhere from three to five years. But the Street has to play to the paying customer, and the paying customer now is hedge funds and the hot money. We're not trading enough to make anyone rich" (Schack [2003]).

than moderating such a conflict. My study might also inform investors. When investors see that analysts' consensus recommendation on a stock is optimistic and hedge funds' long positions are high, they should be careful since the stock can have negative future returns.

The remainder of the paper is organized as follows: Section 2 develops two hypotheses; Section 3 explains the main variables and outlines the research design; Section 4 describes data collection for this study; Section 5 presents the results of my empirical analyses; finally, Section 6 concludes.

2. Hypothesis development

For hedge fund managers to pressure analysts effectively, they need to have a means of influencing analysts.[13] Hedge funds' commission allocation process is such a means, and explains how analysts can be susceptible to pressure from hedge fund managers. According to the Greenwich Associates survey of institutional investors, hedge funds use 60 brokers on average.[14] Portfolio managers in hedge funds participate in the broker voting process, which determines commission spending among the 60 brokers. If hundreds of portfolio managers worked on a hedge fund, one portfolio manager's voting power in the commission allocation process would be minimal. However, there are typically not many portfolio managers in a hedge

[13] Hedge funds managers must talk to analysts to pressure them. Regarding this issue, Groysberg, Healy and Maber [2008] find that one of the criteria for an analyst's performance assessment in her department is "the number of calls to clients" and "the number of one-on-one meetings with clients." I assume that if analysts are aware that the time spent in conversation is directly linked to their performance evaluations, analysts will spend a good deal of time talking to clients. Further, hedge fund managers seem to value personal conversation with analysts. Stefano Natella, global head of equity research at CSFB says, "hedge funds hate written products….they would rather spend two hours on the phone with our analysts" (Abramowitz [2005]).

[14] Conversation with a consultant at Greenwich Associates reveals that of the 60 brokers, hedge funds use the top 20 brokers most heavily and the top 20 brokers get the lion's share of commission payments.

fund – there are between six and ten unless the fund is especially large.[15] Hedge fund managers are likely to invest greater amounts of money through the brokers whose analysts provide helpful services. In this commission allocation process, analysts will be hesitant to revise their recommendations against their important clients' positions if such an action can hurt the clients' assets. Also, should analysts help hedge fund managers get out of their long (or short) positions safely by holding up (or down) their recommendations, this could be appreciated by hedge fund managers. The polls of brokerage houses' own sales representatives often serve to evaluate analysts (Groysberg, Healy and Maber [2008]). Sales forces compensated by trading commissions would not like analyst behaviors that upset their lucrative hedge fund clients, which likely makes analysts susceptible to pressure from hedge fund managers.[16]

While my study focuses on pressuring as the mechanism through which hedge fund managers gain the cooperation of sell-side analysts, analysts can simply help hedge fund managers because of their close connections. Pretorius and Shanahan [2008] document that a number of hedge fund managers are ex-employees of hedge funds' prime brokers and that sometimes the prime brokers have invested a significant amount of money in hedge funds. Additionally, hedge funds borrow money from their prime brokers in order to buy securities, which then serve as collateral for the loan (Wyderko [2006]). If a hedge fund that borrowed money from a broker defaults or the value of the collateral decreases, it can damage the broker.

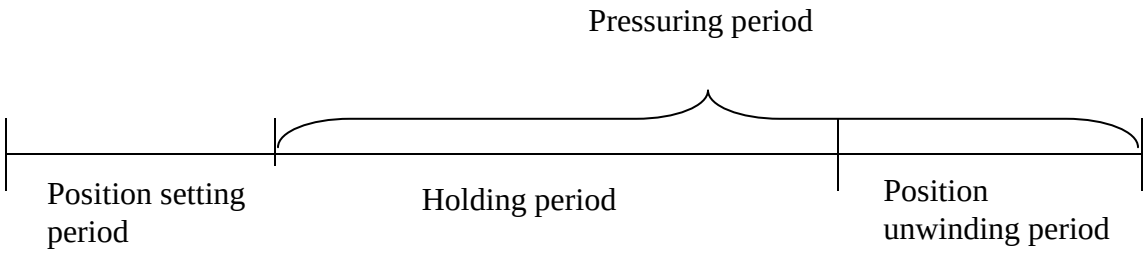
[15] Some advisors (holding companies) of hedge funds are registered with the SEC. If they are registered, they must fill out the ADV form. One of the questions on the form ADV is "Approximately how many of these *employees* perform investment advisory functions (including research)?" Most advisors check either "6-10" or "11-50." For example, AM Investment Partners LLC, whose discretionary asset worth is $651 million, checks "6-10." Large advisors whose discretionary asset worth is more than $1 billion tend to check "11-50".

[16] Hedge funds also have their own research analysts. According to Euroweek [2005] and Groysberg, Healy, Chapman, Shanthikumar and Gui [2007], most buy-side analysts cover about four or five times as many companies as sell-side analysts. Hence, buy-side analysts need support from sell-side analysts for a more detailed understanding of firms and industries (Field [2000]).

The brokers' enhanced risk resulting from loans to hedge funds indicates that hedge funds' interests are, to some extent, in line with those of brokers.

The following timeline describes in more detail my expectation about how pressure from hedge fund managers affects analysts' recommendations:

Figure1



Assume that a hedge fund manager buys a stock and starts pressuring analysts to upgrade their recommendations. If analysts succumb to the pressure, they will upgrade their recommendations. If the hedge fund manager buys an undervalued stock and pressures analysts to reflect her view in their reports, pressure from the hedge fund manager would not necessarily lead to overly optimistic recommendations as long as the hedge fund manager's view is correct. However, if the hedge fund manager keeps pressuring analysts when she is selling her shares, analysts' recommendations can be overly optimistic because the recommendations would not reflect the reasons why she is selling in a timely manner. Because optimistic recommendations can help hedge fund managers exit their positions at high prices, hedge fund managers have an incentive to push analysts not to downgrade stocks when they sell their shares. The above scenario is based on hedge funds in long positions, but I expect hedge fund managers in short positions to pressure analysts as well. I use hedge funds' net positions (long – short) as the main measure of

hedge funds' influence in my analysis, since net positions determine the direction of pressure from hedge fund managers. However, I also examine the effects of hedge funds' long and short positions separately due to the possibility that long and short positions affect analysts' recommendations differently. One concern is that my proxy for hedge funds' short positions is noisy. There are no data that show hedge funds' short positions exactly. Thus, I use a firm's total short interest as a proxy for hedge funds' short positions. According to Williamson [2005], hedge funds' shorting only accounts for 40% of total market shorting in 2005.

To see the effect of hedge funds' net positions on analysts' overall recommendations, my study first investigates the association between hedge fund net positions in a firm at a given quarter and analysts' consensus recommendations in the next quarter, which are measured as the mean of all the analysts' most recent recommendations issued for a firm before the next quarter.[17] If analysts face pressure not to downgrade (or upgrade) stocks in which hedge funds have large net long (or short) positions and analysts succumb to the pressure, only recommendations in line with hedge fund positions will remain in the market or be newly issued after hedge funds establish large positions. Analysts' consensus recommendations would be optimistic when hedge funds have large net long positions and pessimistic when hedge funds have large net short positions. This reasoning leads to the following hypothesis (stated in alternative form):

H1: Hedge fund net positions are positively associated with analysts' consensus recommendations.

[17] For example, if analysts A, B, and C recommend Strong buy, Buy, and Hold in the first, second, and third quarters of a year, respectively, the analysts' consensus recommendation in the third quarter is Buy. This is how IBES calculates analysts' mean consensus recommendations.

If I find that the consensus recommendations are optimistic when hedge funds have large long positions and pessimistic when they have large short positions, I examine whether the optimistic (or pessimistic) consensus recommendations are overly optimistic (or overly pessimistic). I judge whether the mean consensus is overly optimistic or overly pessimistic by its association with future returns.[18] If the market is semi-strong efficient, neither optimistic nor pessimistic consensus recommendations in a quarter will have a significant association with future long-run returns after the quarter. However, if analysts do not downgrade (or upgrade) their recommendations due to pressure from hedge fund managers when the actual target prices in their minds are lower (or higher) than the current prices, analysts' optimistic (or pessimistic) consensus recommendations are followed by statistically significant negative (or positive) returns when hedge funds have large net long (or short) positions. Suppose that a stock's current price is $100 and an analyst's target price in her mind is $50. In such a case, the analyst is supposed to recommend "Sell." However, if the analyst is maintaining her previously issued "Buy" recommendation because of the pressure from hedge fund managers, the current "Buy" recommendation will lead to negative returns. Similarly, if analysts' consensus recommendations are overly pessimistic because hedge funds are pressuring analysts not to revise up their recommendations when hedge funds are unwinding their short positions, the pessimistic mean consensus will lead to positive future returns. This reasoning leads to my second hypothesis:

H2: Analysts' consensus recommendations for stocks in which hedge funds have large net long (or short) positions are followed by negative (or positive) future returns.

[18] As returns to analysts' mean consensus recommendations, I will use three and six month returns. This detail will be explained in the research design section.

3. Research design and variable measurement

In this section, I develop empirical models to examine the effect of hedge fund positions on analysts' recommendations. The test of my hypotheses requires the measure of hedge fund net positions (long – short). I calculate hedge fund long positions in a firm (H_LONG_{jt}) by summing the number of shares held by each hedge fund at a given quarter and scaling the sum by the number of shares outstanding at the end of the quarter. Since data for hedge funds' short positions is not available anywhere, I use the total short interest in a firm scaled by the number of shares outstanding at the end of a given quarter as a proxy for hedge fund short positions ($SHORT_{jt}$). Hedge funds' net position (H_NET_{jt}) in each quarter is the difference between hedge funds' long and short positions.

I first examine whether analysts' consensus recommendation ($MEAN\_REC_{jt+1}$) is positively associated with hedge fund net positions (H_NET_{jt}). IBES provides analysts' consensus recommendations each month, but the consensus includes stale recommendations. Hence, I compute the consensus recommendations with individual recommendations from the IBES Detail file, and confine the individual recommendations to those issued within a one-year window before a given quarter.[19] In examining the association between $MEAN\_REC_{ijt+1}$ and H_NET_{jt}, I control for several variables. First, I control for other institutional holdings ($OTHER\_INST_{jt}$) to account for possible pressure from other institutions. Second, Jegadeesh, Kim, Krische and Lee [2004] document that analysts generally recommend high volume stocks, high growth stocks, and stocks with positive momentum. Hence, I control for firm-specific average daily volume ($VOLUME_{jt}$) for six months preceding the end of quarter t, Book-to-market

[19] IBES codes recommendations as 1 (Strong buy), 2 (Buy), 3 (Hold), 4 (Market underperformance), and 5 Brown, Wei and Wermers]. The ordering is not necessarily intuitive because higher values represent more pessimistic recommendations. Thus, I reverse the order so that higher values represent more optimistic recommendations. In my sample, 5 is Strong buy and 1 is Sell.

value (BTM_{jt}) measured at the end of quarter t, and six month size-decile adjusted buy-and-hold returns preceding the end of a quarter t (LAG_CAR6_{jt}). Third, to account for the possible effect firm size has on analysts' recommendations, I include the natural log of a firm's market capitalization ($LNMV_{jt}$). Fourth, I control for the earnings changes relative to the earnings of the same quarter of the prior year for the four quarters that follow the quarter at which I measure hedge funds' net positions ($\sum_0^3 \Delta EARNINGS_{jt+1}$). The consensus recommendations will be positively correlated with hedge funds' net positions if both parties are chasing after the same future earnings information. Since past earnings momentum could affect the past recommendations used in calculating the consensus recommendations, I control for the past three quarter earnings changes relative to earnings of the same quarters in the prior year ($\sum_{-3}^{-1} \Delta Earn_{jt+1}$) in the model. I run all the regressions with clustered robust standard errors to control for within firm and within quarter correlations (Rogers [1993]; Peterson [2009]). I formally test H1 with the following model:

$$MEAN\_REC_{jt+1} = \alpha_0 + \alpha_1 H\_NET_{jt} + \alpha_2 OTHER\_INST_{jt} + \alpha_3 VOLUME_{jt} + \alpha_4 BTM_{jt} + \alpha_5 LAG\_CAR6_{jt} + \alpha_6 LNMV_{jt} + \alpha_m \sum_0^3 \Delta Earn_{jt+1} + \alpha_n \sum_{-3}^{-1} \Delta Earn_{jt+1} + \varepsilon \quad \ldots\ldots (1),$$

where i = analyst index, j = firm index, and t = time index.

