Performance of Hedge Funds and Selective Disclosure of Information by Prime Brokers

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Abstract

This paper finds that hedge funds can profit from anticipating upcoming changes in analysts' recommendations before they become public. We provide evidence supporting the hypothesis that hedge funds that have prime brokerage affiliations with analysts' investment banks have access to information on upcoming analysts' recommendations. Focusing on recommendations issued up to two days following stock holding report date, We find that large hedge funds that are clients of the investment bank (affiliated hedge funds) tend to buy upgrades and sell downgrades in a larger magnitude compared to other hedge funds before the public release of recommendations. Moreover, relative to non-affiliated hedge funds, affiliated hedge funds have a higher probability to trade in a way that is consistent with upcoming recommendation changes and earn higher (or avoid lower) short-term abnormal returns by buying (or selling) before upgrades (or downgrades). The results indicate that prime brokerage affiliation is an important source of private information on analysts' reports for hedge funds.

Keywords: Hedge Funds, Analysts, Prime Brokerage Affiliations, Private Information

JEL Classification: G23, G24

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Abstract

This paper finds that hedge funds can profit from anticipating upcoming changes in analysts' recommendations before they become public. We provide evidence supporting the hypothesis that hedge funds that have prime brokerage affiliations with analysts' investment banks have access to information on upcoming analysts' recommendations. Focusing on recommendations issued up to two days following stock holding report date, We find that large hedge funds that are clients of the investment bank (affiliated hedge funds) tend to buy upgrades and sell downgrades in a larger magnitude compared to other hedge funds before the public release of recommendations. Moreover, relative to non-affiliated hedge funds, affiliated hedge funds have a higher probability to trade in a way that is consistent with upcoming recommendation changes and earn higher (or avoid lower) short-term abnormal returns by buying (or selling) before upgrades (or downgrades). The results indicate that prime brokerage affiliation is an important source of private information on analysts' reports for hedge funds.

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1 Introduction

An important channel through which hedge funds earn abnormal returns is by trading ahead of sell-side analysts recommendations. Studies have attributed this trading pattern before the public release of recommendations to the leakage of information on analysts' reports. For example, the institutional trades that anticipate changes to analyst recommendations are shown to be consistent with institutional traders receiving tips on analysts' reports (see Irvine, Lipson, and Puckett (2007)). Klein, Saunders, and Wong (2014) and Swem (2014) show that hedge funds trade profitably on analysts' private information by buying before upcoming upgrades and selling before upcoming downgrades, but no similar trading pattern is found for other types institutional traders. In addition, Soltes (2014) and Solomon and Soltes (2015) argue that hedge funds can gain information from the firm management in conjunction with sell-side analysts in private meetings set up by investment bank.

Although information leakage could be the most plausible explanation for the trading activities of hedge funds before the public release of analysts' reports, little evidence has been provided on the underlying motivation and the channel through which information is leaked to hedge funds. According to Klein, Saunders, and Wong (2014), information leakage related to analysts' recommendations occurs between hedge funds and one or two investment banks only. However, the economic incentives that motivate this relationship are not examined. Why do investment banks reveal information or provide information-acquisition opportunity to hedge funds? Why do investment banks favor hedge funds over other investors by offering them profitable investment opportunities?

The purpose of this study is to provide direct evidence of information leakage by examining whether investment banks are incentivized to provide hedge funds with private information related to their sell-side analysts' recommendations. The growth of hedge funds and their demands for investment banking services have produced massive flows of fees for investment banks over the past few years. Among various services offered by investment banks to hedge funds, the business of prime brokerage is highly profitable. A 2011 report by Coalition Development Ltd claims that ten largest investment banks earned about $10 billion in revenue from prime brokerage business

in 2010, which is nearly comparable to the amount earned from their stock tradings[1]. Investment banks, acting as prime brokers, provide a variety of services such as securities lending, margin financing, and settlement facilities to hedge funds. In return, hedge funds boost revenues for investment banks by paying prime brokerage fees on financing spread and trading commissions. Therefore, it is in investment banks' interests to obtain and retain hedge fund clients. Investment banks compete aggressively for hedge fund clients by providing them with informational advantages or other profitable investment opportunities (see Goldie (2011), Qian and Zhong (2014), Chuang and Kang (2014), and Getmansky, Kazemi, and Yang (2014)).

Investment banks are motivated to share private information related to analysts' reports with hedge funds who use prime brokerage services from the investment banks. If there is leakage of information on analysts' reports, advanced tradings are more likely to be observed with larger magnitude for hedge funds that have prime brokerage affiliations with analysts' employers than for other hedge funds. Nonetheless, it does not necessarily mean that other hedge funds will not trade abnormally before the reports release, as experienced hedge funds may learn the related information by analyzing market tradings, reading news, or using alternative information channels. Moreover, hedge funds with short-term investment horizons are more likely to profit from the prime brokerage relationships with analysts' employers by taking advantage of private information and trading based on it.

In this paper, we test the hypotheses of selective pre-release of analyst recommendations to the affiliated hedge funds. We define affiliated hedge funds as hedge funds that use reporting analysts' investment banks as their prime brokers. A recommendation is referred to as affiliated if at least one affiliated hedge funds have positions in the covered stock. We hypothesize that hedge funds that have prime brokerage affiliations with analyst's investment banks display superiority in anticipating that analysts private information. In particular, we test whether tradings of affiliated hedge funds are more likely to vary with the forthcoming analysts' recommendation changes than those of non-affiliated hedge? If hedge funds benefit from investment banks' information leakage, would the affiliated tradings lead to higher profits than non-affiliated tradings?

[1]See "Morgan Stanley at Brink of Collapse Got $107 Billion From Fed, Bloomberg Business, Aug 2011".

Combining a comprehensive dataset of hedge funds and analyst recommendations with SEC 13F fillings, we identify the affiliation of hedge funds with sell-side analysts through their investment banks and quarterly equity holdings. Because the intra-quarter timing of hedge fund trades are not available in 13F fillings, we are unable to identify hedge fund trading patterns around the release of analysts' recommendations. Following Klein, Saunders, and Wong (2014), we address this limitation by lining up the recommendations issued up to two trading days following calendar quarter-end dates. For example, suppose March 31 is the quarter-end date reported by hedge funds in Form 13F, and then all recommendations on the first or the second trading day after March 31 will be lined up with the first quarter hedge fund holdings. We believe that hedge fund tradings one or two days before the public release of analysts' recommendations most likely reflect informed trading activities of hedge funds[2]. The regression results bear out my anticipation of the timing of hedge fund trading activities.

My results support my hypotheses that prime brokerage affiliations motivate information leakage of analysts' recommendations and benefit hedge funds. First, we document a positive association between changes in quarterly stock holdings of affiliated hedge funds and changes in the subsequent analysts' recommendations. We find that affiliated hedge funds increase (or decrease) their stock holdings one or two days before the public release of upgrade (or downgrade) recommendations. We do not see the similar association for non-affiliated hedge funds, and neither do we find significant change in hedge fund holdings more than two days before the release of recommendations. These results are consistent with Klein, Saunders, and Wong (2014) that hedge funds trade one to two days prior to recommendation changes.

Second, we find that affiliated large hedge funds tend to buy upgrades and sell downgrades in a larger magnitude compare to non-affiliated hedge funds before the public release of recommendations. The results hold even if analysts do not correctly predict market reactions for downgrade recommendations. In contrast, small hedge funds do not show similar trading pattern difference between affiliated and non-affiliated groups, as small funds tend to generate less prime brokerage

[2]Irvine, Lipson, and Puckett (2007) document abnormally high institutional trading volume in the period beginning about five days before the public release of analysts' recommendations. Klein, Saunders, and Wong (2014) find that hedge fund stock tradings up to two days before the analysts' reports are positively correlated with analysts' recommendation changes.

fees, on average. Thus, investment banks are less incentivized to share private information with small hedge funds. These results provide strong evidence that affiliated hedge funds especially large ones trade advantageously over non-affiliated hedge funds on forthcoming recommendations, suggesting the existence of information leakage of investment banks to their prime brokerage hedge fund clients.

Third, we show that affiliated hedge funds, either large or small, are more likely to buy upcoming upgrades and sell upcoming downgrades than non-affiliated hedge funds. For each stock, we calculate net trading ratio, the probability that hedge funds trade in a way consistent with upcoming recommendation changes. The net trading ratio is higher for affiliated hedge funds than for non-affiliated hedge funds. The results suggest that, as investment banks compete for prime brokerage business, information leakage is more pervasive among affiliated hedge funds, even if they are small hedge funds.

Fourth, we present evidence that the prime brokerage affiliations with investment banks affect hedge fund abnormal returns. Hedge funds cannot benefit from banks' information leakage if analysts' recommendations have little impact on the stock price movements. We show that affiliated hedge funds earn higher short-term abnormal returns by buying before upgrades than do non-affiliated hedge funds; meanwhile, the prime brokerage affiliations with analysts' investment banks help hedge funds avoid negative or relatively low short-term abnormal returns induced by downgrade recommendations. These results suggest that affiliated hedge funds are more likely to obtain profitable information on upcoming recommendations from investment banks.

These results are robust to alternative explanations. In particular, we analyze the investment values of hedge funds by controlling for star analysts and influential recommendations. We find that prime brokerage affiliations with analysts' investment banks have positive impact on hedge funds' abnormal returns no matter whether the analysts are star analysts or not. Similar patterns of abnormal returns are observed for hedge funds that trade ahead of non-influential recommendations. However, for influential recommendations, abnormal returns are comparable across affiliated and non-affiliated hedge funds, suggesting that investment banks tend to cater to their hedge fund clients in an inconspicuous way.

We also provide evidence that the relatively high abnormal returns earned by affiliated hedge funds cannot be attributed to fund managers' skills. Rather, it owes to investment banks that add values to hedge funds by providing them with profitable investment opportunities. Moreover, investment banks are more likely to show favoritism to the affiliated hedge funds with higher skills, in expectation that they can earn more future rewards from the hedge funds.

This paper relates to three strands of literature. First, this paper contributes to the literature by demonstrating the incentive and consequence of information leakage of analysts' reports. More important, we examine the incentives of investment banks to provide hedge funds with information on analysts' reports. Analysts may have strong incentives to leak information because the relationships with institutional investors help their brokerage firms generate additional commission revenue and thus make them receive higher compensation (see Irvine (2004), Jackson (2005), Groysberg, Healy, and Maber (2011), Maber, Groysberg, and Healy (2014)) or get job offers from prestigious investment banks (see Hong and Kubik (2003), Hong, Kubik, and Solomon (2000)). Moreover, analysts rely on institutional investors to build career reputations, as institutional investors periodically evaluate analysts' performance by electing All-America Research Team (see Leone and Wu (2007), Ljungqvist, Marston, Starks, Wei, and Yan (2005)) or choosing which brokerage firms to use (see Maber, Groysberg, and Healy (2014)). This paper complements the prior research by studying the tipping behavior induced by prime brokerage business relationships between hedge funds and investment banks, as prime brokerage fees are an important source of revenue earned by investment banks.

Second, this paper contributes to the growing literature of leaking information on analysts' reports to institutional investors. Irvine, Lipson, and Puckett (2007) document an increase in institutional tradings before the announcement of initial buy or strong buy recommendations. Correspondingly, Christophe, Ferri, and Hsieh (2010) show an abnormally high level of short selling before downgrade recommendations. In both papers, either buying or selling before recommendations presents evidence for potential information flows from analysts to institutional investors. This paper is most closely related to Klein, Saunders, and Wong (2014) and Swem (2014), which find a positive correlation between hedge fund trading and the subsequent changes in analysts' recommendations and no obviously similar trading patterns for other institutional investors. However,

these authors do not test the underlying motives of information leakage, neither do they differentiate investors that have interest-driven relationships with analysts' brokerage firms from those without such relationships. This paper complements and extends previous studies by comparing trading behaviors of investors in different relationship groups.

Third, this paper provides strong support for the beneficial role of prime brokers in hedge funds' equity investments. Getmansky, Kazemi, and Yang (2014) find that investment banks support hedge fund investments and growth by allocating underpriced IPOs, especially for start-up hedge funds or poorly-performed hedge funds. Other related studies focus on the information provision role of prime brokers. Qian and Zhong (2014) study hedge funds' possession of private information through post-IPO stock abnormal returns. They show that connections between prime brokers and IPO underwriters are an important source of private information for hedge funds. Goldie (2011) finds that risk arbitrage hedge funds are more likely to invest in mergers and acquisitions (M&A) when hedge funds' prime brokers also work as advisors in the deals, and hedge funds outperform naive portfolios of risk arbitrage investment by gaining information advantages through their connections with investment banks. Chuang and Kang (2014) examine the comovement of hedge fund returns and argue that the strong comovement in hedge fund returns is induced by valuable information provided by prime brokers. We find that information leakage of analysts' recommendations provide another channel that investment banks reward their hedge fund clients and boost their competitiveness in the prime brokerage businesses.

The remainder of this paper is organized as follows. Section 2 discusses the hypotheses and my research design. Section 3 describes sample construction and presents summary statistics. Section 4 presents methodologies and test results of comparing the trading activities of affiliated and non-affiliated hedge funds. Section 5 shows the difference of abnormal returns between affiliated and non-affiliated portfolios. Section 6 concludes.

2 Hypotheses and research design

As investment banks are interested to attract and retain hedge funds, they tend to reveal information or provide information-acquisition opportunity to their hedge fund clients. Thus, prime

brokerage affiliation creates a potential channel for information flows between investment banks and hedge funds. Based on my discussion thus far, we state the hypotheses as follows.

Hypothesis 1: Hedge funds are more likely to acquire private information on upcoming stock recommendations if they use prime brokerage services from the reporting analysts' investment banks.

If analysts' investment banks provide prime brokerage services to hedge funds, the trading demands of hedge funds are predicted to be more likely to vary with upcoming recommendations. Meanwhile, more hedge funds will buy stocks on upcoming upgrades and sell stocks on upcoming downgrades if they use prime services from the analysts' employers.

