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Hedge Funds and Their Prime Broker Analysts

Abstract

Are sell-side analysts reluctant to go against the investment views of their hedge funds when these hedge funds are their prime brokerage clients? We show that prime broker analysts tend to upgrade stocks recently bought by their clients. For stocks with upgraded recommendations, post-announcement cumulative abnormal returns are significantly lower for those purchased by the prime brokerage clients. Our results are stronger with high-dollar-turnover clients who generate more trading commissions. We also find that a hedge fund with a large bet on a stock has a stronger incentive to pressure the fund's prime brokers to issue a favorable recommendation on the stock. Results are not driven by stocks of firms with low analyst coverage or small size.

Keywords: Hedge funds; Prime brokers; Analysts; Conflicts of interest

1. Introduction

We explore the link between hedge funds and analysts via prime brokerage. In a post-Spitzer era, Wall Street research departments can no longer share in the revenues from investment banking. Instead, anecdotal evidence suggests that sell-side analysts now cater increasingly to hedge funds which trade frequently and therefore generate the brokerage commissions and fees needed to sustain research.[1] These fees include the lucrative charges for prime brokerage services. Prime brokerage is a bundled package of services offered by investment banks and securities firms to hedge funds. The services include financing to facilitate leverage, securities lending to facilitate short sales, global custody (clearing, custody, and asset servicing), customized technology to allow, for example, real time portfolio reporting, operational support, and capital introduction where the prime broker introduces qualified investors to the hedge fund.[2] Prime brokerage is a big business for the investment banking industry, generating about $18.4 billion in revenues in 2015 (Crowe, 2016). Given that the prime brokerage revenue was $10 billion in 2010 and that investment banking revenue was $12.9 billion in 2015, prime brokerage has become a major revenue source to brokers. Hedge fund assets also have been growing, from $2.2 trillion in 2012 to $3.2 trillion at the end of 2017 (Williamson, 2018). With this outstanding growth in the assets

[1] According to Amadeo (2019), about one-third of the total NYSE daily volume is done by hedge funds. Market observers have raised concerns that analysts are often reluctant to issue reports that go against the investment views of important institutional clients such as hedge funds (Unger, 2001). Prominent hedge funds, such as Steven Cohen's SAC Capital Advisors, James Chanos's Kynikos Associates, and Daniel Loeb's Third Point, have been sued for allegedly conspiring with analysts to manipulate the prices of stocks in which they have built up large positions. In one such lawsuit, Biovail, a Canadian drug firm listed in New York and Toronto, claims that analysts published a negative report or "hatchet job" on Biovail at the behest of SAC, based on information provided by the hedge fund. See "Hedge Funds and Equity Research: Fair Comment or Foul?" The Economist, April 1, 2006, and "SEC Looks at Hedge Funds' Trades," The Wall Street Journal, February 13, 2009.

[2] The prime broker derives most of her revenues from fees or spreads on financing and lending, trading commissions, and fees for the settlement of transactions done away from the prime broker.

managed by hedge funds, the prime brokerage business is expected to continue being important to brokers.

The relationship between hedge funds and their prime brokers has been of interest in finance literature. For example, Chung and Kang (2016) and Gerasimova (2016) document positively correlated movement in the performance of hedge funds that use the same prime brokers. These papers suggest some sort of information sharing between hedge funds and their prime brokers. In fact, the popular press raises a concern that their relationship has become more like a partnership and too close.[3] Such concerns stoke fears that analysts are subject to fresh conflicts of interest on top of the agency problems induced by investment banking and other trading commissions documented in the academic literature on sell-side analysts.[4]

Motivated by these issues, we explore the relationship between hedge fund equity trades and the recommendations of analysts who work for the hedge fund's prime brokers. We leverage on prime broker data that allow us to directly link individual hedge funds to analysts and test the influence of hedge funds that are prime brokerage clients of an analyst's investment bank. We specifically ask the following: Do hedge fund stock purchases and sales impact the prime broker's recommendation revisions? If so, are the upgraded recommendations following the stock purchase of hedge fund clients overly optimistic and biased? Are these results stronger for hedge funds that

[3] See "Prime brokerage industry faces change," Global Investor, April 2013. According to this article, "the leading prime brokers today want to expand the relationship with their clients to generate revenue from the firms' entire service offerings, not just traditional prime broker activities." Also see "Hedge funds get 'too cosy' with prime brokers," Financial Times, November 2013.

[4] Examples of work on investment banking–induced conflicts of interest include Dugar and Nathan (1995), Lin and McNichols (1998), Michaely and Womack (1999), and Kadan et al. (2009). For examples of work on trading commission–induced agency problems, see Irvine (2004), Jackson (2005), Cowen, Groysberg, and Healy (2006), Irvine, Lipson, and Puckett (2007), and Juergens and Lindsey (2009).

generate more significant brokerage commissions? The answers will shed light on the agency issues confronting sell-side analysts in the aftermath of the Global Research Analyst Settlement.

Our empirical analyses reveal that analysts are more likely to upgrade stocks purchased by their prime brokerage clients in the last quarter and downgrade stocks sold by the clients. If analysts are reacting to the same fundamental information as hedge funds albeit at a slow pace, we would also find the above results. However, the lead-lag relation between the stock trades of hedge funds and subsequent analyst recommendation revisions are only significant with the trades of hedge funds that are the prime brokerage clients of the analysts. The relation is not significant with the trades of the hedge funds that are not prime brokerage clients, which appears to eliminate the possibility of the alternative explanations. Furthermore, if analysts and hedge fund managers are using the same information sets, there is no reason that the recommendations revised one quarter after the client trades have information that is different from information in other revised recommendations. However, the recommendation revisions that are sympathetic to the trades of the prime brokerage clients in the last quarter, particularly recommendation upgrades, contain less information on future stock returns than other recommendation revisions.