My expectation is that the coefficient (α_1) on H_NET_{jt} will be positive if it is difficult for analysts to downgrade (or upgrade) stocks held by hedge funds due to pressure from hedge fund managers.

Next, I investigate how the future returns to the consensus recommendations ($MEAN\_REC\_RET_{jt+1}$) vary when hedge funds have large long or short positions.[20] As the returns to the consensus recommendations, I use the size-decile adjusted buy-and-hold three-month and six-month returns following the consensus measuring window. In this examination, I control for three variables found to relate to returns by prior literature: Size ($LNMV_{jt}$; Banz [1981]), Book-to-Market value (BTM_{jt}; Fama and French [1992]), and Momentum (LAG_CAR6_{jt}; Jegadeesh and Titman [1993]). I formally test H2 with the following model:

$$\begin{aligned} MEAN\_REC\_RET_{jt+1} = {} & \alpha_0 + \alpha_1 H\_LONG_{jt} + \alpha_2 SHORT_{jt} + \alpha_3 OTHER\_INST_{jt} + \alpha_4 MEAN\_REC_{jt+1} \\ & + \alpha_5 MEAN\_REC_{jt+1} \times H\_LONG_{jt} + \alpha_6 MEAN\_REC_{jt+1} \times SHORT_{jt} \\ & + \alpha_7 MEAN\_REC_{jt+1} \times OTHER\_INST_{jt} + \alpha_8 LNMV_{jt} + \alpha_9 BTM_{jt} + \alpha_{10} LAG\_CAR6_{jt} \\ & + \varepsilon \ldots\ldots\ldots\ldots \quad (2) \end{aligned}$$

I expect that an overly optimistic consensus will lead to significantly lower returns than a consensus that is not affected by pressure. Also, I expect an overly pessimistic consensus recommendation to be followed by higher returns than normal pessimistic recommendations. If so, the coefficient (α_5) on $MEAN\_REC_{jt+1} \times H\_LONG_{jt}$ and the coefficient (α_6) on $MEAN\_REC_{jt+1} \times SHORT_{jt}$ will be negative.

4. Data

In this study, analysts' recommendations come from IBES, firm prices and the number of shares outstanding in firms come from CRSP, accounting variables such as earnings and book values of firms come from Compustat, and the short interest data come from NASDAQ. I gather

[20] Appendix shows how I measure analysts' mean consensus recommendations and the returns to the mean consensus, and when I measure hedge funds' positions.

my main variable of interest, hedge funds' long position data, as follows: all the U. S. institutional investors who have more than $100 million worth of assets have had to file their equity positions worth more than $200,000 or consisting of more than 10,000 equity shares with the SEC every quarter since 1978. Hedge fund management firms (holding companies) are included in this rule. As long as they hold assets valued at more than $100 million, they must release information about their holdings. Institutional holdings data are available from CDA/Spectrum, but verification is necessary to determine which institutional investors are hedge funds. Bloomberg provides a list of hedge funds that file the SEC's 13F-HR. It is possible, however, that those 13F filers' main businesses are not hedge funds. Usually, one management firm (or holding company) has many funds under its purview. For example, "Paulson & Co." controls "Paulson International," "Paulson Enhanced," "Paulson Advantage," "Paulson Advantage Plus," and "Paulson Credit Opportunities." A management firm aggregates each affiliated fund's equity holding information and files the aggregate holding data with the SEC.

To ascertain the institutional investors whose main businesses are hedge funds, I rely upon the filtering process suggested in Brunnermeier and Nagel [2004]. First, I check whether an institution is registered as an investment advisor with the SEC. All mutual funds or pension funds must be registered with the SEC; the same requirement does not apply to hedge funds. When registered, fund managers complete a Form ADV, obtainable from the SEC website.[21] If an institution on the Bloomberg list is not registered, I assume it to be a hedge fund and include it in the research sample. If the institution is registered, a check of the institution's Form ADV determines the suitability of including it based on the following two criteria: (1) at least 50

[21] http://www.adviserinfo.sec.gov/IAPD/Content/IapdMain/iapd_SiteMap.aspx

percent of its clients are "other pooled investment vehicles" (e. g., hedge funds) or "high net worth individuals"; and (2) it charges performance-based fees.

Finally, the sample period for my study runs from the third quarter of 2003 to the end of 2006. The hedge fund data I obtain from Bloomberg are only available after the third quarter of 2003 through the end of 2006.

5. Empirical results

5.1 Main results

Table 1 compares the long position characteristics of hedge fund management firms and other institutions.[22] As stated, one management firm often has several funds under its purview, and information about individual funds is not available. Thus, I provide information based on the holdings of the management firms of hedge funds or other funds. The table reveals the following things: (1) hedge fund management firms are smaller than other institutions; (2) hedge fund management firms hold fewer firms; (3) hedge fund management firms invest in relatively small firms;[23] (4) hedge fund management firms tend to hold stocks in larger blocks than other institutions do, as indicated by their mean and median per-firm holding percentage; and (5) hedge fund management firms trade more frequently than other institutions. Table 2 provides the descriptive statistics of my final sample. On average, the long positions of hedge funds are greater than their short positions. This is consistent with Hennessee Group's survey of hedge fund managers. According to the survey, approximately one third of total hedge fund assets are

[22] There is no data that shows institutional short positions. Thus, I only show the descriptive statistics of institutional long positions.

[23] Although hedge funds invest in relatively small firms, those firms are not too small. As we find in table 2, the mean and median market values of equity in my sample are $1,769 million and $350 million. The median market value of firms in which hedge funds have long positions, $2,157 million, is still greater than the mean market value of the entire sample of firms, $1,769 million. As such, we can interpret the table as indicating that other institutions' investments are heavily tilted toward large firms.

in short positions and the remaining assets are in long positions.[24] Table 3 reports Pearson and Spearman correlations of variables for my consensus recommendation samples. Univariate analysis reveals that analysts' consensus recommendations are positively associated with hedge funds' net positions. As the negative correlation between other institutional holdings and hedge funds' net positions shows, hedge funds appear to have a different investment strategy than other institutions.

Table 4 presents the regression results for analysts' consensus recommendations. The coefficient on H_NET_{jt} is positive, consistent with the finding in the univariate analysis in table 3. The last two columns of table 4 report the coefficients and p-values of the regressions when hedge funds' long and short positions are used as the main independent variables instead of hedge funds' net positions. Both hedge funds' long and short positions have significant associations with the mean consensus.[25] The results suggest that analysts' consensus recommendations are optimistic (or pessimistic) when hedge funds have large long (or short) positions.[26]

To ascertain whether analysts' recommendations are likely to be either Strong buy or Buy when hedge funds have large long positions, I create an indicator variable of one if analysts' consensus recommendation is above-Buy and zero otherwise and call the variable $BUY\_CONSENSUS_{jt}$.[27] Then, I run a logit regression model of $BUY\_CONSENSUS_{jt}$ on hedge

[24] This information is available on the following website: http://www.hennesseegroup.com/releases/release20070501.html

[25] I do not report the coefficients on the control variables because they are almost identical after I use hedge funds' long and short positions instead of the net positions in model (1).

[26] The coefficient on other institutions' holdings ($OTHER\_INST_{jt}$) is also significant, but the magnitude of the coefficient is much smaller than the coefficient on hedge funds' long positions (H_LONG_{jt}). An F-test confirms the significant difference between the two coefficients within a 1 percent confidence level.

[27] Since I allocate 5 to Strong buy and 1 to Sell, an above-Buy mean consensus is a mean consensus recommendation greater than 4 (Buy).

funds' long positions (H_LONG_{jt}) and short positions ($SHORT_{jt}$) after including all the control variables in model (1). Table 5 reports the results. The coefficient on H_LONG_{jt} is significantly positive, indicating that analysts are likely to recommend Buy or Strong buy when hedge funds have large long positions. The coefficient on $SHORT_{jt}$ is significantly negative. The coefficient on other institutions' holdings ($OTHER\_INST_{jt}$) is also significantly positive in this logit regression. However, the coefficient on hedge funds' long positions (H_LONG_{jt}) is about four times larger than the coefficient on $OTHER\_INST_{jt}$ (2.186 vs. 0.526).[28]

Table 6 shows how future returns to consensus recommendations vary depending on hedge fund positions. The variable of interest, the interaction between the mean consensus and hedge fund net positions ($MEAN\_REC_{jt+1} \times H\_NET_{jt}$) is significantly negative when both three-month and six-month returns are used as dependent variables. This result means that the association between the consensus and the future returns is lower when hedge funds' long positions are larger than normal, suggesting that the optimistic consensus recommendations are overly optimistic. To ascertain whether the significant coefficient on the interaction is driven by the optimistic consensus recommendations, I divide the sample into two parts: one with above-Buy consensus recommendations and one with below-Buy consensus recommendations. Then, with the sample of above-Buy recommendations, I run a regression of the returns to the consensus recommendations on hedge fund long positions (H_LONG_{jt}) after including all the control variables in model (2). Table 7 panel A shows that the coefficient on hedge fund long positions is significantly negative. To see whether the effect of hedge funds' long positions on the future returns to analysts' above-Buy recommendations is economically significant, I rank hedge funds' long positions into decile and divide the ranked variable by nine so that the newly

[28] An F-test confirms the significant difference.

created variable ranges from zero to one. Then, I run a regression of future returns to the above-Buy consensus on the ranked variable of hedge funds' long positions (RH_LONG_{jt}). The coefficient on RH_LONG_{jt} shows the return difference between the top and bottom decile groups. Table 7 panel B shows the results. When the dependent variable is 3-month (or 6-month) size-adjusted returns, the coefficient is approximately 4% (or 6.6%). These results indicate that the bias in analysts' recommendations triggered by hedge fund managers is not economically trivial.[29]

I do not find a significant coefficient on the interaction between the mean consensus and hedge fund short positions ($MEAN\_REC_{jt+1} \times SHORT_{jt}$), suggesting that the pessimistic recommendations that accompany hedge fund short positions are not overly pessimistic. First, I conjecture that this finding can be attributed to the noise in my hedge fund short position data. I use the total short interest in a firm as a proxy for hedge funds' short positions. However, according to Citigroup's study in 2005, hedge funds' shorting accounts for about 40% of total shorting in the US market, indicating that the remaining 60% of shorting is done by other institutions or individual investors (Williamson [2005]). Second, it is hard for hedge funds to hold short positions in large blocks. Thus, it may not take long for hedge funds to recover their positions. Hedge funds tend to hold larger percentages of shares outstanding in fewer firms than do other institutions, as shown in table 1. If a hedge fund has a large long position in a firm, it can take a while to get out of its position, enhancing the hedge fund manager's incentive to pressure analysts. However, to short a stock, investors must borrow a stock from other

[29] Some control variables are included in the regression models in my study because prior literature finds some significant associations between them and the dependent variables in the model. It is important to note that dropping those control variables does not change the results.

institutions. It is questionable that hedge fund managers can borrow a stock in a large block.[30] As indicated, hedge funds' assets in long positions are twice as large as those in short positions. If hedge funds' average short position in a firm is smaller than their average long position, they can get out of their short positions more quickly, reducing their need to pressure analysts. Third, holding a pessimistic recommendation would be harder for analysts than holding an optimistic recommendation because they have to consider their relationship with company management. Holding an optimistic recommendation for a while would not displease a company's management. However, holding a pessimistic recommendation for a while although there is a positive signal about the firm in the market can upset a company's management.