Hypothesis 2: Hedge funds are more likely to acquire profitable information on upcoming stock recommendations if they use prime brokerage services from the reporting analysts' investment banks.

If analysts' investment banks provide prime brokerage services to hedge funds, the quality of acquired information on forthcoming recommendations is expected to be higher. Thus, hedge funds are more likely to receive accurate information on analysts' reports, and their investment values tend to be correlated with upcoming recommendation changes. Moreover, as analysts cater to hedge funds by providing them with profitable investment opportunities, the short-term investment values of affiliated tradings are expected to outperform those of non-affiliated tradings.

To test these hypotheses, we model hedge funds' information acquisition as trading in a way consistent with upcoming recommendation changes shortly before the public release of recommendations. We use Form 13F to identify hedge fund quarterly holdings, as well as changes in stock holdings. Thus, we are able to determine hedge funds' buying or selling activities through the increase or decrease of their stock holdings over a particular quarter. We associate hedge fund trading with analyst recommendations on the same stocks issued one or two days subsequent to 13F filing date. We believe that buying or selling stocks immediately prior to recommendation release date will most likely capture the activities induced by information flows from investment banks to hedge funds.

In order to separate the effect of each recommendation, we remove samples that associate quarter-end hedge fund holdings with recommendations in both the following 1st and 2nd day. We include yearly fixed effects to control for macroeconomic effects and cluster the standard errors by hedge funds, investment banks, and stocks, respectively. The settings of tests are not subject to earnings announcement drift.

3 Sample construction and summary statistics

We construct the sample by compiling a comprehensive dataset of hedge fund equity holdings and analyst recommendations. The final samples include a universe of 176 hedge fund management companies with 11 prime brokers and 750 recommendation changes with 550 sell-side analysts, spanning the period from 2003 to 2012.

3.1 Hedge fund sample

We use TASS database to identify all the hedge funds and hedge fund management companies. The TASS database is one of the most comprehensive hedge fund database consisting of monthly hedge fund returns, asset under management (thereafter, AUM), and other fund-specific information. More importantly, it provides information on prime brokers which is useful in identifying the special association of hedge funds with investment banks.

We identify hedge fund equity holdings based on institutional holdings from 13F fillings to Securities and Exchange Commission (SEC). As a private investment company, hedge funds with more than $100 million under management must report their holdings to the SEC each quarter on form 13F, including all long positions (but no short position) in U.S. stocks and a few other securities greater than 10,000 shares or $200,000 in the market value. Holdings are reported at the management company level at the end of each calendar quarter.

Following the methodology of Brunnermeier and Nagel (2004) and Griffin and Xu (2009), we compile a list hedge fund management companies from TASS hedge fund databases, and manually match them with the companies registered as investment advisers from 13F database. If a

firm is not registered, we include it in the sample, since registration is a prerequisite for conducting non-hedge fund business such as advising mutual funds and pension plans. If the firm is registered, we obtain its ADV form and check its eligibility for the sample based on two criteria: (1) at least 50% of its clients are Other pooled investment vehicles (e.g., hedge funds)" or High net worth individuals," and (2) it charges a performance fee for its advisory services. This process leaves us with 380 companies and 25,633 total stock holdings.

To identify hedge funds holdings in long positions, we focus solely on hedge funds using long/short equity hedge, equity market neutral, Multi-Strategy, and event driven strategies. We used both Live" and Graveyard" funds to mitigate a potential survivorship bias. Since holdings data are company-based, we upgrade fund-level characteristics to the company-level to satisfy the consistency requirements. For example,a hedge fund company's asset under management is calculated as the sum of AUMs of all hedge funds managed by the company at each time point. We include only hedge funds that have at least $1 billion asset under management and have no less than 6 quarters of observations.

An important motive for using TASS is that it provides information on prime brokers that a hedge fund requests services from. In recent years, the demand of hedge funds has boosted the revenues of investment banks through their prime brokerage divisions. The core services offered by a prime broker include execution and custody, margin financing, securities lending, and consolidated reporting. As hedge funds continue to growth, prime brokers are quickly expanding their businesses to include services such as risk management and capital introduction.

In TASS, prime brokers are cross-sectionally identified at fund level, and a hedge fund may be associated with one or more prime brokers. Since a management company often offers multiple hedge funds, we use all listed prime brokers within the same institution for a hedge fund company. In the unreported summary statistics of filtered TASS database, there are 1,220 hedge fund companies and 343 prime brokers. The prime brokers are reported by 49% of hedge funds, among which about 17% declare to have multiple prime brokers. In the sample, we excluded funds that did not report information on their prime brokers.

For most hedge funds, prime brokerage, especially the division of large investment bank, is indispensable to the operation and ultimate success of their businesses. According to the snapshots

of TASS data from 2006 to 2012, the eleven major prime brokers ranked by their average market share were Goldman Sachs, JP Morgan, Morgan Stanley, Credit Suisse, Deutsche Bank, UBS, Citi, Lehman Brothers, Bear Stearns, Bank of America, and Merrill Lynch. In TASS, there are 465 global prime brokers, with top 11 biggest prime brokers account for about 86% of the market share in hedge fund businesses. Therefore, we include only these 11 biggest prime brokers in this study.

We examine the prime brokers turnover using yearly snapshots from 2006 to 2012. We do not find significant changes of prime brokers for each hedge fund company and neither do the changes of multiple prime brokers over these years. As the relationships between hedge funds and prime brokers are relatively stable in this sample, we use prime broker data in 2006 snapshot for the time-series sample construction prior to 2006.

In additional to the hedge fund holdings, we also identify the holdings of other institutional investors using the form 13F. The 13F institutions are classified into six types of institutional investors: (1) Banks, (2) Insurance companies, (3) Investment companies (or mutual funds), (4) Independent investment advisors, (5) Hedge funds, and (3) All others. We identify the other institutional investors by combining all non-hedge fund categories into one group.

3.2 Analyst recommendation sample

We obtain stock recommendations data from Thomson Financial's Institutional Brokers Estimate (I/B/E/S) detail file, which identifies the names of analysts covering a given stock, the broker codes, the stock ratings, and the report date. We build the sample by searching for stock ratings issued by individual analysts in particular brokerage firms from 2003 to 2012[3], with ratings ranging from 1 (strong buy) to 5 (strong sell). We reverse the ratings (e.g. strong buy now is denoted by 5 and strong sell now is denoted by 1) to allow higher ratings correspond to more favorable recommendations.

We focus on recommendation revisions rather than mere levels, since recommendation changes are more informative on future stock values (see Jegadeesh and Kim (2009), Loh and

[3]Prior to the issuance of National Association of Securities Dealers (NASD) rule 2110 in 2002, analysts are compensated through their services to investment bank. As a result, member firms of analysts' invest bank may trade based on the pre-released analysts' research reports. Therefore, rating samples before 2003 are likely to bias the test results for the affiliated trading.

Stulz (2011)). The recommendation change (Δrec) is computed as the current rating minus the prior rating by the same analyst, with the value ranging from -4 to +4. A recommendation upgrade is defined as positive recommendation change, and a recommendation downgrade refers to negative recommendation change. We remove analysts coded as anonymous by I/B/E/S and lack of brokerage house information. We also remove observations for which fewer than three analysts have active ratings. For each stock in the sample, there should be at least one analyst who issues one recommendation and then another within 6 months.

We obtain analysts' brokerage house information by mapping broker codes in the detail file to names of brokers in the translation file[4] . The translation file is no longer available in I/B/E/S subsequent to 2005, but the most of the broker codes are still being used by I/B/E/S. Therefore, we use the latest version of the file associated with searching through LexisNexis, Bloomberg, and Google to identify the brokerage house that the analysts work for after 2005.

We identify the affiliation of hedge funds with sell-side analysts by manually matching analysts' brokerage firms with the prime broker(s) that a hedge fund is associated with from TASS hedge fund database. The affiliated trading is then identified as a hedge fund's buying/selling a stock if the hedge fund is affiliated with a sell-side analyst's investment bank. The stock information including return, share price, and turnover are from Center for Research in Security Prices (CRSP).

3.3 Summary statistics

Table 1 reports summary statistics of the samples from 2003 to 2012 with hedge fund holdings lined up up to two days before the release of recommendations. Panel A shows that there are a total of 3,698 cumulative stock recommendations in the sample, with 1,309 upgrades, 1,796 downgrades, and 593 no changes. Among these recommendations, approximately 47% are one level changes, 36% are two level changes, and only less than 1% are three or four level changes. Panel B shows the cumulative number of recommendation changes by years over the sample period. On average, there are 370 recommendation changes each year, with the number of downgrades greater

[4]We are grateful to Alexander Ljungqvist for sharing the translation file with me.

than that of upgrades and no changes. More firms receive upgrade and downgrade recommendations in bull market than in bear market.

As Panel C show, we capture the trading of 176 hedge funds in 750 recommendation changes which are reported by 550 analysts from 11 investment banks. In order to examine the impact of prime brokerage affiliations, we divide hedge fund trading into two groups: affiliated and non-affiliated. Among the 3,698 hedge fund tradings, about 30% are affiliated and 70% are non-affiliated. We further show the size effect of hedge funds on its tradings. We refer to hedge funds with asset under management no less than $1 billion as large hedge funds, and small hedge funds otherwise. For large hedge funds, which account for about 33% total hedge funds in the sample, 31% tradings are affiliated and 69% are non-affiliated. The affiliated tradings of small hedge funds account for 42% of their total tradings, which is relatively higher than that of large funds.

Panel C also show descriptive statistics for subsamples that will be used for robustness tests in this study. We define Net-rec as hedge funds that trade in the same direction as recommendation changes and Net-rec I as subsamples of Net-rec in which hedge fund tradings have different signs than those of stock abnormal returns in the corresponding month. We show that, for affiliated hedge funds, approximately 37% of trading is in the same direction as recommendation changes, among which 43% have different signs than those of the monthly stock abnormal returns. For non-affiliated hedge funds, Net-rec and Net-rec I account for 40% and 18% total hedge fund tradings, respectively.

Panel D reports the characteristics of analysts, stocks, and hedge funds for the full sample from TASS hedge fund database matched with 13F institutional holding data and I/B/E/S database from 2003 through 2012. The characteristics include analyst experience, which is calculated as the number of years since an analyst issued the first recommendation on I/B/E/S, coverage, which is the number of analysts that issued at least one recommendation for a firm over a quarter, market value (in millions), quarterly stock return, quarterly stock turnover, hedge fund AUM (in millions), which is calculated as the sum of AUMs of all hedge funds managed by a company at a quarter, hedge fund quarterly return, which is calculated as the percentage change of the net asset values of the fund company between the beginning and the end of a quarter, and hedge fund age (in

months), which is calculated as the asset weighted average age of the managed hedge funds. All these variables are used as control variables in regression analyses in section 4.3.

4 Affiliation and information acquisition

We begin the analysis by comparing the trading patterns of affiliated hedge funds with non-affiliated hedge funds. We also examine how hedge fund tradings relative to other institutional investors vary with the changes of information. Then we use regression analyses to test whether prime brokerage affiliations impact information acquisition of hedge funds.

4.1 Hedge fund trading measures

We use three measures to evaluate trading activities of hedge funds prior to the release of analysts' recommendations based on the Form 13F. The first measure is the holdings change ($\Delta shares_{j,i,t}$) of a hedge fund j, which is defined as the change in the number of shares held by the hedge fund in stock i during quarter t. The holdings change represents hedge fund's net buys or net sales of a particular stock over a quarter, which directly reflect the trading activities of hedge funds before the release of recommendations.

$$\Delta shares_{j,i,t} = shares_{j,i,t} - shares_{j,i,t-1} \tag{1}$$

It is intuitive that both hedge funds' buying and selling activities and analysts' recommendation changes are based on the anticipated stock market value. For example, hedge funds may buy more stocks with lower price and purchase less stocks that are more expensive. As a result, holding quantity based measure may bias the tests of information leakage to hedge funds. Therefore, as an alternative to holdings change, we define net trading value ($\$\Delta shares_{j,i,t}$) as the dollar turnover of hedge fund j's holdings in stock i over quarter t.

$$\$\Delta shares_{j,i,t} = shares_{j,i,t} * p_{i,t} - shares_{j,i,t-1} * p_{i,t-1} - shares_{j,i,t-1} * \Delta p_{i,t} \tag{2}$$

where $\Delta p_{i,t} = p_{i,t} - p_{i,t-1}$, and $p_{i,t}$ and $p_{i,t-1}$ is the share price of stock i at the end of quarter t and $t-1$, respectively. This measure is designed to control for the impact of level and movement of stock price on hedge fund trading.

The last measure is used to examine the likelihood of informed trading of hedge funds prior to recommendation changes. We introduce net trading ratio ($NTR_{i,t}$), which is calculated as the number of hedge funds js that trade in the same direction as recommendation change released on day d ($d > t$) on stock i scaled by the total number of hedge funds in the sample in quarter t.

$$NTR_{i,t} = \frac{\sum_{j \in HFSample} HF_{j,i,t} \; with \; sign(\Delta shares_{j,i,t}) = sign(\Delta rec_{i,d})}{\sum_{i \in RecSample} \sum_{j \in HFSample} HF_{j,i,t}} \tag{3}$$

Different than the previous two measures, net trading ratio is calculated on the stock level. If the direction of a hedge fund's trading is consistent with a recommendation change, the hedge fund might have acquired information on the analyst's report. If not, the hedge fund either did not get information or traded with its own skill. To the extent that trading ahead explains information leakage, net trading ratio measures the probability of information-induced trading of hedge funds, and the higher ratio indicates the higher probability of information leakage.

To examine information-induced trading, we categorize all hedge fund samples into two groups: affiliated and non-affiliated, and further divide each group into large and small hedge funds. Investment banks are more likely to cater to hedge funds that are their business clients, considering massive prime brokerage fees earned from these high net-worth investors. In addition, investment banks prefer to serve large-size hedge funds, as they possess a large amount of capitals and are expected to pay higher fees on financing spread and trading commissions. Therefore, considering the impact of fund size on banks' payback, we partition hedge funds into large and small funds based on their asset under management, with a threshold of $1 billion. If information leakage occurs, affiliated large hedge funds are expected to display superiority in pre-release trading than other funds.

Table 2 and Figure 2 presents statistical analysis for the trading of affiliated and non-affiliated hedge funds prior to the release of recommendations. We separately test the trading

of large and small hedge funds in upgrade and downgrade recommendations using three measures. Table 2 Panel A presents results for upgrade recommendations. The means and medians of the three measures are all positive for both large and small funds. For the affiliated large hedge funds, the average increments of share holdings and net trading values prior to the recommendation release are significantly greater than those of non-affiliated large hedge funds and small hedge funds. In contrast, small hedge funds do not show similar trading pattern differences between the affiliated and non-affiliated groups. In terms of net trading ratio, affiliated hedge funds show significant advantages over non-affiliated funds, either large or small funds, in buying upcoming upgrades beforehand. We do not observe obvious difference of net trading ratios between large and small hedge funds with prime brokerage affiliations.

For downgrade recommendations, as shown in Table 2 Panel B, the average share holdings and net trading values still increase over a quarter prior to the recommendation release. However, the magnitudes of increments for affiliated large funds are significantly smaller than those of non-affiliated large hedge funds and small hedge funds. In addition, the average net trading ratio of selling upcoming downgrades are significantly higher for affiliated hedge funds than for non-affiliated funds. The average net trading ratio of selling downgrades is comparable across large and small hedge funds.

These results provide evidence that affiliated hedge funds especially large ones trade advantageously over non-affiliated hedge funds on forthcoming recommendations. Specifically, affiliated large hedge funds tend to buy more upgrades and sell more (or buy less) downgrades prior to the release of recommendations than non-affiliated hedge funds. The results suggest the existence of information leakage on analysts' recommendations due to prime brokerage business relationships. We also find that, consistent with the profit-driven nature of the banking business, the magnitude of information leakage is positively related to fund size, as investment banks earn higher prime brokerage fees from large hedge funds. Small hedge funds may also acquire private information from investment bank, as their prime brokerage affiliations are associated with a higher likelihood of information-induced trading.

4.2 Information acquisition and trading demand

We further examine how hedge fund tradings vary with the change of information under the impact of prime brokerage affiliations. According to Kacperczyk and Seru (2007), if investors receive more precise private information before the release of recommendation, they are more sensitive to information than less-informed investors and trade advantageously on it. As information goes from private to public, demands of less-informed investors are more responsive to public information than informed investors. Thus, less-informed investors tend to boost (or cut) their holdings relative to informed investors after upgrade (or downgrade) recommendations are released. Based on this, we ask whether hedge funds show a similar trading pattern, and whether prime brokerage affiliation is an important determinant of this pattern?

Tests are based on the noisy Rational Expectations Equilibrium model of Grossman and Stiglitz (1980), which argues that as the quality of informed traders' information increase, the more their demands will vary with the information. In this paper, the premise of the argument is that prime brokerage affiliations with analysts' investment banks lead to more precised private signals received by hedge funds. Given this premise, if hedge funds receive prime brokerage services from analysts' investment banks, their aggregate demands for the forthcoming recommendations will change in a bigger magnitude with the change of information than those of non-affiliated funds.

We estimate relative trading demands of affiliated and non-affiliated hedge funds and test their difference prior to and after the release of recommendations. Relative trading demand is defined as the trading demand of hedge funds relative to that of other institutional investors. For each recommendation change, trading demand is calculated as the percentage changes of aggregate stock holdings in a quarter. We use the demand of other institutional investors as a benchmark in order to control for factors unrelated to information leakage[5].

In the unreported tests, trading demands are asymmetrically distributed, with the value spans from -0.42 to 7.502 for hedge funds and from -0.098 to 0.307 for other institutional investors.

[5]According to Klein, Saunders, and Wong (2014) and Swem (2014), other institutional investors do not show similar pre-recommendation trading patterns of buying upgrades and selling downgrades as hedge funds, suggesting that other institutional investors are uninformed relative to hedge funds.

For large hedge funds, the average pre-release demand for upgrades is significantly greater than that of other large institutional investors, either affiliated and non-affiliated. We do not observe particular pattern for small hedge funds and for the post-release trading. These results indicate that, relative to hedge funds, other institutional investors are uninformed of the upcoming analyst reports. Hedge funds trade actively in certain stocks and are among the most important players in equity market.

Table 3 presents the statistical analyses of relative trading demand of affiliated and non-affiliated hedge funds prior to (pre) and after (post) the release of analyst recommendations. We value-weight investors' demand for each stock by dividing investors' holding values in a stock with their holding values in all stocks in a quarter. We test the mean and median difference of pre-release and post-release relative demand for the two groups of hedge funds using paired t-test and Wilcoxon rank-sum test. We separately show the results for large and small hedge funds, as well as the mean trading demand of other large and small institutional investors.

Panel A show that, for upgrade recommendations, the pre-release relative trading demand of large hedge funds, either affiliated and non-affiliated, are significantly higher than their post-release relative demand. Two sample Wilcoxon rank-sum test shows that the average pre-release relative demand of affiliated large hedge funds is significantly greater than that of non-affiliated funds, whereas post-release tradings do not show a similar pattern. For the affiliated large hedge funds, the average variation of relative demand from pre- to post-release is 1.362, which is greater than 0.920 for the non-affiliated large hedge funds at 5% significance level. We do not observe similar demand patterns for the small hedge funds. These results provide evidence that large hedge funds especially affiliated ones tend to buy pre-release upgrades and reverse the trades after the release of recommendations.

Panel B presents the statistical analysis of relative trading demand around downgrade recommendations. The paired t-test results are not quite straightforward, as the potential decreases in demands are balanced out by big trades of large hedge funds. Nonetheless, we find that, for the affiliated large funds, the median relative demand is negative, suggesting that the probability that hedge funds sell more (or buy less) pre-release downgrades than other institutional investors

are above fifty percent. Moreover, unlike non-affiliated hedge funds, the average pre-release relative trading demand of affiliated hedge funds is not significantly higher than post-release relative demand, which is consistent with the test results for upgrade recommendations.

In sum, the analyses of relative trading demand in Table 3 provide support for the hypothesis, as affiliated hedge funds have a higher (or lower) pre-release trading demand for upgrades (or downgrades) than non-affiliated funds. More important, consistent with Kacperczyk and Seru (2007), the results suggest that affiliated hedge funds are sensitive to private information prior to the recommendation release and are less likely to rely on public information in the post-recommendation tradings than non-affiliated hedge funds. These results provide evidence on the importance of prime brokerage affiliations on the information acquisition of hedge funds.

4.3 Regression analysis of pre-release hedge fund trading

To test whether hedge funds that have prime brokerage affiliations with analysts' investment banks are more likely to obtain private information, we start by examining the timing of hedge fund trading prior to recommendation changes. We include additional 22,109 recommendation change samples, which are issued up to 10 trading days following the Form 13F quarter-end date. We line up these recommendation changes with hedge fund quarterly holdings from the Form 13F. The total samples for the timing test consist of 62 large hedge funds and 133 small hedge funds associated with 7,917 affiliated tradings and 17,890 non-affiliated tradings.

Following Klein, Saunders, and Wong (2014), we form 10 portfolios by assigning each recommendation change to a portfolio based on k days between the Form 13F quarter-end date t and the release date of recommendation d. We run the regression $\Delta share_{j,i,t} = \alpha_k + \beta_k \Delta rec_{i,d} + \epsilon_{i,k}$, where $\Delta share_{j,i,t}$ is the change in the number of shares held by hedge fund j in stock i during quarter t, and $\Delta rec_{i,d}$ is the change of an analyst's recommendation for stock i issued on day d ($d = t + k, k = 1, 2, ..., 10\ day(s)$). Yearly fixed effects are included, and standard errors are clustered by hedge funds and investment banks. The estimated β_k infers whether hedge funds trade k day(s) prior to recommendation release.

Table 4 reports results for the estimated β_k for each portfolio, with the last row shows results for the aggregated 5 portfolios from day $d = t + 6$ to $t + 10$. We separately estimate β_k for the affiliated and non-affiliated hedge funds. The results show that only β_1 and β_2 for affiliated hedge funds are positive and significant, and β_k from $d = 3$ to $d = 10$ are insignificant for any group of hedge funds. Consistent with Irvine, Lipson, and Puckett (2007) and Klein, Saunders, and Wong (2014), these results provide evidence that affiliated large hedge funds trade one or two days prior to recommendation changes, suggesting the existence of information leakage of analysts' recommendation. Therefore, in order to examine the effect of prime brokerage affiliations on hedge fund trading, we focus on recommendations issued up to two trading days following the Form 13F quarter-end date throughout the rest of this paper.

We then perform three sets of multivariate regressions on hedge fund tradings, which are measured using $\Delta shares$, $\$\Delta shares$, and NTR, respectively, to examine trading activities of individual hedge funds prior to recommendation changes. As discussed above, hedge funds are categorized into four groups: affiliated large, non-affiliated large, affiliated small, and non-affiliated small, and we generate a corresponding dummy variable for each group: AL, NAL, AS, and NAS. We use non-affiliated small group as a base group and include the other three dummy variables along with their interactions with Δrec in the regression. We include a vector of variables for stocks, analysts, and hedge funds to control for factors influencing hedge fund tradings. Analyst experience ($Ana\ exp$), which is calculated as the number of years since an analyst issued the first recommendation on I/B/E/S, controls for the effect of analyst experience on hedge fund tradings. Analyst coverage ($Coverage$), which is the number of analysts that issued at least one recommendation for a firm over a quarter, captures the impact of analyst opinions on fund tradings. The logarithm of stock market value ($Ln\ MV$) from the previous year, stock return ($Stk\ return$) over previous quarter, and stock turnover ($Stk\ turnover$) over previous quarter are used to control for the effect of firm size, stock return and turnover on fund tradings, respectively. $HF\ flow$ is the quarterly flow of a hedge fund company, calculated as the percentage change of AUMs of a fund company between the beginning and the end of a quarter. Hedge fund return ($HF\ return$), which is calculated as the percentage change of net asset values of a fund company between the beginning and the end of previous quarter, controls for fund performance effect. Hedge fund age ($HF\ age$),

which is calculated as the asset weighted average age (in months) of the managed hedge funds, controls for the fund age effect.

Table 5 reports test results of pre-release hedge fund tradings measured by $\Delta shares$ and $\$\Delta shares$, with Panel A shows the regression analysis for all hedge funds, Panel B presents the results of equality tests for the differences between regression coefficients in different groups, and Panel C, D, and E present the regression results for large hedge funds only. We include yearly fixed effect in the regressions, and standard errors are clustered by hedge funds and investment banks.

Panel A shows regression results for total recommendation changes, as well as non-negative and non-positive recommendation changes. In all models, the coefficients on interaction terms of Δrec and AL are positive and significant, indicating that affiliated large hedge funds tend to buy more shares for bigger upcoming upgrades and sell more shares for bigger upcoming downgrades. This result suggests that tradings of affiliated large hedge funds are positively associated with the forthcoming recommendation changes with the magnitude greater than that of the base group. The coefficients on Δrec and $\Delta rec \times NAL$ are not significant and are even significantly negative on $\Delta rec \times AS$ for the total and non-positive recommendation change samples, suggesting that the tradings of small hedge funds and non-affiliated hedge funds are inconsistent with the upcoming recommendation changes.

We also compare the trading behavior of three non-base groups by testing the differences of regression coefficients. Panel B presents F-stats of the equality tests between coefficients on three interaction variables. For the regressions of both $\Delta shares$ and $\$\Delta shares$, the coefficients of $\Delta rec \times AL$ are significantly bigger than those of $\Delta rec \times NAL$ and $\Delta rec \times AS$, suggesting that affiliated large hedge funds are more likely to buy upcoming upgrades and sell upcoming downgrades in a larger magnitude compared to other hedge funds. These results provide evidences on the information leakage hypothesis that affiliated large hedge funds are more likely to acquire private information on upcoming stock recommendations.

We perform the robustness tests by doing regression analyses for large hedge funds only. If information leakage is present, affiliated large hedge funds are expected to buy upgrades and sell downgrades prior to the release of reports even if analysts do not correctly predict market

reactions. Thus, we define Net-rec as hedge funds that trade in the same direction as upcoming recommendation changes and Net-rec I as subsamples of Net-rec in which hedge fund tradings have different signs than those of stock abnormal returns in the corresponding month. The monthly stock abnormal returns are estimated from the Fama-French-Carhart (see Carhart, 1997) four-factor model[6].

Panel C, D, and E in Table 5 present the regression results of upgrades & downgrades, upgrades, and downgrades, respectively, and for the total samples of large hedge funds, Net-rec, and Net-rec I, separately. For the regressions of both $\Delta shares$ and $\$\Delta shares$, the coefficients on $\Delta rec \times AL$ are positive and significant for the total samples and for the Net-rec samples in upgrades & downgrades. These results are consistent with the previous test results. More importantly, the results provide strong evidence that affiliated large hedge funds are privately informed on analysts' recommendations and they trade ahead by taking advantage of it.

As a result of robustness check, the coefficients on $\Delta rec \times AL$ for Net-rec I in the regressions of both $\Delta shares$ and $\$\Delta shares$ are significant and positive in the downgrades samples in Panel E. The results provide evidence that hedge funds are likely to sell ahead prior to the release of downgrade recommendations, even if the expected stock price downward heading does not occur. However, for upgraded stocks with negative post-event abnormal returns, we do not find the similar trading patterns. A potential explanation is that analysts are more likely to tip off hedge funds on the upcoming downgrade recommendations than on upgrade recommendations. According to Barber et al. (2005), analysts are reluctant to downgrade stocks that are predicted to have dimming prospects. If there is a downgrade recommendation, the chances that the subsequent stock price heads downward is bigger, relative to the chances of heading upward after a upgrade recommendation. Therefore, private information on downgrades is more valuable than that on upgrades for hedge funds with prime brokerage affiliations.