5.2 Do hedge fund managers sell when analysts' recommendations are optimistic?

I argue that analysts' recommendations lead to lower returns when hedge funds have large long positions because analysts do not downgrade their recommendations in a timely manner or hold up their recommendations when hedge fund managers are selling their stocks. If my argument is correct, hedge fund managers would sell their stocks in many cases when analysts' recommendations are optimistic and analysts would downgrade their recommendations after hedge fund managers sell stocks. I investigate hedge fund managers' trading behaviors when analysts' recommendations are optimistic in this section and examine whether analysts tend to downgrade their recommendations following hedge funds' sales in the next section.

To examine hedge fund managers' trading behavior when analysts' mean consensus is optimistic, I run a Logit model. In the model, the dependent variable is one if hedge fund net position decreases and zero otherwise ($H\_NET\_DEC_{jt}$). The main independent variable in the

[30] There is no central market for borrowing shares. An investor who wants to short a stock must find institutions or individuals willing to lend the stock. Thus, although an investor finds an overpriced stock, she cannot short the stock if she cannot find another investor who is willing to lend the stock (Fabozzi [2004];p.181).

model is an indicator variable of one if analysts' consensus recommendation is above-Buy and zero otherwise ($\text{BUY\_CONSENSUS}_{jt}$). Griffin and Xu [2007] document that hedge funds tend to hold small and medium sized firms, value stocks, and stocks with negative past returns. Thus, I control for Size (LNMV_{jt}), Book-to-Market value (BTM_{jt}), and past six-month size-decile adjusted buy-and-hold returns prior to the quarter of hedge funds' transactions (LAG_CAR6_{jt-1}). The following figure explains when I measure analysts' consensus recommendations and hedge funds' transactions:

Figure 2

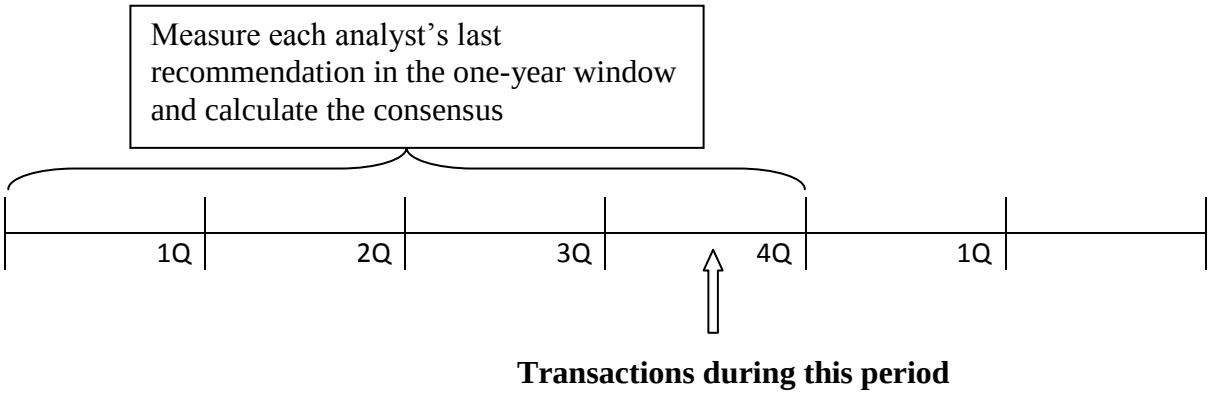


Table 8 shows the regression results. The coefficient on $\text{BUY\_CONSENSUS}_{jt}$ is significantly positive when the dependent variable is the decrease in hedge fund net position (H_NET_DEC_{jt}). To see whether hedge funds' long or short position changes drive the positive coefficient on $\text{BUY\_CONSENSUS}_{jt}$, I run a regression of the decrease in their long positions (HEDGE_SELL_{jt}: one if hedge fund long positions decrease at a given quarter and zero otherwise) on $\text{BUY\_CONSENSUS}_{jt}$ and a regression of the increase in their short positions (SHORT_INC_{jt}: one if a firm's short interest increases at a given quarter relative to the short interest level at the

end of prior quarter and zero otherwise) on $BUY\_CONSENSUS_{jt}$, respectively. The third and fourth columns report the regression results. The coefficients on $BUY\_CONSENSUS_{jt}$ are all significantly positive. The positive coefficients indicate that when analyst consensus is optimistic, hedge funds are more likely to sell their shares and to increase their short positions. If I use continuous variables for the transactions of hedge funds instead of indicator variables ($H\_NET\_DEC_{jt}$, $HEDGE\_SELL_{jt}$, and $SHORT\_INC_{jt}$), the results are identical if I either delete or winsorize the variables at the top and bottom 1%. If there is extremely bad news about a firm that is public, such as its imminent bankruptcy, hedge fund managers have to sell large amounts of its stock and analysts have to downgrade the stock immediately. In such a case, analysts could not hold up their recommendations when hedge funds are selling their stocks. The extreme public bad news scenario seems to be the reason why I get identical results after deleting or winsorizing the outliers of hedge funds' transactions.

I also examine how analysts' optimistic consensus affects other institutional investors' trading behavior with a regression of other institutions' sales ($OTHER\_SELL_{jt}$: one if other institutions sell stocks and zero otherwise) on $BUY\_CONSENSUS_{jt}$. As the significantly negative coefficient on $BUY\_CONSENSUS_{jt}$ in the last column indicates, other institutions are more likely to either buy more stocks or hold their stocks when the analyst consensus is optimistic.[31] Chen and Cheng [2005] and Brown, Wei and Wermers [2008] find that institutional investors in general follow analysts' recommendations and are likely to buy into the stocks recommended by analysts. However, the results in table 8 reveal that this finding is likely driven by institutional

[31] The results for other institutional sales ($OTHER\_SELL_{jt}$) are the same when I use the continuous variable regardless of deleting or winsorizing the outliers.

investors other than hedge funds. Analysts' most important clients, hedge fund managers, are actually selling their stocks when analysts' consensus is optimistic.

The finding in table 8 has an alternative explanation. Hedge funds may time their stock sales when analysts' mean consensus is high without any interaction with analysts. Booz Allen Hamilton, a consulting firm, surveyed hedge fund managers and found that more than 60% of hedge fund respondents believed sell-side research to be very important while only 10% of large fund management groups (e.g., Fidelity), which have their own well-settled in-house research divisions, believed sell-side research to be important (Economist [2007]). Abramowitz [2005] states that other institutional investors including mutual funds increasingly trade via electronic exchanges for lower commission rates while hedge funds managers still pay full commissions.[32] Booz Allen Hamilton's survey and Abramowitz's article indicate that many hedge fund managers use sell-side research. The finding in table 8 raises the question of why hedge funds are selling stocks when analysts' consensus is optimistic if hedge fund managers are actually using analysts' sell-side research. Alternatively, we can ask the question of why the consensus of analysts is optimistic when hedge funds are selling their shares and increasing their short interests if hedge funds rely on sell-side research. Booz Allen Hamilton's survey and Abramowitz's article suggest that the pressuring scenario best describes my results.

5.3 Do analysts revise down their recommendations following hedge funds' sales transactions?

Table 8 shows that hedge fund managers sell stocks when analysts' recommendations are optimistic. If analysts are holding up their recommendations while hedge funds are selling their

[32] The author suggests that hedge funds seek quick and fresh information from analysts, in return for paying full commissions.

stocks facing some bad news, analysts' recommendation downgrade will follow hedge funds' sales transactions. I examine whether such a lead-lag relationship exists in this section.

I first create an indicator variable of one if an analyst's recommendation revision (the difference between an analyst's current and prior recommendation) is a downgrade and zero otherwise ($DOWN_{ijt+1}$). I use $DOWN_{ijt+1}$as a dependent variable in my logit model. As in the previous section, I use the hedge funds' and other institutions' sales indicator variables measured in the quarter prior to analysts' recommendation revisions as my main independent variables ($LAG\_HEDGE\_SELL_{jt}$, $LAG\_SHORT\_INC_{jt}$, and $LAG\_HEDGE\_SELL_{jt}$). I include all the control variables used in model (1) except past quarter earnings changes. Table 9 shows the regression results. As expected, the coefficient on $LAG\_HEDGE\_SELL_{jt}$ is significantly positive, indicating that analysts' recommendation revisions at a given quarter follow the changes in hedge fund long positions in the prior quarter.

I also examine how hedge funds' and other institutional stock sales at a given quarter ($CUR\_HEDGE\_SELL_{jt}$, $CUR\_SHORT\_INC_{jt}$, and $CURRENT\_HEDGE\_SELL_{jt}$) are related to the same quarter's recommendation revisions ($DOWN_{ijt}$). The fourth and fifth column show the regression results. The coefficient on the change in hedge funds' long positions measured at the same quarter as the recommendation revisions ($CUR\_HEDGE\_SELL_{jt}$) is significantly positive, implying that some analysts are making timely recommendation downgrades when hedge fund managers sell stocks.

5.4 Alternative explanations for the lead-lag relationship between hedge funds' sales and analysts' downgrades

For the finding that analysts' recommendation downgrades follow hedge funds' stock sales, my argument is that analysts hold up their recommendations when hedge funds sell stocks and downgrade their recommendations afterwards. However, hedge fund managers are perceived as the most sophisticated investors in the market. Thus, analysts can make inferences based on public information about hedge funds' ownership changes, and revise their recommendations accordingly. I call this explanation the signaling scenario. Also, analysts and hedge fund managers may chase after the same information without interaction, but hedge fund managers may get information quicker than analysts. I call this explanation the superiority scenario. In this section, I address these two scenarios.