Another possible reason is that investors are downside risk averse. If information uncertainty is high, hedge funds would rely more on its own skills or other information sources than purely on private information from analysts to trade stocks with bright prospects. However, for the

[6]We are grateful to Kenneth French for making the data on the four factors available for download from his website at `http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html`.

expected downgraded stocks, affiliated hedge funds tend to put more weight on analysts' opinions and reduce their share holdings more than they should have done based on the acquired information. As a result, the difference of trading sensitivity to downgrade information between affiliated and non-affiliated hedge funds become bigger, compared to funds' reactions to upgrade information. In addition, information leakage of downgrade recommendations may lead to more short selling of hedge funds with prime brokerage affiliations, which is beyond the discussion of this paper and need further data supports.

To examine the pervasiveness of information leakage, we further perform stock-level regression analyses of the pre-release hedge fund trading measured by net trading ratio (NTR).

$$NTR_{i,t} = \alpha_d + \beta_{1d}\Delta rec_{i,d} + \beta_{2d}AR_{i,d} + \beta_{3d}\Delta rec_{i,d} \times AR_{i,d} + \gamma_d X_{i,t-1} + \epsilon_{i,d} \qquad (4)$$

where $\Delta rec_{i,d}$ is the change of an analyst's recommendation for stock i issued on day d, which is one or two trading days following the Form 13F report date t ($d = t+1$ or $t+2$), $AR_{i,d}$ is a dummy variable indicating whether the recommendation is affiliated, that is, whether at least one affiliated hedge funds have positions in the stock i, $\Delta rec_{i,d} \times AR_{i,d}$ is an interaction variable of $\Delta rec_{i,d}$ and $AR_{i,d}$, and $X_{i,t-1}$ is a vector of control variables for analysts and stocks in quarter $t-1$, including $Ana\ exp$, $Coverage$, $Ln\ MV$, $Stk\ return$, and $Stk\ turnover$.

We separately compute NTR for large hedge funds and small hedge funds, denoted as NTR_L and NTR_S, respectively, and estimate a system of two equations simultaneously using seemingly unrelated regressions (SUR). We do not use independent ordinary least squares (OLS) estimation of the two equations because the error terms in two models are correlated, and it is more efficient to use a joint estimation than OLS.

Table 6 reports the results of SUR tests, with Panel A presents the regression analysis for upgrades and downgrades and Panel B presents the results of equality tests for the coefficient differences between large and small hedge funds. As Panel A shows, in both models, the coefficients on Δrec and $\Delta rec \times AR$ are significantly positive for upgrade recommendations and significantly negative for downgrade recommendations. These results provide evidence that bigger upgrade (or downgrade) recommendations are associated with higher percentage of stock purchase (or selling)

by hedge funds, either affiliated or non-affiliated. More importantly, we find that affiliated hedge funds have a significantly higher probability to trade in a way that is consistent with upcoming recommendation changes than non-affiliated hedge funds. The results suggest the existence of information leakage from investment banks to affiliated hedge funds.

These results hold even for small hedge funds, indicating that not merely large hedge funds but small hedge funds acquire more or less information on analysts' recommendations. There might be other channels through which hedge funds get private information on stock trading, however, the positive coefficients on $\Delta rec \times AR$ suggest that small hedge funds are also tipped by investment banks. Based on this, we further examine the extent to which small hedge funds differ from large hedge funds in information acquisition by testing the differences of regression coefficients between large and small hedge funds. The Chi-square test results are presented in Table 6 Panel B. The results show that, for upgrade recommendations, the coefficient on $\Delta rec \times AR$ for large hedge funds is higher than that for small hedge funds at 1% significance level, whereas no similar pattern is observed for downgrade recommendations. These results suggest that affiliated large hedge funds are more likely to acquire private information on upcoming upgrades than small hedge funds, but for downgrade recommendations, the chances of being tipped off are alike between large and small hedge funds.

In summary, the results suggest that the prime brokerage affiliations of hedge funds with analysts' investment banks contribute positively to the trading of hedge funds in relation to recommendation changes. Moreover, it shows that affiliated hedge funds are more likely to buy stocks on upcoming upgrades or sell stocks on upcoming downgrades. Given that the coefficients on the interaction of recommendation changes and affiliations proxy for the information leakage, the results support the hypothesis that hedge funds are more likely to acquire private information on forthcoming stock recommendations if they have prime brokerage relationships with analysts' investment banks.

5 Affiliations and abnormal returns

In this section, we compare the post-recommendation abnormal returns earned by affiliated and non-affiliated hedge funds. We then do the robustness check by testing whether the abnormal returns are determined by the characteristics of recommendations, analysts, or fund managers.

5.1 Abnormal returns: affiliated vs. non-affiliated hedge funds

If investment banks compete for prime brokerage businesses, we would expect that trading based on banks' private information leads to higher profits for affiliated hedge fund clients. In order to evaluate the investment values of informed trading, we focus on net-rec tradings. We define net-rec tradings as hedge fund tradings that are in the same direction as the subsequent recommendation changes. We include only hedge funds with stock holdings increased (or decrease) one or two days before the public release of upgrade (or downgrade) recommendations. The analyses are performed separately for upgrade and downgrade recommendations.

We partition the stocks held by affiliated and non-affiliated hedge funds and received recommendations from analysts into two portfolios, with each portfolio weighted by the dollar value of stock holdings of each hedge fund. The portfolios are rebalanced at the end of every quarter so that the latest fund trades are included in the portfolios at each point in time. Over the sample period, 362 tradings for upgrades and 441 tradings for downgrades are classified in the affiliated group, and 947 tradings for upgrades and 1355 tradings for downgrades are classified in the non-affiliated group, respectively.

To evaluate variations in returns earned by hedge funds, we compute the abnormal return of a stock as the difference between the stock return and the return of one of the 125 benchmark portfolios that have comparable characteristics in size, book-to-market ratio, and past stock returns (Daniel, Grinblatt, Titman, and Wermers 1997, thereafter DGTW[7]). The cumulative abnormal return (CAR) of each stock held by hedge fund are then calculated based on d days (d=2, 30, 60, 90, 120, 150, 180, 270, and 360 days) trading windows after the recommendation release date.

[7]The DGTW benchmarks are available via `http://www.smith.umd.edu/faculty/rwermers/ftpsite/Dgtw/coverpage.htm`

Table 7 and Figure 3 present post-recommendation cumulative abnormal returns of the affiliated and non-affiliated portfolios. The average cumulative abnormal returns in d days (d=2, 30, 60, 90, 120, 150, 180, 270, and 360 days) after recommendation release date are reported for upgrades and downgrades, respectively. In Table 7 Panel A, the average CARs in all time windows subsequent to upgrades are significantly positive for the affiliated portfolios, with the highest 360-day average CAR of 0.0718 and the lowest 30-day average CAR of 0.0082. However, it is the case only for the 2-day average CAR for the non-affiliated portfolios. Except for the 30-day window, the average post-upgrades CARs in all time windows of the affiliated portfolios are higher than those of the non-affiliated portfolios at the 1% significance level. The test results suggest that affiliated hedge funds earn higher post-event short-term abnormal returns by buying prior to upgrades than do non-affiliated hedge funds.

Table 7 Panel B presents the analyses of post-downgrades average CARs of the affiliated and non-affiliated portfolios. From the 2-day to 120-day time windows, the average CARs of the affiliated portfolios are significantly lower than those of the non-affiliated portfolios at 1% level, suggesting that the prime brokerage affiliations help hedge funds avoid negative or relatively low abnormal returns induced by the release of downgrade recommendations. For the remaining time windows, the average CARs of the affiliated portfolio show a growing pattern relative to those of the non-affiliated portfolio. These results suggest the potential profitable opportunities for the reverse tradings of hedge funds after downgrades.

We further analyze the short-term abnormal returns earned by hedge funds through informed trading based on two characteristics. The first is the reputation of the analysts issuing recommendations. A star is defined as any analyst that ranked as an All-American (first, second, third, or runner-up teams) in the annual polls in the Institutional Investor magazine. The star characteristics indicate that an analyst has a high reputation relative to others, and a recommendation issued by the star analyst could cause extensive attention in the market.

The second characteristics is the influence of recommendation changes on stock price. A recommendation change is influential if it has a significant impact on the stock price of the covered firm, as many investors adjust their holdings to the information produced by analysts. Based on Loh and Stulz (2011), we identify an influential recommendation by checking if the two-day CAR is in

the same direction as the recommendation change and the absolute value of CAR exceeds $1.96 \times \sqrt{2} \times \sigma_\epsilon$, where σ_ϵ is the standard deviation of residuals from a daily time-series regression of past three-month stock returns against market returns and the Fama-French factors SMB and HML. The purpose of characteristics-based analyses is to examine the impact of prime brokerage affiliations on the abnormal returns earned by hedge funds after controlling for analyst- and recommendation-level factors.

Panel A and B in Table 8 provide the analyses of characteristics-based average CARs of affiliated and non-affiliated portfolios over 2 days, 30 days, 60 days, and 90 days. In the sample from 2003-2012, 8.75% of hedge fund tradings are in recommendations issued by star analysts and 17% in influential recommendations. From recommendations issued by both stars and by non-stars, the affiliated portfolios earn significantly higher average CARs and avoid significantly lower average CARs in 2-day, 60-day, and 90-day time windows than the non-affiliated portfolios[8]. The results suggest that prime brokerage affiliations with analysts' investment banks have positive impact on hedge funds' abnormal returns no matter whether the analysts are star analysts or not. A potential explanation is that analysts tend to show their favoritism to hedge funds, as hedge funds with affiliations are either important to their brokerage firms or important to their own compensation and future career[9].

In contrast, there are disparities between abnormal returns earned from influential and non-influential recommendations. Relative to non-affiliated hedge funds, affiliated hedge funds earn significantly higher average CARs and avoid significantly lower average CARs in most time windows by trading prior to non-influential recommendations. However, the average CARs earned or avoided from influential recommendations appear to be comparable across two portfolios, especially for upgrades. A potential explanation is that information leakage is less likely to occur among influential recommendations as analysts tend to hide their catering behavior in the non-influential recommendations.

[8]All upgraded recommendations issued by star analysts in the sample are in the affiliated portfolio, which indirectly provides evidence that affiliated hedge funds earn higher short-term abnormal returns than non-affiliated hedge funds (see Loh and Stulz (2011))

[9]Concerned about their compensation and career prospects, analysts are motivated to leak private information to their hedge fund clients as they attempt to win broker votes (see Maber (2014)) or the votes for All-America analysts from hedge funds.

In summary, the above analyses suggest that affiliated hedge funds earn higher post-recommendation abnormal returns by buying prior to upgrades and avoid lower post-recommendation abnormal returns by selling prior to downgrades than non-affiliated hedge funds. Test results are consistent with the hypothesis that hedge funds with prime brokerage affiliations with analysts' employer are more likely to acquire profitable information on future stock recommendations from the analysts. Investment banks play an important role in offering profitable opportunities for hedge funds to buy (or sell) prior to upgrades (or downgrades) even after controlling for star analysts and influential recommendations.

5.2 Affiliations or skills?

We check the robustness of the results by testing whether affiliated hedge funds are more likely to invest in stocks that analysts issue profitable recommendations. If affiliated hedge funds have better stock picking and timing skills, would information be transmitted the other way around from hedge funds to analysts? Specifically, we examine whether the relatively high abnormal returns earned by affiliated hedge funds are determined by managers' skills in getting information from sources other than investment banks.

We examine hedge fund managers' skills based on fund alphas and compare them across the affiliated and non-affiliated portfolios. We estimate alpha of an individual hedge fund by adopting a rolling-window method to regress the net-of-fee monthly excess return (in excess of risk-free rate) of each hedge fund on the seven factors constructed by Fung and Hsieh (2004). The seven factors include the S&P 500 monthly return minus risk free rate, Russell 2000 index monthly return minus S&P 500 monthly return, change in the 10-year treasury constant maturity yield, change in the Moody's Baa yield less 10-year treasury constant maturity yield, the return of bond primitive trend-following strategy, the return of currency primitive trend following strategy, and the return of commodity primitive trend-following strategy. Following Naik, Ramadorai, and Stromqvist (2007), for each month, we calculate a fund's factor loadings of the seven factors using the previous 24 months of data, and obtain the risk-adjusted return as the fund's alpha. A fund company's alpha is calculated as the average alphas of the managed hedge funds in the same company.

In the unreported results, the average alpha is 1.33% for large hedge funds and 1.11% for small hedge funds. The alphas are comparable across affiliated and non-affiliated hedge funds, either large or small, suggesting that affiliated hedge funds are not more skillful in equity tradings than non-affiliated hedge funds.

Table 9 presents the analyses of post-recommendation cumulative abnormal returns of affiliated and non-affiliated portfolios by controlling for managers' alphas. We separately sort large and small hedge funds into three terciles based on fund's alpha in a quarter, with the top and bottom terciles defined as high alpha and low alpha hedge funds, respectively. We test the differences of CARs over 2-day, 30-day, 60-day, and 90-day windows between affiliated and non-affiliated portfolios for the high alpha and low alpha hedge funds, respectively. If the affiliated and non-affiliated hedge funds with comparable skills show differences in abnormal returns, it is likely that the disparities are from the "hidden" skills or affiliation-driven skills of hedge funds.

We find that, in the high alpha hedge fund group, the post-upgrade (or post-downgrade) CARs of affiliated portfolio are significantly higher (or lower) than those of non-affiliated portfolio in most of the reported time windows. However, the similar difference pattern only exist in the 2-day window in the low alpha group. The results of robustness tests support the hypotheses after controlling for hedge fund managers' skills. Hedge funds benefit from the prime brokerage affiliations with analysts' investment banks by investing in stocks that analysts issue profitable recommendations.

We also find that, only in the affiliated portfolios, the highly-skilled hedge funds display superiority in earning higher post-upgrade abnormal returns or avoid lower post-downgrade abnormal returns, relative to the less-skilled hedge funds. These results indicate that hedge fund skills in stock investments can be realized only in an informed environment, and private information plays an important role in making difference in the equity trading skills of hedge funds. These results also provide support that investment banks tend to cater to hedge funds with high skills by providing them with more profitable opportunities, in expectation of higher rewards in the future.

5.3 Hedge fund risk exposure

So far we have shown the beneficial impact of investment banks on hedge fund equity investments by examining the short-term stock abnormal returns. A concern we address here is the extent to which values are added to hedge funds through informed tradings. Sharpe (1992) show that an asset class factor model can be used to determine how effectively individual fund managers have allocated the overall assets and achieved performance target through active management. The funds' risk/reward characteristics can be captured by taking on risk exposures on certain factors, with the weights estimated by regressing individual fund returns on the risk factors (Hasanhodzica and Lo (2006)). Accordingly, we use a linear factor model to examine the exposure of hedge fund returns to recommendation changes. If hedge funds with prime brokerage affiliations have priority in acquiring information on analysts' recommendations, we anticipate that these hedge funds have higher exposure to the stock recommendation changes with large market reactions.

We perform the analysis by constructing recommendation factors for hedge funds and examining the allocation of hedge funds' portfolios among recommendation-oriented asset classes. We focus on hedge funds that earn immediate positive two-day abnormal returns by buying upgrades and avoid immediate negative two-day abnormal returns by selling downgrades prior to the recommendation release. For a hedge fund, the immediate profits earned (or the losses avoided) in each share of stock is the two-day CAR (or -CAR) of an analyst recommendation. We use the earned profits to denote the immediate positive profits earned and the immediate negative losses avoided by hedge funds in the following text. To effectively compare the investment values of affiliated and non-affiliated hedge funds, we choose 3 stocks with the highest earned profits out of those invested by affiliated hedge funds and 3 stocks with the highest earned profits out of those invested by non-affiliated hedge funds. We put each stock into one of the six barrels that belong to two different groups and rank the stocks by earned profits from high to low in each group. We refer to the time-series stock returns in each barrel as a recommendation factor.

We perform a time-series regression of hedge funds' monthly returns on the recommenda-

tion factors and the Fama-French-Carhart four factors.

$$R_{it} = \sum_{k=1}^{3} \beta_{ik}\ A.\ RecFactor_{kt} + \sum_{k=1}^{3} \gamma_{ik}\ NA.\ RecFactor_{kt} + \delta_1 MKT_t + \delta_2 SMB_t + \delta_3 HML_t + \delta_4 MOM_t + \epsilon_{it} \quad (5)$$

where $A.\ RecFactor_{kt}$ is the recommendation factor k in the affiliated group in month t, $NA.\ RecFactor_{kt}$ is the recommendation factor k in the non-affiliated group in month t, R_{it} is the return of hedge fund i in month t, and MKT_t, SMB_t, HML_t, and MOM_t are the Fama-French-Carhart four factors, respectively. β_{ik} and γ_{ik} are factor loadings on recommendation factor k in the affiliated and non-affiliated groups, respectively, which reflect the extent to which hedge fund returns are exposed to the recommendation changes.

Table 10 shows the analyses of hedge funds' exposure to analysts' recommendation changes. The results are presented separately for large and small hedge funds. From $k = 1$ to 3, the mean and median factor loadings β_{ik}s in the affiliated groups, either large or small, are bigger than the mean and median γ_{ik}s in the non-affiliated group at 1% significance level. These results suggest that, relative to non-affiliated hedge funds, significantly bigger proportion of funds' returns in the affiliated group are attributable to recommendation changes. As affiliated hedge funds do not have superior skills in stock trading, the higher exposure of their returns to recommendation changes is consistent with the hypothesis that hedge funds with prime brokerage affiliations are more likely to acquire private information on future analysts' recommendations.

Even the most intentional catering behavior can be unhelpful to hedge funds if the recommendation change does not move stock price. In the unreported test, we construct recommendation factors by choosing 3 stocks with the lowest profits out of those invested by hedge funds in affiliated and non-affiliated groups, respectively, and test the weights on the recommendation factors in two groups through regression analyses. We find that the factor loadings are comparable across affiliated and non-affiliated groups for both large and small hedge funds.

The exposure analysis provide evidence that prime brokerage affiliations with analysts' investment banks add values to hedge funds by providing them with profitable investment opportunities. Investment banks offer benefits to hedge funds in addition to the prime brokerage services

they meant to provide, in order to attract customers and boost their competitiveness in the prime businesses.

6 Conclusions

The paper examines the channel through which hedge funds obtain private information on analysts' recommendations by testing their trading behaviors before public release of analysts' reports. Empirical results provide strong support for the importance of prime brokerage affiliations on information acquisition of hedge funds. First, we find that affiliated hedge funds buy (or sell) stocks one or two days before the public release of upgrade (or downgrade) recommendations. Second, affiliated large hedge funds tend to buy upgrades and sell downgrades in a larger magnitude compare to non-affiliated hedge funds. Third, affiliated hedge funds have a higher probability to trade in a way that is consistent with upcoming recommendation changes than non-affiliated hedge funds. Fourth, affiliated hedge funds earn higher (or avoid lower) short-term abnormal returns by buying (or selling) before upgrades (or downgrades) than non-affiliated hedge funds.

We show that, although affiliated large hedge funds have a higher (or lower) average pre-release demands for upgrades (or downgrades) than non-affiliated hedge funds, the same differences have not been observed in the post-recommendation tradings. Nor do we see difference in the magnitude of tradings between affiliated and non-affiliated small hedge funds. Nevertheless, we find that small hedge funds acquire private information from analysts' investment banks, as the probability that affiliated small funds trade ahead in the same direction as subsequent recommendation changes is higher compared to that of non-affiliated funds.

The results are robust after controlling for the characteristics of analysts and recommendations. We also test an alternative explanation that affiliated hedge funds are skillful enough to invest in stocks that analysts issue profitable recommendations. The test results do not bear out this explanation by showing that disparities of abnormal returns between affiliated and non-affiliated hedge funds still exist even if controlling for fund managers' alphas.

Some caveats should be noted in regards to the interpretation of my findings. First, data limitations make it impossible to estimate the quantitative benefits of leaking information to hedge

funds. As a result, we are unable to build a direct connection between hedge fund tradings and investment bank revenues from prime brokerage business. The classification of large and small hedge funds alleviates this concern to some extent, as prime brokerage fees are likely positively related to the size of investors. Second, an alternative potential explanation for trading ahead is the analysts' optimistic reporting. According to Bilinsky, Cumming, and Hass (2014) and Chung and Teo (2012), analysts cater to hedge funds by issuing optimistic research reports, so that hedge funds can make profits by trading ahead in the same direction as the reports. The information leakage assertion does not disconfirming theirs, as both arguments can coexist and share the same purposes. However, analyst reports are likely to be determined by various factors in addition to the catering behaviors, and lacking of comprehensive empirical analyses makes the explanation relatively weak. In conclusion, the results provide strong evidence on the importance of investment banks in setting up information channels between hedge funds and analysts.

Appendix: Definitions of variables

Variable	Definition
Measures of hedge fund tradings	
Δshare	Holdings change, defined as the change in the number of shares held by the hedge fund in a stock in a quarter.
\$$\Delta$share	Net trading value, defined as the dollar value of the change in hedge fund shares holding in a stock over a quarter.
NTR	Net trading ratio, defined as the ratio of the number of hedge funds that trade in the same direction as the future recommendation changes on a stock to the total number of hedge funds in a quarter.
Relative demand	The percentage change of hedge fund holdings relative to that of other institutions over a quarter.
Analyst and recommendation characteristics	
Analyst experience	The number of quarters since an analyst issued the first recommendation on I/B/E/S.
Analyst coverage	The number of analysts that issued at least one recommendation for a firm over a quarter.
Influential Δrec	A recommendation change is influential in stock returns if its associated abnormal return is in the same direction as the recommendation change and is statistically significant (See Loh and Stulz (2011)).
Star analyst	An indicator variable that equals one if the analyst is ranked as an All-American (first, second, third, or runner-up teams) in the annual polls in the Institutional Investor magazine.
Stock characteristics	
Market value	Firm market value at the fiscal year-end.
Stock return	The return of a stock over a quarter.
Stock turnover	The turnover of a stock over a quarter.
Hedge fund characteristics	
HF AUM	The asset under management of a hedge fund company, calculated the sum of AUMs of all hedge funds managed by a company at a quarter.
HF return	The quarterly rate of return of a hedge fund company, calculated as the percentage change the net asset values of the fund company between the beginning and the end of a quarter.
HF Flow	The quarterly flow of a hedge fund company, calculated as the percentage change of AUMs of the fund company between the beginning and the end of a quarter.
HF Age	The age of a hedge fund company, calculated as the asset weighted average age of the management hedge funds.

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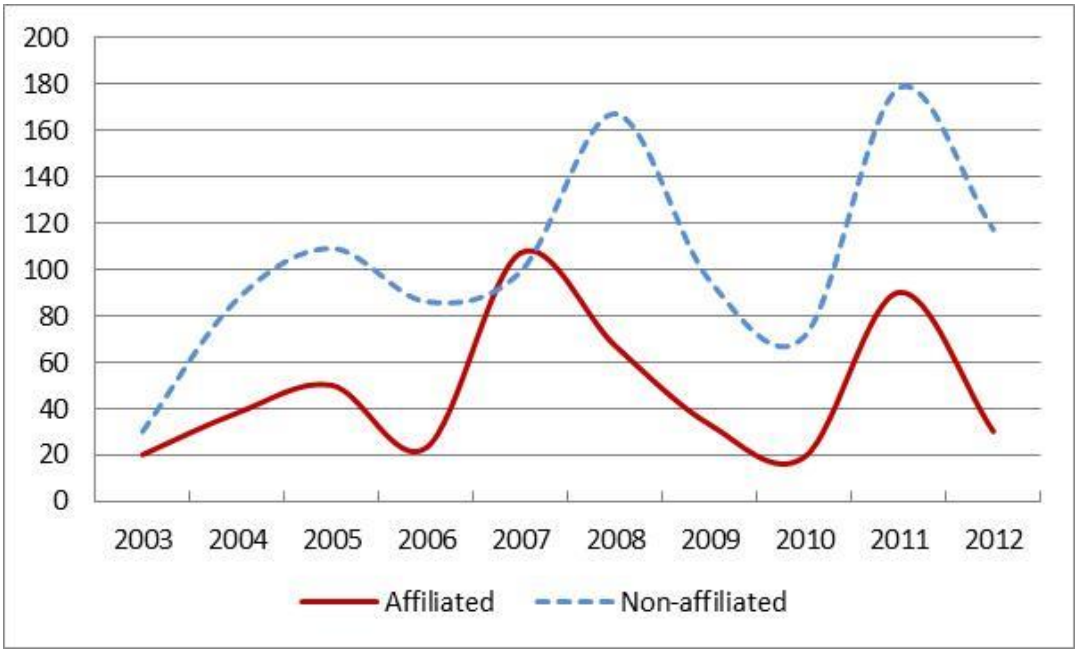


Figure 1: The cumulative hedge fund tradings: affiliated vs non-affiliated

The figure plots the number of cumulative tradings prior to recommendation changes of affiliate and non-affiliated hedge funds by years. Affiliated hedge funds are hedge funds that use reporting analysts' investment banks as their prime brokers. The remaining funds are non-affiliated hedge funds.

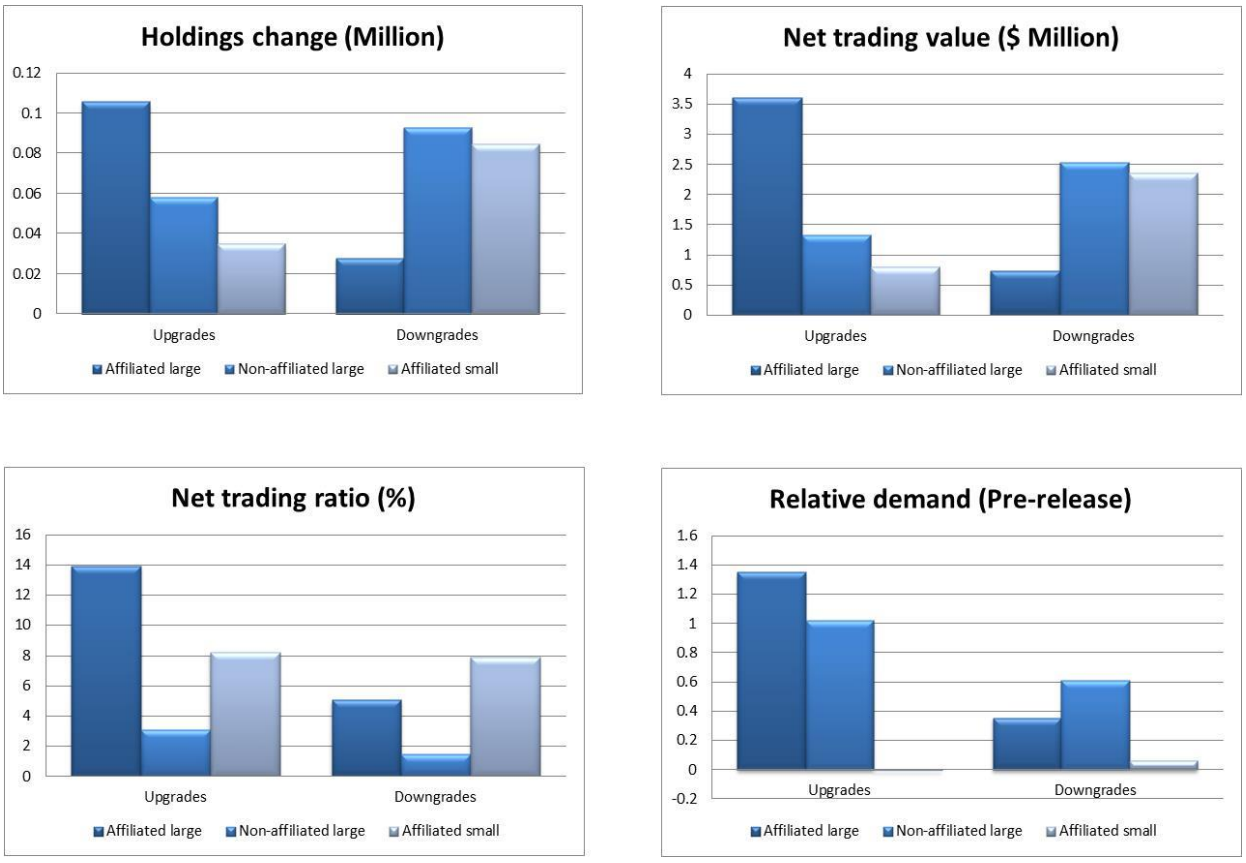
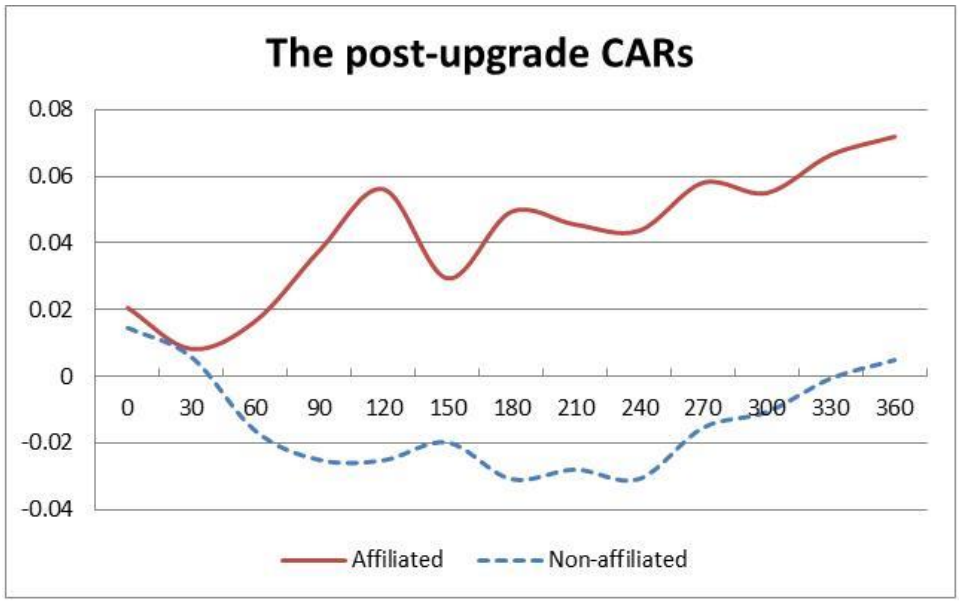