5.4.1 Signaling scenario

If analysts are rational, they would revise their recommendations following hedge fund position changes only if the change in hedge fund positions signals future returns. To see if hedge funds' position changes provide a valid signal about future returns, I run a regression of future returns on hedge funds' long and short position changes. Since hedge funds' position changes can send a signal that is valid in the short or long term, I use both three-month and one-year size-decile adjusted returns as the dependent variables. Table 10 shows the regression results when I use the merged sample between institutional investor data and IBES and the results when I use the full institutional investor data without merging. The result reveals that except for the change in short positions when I use the full sample and one-year size-adjusted returns, the changes in hedge funds' positions do not predict future returns.[33]

[33] One may wonder why the hedge fund managers do not make money if all the analysts are helping them. However, the insignificant association between the quarterly changes in hedge funds' positions and future long-run returns does not necessarily imply that hedge fund managers do not make money by their stock trading. We do not know

Although hedge fund position changes do not signal future returns during my sample period, the changes may have provided a valid signal before my sample period. Analysts may just follow hedge fund position changes because of hedge funds' historical performance. If hedge fund positions had provided a valid signal before my sample period, everyone in the market including other institutional investors would follow hedge funds' position changes. Thus, I check whether hedge funds' position changes lead to other institutional ownership changes. As shown in table 11, none of the coefficients on the changes in hedge funds' positions are significant, indicating that other institutional investors do not follow hedge funds' position changes in the prior quarters. All these results suggest that the signaling scenario is unlikely.

5.4.2 Superiority scenario

The best way to address this concern would be to compare hedge funds' trading returns to analysts' recommendation revision returns. If hedge funds' performance is better than that of analysts, the superiority scenario is more likely than the pressuring scenario. Unfortunately, the exact dates of hedge funds' trades are not available. In the previous section, I found that the changes in hedge funds' positions do not predict future returns. Since we do not know the exact hedge fund trading dates, however, it is premature to say that hedge funds' overall profit from their stock trades is zero on average. Nevertheless, checking the returns to analysts' recommendation revisions can be helpful in distinguishing between the superiority and pressuring scenarios. If I find that the recommendation revisions predict future returns, the superiority scenario would be unlikely to be taking place. Simply put, being superior to the market-savvy is harder than being superior to an average person.

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hedge funds' exact trading dates. If I knew the exact trading dates and were to calculate hedge funds' holding period returns, I would expect to find that hedge fund managers make money on their stock trading.

Since IBES provides the exact recommendation issuance dates, I can measure the performance of analysts' recommendation revisions accurately. I first calculate the degree of recommendation revision on each analyst's recommendation issuance date by comparing the level of the recommendation issued to the level of the same analyst's previously issued recommendation. Then, I measure the size-decile adjusted buy-and-hold returns from the analyst's recommendation announcement date to his or her subsequent recommendation announcement date. Finally, I investigate whether the degree of the recommendation revision has a positive and significant association with the future returns.[34] Since analysts often stop covering a firm, some recommendations go stale. To address this concern, I confine the return window to one year, following Lin and McNichols [1998]. In examining this association, I control for Size ($\mathrm{LNMV_{jt}}$), Book-to-Market value ($\mathrm{BTM_{jt}}$), and Momentum ($\mathrm{LAG\_CAR6_{jt}}$) as in model (2). The Momentum ($\mathrm{LAG\_CAR6_{jt}}$) is the six-month size-decile adjusted buy-and-hold returns until the month of an analyst's recommendation issuance date. I also control for the number of days of the return measuring window to account for the possible effect of the length of the return window on the returns to analysts' recommendation revisions.

Table 12 shows that the coefficient on the recommendation revisions ($\Delta\mathrm{REC_{ijt}}$) is significantly positive, indicating that analysts' recommendation revisions are, on average, informative. I also examine whether recommendation upgrades or downgrades drive the significant coefficient on $\Delta\mathrm{REC_{ijt}}$. The third column presents the regression result with the sample of recommendation upgrade and reiteration. The fourth column shows the regression result with the sample of recommendation downgrade and reiteration. The results indicate that

[34] For example, an analyst issues Strong Buy recommendations on January 1st, Buy recommendation on April 1st and Hold recommendation on July 1st sequentially. The degree of recommendation revision on April 1st is minus one downgrade. I measure the size-decile adjusted buy-and-hold returns from April 1st to July 1st and check how minus one downgrade on April 1st is associated with the returns from April 1st through July 1st.

both recommendation upgrade and downgrade are informative. We can infer from this finding that analysts have some ability to find mispriced securities in the market, which makes it harder for hedge fund managers to be better than analysts.

Prior studies also cast doubt on hedge fund managers' superiority over other market players. Griffin and Xu [2007] fail to find a significant difference between the returns to the changes in hedge funds' stock ownership and the returns to changes in mutual funds' stock ownership, suggesting the stock picking ability of hedge fund managers is not superior to that of mutual fund managers. Furthermore, Fung et al. [2008], Naik, Ramadorai and Stromqvist [2007], and Zhong [2008] document that hedge funds' risk-adjusted returns have diminished dramatically since 2003.[35] There are two explanations for this decline in hedge funds' performance. One is that the high compensation structure of the hedge fund industry has attracted managers who lack ability. The other is that the recent incoming capital inflows to the hedge fund industry decrease the investment opportunities sets because there is a limited number of profitable opportunities for each hedge fund strategy (Fung et al. [2008] and Zhong [2008]). The period of declining returns coincides with my sample period, indicating that hedge fund managers in my sample did not show high information acquisition abilities.[36]

The findings of Busse, Green and Jegadeesh [2008] also make the superiority scenario unlikely. The authors compare the future returns to sell-side analysts' recommendation revisions with mutual funds' trades using a database that shows mutual funds' daily trades. They collect

[35] Zhong [2008] documents that hedge funds showed statistically significant risk-adjusted returns (0.4 to 0.5 percent monthly returns) before 2002. However, the statistically significant returns disappeared after 2003 (see table 3 of Zhong [2008]).

[36] It is possible that some hedge funds persistently deliver positive returns and analysts follow those funds' position changes. However, while some previous studies find evidence of monthly or quarterly performance persistence of hedge funds, no study finds evidence of annual performance persistence of individual hedge funds (see Brown, Goetzmann and Ibbotson [1999]; Agarwal and Naik [2000]; Bares, Gibson Brandon and Gyger [2003]). If it is hard for analysts to find hedge funds who deliver persistent performance, I assume that analysts would not blindly follow hedge fund position changes.

recommendation revisions and mutual fund trades that occur in the same week and run a regression model of future returns (e.g., three-month returns) on mutual fund trades and recommendation revisions. The results show that the coefficient on analysts' recommendation revisions is significantly positive while the coefficient on mutual funds' trades is not statistically significant. These results suggest that the stock selection skills of analysts are superior to those of mutual fund managers. Griffin and Xu [2007] do not find any difference between hedge fund ownership changes and mutual fund ownership changes. From these two studies, we can indirectly infer that analysts are, at least, no worse than hedge fund managers at selecting stocks.

It is possible that some relatively incapable analysts drive the results of the significantly positive lead-lag relationship between hedge funds' sales and analysts' recommendation downgrade. For example, some junior members or analysts who cover a large number of firms can blindly follow hedge funds' positions changes or acquire information late for their lack of experience or time. To mitigate this concern, I measure each analyst's experience by computing the number of months since the analyst first appeared in IBES until the month of the analyst's recommendation issuance date and the number of firms each analyst covers at a given year. Then, after splitting my sample into the recommendation revisions made by more experienced and less experienced analysts, and the recommendation revisions made by analysts with less coverage and more coverage, I run a regression of analysts' recommendation revisions at a given quarter on hedge funds' sales in the prior quarter in each sample. Table 13 reports the results. Panel A shows that more experienced analysts revise down their recommendations following hedge funds' stocks sales as indicated by the positive and significant coefficient on LAG_HEDGE_SELL. Less experienced analysts are more likely to downgrade their recommendations when hedge funds sell their stocks as indicated by the positive and significant coefficient on

CUR_HEDGE_SELL. We can infer that the positive and significant coefficient on CUR_HEDGE_SELL for all the recommendation revision samples in table 9 is driven by these junior analysts. Panel B shows the regression results for the sample of the recommendation revisions of analysts with more firm coverage and less firm coverage. The positive and significant coefficient on LAG_HEDGE_SELL in the second column suggests that it is analysts with less coverage who downgrade their recommendations after hedge funds sell stocks. The coefficients on LAG_HEDGE_SELL and CUR_HEDGE_SELL for the sample of recommendation revisions of analysts with more coverage are insignificant, indicating that the recommendation revisions of analysts with large coverage have nothing to do with hedge funds' sales in the prior and current quarters. These results show that the significantly positive lead-lag relationship between hedge funds' sales and analysts' recommendation downgrades is driven by more experienced analysts who cover a relatively small number of firms.[37]

5.5 Supplemental analysis of analysts' earnings forecasts

Ms. Unger and the financial press do not mention that pressure from hedge fund managers could affect analysts' earnings forecasts. Such a relationship could exist because earnings forecasts are inputs to the valuation model through which analysts make recommendations. Thus, I examine the association between the positions of hedge funds at a given quarter and the direction of errors of analysts' one-year and two-year ahead earnings

[37] Junior analysts have an incentive to work harder than senior analysts to get promoted. Thus, it is possible that junior analysts acquire information faster than senior analysts and revise their recommendations faster than senior analysts. If so, junior analysts might revise down their recommendations in the same quarter that hedge funds sell their stocks, while senior analysts revise down their recommendations after hedge funds sell stocks. If senior analysts were slower in information acquisition than junior analysts, senior analysts would revise their recommendations after junior analysts revised their recommendations. However, correlation analysis reveals that junior and senior analysts tend to revise their recommendations in the same quarter and that senior analysts revise down their recommendations if junior analysts revise up their recommendations in the previous quarters. These results suggest that senior analysts are not slower in information acquisition than junior analysts.

forecasts in the next quarter. I also investigate whether a change in hedge funds' positions at a given quarter leads to a change in analysts' one-year and two-year ahead earnings forecasts.[38]

Both tests do not provide any significant results, suggesting that the level and the change of hedge funds' positions do not affect analysts' earnings forecasts. The results are strange because I find that changes in hedge fund positions at a given quarter lead to analysts' recommendation revisions in the next quarter. If earnings forecasts are inputs to analysts' recommendations, I would expect that when recommendations change, earnings forecasts change in the same direction. These inconsistent results raise the question of why only recommendation changes follow hedge fund position changes. I conjecture that analysts' costs to bias earnings forecasts are different than their costs to bias recommendations. Prior literature finds that analysts can be penalized in the market if their earnings forecasts are not accurate (Mikhail, Walther and Willis [1999]; Hong and Kubik [2003]). To my knowledge, no study has documented that analysts' low recommendation profitability is significantly related to analysts' turnovers or promotions.

5.6 Analysts at top 10 prime brokers and top100 hedge funds

Hedge funds are important to brokers not only because of the large commissions hedge funds generate but also because of prime brokerage fees such as interests for the loans the hedge funds pay to the brokers. According to Lambe [2004], the top ten brokers in the prime brokerage industry are JPMorgan, Deutsche Bank, Goldman Sachs, Morgan Stanley, Merrill Lynch, CSFB,

[38] In both tests, I control for firm size (the natural log of a firm's market capitalization), the number of analysts following a firm, forecast horizon (the number of days from the date of an earnings forecast issuance until the actual earnings announcement date), the number of firms an analyst covers, analysts' general experience, whether a firm makes a loss or not, and prior six-month market-adjusted returns before the month that an analyst issues an earnings forecast. Prior studies find that these variables are associated with earnings forecast errors (e. g., Kang, O'Brien and Sivaramakrishnan [1994]; Lim [2001]; Clement [1999]; Jacob, Lys and Neale [1999]; Brown [2001]; and Lys and Sohn [1990]).