Figure 2: The measures of trading activities: affiliated vs non-affiliated hedge funds

The figure plots the averages of hedge fund tradings for two different fund groups: affiliated and non-affiliated. The measures of hedge fund trading activities include holdings change, net trading value, net trading ratio, and pre-release relative demand, which are defined in Section 4.1 and 4.2. Affiliated hedge funds are hedge funds that use reporting analysts' investment banks as their prime brokers. The remaining funds are non-affiliated hedge funds. Hedge funds with asset under management no less than $1 billion are defined as large hedge funds, and small hedge funds otherwise.



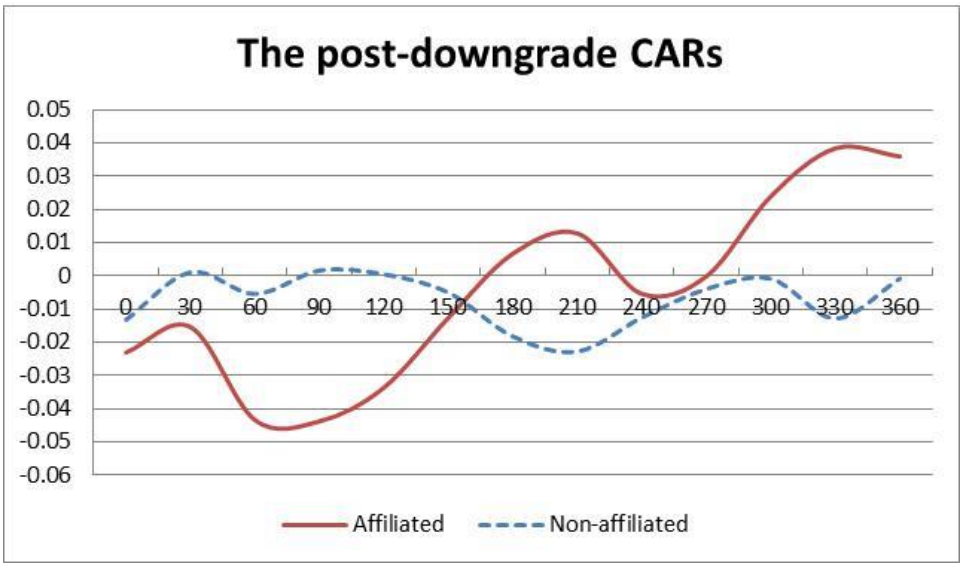


Figure 3: The post-recommendation CARs: affiliated vs. non-affiliated portfolios

The figures plot the post-recommendation cumulative abnormal returns of stocks invested by affiliate and non-affiliated hedge funds, with the top one for upgrades and the bottom one for downgrades. Affiliated hedge funds are hedge funds that use reporting analysts' investment banks as their prime brokers. The remaining funds are non-affiliated hedge funds.

Table 1: Summary statistics of recommendation changes and hedge fund tradings

This table presents summary statistics of recommendation changes and hedge fund tradings. The recommendation change data are from I/B/E/S detail file matched with 13F institutional holding data and TASS hedge fund database from 2003 to 2012. Panel A shows the distribution of recommendation changes in the sample. Panel B shows the cumulative number of recommendation changes over years. Panel C shows the descriptive statistics for hedge fund tradings in recommended stocks, where Net-rec refers to hedge funds that trade in the same direction as recommendation changes, and Net-rec I refers to subsamples of Net-rec in which hedge fund tradings have different signs than those of stock abnormal returns in the corresponding month. Panel D shows the summary statistics for regression variables.

Panel A: recommendation change frequencies

Change in recommendations	Frequency	Percent	Cumulative Frequency	Cumulative Percent
-4	3	0.08	3	0.08
-3	16	0.43	19	0.51
-2	816	22.07	835	22.58
-1	961	25.99	1796	48.57
0	593	16.04	2389	64.60
1	776	20.98	3165	85.59
2	533	14.41	3698	100
3	0	0	3698	100
4	0	0	3698	100

Panel B: cumulative recommendation changes

	Total	Upgrades	Downgrades	No change
2003	192	60	74	58
2004	506	205	248	53
2005	475	142	206	127
2006	388	108	259	21
2007	421	97	204	120
2008	442	197	179	66
2009	266	92	133	41
2010	173	70	96	7
2011	502	218	214	70
2012	333	120	183	30
Average	370	131	180	59

Table 1 - continued

Panel C: descriptive statistics

	Total	Upgrades	Downgrades	NoChg	Net-rec	Net-rec I
All separate recommendation change samples						
Num of firms	539					
Num of investment banks	11					
Num of analysts	550					
Num of star analysts	25					
Num of rec changes	750	273	374	103	571	273
Num of affiliated recs	177	62	70	45	148	64
Num of non-affiliated recs	573	211	304	58	423	209
Num of influential recs	136	55	81	0	105	50
Num of non-influential recs	614	218	293	103	466	223
All hedge fund samples						
Num of hedge funds	176					
Num of hedge fund tradings	3698	1309	1796	593	1460	652
Affiliated tradings	1130	362	441	327	417	182
Non-affiliated tradings	2568	947	1355	266	1043	470
Large hedge fund samples						
Num of hedge funds	59					
Num of hedge fund tradings	1599	581	758	260	645	279
Affiliated tradings	504	172	192	140	196	87
Non-affiliated tradings	1095	409	566	120	449	192
Small hedge fund samples						
Num of hedge funds	117					
Num of hedge fund tradings	2099	728	1038	333	815	373
Affiliated tradings	626	190	249	187	221	95
Non-affiliated tradings	1473	538	789	146	594	278

Panel D: summary statistics for regression variables

	N	Mean	Median	Std Dev	Min	Max
Analyst experience (yrs)	3698	2.409	2	3.164	0	17
Coverage	3698	5.392	5	3.052	1	22
Ln MV ($ million)	3559	3.846	3.881	0.701	1.790	5.549
Stock return (qtrly)	3635	0.021	0.021	0.198	-0.670	1.296
Stock turnover (qtrly)	3635	0.846	0.681	0.642	0.055	4.067
Hedge fund AUM (million)	3612	18.598	18.739	1.509	11.512	23.083
Hedge fund return (qtrly)	3509	0.0183	0.019	0.089	-0.609	0.744
Hedge fund flow (qtrly)	3612	0.146	0.000	2.998	-1.032	69.051
Hedge fund age (months)	3612	84.095	61.026	68.297	0	310.614

Table 2: Statistical analysis of affiliated vs. non-affiliated trading

This table presents statistical analysis for the trading of affiliated and non-affiliated hedge funds prior to the release of recommendations. Hedge fund tradings are measured through holdings change, net trading value, and net trading ratio for upgrades (Panel A) and downgrades (Panel B), respectively. The last four columns test the mean differences, with t-values in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: upgrades

	Large hedge funds		Small hedge funds		Mean difference / t-value			
	Affiliated (1)	Non-aff. (2)	Affiliated (3)	Non-aff. (4)	(1)-(2)	(3)-(4)	(1)-(3)	(3)-(2)
Holdings change (Million)								
Mean	0.106	0.058	0.035	0.053	0.048**	-0.018	0.069***	-0.023
Median	0.017	0.007	0.004	0.005	(2.25)	(-1.06)	(2.67)	(-0.31)
Min	-0.314	-0.201	-0.525	-0.524				
Max	0.973	0.650	0.892	0.709				
Net trading value ($ Million)								
Mean	3.607	1.334	0.799	1.256	2.273***	-0.457	2.637***	-0.243
Median	0.389	0.129	0.126	0.149	(2.85)	(-0.58)	(3.28)	(-0.73)
Min	-41.075	-21.522	-70.072	-30.651				
Max	44.598	24.405	48.099	48.873				
Net trading ratio (%)								
Mean	13.876	3.097	8.175	3.134	10.780***	5.041***	2.265*	5.078***
Median	9.918	2.469	6.981	2.174	(6.94)	(5.52)	(1.76)	(5.26)
Min	0	0	0	0				
Max	66.667	11.428	28.571	12.001				

Panel B: downgrades

	Large hedge funds		Small hedge funds		Mean difference / t-value			
	Affiliated (1)	Non-aff. (2)	Affiliated (3)	Non-aff. (4)	(1)-(2)	(3)-(4)	(1)-(3)	(3)-(2)
Holdings change (Million)								
Mean	0.028	0.093	0.085	0.040	-0.064**	0.045	-0.051**	-0.008
Median	0.067	0.010	0.003	0.003	(-2.21)	(1.36)	(-2.20)	(-0.28)
Min	-0.893	-0.954	-2.011	-2.779				
Max	1.652	2.364	2.983	2.979				
Net trading value ($ Million)								
Mean	0.733	2.538	2.354	0.942	-1.805**	1.412**	-1.198**	-0.702
Median	0.222	0.333	0.122	0.117	(-2.07)	(2.20)	(-2.02)	(-0.39)
Min	-30.091	-17.130	-25.381	-30.641				
Max	33.856	61.259	38.204	35.168				
Net trading ratio (%)								
Mean	5.051	1.450	7.856	1.841	3.601***	6.015***	-0.404	6.406***
Median	2.941	0.855	8.088	1.138	(6.19)	(7.80)	(-0.47)	(4.58)
Min	0	0	0	0				
Max	22.222	9.524	30.769	10.526				

Table 3: Pre- and Post-release relative trading demands

This table presents the statistics of relative trading demand of affiliated and non-affiliated hedge funds prior to (pre) and subsequent to (post) the release of analyst recommendation changes. Relative trading demand is calculated as the percentage change in aggregate holdings of a stock in a quarter by hedge funds, relative to other institutional investors. Panel A and B present the relative trading demand for upgrade and downgrade recommendations, respectively. The last four columns test the mean and median differences between the two groups using paired t-test and Wilcoxon rank-sum test, respectively. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: upgrades

	Relative demand							
	Affiliated		Non-affiliated		Difference test			
	Pre	Post	Pre	Post	t-value		Wilcoxon p-val	
	(1)	(2)	(3)	(4)	(1)-(2)	(3)-(4)	(1)-(3)	(2)-(4)
Large hedge funds								
Mean	1.350	0.035	1.019	0.034	(2.76)	(2.61)	(0.0238)	(0.307)
Median	0.252	-0.002	0.049	-0.007	***	**	**	
Min	-0.563	-0.472	-0.563	-0.521				
Max	7.486	0.819	7.547	0.616				
INST mean	0.038	0.008	0.038	0.008				
Small hedge funds								
Mean	-0.008	0.083	0.005	0.022	(-0.71)	(1.08)	(0.438)	(0.0643)
Median	0.048	0.018	-0.051	-0.005				*
Min	-0.418	-0.178	-0.419	-0.303				
Max	0.685	0.432	0.689	0.510				
INST mean	0.137	-0.001	0.137	-0.001				

Panel B: downgrades

	Relative demand							
	Affiliated		Non-affiliated		Difference test			
	Pre	Post	Pre	Post	t-value		Wilcoxon p-val	
	(1)	(2)	(3)	(4)	(1)-(2)	(3)-(4)	(1)-(3)	(2)-(4)
Large hedge funds								
Mean	0.355	0.060	0.610	0.107	(0.83)	(3.1)	(0.0476)	(0.166)
Median	-0.022	0.002	0.055	0.034		***	**	
Min	-0.563	-0.472	-0.578	-0.472				
Max	3.401	0.819	3.527	0.861				
INST mean	0.050	0.005	0.050	0.005				
Small hedge funds								
Mean	0.063	0.053	0.015	0.039	(0.38)	(-0.22)	(0.408)	(0.523)
Median	-0.013	0.025	-0.043	0.009				
Min	-0.405	-0.296	-0.405	-0.296				
Max	0.744	0.479	0.850	0.496				
INST mean	0.127	0.008	0.127	0.008				