UBS, Lehman Brothers, Citigroup and Bear Stearns. Those top 10 brokers reap most of the prime brokerage fees from hedge funds. In this section, I examine how the recommendation downgrades of the analysts who work for these top 10 brokers are related to hedge funds' sales and some of the largest hedge funds' sales.

It would be interesting to examine whether analysts of one main prime broker of a hedge fund show more bias in their recommendations and earnings forecasts for the firms held by the hedge fund, but such data do not exist. Also, it is common for hedge funds with more than $100 million in assets to have relationships with multiple prime brokers (Lambe [2004]). Since my institutional ownership data, Spectrum, only include the institutional investors with more than $100 million in assets, all the hedge funds in my sample have more than two or three prime brokers. Some of the largest hedge funds can have relationships with quite a few prime brokers. Examining the lead-lag relationship between hedge funds' sales and the recommendation revisions of the top 10 prime brokers' analysts would also be interesting because those top 10 prime brokers are highly likely to be main prime brokers of the hedge funds in my sample.

I first split my recommendation revisions into the ones made by top 10 prime brokers' analysts and others. I run the logit regression of analysts' downgrades at a given quarter on hedge funds' sales in the prior and current quarters. Table 14 reports the results. In both groups, the coefficients on LAG_HEDGE_SELL are significantly positive, but the magnitude of the coefficients is different. The coefficient on LAG_HEDGE_SELL is much larger for the sample of recommendation revisions made by analysts at the top 10 prime brokers. Statistical tests reject the significant difference in the magnitude of the coefficients between the two groups, but at least the large coefficient on LAG_HEDGE_SELL in the top 10 prime broker analyst group reveals that analysts from the top 10 prime brokers are quite likely to revise down their

recommendations after hedge funds' sales. The coefficient on CUR_HEDGE_SELL in the top 10 prime broker group is insignificant.

Next, I examine how the recommendation revisions of top prime brokers' analysts are related to the top 100 largest hedge funds' sales. As the importance of hedge funds in the US economy has grown greatly, *Institutional investor* magazine started publishing a sister magazine called *Alpha*, dedicated to the hedge fund industry since 2003. Every May, *Alpha* publishes a list of the 100 largest hedge funds in the US. I manually collected those top 100 hedge funds and matched them with the Spectrum data by their names. According to Tunick [2007], the assets of the top 100 hedge funds account for about half of all hedge fund assets. Because they are large, these hedge funds must generate more trading commissions than other hedge funds. Also, they have relationships with multiple prime brokers. Therefore, the top 100 hedge funds are especially important clients to the top 10 prime brokers. Further, a large fund tends to invest heavily in a firm since a small investment does not help the fund's overall profitability. If the top 100 hedge funds in the US make large bets in a firm, they would need more help from analysts than small hedge funds that can move quickly.[39] Hence, I expect a strong lead-lag relationship between hedge funds' sales (LAG_TOP100_H_SELL: one if the change in the position of the top 100 hedge funds' long positions in the quarter prior to the recommendation measuring quarter is negative, zero otherwise) and recommendation downgrades of the top 10 prime brokers' analysts (PRIME_DOWN: one if the recommendation revision of the top 10 prime broker's analyst is a downgrade at a given quarter and zero otherwise).

Table 15 shows whether the magnitude of the coefficient on LAG_TOP100_H_SELL for the sample of the top 10 prime brokers' analyst group is significantly larger than that of the other

[39] Vickers [2003] states that some analysts admit that traders at one of the top 100 largest hedge funds pressure analysts to write reports in line with the fund's views.

analyst group. The coefficient on the variable of interest, the interaction between PRIME (one if a recommendation is made by a top 10 prime broker's analyst and zero otherwise) and LAG_TOP100_H_SELL is significantly positive. The magnitude of the coefficient on PRIME × LAG_TOP100_H_SELL is about 36%, which means that analysts from top 10 prime brokers are 36% more likely to revise down their recommendations following hedge funds' sales than other analysts.

My argument for this finding is that analysts at the top 10 prime brokers are holding up their recommendations for their valuable clients while these clients are selling their stocks. An alternative explanation is that those large funds must have many talented and resourceful fund managers and should be much faster than analysts for the top 10 prime brokers in information acquisition. Hence, I check the performance of the change in the top 100 hedge funds' stock positions. Table 16 reports the results. As the insignificant coefficients on the change in the top 100 hedge funds' long positions (ΔTOP100_H_LONG) indicates, their long position changes do not predict future three month and one-year returns. This insignificant relationship between the change in large hedge funds' positions and future returns is expected because prior literature finds a negative relationship between fund size and performance (e.g., Ammann and Moerth [2005] and Chen, Hong, Huang and Kubik [2002]). Although we assume that the changes in the top 100 hedge funds' positions provide valuable signals regarding a firm's future performance, there is no reason why analysts for the top 10 prime brokers are more likely to incorporate these signals into their recommendations than other analysts. Information about quarterly changes in hedge funds' positions is public. Any investor can get the information from Bloomberg. Also, although it is true that many talented fund managers work at the top 100 hedge funds, it is quite doubtful that analysts at the top 10 prime brokers such as Goldman Sacks or Morgan Stanley

would be much slower at getting information than the top 100 hedge fund managers. Based on the results of my study, hedge fund managers at the top 100 hedge funds should get information three-months earlier than analysts at the top 10 prime brokers for the superiority scenario to hold. If hedge fund managers at the top 100 hedge funds are so good, we should ask why hedge fund assets declined from USD 1.9 trillion in June 2008 to USD 1.1 trillion in December 2008 (Behrmann [2009]). The major cause of the hedge fund asset decline was investment losses and client withdrawals.[40]

6. Conclusion

The recent proliferation of hedge funds that generate large trading commissions helps sell-side research fend for itself after the Global Settlement in 2003, which prohibited any compensation from investment banking divisions to sell-side research divisions. According to the business press, the whole sell-side industry attempts to cater to hedge funds, which are lucrative clients. In spite of the increasing importance of hedge funds to sell-side research divisions, no study has yet attempted to investigate how hedge fund stock positions are associated with analysts' reporting behaviors. This study shows how hedge fund managers and sell-side analysts, two of the most influential groups in the U.S. stock market, interact. I find indirect evidence that the existence of pressure from hedge fund managers on analysts is highly likely when hedge funds have large long positions and sell stocks. Specifically, analysts' recommendations are optimistic when hedge funds have large long positions. Hedge funds start selling when analysts' recommendations are optimistic and analysts downgrade their recommendations after hedge funds sell stocks. The downgrading of analyst recommendations

[40] I check multicollinearity in all my regression models in the paper, but do not find any severe multicollinearity problems.

following hedge funds' stocks sales is especially prominent with analysts at Top 10 prime brokers and when the managers of the 100 largest hedge funds in the US sell stocks.

I believe that all my results are consistent with my prediction that analysts hold up their recommendations when hedge funds holding large positions are selling their stocks. As we can see in the table 1, Hedge fund managers hold stocks in larger blocks and in smaller companies than other institutional investors do, but they sell their large blocks in four quarters on average while other institutions sell theirs in nine quarters. Hedge fund managers would appreciate analysts' act of holding up their recommendations when hedge funds are selling their stocks. Since analysts should earn their livings through trading commissions after the Global Settlement, they are especially likely to comply with the interests of hedge fund managers. Dan Reingold, a former all-star analyst who covered the telecom industry in the 90s, expresses concern about analyst independence problems after the Global Settlement. He states, "research may be even more of an insider's game than it was during the Internet bubble….The question has become: Does the analyst give a heads-up to his best clients while he is trying to serve them better [or] whether the actual opinion of the analysts, the recommendation, is influenced by the client" (Onaran [2007]).

One caveat of my study is that its sample does not include hedge funds' derivative holdings while hedge funds are known for investing in all kinds of asset classes including options and swaps. Aragon and Martin [2007] manually examine the 13F filings of hedge fund advisors for the period between 1999 and 2005. They find that common stocks account for 84.8 percent of the hedge fund holdings in their sample while option investments account for 10.4

percent of hedge fund assets. This result suggests that the main hedge fund investments are still in common stocks, which my study covers.[41]

Hedge funds are known as secretive investment vehicles, and accordingly, little research into their impact on the market exists. My study assumes that their effect on the market can come through sell-side analysts and attempts to illuminate the influence of these secretive and lightly regulated investment vehicles on the market.

[41] Actual hedge fund option positions can be larger than 10 percent because hedge funds use leverage in option investments. Still, hedge funds' equity long positions seem to account for large portions of hedge funds' assets. Griffin and Xu [2007] obtain their sample of hedge funds' equity long positions using the method employed in this study and compute the correlation between the returns to a hedge fund's long positions and the hedge fund's profitability from all of its assets. They report a mean and median correlation of 0.55 and 0.64, respectively (p. 4). If hedge funds' long positions account for only a marginal portion of hedge funds' assets, the correlation would not be so high.

<Appendix>

Consensus recommendation and the Returns to the Consensus Measurement

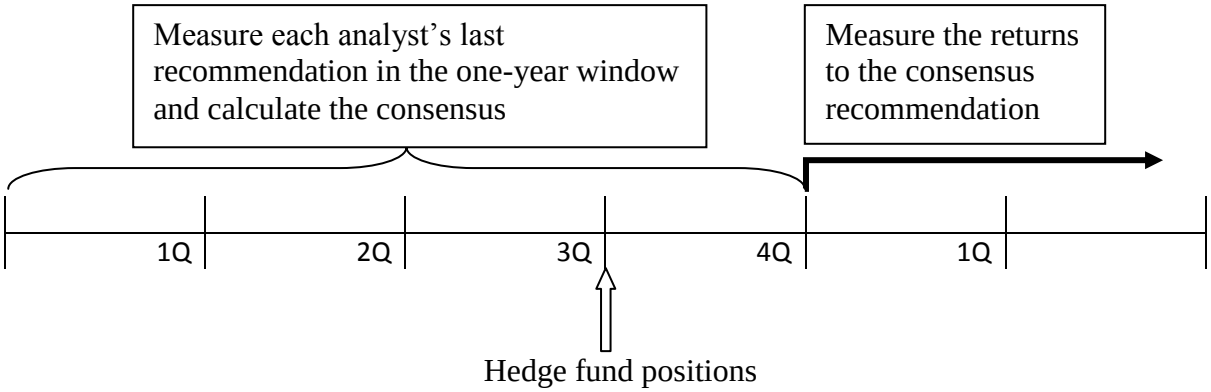

TABLE 1

Institutional Level Descriptive Statistics

(Hedge Fund Management Firms vs. Other Institutions)

	Hedge Fund Management Firms		Other Institutions	
	Mean	Median	Mean	Median
HOLD_AMT ($ Million)	1,104	280	4,941	361
NUM_FIRMS	157	65	308	113
MEDIAN_MV ($ Million)	3,941	2,157	12,687	7,440
HOLD_PERC (%)	0.747	0.347	0.608	0.095
TURNOVER (Quarters)	4.320	4	8.980	9

This table reports descriptive statistics about the long positions of hedge fund management firms and other institutions. The values presented in the table are calculated as follows. First, I calculate each institution's median value of the following variables over my sample period (July 2003-Dec.2006): (1) the sum of the dollar holding amount in firms, (2) the number of firms held, (3) the market value of the firms held, (4) the holding percentage (the number of shares held by an institution divided by the firm's shares outstanding), and (5) the number of quarters for which a firm is held. Second, I divide the institutions into hedge fund management firms and other institutions. Finally, I compute the mean and median of per-institutional value in each group.

Variable definition:

HOLD_AMT = Average holding amount of an institution in a quarter (Unit: $ Millions);

NUM_FIRMS = Median number of firms held by an institution in a quarter;

MEDIAN_MV = Median market value of firms held by an institution in a quarter (Unit: $ Millions);

HOLD_PERC = Average institutional holding percentage in a firm in a quarter (Unit: %);

TURNOVER = the median number of quarters for which an institution holds a firm.

TABLE 2

Merged Sample Descriptive Statistics

Variable	N	Mean	StdDev	25th Perc	Median	75th Perc
H_NET (%)	17,987	1.782	7.102	-1.478	0.295	4.308
H_LONG (%)	17,987	5.776	6.623	1.021	3.580	8.291
SHORT (%)	17,987	3.994	4.851	0.844	2.471	5.328
OTHER_INST (%)	17,987	47.037	25.233	25.869	46.496	67.990
MEAN_REC	17,987	3.665	0.710	3.000	3.667	4.000
MEAN_REC_RET6	17,974	0.004	0.312	-0.168	-0.021	0.133
MEAN_REC_RET3	17,971	0.003	0.213	-0.113	-0.011	0.097
MV ($Million)	17,870	1,769	10,778	166	350	817
BTM	17,864	0.440	0.279	0.242	0.400	0.588
LAG_CAR6	17,966	0.049	0.480	-0.182	-0.019	0.166
VOLUME	17,987	9.057	12.624	2.776	6.110	11.495

This table reports the descriptive statistics of variables used in this study for the sample period between the third quarter of 2003 and the fourth quarter of 2006.

Variable definition:

H_NET (%) = hedge funds' long positions minus short positions at a given quarter;

H_LONG (%) = sum of shares held by hedge funds for a firm at a given quarter scaled by shares outstanding at the end of a quarter;

SHORT (%) = total short interest for a firm in the last month of a given quarter scaled by shares outstanding at the end of a quarter;

OTHER_INST (%) = sum of shares held by other institutions excluding hedge funds scaled by shares outstanding at the end of a quarter;

MEAN_REC = The average level of analysts' recommendations at a given quarter, which is measured at the end of a given quarter as the mean of recommendations among analysts covering a firm over a prior one-year window;

MEAN_REC_RET6 = Six-month size-decile adjusted buy-and-hold returns after the consensus measuring window;

MEAN_REC_RET3 = Three-month size-decile adjusted buy-and-hold returns after the consensus measuring window;

MV ($Million) = market value of equity, measured at the end of a given quarter;

BTM = the ratio of book value to market value of common equity measured at the end of a quarter;

LAG_CAR6 = six-month size-decile adjusted buy-and-hold returns until the end of a quarter;

VOLUME = Average daily volume scaled by shares outstanding for six months preceding the end of a quarter;

TABLE 3

Spearman (above diagonal) and Pearson (below diagonal) Correlation

	H_NET	OTHER_ INST	MEAN_ REC	MEAN_ REC_RET6	LNMV	BTM	LAG_ CAR6	VOLUME
H_NET		**-0.087**	**0.152**	0.013	**-0.206**	**0.091**	**0.017**	**-0.114**
OTHER_INST	**-0.102**		0.002	**0.029**	**0.558**	**-0.077**	**0.071**	**0.478**
MEAN_REC	**0.125**	-0.010		-0.002	**-0.084**	**-0.158**	**0.162**	**0.084**
MEAN_REC_RET6	0.005	-0.004	0.011		**0.051**	**0.040**	0.008	**-0.075**
LNMV	**-0.153**	**0.519**	**-0.081**	-0.006		**-0.287**	**0.219**	**0.377**
BTM	**0.074**	**-0.069**	**-0.142**	**0.025**	**-0.310**		**-0.271**	**-0.351**
LAG_CAR6	-0.005	-0.014	**0.127**	-0.013	**0.094**	**-0.237**		**0.089**
VOLUME	**-0.197**	**0.182**	-0.005	**-0.039**	**0.195**	**-0.201**	**0.166**	

This table reports Spearman and Pearson correlation among the variables in my analysis. LNMV is the natural log value of firms' market capitalization. See table 2 for other variable definitions. Bold numbers indicate correlations that are significant at the 5% level for a two-tailed test. This table is based on 17,987 observations.

TABLE 4

Regression of Analysts' Consensus Recommendations on Hedge Funds' Positions

$$MEAN\_REC_{jt+1} = \alpha_0 + \alpha_1 H\_NET_{jt} + \alpha_2 OTHER\_INST_{jt} + \alpha_3 VOLUME_{jt} + \alpha_4 BTM_{jt} + \alpha_5 LAG\_CAR6_{jt} + \alpha_6 LNMV_{jt} + \alpha_m \sum_0^3 \Delta Earn_{jt+1} + \alpha_n \sum_{-3}^{-1} \Delta Earn_{jt+1} + \varepsilon \ldots\ldots (1),$$

where i = analyst index, j = firm index, and t = time index.

	Coefficient	p-value	Coefficient	p-value
Intercept	4.2577	(0.000)	3.8077	(0.000)
H_NET	1.1728	(0.000)		
H_LONG			0.8471	(0.000)
SHORT			-2.2368	(0.000)
OTHER_INST	0.2441	(0.000)	0.3139	(0.000)
VOLUME	-0.0010	(0.277)		
BTM	-0.4519	(0.000)		
LAG_CAR6	0.1493	(0.000)		
LNMV	-0.0887	(0.000)		
ΔEARNINGS_3	0.0017	(0.122)		
ΔEARNINGS_2	0.0010	(0.038)		
ΔEARNINGS_1	-0.0048	(0.000)		
ΔEARNINGS1	0.2131	(0.001)		
ΔEARNINGS2	0.1039	(0.003)		
ΔEARNINGS3	-0.0288	(0.661)		
ΔEARNINGS4	0.0038	(0.034)		
Adj. R-Square	0.0679		0.0728	
Observations	17,678			

This table reports regression results for model (1). The last two columns show the coefficients and the p-values of the regression when I split the net position of hedge funds (H_NET) into the long positions (H_LONG) and the short positions (SHORT). ΔEARNINGS_1 to _3 are the changes in earnings (COMPUSTAT quarterly data item 19; EPS before extraordinary items) at quarter t-1 to t-3 relative to the earnings of the same quarter of the prior year scaled by the quarter end price, respectively. ΔEARNINGS1 to 4 are the changes in earnings at quarter t+1 to t+4 relative to the earnings of the same quarter of the prior year. See table 2 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 5

Logit Regression of Buy Consensus on Hedge Funds' Positions

$$BUY\_CONSENSUS_{jt+1} = \alpha_0 + \alpha_1 H\_NET_{jt} + \alpha_2 OTHER\_INST_{jt} + \alpha_3 VOLUME_{jt} + \alpha_4 BTM_{jt} + \alpha_5 LAG\_CAR6_{jt} + \alpha_6 LNMV_{jt} + \alpha_m \sum_0^3 \Delta Earn_{jt+1} + \alpha_n \sum_{-3}^{-1} \Delta Earn_{jt+1} + \varepsilon \ldots\ldots (1\_1),$$

where i = analyst index, j = firm index, and t = time index.

	Coefficient	p-value	Coefficient	p-value
Intercept	1.2740	(0.000)		
H_NET	2.6810	(0.000)		
H_LONG		(0.000)	2.1857	(0.000)
SHORT		(0.000)	-5.2535	(0.000)
OTHER_INST	0.3956	(0.037)	0.5258	(0.009)
VOLUME	-0.3683	(0.000)		
BTM	-1.2557	(0.000)		
LAG_CAR6	-0.0052	(0.054)		
LNMV	-0.3788	(0.000)		
ΔEARNINGS_3	-0.0171	(0.359)		
ΔEARNINGS_2	0.0131	(0.113)		
ΔEARNINGS_1	-0.0322	(0.582)		
ΔEARNINGS1	0.2681	(0.126)		
ΔEARNINGS2	0.0847	(0.461)		
ΔEARNINGS3	-0.0149	(0.854)		
ΔEARNINGS4	0.0459	(0.491)		
Pseudo. R-Square	0.0501		0.0504	
Observations	17,678			

This table reports regression results for model (1_1). BUY_CONSENSUS is 1 if analyst mean consensus is above Buy, 0 otherwise. Since I allocate 5 to Strong buy and 1 to Sell, an above-Buy mean consensus is a consensus recommendation greater than 4 (Buy). The last two columns show the coefficients and the p-values of the regression when I split the net position of hedge funds (H_NET) into the long positions (H_LONG) and the short positions (SHORT). ΔEARNINGS_1 to _3 are the changes in earnings (COMPUSTAT quarterly data item 19; EPS before extraordinary items) at quarter t-1 to t-3 relative to the earnings of the same quarter of the prior year scaled by the quarter end price, respectively. ΔEARNINGS1 to 4 are the changes in earnings at quarter t+1 to t+4 relative to the earnings of the same quarter of the prior year. See table 2 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 6

Regression of Future Returns to Consensus Recommendations on the Interaction between Hedge Funds' Positions and Consensus Recommendations

$$MEAN\_REC\_RET_{jt+1} = \alpha_0 + \alpha_1 H\_LONG_{jt} + \alpha_2 SHORT_{jt} + \alpha_3 OTHER\_INST_{jt} + \alpha_4 MEAN\_REC_{jt+1} + \alpha_5 MEAN\_REC_{jt+1} \times H\_LONG_{jt} + \alpha_6 MEAN\_REC_{jt+1} \times SHORT_{jt} + \alpha_7 MEAN\_REC_{jt+1} \times OTHER\_INST_{jt} + Controls + \varepsilon \ldots\ldots\ldots\ldots \quad (2)$$

	Three-month return		Six-month return	
	Coefficient	p-value	Coefficient	p-value
Intercept	-0.0210	(0.333)	-0.0290	(0.429)
H_LONG	0.2312	(0.078)	0.3810	(0.082)
SHORT	-0.0294	(0.897)	-0.2609	(0.498)
OTHER_INST	0.0282	(0.380)	0.0352	(0.547)
MEAN_REC	0.0081	(0.074)	0.0118	(0.202)
MEAN_REC × H_LONG	-0.0712	(0.028)	-0.1166	(0.027)
MEAN_REC × SHORT	-0.0260	(0.671)	0.0141	(0.894)
MEAN_REC × OTHER_INST	-0.0059	(0.415)	-0.0054	(0.733)
LNMV	-0.0005	(0.859)	-0.0008	(0.814)
BTM	0.0018	(0.838)	-0.0008	(0.960)
LAG_CAR6	0.0042	(0.399)	-0.0107	(0.419)
Adj. R-square	0.0014		0.0019	
Observations	17,842			

This table reports regression results for model (2). The second and third (or fourth and fifth) columns show the regression results when three-month (or six-month) returns to the consensus recommendations are used as the dependent variable. See table 2 for variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 7

Regression of Future Returns to Analysts' Above-Buy Consensus Recommendations on Hedge Funds' Long Positions

$BUY\_RET_{jt+1} = \alpha_0 + \alpha_1 H\_LONG_{jt} + Controls + \varepsilon$…… (3)

Panel A:

	Three-month return		Six-month return	
	Coefficient	p-value	Coefficient	p-value
Intercept	-0.0033	(0.896)	-0.0102	(0.830)
H_LONG	-0.1637	(0.001)	-0.2530	(0.007)
LN_MV	-0.0009	(0.675)	0.0010	(0.853)
BTM	0.0534	(0.080)	0.0619	(0.080)
L_CAR6	0.0076	(0.331)	-0.0276	(0.042)
Adj. R-square	0.0065		0.0091	
Observations	4,135			

Panel B:

	Three-month return		Six-month return	
	Coefficient	p-value	Coefficient	p-value
Intercept	0.0026	(0.919)	0.0009	(0.986)
RH_LONG	-0.0397	(0.000)	-0.0661	(0.001)
LN_MV	0.0001	(0.978)	0.0027	(0.628)
BTM	0.0521	(0.084)	0.0590	(0.091)
L_CAR6	0.0076	(0.332)	-0.0277	(0.042)
Adj. R-square	0.007		0.0102	
Observations	4,135			

These tables report regression results for model (3) with the sample of above-buy consensus recommendations. H_LONG is a continuous variable of hedge funds' long positions. RH_LONG is a decile-ranked variable of H_LONG divided by nine. Thus, RH_LONG ranges from 0 to 1. BUY_RET_{jt+1} is the size-decile adjusted buy-and-hold returns to the above-buy consensus recommendations. See table 2 for variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering within firm and quarter (Rogers [1993]).