Table 4: The timing of hedge fund tradings prior to recommendation changes

This table presents the timing of affiliated and non-affiliated hedge fund trading by regressing stock holdings changes in quarter t on subsequent recommendation changes. Following Klein, Saunders, and Wong (2014), the estimated regression is: $\Delta share_{j,i,t} = \alpha_k + \beta_k \Delta rec_{i,d} + \epsilon_{i,k}$, where $\Delta share_{j,i,t}$ is the change in the number of shares held by hedge fund j in stock i during quarter t, and $\Delta rec_{i,d}$ is the change of an analyst's recommendation for stock i issued on day d $(d = t + k,\ k = 1, 2, ...,\ 10\ day(s))$. Ups and Downs refer to the samples that are associated with non-negative and non-positive recommendation changes, respectively. Standard errors are two-way clustered by hedge funds and investment banks. Yearly fixed effects are included. This table reports the estimated coefficients for affiliated and non-affiliated hedge fund trading from 2003 to 2012. T-values are presented in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Day d = Form 13F	β_k from regression $\Delta share_{j,i,t} = \alpha_k + \beta_k \Delta rec_{i,d} + \epsilon_{i,k}$					
quarter-end	Affiliated			Non-affiliated		
$t + k$ day(s)	Ups & Downs	Ups	Downs	Ups & Downs	Ups	Downs
$(k = 1, 2, ..., 10)$	(1)	(2)	(3)	(4)	(5)	(6)
$d = t + 1$	0.013*	0.059**	0.036*	0.006	-0.011	-0.037
	(1.76)	(2.21)	(1.72)	(0.73)	(-0.28)	(-0.93)
$d = t + 2$	0.021***	0.030***	0.068**†	0.001	-0.014	-0.008
	(7.21)	(3.89)	(2.10)	(0.21)	(-0.59)	(-0.62)
$d = t + 3$	0.015	0.017*	0.001	0.007	0.003	0.012
	(0.91)	(1.68)	(0.05)	(1.26)	(0.18)	(0.92)
$d = t + 4$	0.010	0.025	0.005	0.001	0.021	-0.013
	(1.02)	(1.15)	(0.58)	(0.12)	(0.94)	(-0.54)
$d = t + 5$	0.121	0.012	-0.017	-0.004	-0.025	0.014
	(1.17)	(0.85)	(-1.00)	(0.46)	(-0.71)	(0.36)
$d = t + 6$	-0.005	-0.006	-0.258	0.004	0.001	0.006
to $t + 10$	(-0.37)	(-0.24)	(-1.25)	(1.29)	(0.15)	(1.35)

† - Large hedge funds only.

Table 5: Regression analyses of hedge fund trading prior to recommendation changes

This table presents the regression analyses of hedge fund trading prior to recommendation changes. We line up hedge fund holdings reported at quarter-end date t in Form 13F with analyst recommendations released on days d ($d = t + 1$ or $t + 2$). The dependent variable is hedge fund trading, which is measured through $\Delta shares$ and $\$\Delta shares$ for a stock during quarter t. Independent variables are as follows: Δrec is the change of an analyst's recommendation for a stock released on day d. AL, NAL, and AS are dummy variables indicating the affiliated large hedge funds, non-affiliated large hedge funds, and affiliated small hedge funds, respectively. Three interaction variables are included: $\Delta rec \times AL$, $\Delta rec \times NAL$, and $\Delta rec \times AS$. $Ana\ exp$ is analyst experience calculated as the number of quarters since an analyst issued the first recommendation on I/B/E/S. $Coverage$ is the number of analysts that issued at least one recommendation for a firm over a quarter. $Ln\ MV$ is the logarithm of the firm's market value at last fiscal year-end. $Stk\ return$ is the return of a stock over last quarter. $Stk\ turnover$ is the turnover of a stock over last quarter. $HF\ return$ is the quarterly rate of return of a hedge fund company, calculated as the percentage change of net asset values of a fund company between the beginning and the end of last quarter. $HF\ flow$ is the quarterly flow of a hedge fund company, calculated as the percentage change of AUMs of a fund company between the beginning and the end of a quarter. $HF\ age$ the age of a hedge fund company, calculated as the asset weighted average age (in months) of the managed hedge funds. Panel A presents the regression analyses of using two different measures as dependent variables, with column (1) and (4) show the results for total samples, column (2) and (5) for non-negative recommendation changes, and column (3) and (6) for non-positive recommendation changes. Panel B presents the F-stats of equality tests between regression coefficients of the two regressions. Panel C presents the regression analysis of large hedge funds, with Net-rec in column (2) and (5) refers to the hedge funds that trade in the same direction as recommendation changes and Net-rec I in column (3) and (6) refers to the subsamples of Net-recs that have different signs than those of the corresponding monthly stock abnormal returns. Yearly fixed effects are included. Standard errors are two-way clustered by hedge funds and investment banks. The table reports the estimated coefficients for the entire period from 2003 to 2012. The last three rows report the number of observations, the adjusted R^2, and the F-tests results of each regression. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: regression analysis

	Δshares (Million)						$Δshares (Million)					
	Total (1)	t-val	Ups (2)	t-val	Downs (3)	t-val	Total (4)	t-val	Ups (5)	t-val	Downs (6)	t-val
Δrec	0.025	0.36	-0.009	-0.73	-0.002	-0.42	0.074	0.64	0.034	0.10	-0.082	-0.20
AL	0.024	0.97	-0.005	-0.27	0.022	1.49	1.005	1.52	1.153	1.15	0.843	1.09
AS	-0.006	-0.35	-0.037**	-2.59	-0.010	-0.97	-0.093	-0.28	-0.507	-0.76	-0.747	-1.52
NAL	0.016	0.67	0.016	0.73	0.002	0.10	0.437	0.77	0.799	0.94	-0.539	-0.61
$\Delta rec \times AL$	0.025***	3.51	0.050***	2.81	0.025***	2.85	0.723***	3.94	0.472	1.49	1.218**	2.49
$\Delta rec \times AS$	-0.021**	-2.25	0.002	0.05	-0.021*	-1.93	-0.727***	-3.31	-0.546	-1.06	-0.806*	-1.92
$\Delta rec \times NAL$	0.006	0.54	0.006	0.58	-0.001	-0.16	0.065	0.20	-0.138	-0.56	-0.232	-0.60
$Ana\ exp$	-0.0006	-0.55	-0.0003	-0.31	0.0002	0.01	-0.005	-0.14	-0.036	-0.74	-0.003	-0.06
$Coverage$	0.002	1.07	0.0025	0.70	-0.0007	-0.29	0.025	0.29	0.126	0.98	-0.023	-0.28
$ln\ MV$	0.006	0.75	0.017*	1.80	0.009	0.85	0.491*	1.78	0.621**	2.05	0.935**	2.54
$Stk\ return$	0.007	0.39	0.022	0.71	-0.001	-0.08	0.769	1.06	1.205	1.06	1.068	1.40
$Stk\ turnover$	-0.001	-0.11	-0.007	-0.81	0.011	0.77	-0.139	-0.43	-0.257	-0.53	0.293	0.73
$HF\ return$	-0.027	-0.38	-0.033	-0.53	-0.050	-0.58	-0.658	-0.34	-1.879	-1.04	-3.083	-0.94
$HF\ flow$	0.0007	0.39	0.001	0.04	0.002	0.08	0.031	0.04	0.035	0.10	0.073	0.07
$HF\ age$	0.0001	0.49	0.0001	0.74	-0.00003	-0.69	0.001	0.32	0.003	0.63	-0.004	-1.32
$Constant$	-0.0209	-0.49	-0.072	-1.35	0.001	0.02	-1.293	-1.25	-2.30**	-1.99	-1.661	-1.32
Yearly fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
SE clustered by HF	Yes		Yes		Yes		Yes		Yes		Yes	
SE clustered by IB	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	3698		1902		2389		3698		1902		2389	
R-square	0.0252		0.0465		0.0253		0.0372		0.0631		0.0229	
F Statistic	6.70		6.17		17.54		11.10		14.73		22.42	

Table 5 - continued

Panel B: equality tests between regression coefficients (F-stats)

	Δshares (Million)						$Δshares (Million)					
	Total (1)		Ups (2)		Downs (3)		Total (4)		Ups (5)		Downs (6)	
$\Delta rec \times AL \quad - \quad \Delta rec \times NAL$	8.62	***	18.97	***	12.67	***	11.00	***	0.94		21.66	***
$\Delta rec \times AL \quad - \quad \Delta rec \times AS$	40.82	***	5.30	**	186.86	***	34.75	***	4.02	**	42.96	***
$\Delta rec \times NAL \; - \quad \Delta rec \times AS$	4.65	**	0.03		3.85	*	6.17	**	0.08		9.56	***

Panel C: regression analysis of large hedge funds: upgrades & downgrades

	Δshares (Million)						$Δshares (Million)					
	Total (1)	t-val	Net-rec (2)	t-val	Net-rec I (3)	t-val	Total (4)	t-val	Net-rec (5)	t-val	Net-rec I (6)	t-val
Δrec	0.006	0.90	0.073***	3.29	0.038***	3.75	0.091	0.24	1.899***	3.91	1.453**	2.08
AL	-0.002	-0.13	-0.001	-0.03	0.018*	1.89	0.146	0.33	0.691	0.17	1.300	2.08
$\Delta rec \times AL$	0.022**	3.01	0.062**	2.09	0.033	1.41	0.844***	3.22	2.441**	2.19	1.307	1.06
Control variables	Yes		Yes		Yes		Yes		Yes		Yes	
Yearly fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
SE clustered by HF	Yes		Yes		Yes		Yes		Yes		Yes	
SE clustered by IB	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	1599		645		404		1599		645		404	
R-square	0.0591		0.3426		0.2956		0.0587		0.3797		0.2808	
F Statistic	5.82		9.82		11.78		6.77		11.00		4.38	

Table 5 - continued

Panel D: regression analysis of large hedge funds: upgrades

	Δshares (Million)						$Δshares (Million)					
	Total (1)	t-val	Net-rec (2)	t-val	Net-rec I (3)	t-val	Total (4)	t-val	Net-rec (5)	t-val	Net-rec I (6)	t-val
Δrec	-0.001	-0.07	0.031	0.82	-0.013	-0.41	-0.167	-0.19	1.455	1.66	-0.508	-0.30
AL	-0.030**	-2.66	-0.071	-1.22	0.019	1.35	-0.036	-0.06	-2.313	-1.56	1.467	1.19
$\Delta rec \times AL$	0.046***	4.14	0.097*	1.74	-0.004	-0.19	0.708*	1.73	3.285*	1.84	-0.966	-0.72
Control variables	Yes		Yes		Yes		Yes		Yes		Yes	
Yearly fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
SE clustered by HF	Yes		Yes		Yes		Yes		Yes		Yes	
SE clustered by IB	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	581		280		121		581		280		121	
R-square	0.0747		0.1911		0.1835		0.1034		0.2340		0.2559	
F Statistic	3.27		7.81		2.08		8.94		7.89		2.39	

Panel E: regression analysis of large hedge funds: downgrades

	Δshares (Million)						$Δshares (Million)					
	Total (1)	t-val	Net-rec (2)	t-val	Net-rec I (3)	t-val	Total (4)	t-val	Net-rec (5)	t-val	Net-rec I (6)	t-val
Δrec	0.006	0.90	0.013	0.34	0.068	1.62	-0.052	-0.11	0.532	0.26	2.123	1.53
AL	-0.002	-0.13	0.067	0.71	0.029	1.43	0.840**	2.21	2.132	0.66	3.539**	2.00
$\Delta rec \times AL$	0.022**	3.01	0.066	1.10	0.068*	1.82	1.067**	2.02	1.641	0.71	4.825***	5.20
Control variables	Yes		Yes		Yes		Yes		Yes		Yes	
Yearly fixed effects	Yes		Yes		Yes		Yes		Yes		Yes	
SE clustered by HF	Yes		Yes		Yes		Yes		Yes		Yes	
SE clustered by IB	Yes		Yes		Yes		Yes		Yes		Yes	
Observations	758		365		158		758		365		158	
R-square	0.0591		0.1535		0.4633		0.0488		0.1921		0.4645	
F Statistic	5.82		2.19		7.57		2.42		2.16		7.66	

Table 6: Regression analyses of hedge fund trading on stock level

This table presents stock-level regression analysis of hedge fund trading prior to recommendation changes. We use Seemingly Unrelated Regressions (SUR) to estimated a system of four equations. The dependent variables are NTR_L and NTR_S, which are net trading ratio (NTR) of the stocks traded by large and small hedge funds, respectively. Independent variables include Δrec, which is the change of an analyst's recommendation for a stock issued up to two days following 13F report date, AR is a dummy variable indicating whether a stock receives at least one affiliated recommendations, $\Delta rec \times AR$ is an interaction variable of Δrec and $Affiliated$, $Ana\ exp$ is analyst experience calculated as the number of quarters since an analyst issued the first recommendation on I/B/E/S, $Coverage$ is the number of analysts that issued at least one recommendation for a firm over a quarter, $Ln\ MV$ is the log of the firm's market value at last fiscal year-end, $Stkreturn$ is the return of a stock over last quarter, and $Stkturnover$ is the turnover of a stock over last quarter. Panel A presents the regression analyses of upgrades and downgrades, respectively. Panel B shows the corresponding equality tests between estimated coefficients on $\Delta rec \times AR$ and Δrec. Z-values and χ^2 statistics for regression analyses and equality tests are reported. The last three rows in Panel A report the number of observations, the adjusted R^2, and the F-tests results of each regression. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: regression analysis