TABLE 8

Logit Regression of Analyst Buy Consensus on Institutional Transactions

$H\_NET\_DEC_{jt}$, $HEDGE\_SELL_{jt}$, $SHORT\_INC_{jt}$, $OTHER\_SELL_{jt}$

$= \alpha_0 + \alpha_1 BUY\_CONSENSUS_{jt} + Controls + \varepsilon$ ……. (4)

Dep. Var.	H_NET_DEC	HEDGE_SELL	SHORT_INC	OTHER_SELL
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)
Intercept	-0.1088 (0.537)	-0.8761 (0.000)	0.2430 (0.322)	0.2430 (0.322)
BUY_CONS	0.1433 (0.000)	0.1746 (0.000)	0.1335 (0.007)	-0.2565 (0.000)
LN_MV	0.0142 (0.622)	0.0876 (0.000)	0.0016 (0.966)	0.0315 (0.376)
BTM	-0.0610 (0.381)	-0.0486 (0.578)	-0.0770 (0.231)	0.0943 (0.349)
LAG_CAR6	0.0576 (0.226)	-0.1084 (0.005)	0.2334 (0.000)	-0.5076 (0.000)
Pseudo R-Square	0.0018	0.0020	0.0059	0.0130
Observations	17,840			

This table reports regression results for model (4). BUY_CONSENSUS is 1 if analyst mean consensus during the event window is above Buy, 0 otherwise. H_NET_DEC is one if hedge fund net positions decrease and zero otherwise. HEDGE_SELL is 1 if the current quarter's change in hedge fund long positions (ΔH_LONG) is negative, 0 otherwise. SHORT_INC is 1 if the current quarter's change in hedge fund short positions (ΔSHORT) is negative, 0 otherwise. OTHER_SELL is 1 if the current quarter's change in other institutions' positions (ΔOTHER) is negative, 0 otherwise. See table 2 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 9

Logit Regression of the Recommendation Downgrades on Hedge Funds' Sales in the Prior Quarter

$$\Delta DOWN_{ijt+1} = \alpha_0 + \alpha_1 LAG\_HEDGE\_SELL_{jt} + \alpha_2 LAG\_SHORT\_INC_{jt} + \alpha_3 LAG\_OTHER\_NST_{jt} + Controls + \varepsilon, \ldots\ldots\ldots\ldots (5)$$

	Coefficient	P-value	Coefficient	P-value
Intercept	-0.0631	(0.668)	-0.1591	(0.406)
LAG_HEDGE_SELL	0.1054	(0.001)		
LAG_SHORT_INC	0.0909	(0.105)		
LAG_OTHER_SELL	-0.0535	(0.024)		
CUR_HEDGE_SELL			0.1035	(0.014)
CUR_SHORT_INC			0.1048	(0.243)
CUR_OTHER_SELL			0.2343	(0.000)
BTM	-0.0146	(0.827)	-0.0222	(0.742)
LAG_CAR6	0.0335	(0.781)	0.0846	(0.466)
VOLUME	-0.0007	(0.806)	-0.0012	(0.652)
LNMV	-0.0449	(0.001)	-0.0488	(0.001)
ΔEARNINGS1	-0.1168	(0.450)	-0.1245	(0.428)
ΔEARNINGS2	-1.1400	(0.032)	-1.1044	(0.041)
ΔEARNINGS3	-0.1838	(0.165)	-0.1708	(0.163)
ΔEARNINGS4	-0.1409	(0.095)	-0.1248	(0.132)
Adj. R-square	0.0040		0.0055	
Observations	18,928			

This table reports regression results for model (5). DOWN is one if an analyst's recommendation revision (the difference between an analyst's current and prior recommendation) is a downgrade and zero otherwise. LAG_HEDGE_SELL is one if the change in hedge fund long positions (H_LONG) in the quarter prior to the recommendation measuring quarter is negative, zero otherwise. LAG_SHORT_INC is one if the change in hedge fund short positions (SHORT) in the quarter prior to the recommendation measuring quarter is negative, zero otherwise. LAG_OTHER_SELL is one if the change in other institutions' ownership (OTHER_INST) in the quarter prior to the recommendation measuring quarter is negative, zero otherwise. CURRENT_HEDGE_SELL, CURRENT_SHORT_INC, and CURRENT_OTHER_SELL are all measured in the same quarter as the recommendation revisions. The definitions of ΔEARNINGS1 – 4 are in table 4. See table 2 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 10

Regression of Future Long-Run Returns on the Change in Hedge Fund Positions

$SIZE\_CAR_{jt+1} = \alpha_0 + \alpha_1 \Delta H\_LONG_{jt} + \alpha_2 \Delta SHORT_{jt} + \alpha_3 \Delta OTHER\_INST_{jt} + controls + \varepsilon$….(6),

Panel A:

Dependent variable: three-month size-adjusted returns

	Merged sample		Full sample	
	Coefficient	P-value	Coefficient	P-value
Intercept	-0.0054	(0.717)	0.0057	(0.473)
ΔH_LONG	0.1051	(0.302)	0.0712	(0.277)
ΔSHORT	-0.1343	(0.342)	-0.1612	(0.115)
ΔOTHER_INST	-0.0687	(0.132)	-0.0425	(0.186)
BTM	0.0174	(0.235)	0.0067	(0.285)
LN_MV	0.0001	(0.939)	-0.0006	(0.592)
LAG_CAR6	0.0079	(0.106)	0.0075	(0.168)
Adj. R-square	0.0014		0.0019	
Observations	17,842		35,496	

Panel B:

Dependent variable: one-year size-adjusted returns

	Merged sample		Full sample	
	Coefficient	P-value	Coefficient	P-value
Intercept	-0.0159	(0.748)	0.0251	(0.400)
ΔH_LONG	0.2045	(0.105)	0.0963	(0.360)
ΔSHORT	-0.5707	(0.138)	-0.5292	(0.046)
ΔOTHER_INST	-0.1197	(0.157)	-0.0817	(0.320)
BTM	0.0350	(0.372)	0.0267	(0.143)
LN_MV	0.0012	(0.842)	-0.0034	(0.448)
LAG_CAR6	-0.0177	(0.177)	-0.0132	(0.153)
Adj. R-square	0.0024		0.0019	
Observations	17,842		35,496	

These tables report regression results for model (6). Merged sample is the one merged between institutional investor data and IBES. Full sample represents the full institutional investor data without merging. $SIZE\_CAR_{jt+1}$ is the size-decile adjusted buy-and-hold returns after quarter t. See table 2 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 11

Regression of the Change in Other Institutional Ownership at a Given Quarter on the Change in Hedge Funds' Positions in the Prior Quarter

$$\Delta CURRENT\_OTHER\_INST_{jt} = \alpha_0 + \alpha_1 \Delta LAG\_H\_LONG_{jt} + \alpha_2 \Delta LAG\_SHORT_{jt} + Controls + \varepsilon, \ldots\ldots\ldots (7)$$

	Coefficient	P-value
Intercept	0.0181	(0.001)
ΔLAG_H_LONG	-0.0402	(0.337)
ΔLAG_SHORT	-0.0704	(0.101)
BTM	-0.0072	(0.007)
LNMV	-0.0011	(0.163)
VOLUME	-0.0002	(0.008)
LAG_CAR6	0.0189	(0.000)
ΔEARNINGS1	0.0091	(0.532)
ΔEARNINGS2	-0.0001	(0.131)
ΔEARNINGS3	0.0002	(0.000)
ΔEARNINGS4	-0.0002	(0.000)
Adj. R-square	0.0258	
Observations	16,206	

This table reports regression results for model (6). See tables 2 and 9 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 12

Regression of Future Long-Run Returns on Analysts' Recommendation Revisions

$REC\_REV\_RET_{ijt} = \alpha_0 + \alpha_1 \Delta REC_{ijt} + controls + \varepsilon$…… (8),

	Entire sample	Upgrade	Downgrade
	Coefficient (p-value)	Coefficient (p-value)	Coefficient (p-value)
Intercept	0.0122 (0.742)	0.1014 (0.036)	-0.0943 (0.011)
ΔREC	0.0354 (0.000)	0.0322 (0.000)	0.0238 (0.001)
LN_MV	-0.0041 (0.315)	-0.0150 (0.004)	0.0079 (0.038)
BTM	0.0082 (0.797)	-0.0243 (0.477)	0.0309 (0.300)
LAG_CAR6	-0.0155 (0.471)	-0.0287 (0.318)	-0.0092 (0.627)
LENGTH	0.0001 (0.000)	0.0001 (0.000)	0.0001 (0.003)
Adj. R-square	0.0227	0.0122	0.0065
Observations	18,979	10,960	11,363

This table reports regression results for model (6). REC_REV_RET is size-decile adjusted buy-and-hold returns to an analyst's recommendation revision measured from a recommendation announcement date through the same analyst's subsequent recommendation issuance date. LENGTH is the number of days from an analyst's recommendation date to the same analyst's subsequent recommendation date. See table 2 for variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 13

Logit Regression of the Recommendation Downgrades on Hedge Funds' Sales in the Prior Quarter (Cross-sectional Analyses)

$$\Delta DOWN_{ijt+1} = \alpha_0 + \alpha_1 \Delta LAG\_HEDGE\_SELL_{jt} + \alpha_2 LAG\_SHORT\_INC_{jt} + \alpha_3 LAG\_OTHER\_NST_{jt} + Controls + \varepsilon, \ldots\ldots\ldots\ldots (9)$$

Panel A:

	More experienced analysts' recommendation revisions				Less experienced analysts' recommendation revisions			
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Intercept	-0.1727	(0.202)	-0.3280	(0.072)	-0.0287	(0.896)	-0.0783	(0.745)
LAG_HEDGE_SELL	0.1484	(0.002)			0.0777	(0.145)		
LAG_SHORT_INC	0.0551	(0.366)			0.1227	(0.083)		
LAG_OTHER_SELL	-0.0732	(0.198)			-0.0363	(0.382)		
CUR_HEDGE_SELL			0.0809	(0.259)			0.1496	(0.000)
CUR_SHORT_INC			0.1351	(0.119)			0.0632	(0.501)
CUR_OTHER_SELL			0.2861	(0.000)			0.1934	(0.007)
BTM	0.1348	(0.148)	0.1348	(0.176)	-0.0835	(0.289)	-0.0948	(0.237)
LAG_CAR6	-0.0216	(0.890)	0.0404	(0.796)	0.1084	(0.315)	0.1536	(0.109)
VOLUME	-0.0003	(0.902)	-0.0007	(0.805)	-0.0014	(0.660)	-0.0022	(0.506)
LNMV	-0.0358	(0.006)	-0.0379	(0.010)	-0.0422	(0.052)	-0.0474	(0.030)
ΔEARNINGS1	-0.0746	(0.692)	-0.0617	(0.755)	-0.2415	(0.418)	-0.2873	(0.332)
ΔEARNINGS2	-1.1302	(0.005)	-1.0628	(0.007)	-1.0012	(0.259)	-1.0020	(0.267)
ΔEARNINGS3	-0.4747	(0.000)	-0.4429	(0.000)	-0.0171	(0.920)	-0.0087	(0.957)
ΔEARNINGS4	-0.1844	(0.248)	-0.1644	(0.253)	-0.1208	(0.264)	-0.1075	(0.329)
Pseudo R-square	0.0051		0.0074		0.0037		0.0049	
Observations	8,829				9,486			

Panel B:

	Recommendation revisions of analysts with less coverage				Recommendation revisions of analysts with more coverage			
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Intercept	-0.1326	(0.288)	-0.2276	(0.139)	-0.0167	(0.941)	-0.1059	(0.686)
LAG_HEDGE_SELL	0.1548	(0.000)			0.0668	(0.190)		
LAG_SHORT_INC	0.1077	(0.104)			0.0774	(0.290)		
LAG_OTHER_SELL	-0.0323	(0.404)			-0.0807	(0.096)		
CUR_HEDGE_SELL			0.1845	(0.009)			0.0583	(0.171)
CUR_SHORT_INC			0.1271	(0.137)			0.0640	(0.528)
CUR_OTHER_SELL			0.2646	(0.000)			0.2007	(0.002)
BTM	0.1590	(0.004)	0.1381	(0.024)	-0.1336	(0.160)	-0.1312	(0.154)
LAG_CAR6	0.0313	(0.819)	0.0820	(0.544)	0.0712	(0.526)	0.1233	(0.242)
VOLUME	-0.0005	(0.844)	-0.0009	(0.713)	-0.0010	(0.767)	-0.0018	(0.601)
LNMV	-0.0317	(0.029)	-0.0385	(0.005)	-0.0529	(0.008)	-0.0546	(0.008)
ΔEARNINGS1	-0.0538	(0.691)	-0.0805	(0.572)	-0.3157	(0.110)	-0.3070	(0.123)
ΔEARNINGS2	-1.3712	(0.023)	-1.3968	(0.022)	-0.9354	(0.173)	-0.8704	(0.208)
ΔEARNINGS3	-0.6666	(0.273)	-0.6459	(0.248)	0.0806	(0.517)	0.0986	(0.465)
ΔEARNINGS4	-0.0433	(0.653)	-0.0220	(0.814)	-0.2933	(0.163)	-0.2765	(0.195)
Pseudo R-square	0.0061		0.0084		0.0033		0.0042	
Observations	9,269				9,046			

These tables report regression results for model (9). See tables 2, 4, and 9 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 14

Logit Regression of the Top Prime Brokers' Recommendation Downgrades on Hedge Funds' Sales in the Prior Quarter

$$\Delta DOWN_{ijt+1} = \alpha_0 + \alpha_1 \Delta LAG\_HEDGE\_SELL_{jt} + \alpha_2 LAG\_SHORT\_INC_{jt} + \alpha_3 LAG\_OTHER\_NST_{jt} + Controls + \varepsilon, \ldots\ldots\ldots\ldots (9)$$

	Recommendation revisions of analysts from top 10 prime brokers				Other analysts			
	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value	Coefficient	P-value
Intercept	-0.2602	(0.405)	-0.5887	(0.020)	-0.1536	(0.309)	-0.2319	(0.251)
LAG_HEDGE_SELL	0.2418	(0.012)			0.0981	(0.010)		
LAG_SHORT_INC	0.0291	(0.810)			0.0968	(0.107)		
LAG_OTHER_SELL	-0.2256	(0.030)			-0.0332	(0.272)		
CUR_HEDGE_SELL			0.1700	(0.103)			0.1141	(0.003)
CUR_SHORT_INC			0.2848	(0.012)			0.0768	(0.404)
CUR_OTHER_SELL			0.2499	(0.013)			0.2386	(0.000)
BTM	-0.0073	(0.980)	-0.0122	(0.966)	0.0201	(0.675)	0.0172	(0.742)
LAG_CAR6	-0.0577	(0.820)	0.0161	(0.947)	0.0565	(0.620)	0.1057	(0.328)
VOLUME	-0.0010	(0.759)	-0.0009	(0.777)	-0.0007	(0.808)	-0.0014	(0.643)
LNMV	-0.0444	(0.039)	-0.0435	(0.041)	-0.0276	(0.077)	-0.0315	(0.048)
ΔEARNINGS1	1.1360	(0.034)	1.1215	(0.051)	-0.1545	(0.446)	-0.1647	(0.415)
ΔEARNINGS2	-0.4588	(0.017)	-0.4169	(0.073)	-1.4026	(0.012)	-1.3632	(0.014)
ΔEARNINGS3	-0.1190	(0.161)	-0.0886	(0.309)	-0.1955	(0.235)	-0.1835	(0.249)
ΔEARNINGS4	0.3268	(0.226)	0.3349	(0.166)	-0.1403	(0.105)	-0.1233	(0.152)
Pseudo R-square	0.0084		0.0085		0.0036		0.0053	
Observations	2,028				16,287			

These tables report regression results for model (9). See tables 2, 4, and 9 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 15

Logit Regression of the Top Prime Brokers' Recommendation Downgrades on Top 100 Hedge Funds' Sales in the Prior Quarter

$$\Delta PRIME\_DOWN_{ijt+1} = \alpha_0 + \alpha_1 \Delta LAG\_TOP100\_H\_SELL_{jt} + \alpha_2 LAG\_SHORT\_INC_{jt} + \alpha_3 LAG\_OTHER\_NST_{jt} + Controls + \varepsilon, \ldots\ldots\ldots\ldots (9)$$

	Coefficient	P-value	Coefficient	P-value
Intercept	-0.1138	(0.418)	-0.1798	(0.350)
LAG_TOP100_H_SELL	0.0822	(0.020)		
LAG_SHORT_INC	0.0939	(0.113)		
LAG_OTHER_SELL	-0.0367	(0.258)		
CUR_ TOP100_H _SELL			0.0281	(0.575)
CUR_SHORT_INC			0.0725	(0.427)
CUR_OTHER_SELL			0.2253	(0.000)
BTM	0.0167	(0.758)	0.0110	(0.838)
LAG_CAR6	0.0431	(0.709)	0.0924	(0.405)
VOLUME	-0.0007	(0.813)	-0.0011	(0.691)
LNMV	-0.0316	(0.023)	-0.0328	(0.015)
ΔEARNINGS1	-0.0896	(0.549)	-0.0955	(0.530)
ΔEARNINGS2	-1.1232	(0.031)	-1.0573	(0.043)
ΔEARNINGS3	-0.1719	(0.202)	-0.1706	(0.146)
ΔEARNINGS4	-0.1441	(0.101)	-0.1174	(0.149)
PRIME	-0.3480	(0.009)	-0.4559	(0.000)
PRIME × LAG_TOP100_H_SELL	0.3622	(0.001)		
PRIME × LAG_SHORT_INC	-0.0905	(0.412)		
PRIME × LAG_OTHER_SELL	-0.1747	(0.112)		
PRIME × CUR_ TOP100_H _SELL			0.0642	(0.623)
PRIME × CUR_SHORT_INC			0.2104	(0.070)
PRIME × CUR_OTHER_SELL			0.0179	(0.867)
Adj. R-square	0.0062		0.0066	
Observations	18,315			

These tables report regression results for model (9). PRIME_DOWN is one if the recommendation revision of the top 10 prime brokers' analyst is a downgrade at a given quarter and zero, otherwise. LAG_TOP100_H_SELL is one if the change in the position of the top 100 hedge funds' long position in the quarter prior to the recommendation measuring quarter is

negative, zero otherwise. CUR_ TOP100_H _SELL is one if the change in the position of the top 100 hedge funds' long position at the same quarter of analysts' recommendation revision is negative, zero otherwise. PRIME is one if a recommendation revision is made by top 10 prime brokers' analyst and zero otherwise. See tables 2, 4, and 9 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

TABLE 16

Regression of Future Long-Run Returns on the Change in Top 100 Hedge Fund Positions

$$SIZE\_CAR_{jt+1} = \alpha_0 + \alpha_1 \Delta TOP100\_H\_LONG_{jt} + \alpha_2 \Delta SHORT_{jt} + \alpha_3 \Delta OTHER\_INST_{jt} + controls + \varepsilon \ldots.(6),$$

Panel A:

Dependent variable: three-month size-adjusted returns

	Merged sample		Full sample	
	Coefficient	P-value	Coefficient	P-value
Intercept	-0.4518	(0.763)	0.0057	(0.473)
ΔTOP100_ H_LONG	-0.0019	(0.990)	0.0712	(0.277)
ΔSHORT	-0.1176	(0.396)	-0.1612	(0.115)
ΔOTHER_INST	-0.0759	(0.094)	-0.0425	(0.186)
BTM	1.7288	(0.237)	0.0067	(0.285)
LN_MV	0.0058	(0.975)	-0.0006	(0.592)
LAG_CAR6	0.8076	(0.094)	0.0075	(0.168)
Adj. R-square	0.0012		0.0006	
Observations	17,842		35,494	

Panel B:

Dependent variable: one-year size-adjusted returns

	Merged sample		Full sample	
	Coefficient	P-value	Coefficient	P-value
Intercept	-1.3783	(0.781)	2.5618	(0.390)
ΔTOP100_H_LONG	-0.1151	(0.569)	-0.2407	(0.181)
ΔSHORT	-0.5313	(0.172)	-0.5040	(0.059)
ΔOTHER_INST	-0.1371	(0.100)	-0.0953	(0.239)
BTM	3.4750	(0.376)	2.6554	(0.145)
LN_MV	0.0996	(0.866)	-0.3381	(0.453)
LAG_CAR6	-1.7183	(0.187)	-1.2795	(0.169)
Adj. R-square	0.0023		0.0019	
Observations	17,842		35,496	

These tables report regression results for model (6). ΔTOP100_H_LONG is the change in the top 100 largest hedge funds' long positions. Merged sample is the one merged between institutional investor data and IBES. Full sample represents the full institutional investor data without merging. See table 2 and 10 for other variable definitions. All the p-values are calculated based on clustered robust standard errors for addressing clustering (Rogers [1993]).

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