	Upgrades				Downgrades			
	NTR_L (1)	z-val	NTR_S (2)	z-val	NTR_L (3)	z-val	NTR_S (4)	z-val
Δrec	0.509**	2.39	0.819***	3.94	-0.551***	-3.93	-0.476***	-2.83
$Affiliated$	0.064	0.08	1.186*	1.88	1.260**	2.22	1.303**	2.20
$\Delta rec \times Affiliated$	5.505***	5.36	1.828**	2.21	-1.562**	-2.45	-1.916***	-3.19
$Ana\ exp$	0.013	0.16	-0.019	-0.25	-0.048	-0.89	0.003	0.07
$Coverage$	0.208**	1.97	0.038	0.34	0.153*	1.88	0.250**	2.19
$ln\ MV$	0.726	1.64	1.566***	4.37	0.995***	3.15	1.151***	4.05
$Stk\ return$	0.555	0.72	-0.206	-0.26	0.224	0.27	0.847	1.19
$Stk\ turnover$	-0.213	-0.67	0.410	0.72	-0.182	-0.43	-0.914**	-2.29
$Constant$	3.268***	8.26	2.643***	16.09	2.291***	14.76	2.325***	13.57
Yearly fixed effects	Yes		Yes		Yes		Yes	
SE clustered by stock	Yes		Yes		Yes		Yes	
Observations	273		273		374		374	
Adj r-square	0.2426		0.1957		0.2169		0.2806	
F Statistic	14.13		10.98		15.47		21.38	

Panel B: equality tests

Difference between regression coefficients	Upgrades			Downgrades	
$NTR\_L\ -\ NTR\_S$	χ^2	p-val		χ^2	p-val
$NTR\_L\ (\Delta rec \times Affiliated)\ -\ NTR\_S\ (\Delta rec \times Affiliated)$	10.73	0.0011	***	0.30	0.5812
$NTR\_L\ (\Delta rec)\ -\ NTR\_S\ (\Delta rec)$	1.57	0.2109		0.13	0.7190

Table 7: The post-recommendation CARs of stocks invested by the affiliated and non-affiliated hedge funds

This table presents the post-recommendation cumulative abnormal returns (CARs) the affiliated and non-affiliated portfolios. We include only hedge fund tradings that are in the same direction as recommendation changes. For each recommendation change, we calculate the abnormal return for a stock as the difference between the stock return and the return of one of 125 benchmark portfolios that have comparable characteristics in size, book-to-market ratio, and past stock returns (DGTW, 1997). The cumulative abnormal returns in d days (d=2, 30, 60, 90, 120, 150, 180, 270, and 360 days) after recommendation release are reported. The sample mean, t-statistics (in parenthesis), and mean difference are presented for the affiliated and non-affiliated portfolios. Panel A and Panel B present the results for upgrade and downgrade recommendations, respectively. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: upgrades

	The post-recommendation cumulative abnormal returns (CARs)								
	2 days	30 days	60 days	90 days	120 days	150 days	180 days	270 days	360 days
Affiliated	0.0206	0.0082	0.0166	0.0377	0.0561	0.0293	0.0493	0.0580	0.0718
	(14.99)	(1.92)	(2.52)	(4.31)	(4.91)	(2.13)	(3.09)	(4.00)	(4.12)
Non-affiliated	0.0146	0.0058	-0.0163	-0.0249	-0.0251	-0.0197	-0.0307	-0.0153	0.0049
	(17.59)	(1.27)	(-2.86)	(-3.43)	(-3.07)	(-2.25)	(-3.26)	(-1.46)	(0.44)
Affiliated - Non-affiliated	0.006***	0.002	0.033***	0.063***	0.081***	0.049***	0.08***	0.073***	0.067***
	(3.72)	(0.31)	(3.22)	(4.76)	(5.34)	(2.93)	(4.37)	(3.77)	(3.17)

Panel B: downgrades

	The post-recommendation cumulative abnormal returns (CARs)								
	2 days	30 days	60 days	90 days	120 days	150 days	180 days	270 days	360 days
Affiliated	-0.0230	-0.0154	-0.0434	-0.0438	-0.0336	-0.0126	0.0066	-0.0001	0.0359
	(-19.79)	(-3.12)	(-5.92)	(-5.08)	(-3.93)	(-1.27)	(0.65)	(-0.01)	(2.57)
Non-affiliated	-0.0132	0.0011	-0.0054	0.0016	0.0004	-0.0051	-0.0182	-0.0039	-0.0008
	(-17.87)	(0.37)	(-1.57)	(0.34)	(0.09)	(-0.99)	(-3.34)	(-0.58)	(-0.10)
Affiliated - Non-affiliated	-0.0098***	-0.0165***	-0.038***	-0.0454***	-0.0341***	-0.0075	0.025**	0.004	0.037**
	(-6.76)	(-2.89)	(-5.14)	(-4.82)	(-3.41)	(-0.71)	(2.22)	(0.27)	(2.25)

Table 8: Additional tests of CARs with conditioning variables

This table presents the additional tests for the short-term cumulative abnormal returns of affiliated and non-affiliated portfolios. We include only hedge fund tradings that are in the same direction as recommendation changes. The sample mean, t-statistics (in parenthesis), and mean difference are presented for the affiliated and non-affiliated portfolios. Star refers to the analyst that is ranked as an All-American in the annual polls in the Institutional Investor magazine. Influential refers to the influential recommendation change if its associated abnormal return is in the same direction as the recommendation change and is statistically significant (See Loh and Stulz (2011)). Panel A presents the results for recommendation changes made by star and non-star analysts. Panel B presents the results for influential and non-influential recommendation changes. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

Panel A: star vs non-star

	The average post-recommendation cumulative abnormal returns (CARs)							
	Upgrades				Downgrades			
	2 days	30 days	60 days	90 days	2 days	30 days	60 days	90 days
Star								
Affiliated	0.0205	-0.0025	0.0735	0.0463	-0.0333	-0.0351	-0.1822	-0.1299
	(10.91)	(-0.12)	(4.38)	(1.64)	(-11.88)	(-2.80)	(-9.15)	(-4.92)
Non-affiliated	-	-	-	-	-0.0073	-0.0397	-0.0843	-0.2424
					(-6.21)	(-1.92)	(-3.29)	(-3.14)
Affiliated - Non-affiliated	-	-	-	-	-0.026***	0.005	-0.0979***	0.113*
					(-5.57)	(0.19)	(-2.70)	(1.76)
Non-star								
Affiliated	0.0206	0.0096	0.0094	0.0366	-0.0212	-0.0119	-0.0186	-0.0284
	(13.46)	(2.38)	(1.34)	(3.97)	(-16.93)	(-2.22)	(-2.64)	(-3.24)
Non-affiliated	0.0146	0.0058	-0.0163	-0.0250	-0.0133	0.0018	-0.0039	0.0061
	(17.59)	(1.27)	(-2.86)	(-3.43)	(-17.71)	(-0.64)	(-1.13)	(1.42)
Affiliated - Non-affiliated	0.006***	0.004	0.0260**	0.0620***	-0.0079***	-0.0138**	-0.0147*	-0.0346***
	(3.52)	(0.46)	(2.39)	(4.45)	(-5.04)	(-2.26)	(-1.93)	(-3.68)

Table 8 - continued

Panel B: influential vs non-influential

	The average post-recommendation cumulative abnormal returns (CARs)							
	Upgrades				Downgrades			
	2 days	30 days	60 days	90 days	2 days	30 days	60 days	90 days
Influential								
Affiliated	0.0437	0.0275	0.0100	0.0909	-0.0442	-0.0160	-0.0436	-0.0204
	(17.25)	(3.64)	(2.27)	(7.21)	(-31.60)	(-1.54)	(-3.57)	(-2.05)
Non-affiliated	0.0420	0.0417	0.0341	0.0788	-0.0403	-0.0381	-0.0045	-0.0070
	(49.34)	(5.27)	(2.97)	(4.16)	(-28.26)	(-6.02)	(-0.61)	(-0.72)
Affiliated - Non-affiliated	0.0020	-0.0142	-0.0242	0.0120	-0.004*	0.022*	-0.039***	-0.0134
	(0.83)	(-1.02)	(-1.25)	(0.37)	(-1.80)	(1.92)	(-2.92)	(-0.87)
Non-influential								
Affiliated	0.0206	0.0096	0.0094	0.0366	-0.0212	-0.0119	-0.0186	-0.0284
	(13.46)	(2.38)	(1.34)	(3.97)	(-16.93)	(-2.22)	(-2.64)	(-3.24)
Non-affiliated	0.0146	0.0058	-0.0163	-0.0250	-0.0133	0.0018	-0.0039	0.0061
	(17.59)	(1.27)	(-2.86)	(-3.43)	(-17.71)	(-0.64)	(-1.13)	(1.42)
Affiliated - Non-affiliated	0.006***	0.004	0.0260**	0.0620***	-0.0079***	-0.0138**	-0.0147*	-0.0346***
	(3.52)	(0.46)	(2.39)	(4.45)	(-5.04)	(-2.26)	(-1.93)	(-3.68)

Table 9: Hedge fund managers' skills and the post-recommendation cumulative abnormal returns

This table presents the tests for short-term cumulative abnormal returns of stocks invested by hedge funds with high and low alphas. Hedge funds are sorted into three terciles based on fund's alpha in a quarter, with the top and bottom terciles defined as high alpha and low alpha hedge funds, respectively. The sample mean, t-statistics (in parenthesis), and mean difference are presented for the affiliated and non-affiliated portfolios. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

	The average post-recommendation cumulative abnormal returns (CARs)							
	Upgrades				Downgrades			
	2 days	30 days	60 days	90 days	2 days	30 days	60 days	90 days
High alpha								
Affiliated	0.024	0.009	0.025	0.037	-0.020	-0.028	-0.046	-0.039
	(7.56)	(0.92)	(2.01)	(2.39)	(-3.36)	(-2.40)	(-3.46)	(-2.44)
Non-affiliated	0.016	0.010	0.000	-0.015	-0.014	-0.003	-0.011	-0.010
	(6.76)	(1.21)	(0.00)	(-1.27)	(-6.13)	(-0.79)	(-1.85)	(-1.24)
Affiliated - Non-affiliated	0.008**	-0.0008	0.025**	0.053***	-0.006***	-0.024**	-0.036***	-0.029**
	(2.48)	(-0.06)	(2.27)	(2.66)	(-3.42)	(-2.30)	(-2.78)	(-2.10)
Low alpha								
Affiliated	0.021	-0.008	0.0005	0.010	-0.028	-0.016	-0.015	-0.020
	(8.85)	(-1.03)	(0.05)	(0.69)	(-6.61)	(-1.20)	(-1.15)	(-1.20)
Non-affiliated	0.015	0.006	-0.005	-0.010	-0.013	-0.007	-0.020	-0.014
	(6.07)	(0.79)	(-0.50)	(-0.73)	(-6.17)	(-1.42)	(-3.23)	(-1.59)
Affiliated - Non-affiliated	0.006**	-0.015	0.006	0.020	-0.015***	-0.008	0.005	-0.006
	(2.42)	(-1.02)	(0.40)	(1.22)	(-3.36)	(-0.73)	(0.36)	(-0.35)
High alpha - Low alpha								
Affiliated	0.003	0.017**	0.025**	0.027	0.008	-0.012	-0.031**	-0.018
	(0.77)	(2.50)	(2.31)	(1.28)	(1.11)	(-0.66)	(-2.00)	(-0.80)
Non-affiliated	0.002	0.003	0.006	-0.005	-0.0009	0.004	0.009	0.004
	(0.48)	(0.26)	(0.38)	(-0.28)	(-0.28)	(0.53)	(1.07)	(0.31)

Table 10: The exposure of recommendation factors to the movements in hedge fund returns

This table presents the exposure of hedge fund returns to analysts' recommendation changes. We construct recommendation factors by choosing 3 stocks with the highest earned profits out of those invested by affiliated hedge funds and 3 stocks with the highest earned profits out of those invested by non-affiliated hedge funds. We put each stock into one of the six barrels that belong to two different groups and rank the stocks by earned profits from high ($k = 1$) to low ($k = 3$) in each group. We refer to the time-series stock returns in each barrel as a recommendation factor. We regress the monthly hedge fund returns on the recommendation factors and the Fama-French-Carhart four factors.

$$R_{it} = \sum_{k=1}^{3} \beta_{ik}\ A.\ RecFactor_{kt} + \sum_{k=1}^{3} \gamma_{ik}\ NA.\ RecFactor_{kt} + \delta_1 MKT_t + \delta_2 SMB_t + \delta_3 HML_t + \delta_4 MOM_t + \epsilon_{it}$$

where $A.\ RecFactor_{kt}$ is the recommendation factor k in the affiliated group in month t, $NA.\ RecFactor_{kt}$ is the recommendation factor k in the non-affiliated group in month t, R_{it} is the return of hedge fund i in month t, and MKT_t, SMB_t, HML_t, and MOM_t are the Fama-French-Carhart four factors, respectively. β_{ik} and γ_{ik} are factor loadings on recommendation factor k in the affiliated and non-affiliated groups, respectively, which reflect the extent to which hedge fund returns are exposed to the recommendation changes. The last column tests the significance of the differences in the means, with p-values in parentheses. *, **, *** indicate significance at the 10%, 5%, and 1% levels, respectively.

		Large hedge funds		Small hedge funds		Mean difference / t-value		
		β_{ik}	γ_{ik}	β_{ik}	γ_{ik}			
		(1)	(2)	(3)	(4)	(1)-(2)	(3)-(4)	(1)-(3)
k=1								
	Mean	0.515	0.230	0.258	0.171	0.285***	0.087***	0.257***
	Median	0.127	0.053	0.096	0.049	(7.28)	(3.09)	(4.59)
	Std dev	1.279	0.612	0.742	0.943			
	min	0.000	0.000	0.176	0.169			
	max	13.130	7.942	15.197	21.096			
k=2								
	Mean	1.216	0.588	0.641	0.274	0.628***	0.366***	0.575***
	Median	0.231	0.124	0.248	0.087	(5.67)	(6.75)	(3.76)
	Std dev	3.645	1.352	1.735	0.697			
	min	0.001	0.0005	0.000	0.000			
	max	27.291	11.563	25.116	12.368			
k=3								
	Mean	1.425	0.797	0.750	0.481	0.629***	0.269***	0.675***
	Median	0.441	0.187	0.404	0.139	(6.07)	(4.92)	(4.34)
	Std dev	3.640	2.276	1.899	1.095			
	min	0.0005	0.0001	0.0007	0.0005			
	max	46.263	22.647	41.315	1.808			