More specifically, we find that analysts' recommendation upgrades impact the future three-month and six-month returns in our sample. However, we find that the predictive power of the recommendation upgrades on the future abnormal returns becomes significantly weaker when the upgrades follow the client stock purchases. For stocks with upgrades to a Strong Buy recommendation, the top decile of stocks based on the change in the prime brokerage client holdings underperforms the bottom decile of stocks by and economically significant 3.9 percent (6.1 percent) during the three-month (six-month) post-recommendation announcement period.

We also examine how the characteristics of each client hedge fund impact the association between the prime broker's recommendation revisions in the current quarter and the client hedge fund trades in the last quarter. First, the sympathetic recommendation revisions appear driven by the desire among analysts to generate greater trading commissions from their clients. We find that analysts are more likely to issue recommendations consistent with the trades of high-dollar-turnover clients than following trades of other clients. Second, clients themselves seem to pressure their prime brokers more to be sympathetic with their trades. We find that sympathetic broker recommendation revisions follow *after* client hedge funds take on large positions in a particular stock. Finally, we also find that trades by funds that are bigger, relative to the overall portfolio of the prime broker, result in more sympathetic recommendation revisions.

Our paper makes several contributions to the literature on sell-side analysts and agency. Dugar and Nathan (1995), Lin and McNichols (1998), and Michaely and Womack (1999) show that an analyst from a brokerage house that has an underwriting relationship with a stock tends to issue more positive recommendations than analysts from non-affiliated houses.[5] We show that an analyst from a brokerage house that has a prime brokerage relationship with a hedge fund tends to craft more sanguine reports on stocks bought by that fund than on stocks bought by other funds. Irvine (2004), Jackson (2005), and Cowen, Groysberg, and Healy (2006) present evidence that links analyst optimism to trade generation. In the presence of short sales constraints, optimistic recommendations by analysts encourage investors to trade through the analysts' brokerages.[6] Our

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[5] The optimism bias of investment banking–affiliated analysts has waned since the Global Research Analyst Settlement. Kadan et al. (2009) find that while these affiliated analysts are still reluctant to issue pessimistic recommendations on firms that they have an underwriting relationship with, they are now less likely to issue optimistic recommendations.

[6] Gu, Li, and Yang (2013) and Firth et al. (2013) show using Chinese data that Chinese mutual funds are able to leverage on brokerage commissions to influence sell-side analysts into issuing recommendations that are sympathetic to their investment views.

results suggest that prime brokerage fees can also induce favorable analyst recommendation revisions about client trades.

We also contribute to the literature on sell-side analysts and institutional investors. Irvine, Lipson, and Puckett (2007) and Juergens and Lindsey (2009) show that analysts reward institutional investors by revealing to them the contents of forthcoming reports. Our results indicate that analysts also reward prime brokerage clients by issuing recommendations that are sympathetic to their investment views. Ljungqvist et al. (2007) show that institutional investors exert a moderating influence on the bias of sell-side analysts. They argue that this is because institutional investors value unbiased research. After controlling for the trades of other institutional investors in our empirical work, we show that considerable cross-sectional heterogeneity among institutional investors exists in the context of their impact on analyst recommendations.

Finally, we also make a contribution to the recently developing literature on prime brokers. One strand of this literature finds significant co-movement in returns across hedge funds that share a prime broker (e.g. Gerasimova, 2016; Chung and Kang, 2016), thereby suggesting some information sharing by the broker. Another strand further supports an information sharing channel between brokers and client hedge funds when entities (e.g. advisors, banks, underwriters, etc.) related to the broker have information about important corporate events (e.g. mergers (Goldie, 2011), IPOs (Qian and Zhong, 2017), corporate loans (Kumar et al., 2020)). Aragon et al. (2020) even suggest investor preference for funds serviced by certain "connected" prime brokers. Our findings show that prime brokers *actively* cater to their connected hedge funds by issuing biased recommendation revisions to help their clients' trades. In a way, this evidence of catering further cements the view that the prime brokers help their hedge fund clients by providing more than just trading services. Our evidence also reveals prime broker's biased preference for hedge fund clients over other customers who pay for unbiased equity research.

The remainder of this paper is organized as follows: Section 2 describes the data. Sections 3 and 4 report the results from the empirical analysis. Section 5 concludes.

2. Data

Our dataset consists of the intersection of five databases: hedge fund prime brokerage data, the Thomson Financial 13F institutional database constructed from institutional investors' 13F filings, the I/B/E/S database of research analyst recommendations, the Center for Research in Security Prices at Chicago (CRSP) stock data, and Compustat firm characteristics data. We obtain information on hedge funds and their prime brokers from the Barclayhedge, Hedge Fund Research, and the Lipper TASS union, which includes 31,798 funds. Of these, we drop data for the 20,471 funds that stopped reporting returns by December 2010. While this decision likely introduces some survivorship bias in our data, it gives us stable sample of prime broker-hedge fund relationships which is crucial for our study. The prime broker information allows us to identify, for each hedge fund, the prime broker or brokers that service the fund. So that there are a sufficient number of hedge fund clients per prime broker, we confine the analysis to prime brokers who service at least ten hedge fund firms. As the data provide a snapshot of hedge fund prime brokers in 2010, we extend the time period by two years before and after 2010, implicitly assuming that hedge funds did not change their prime brokers between 2008 and 2012.[7] This assumption is supported by the

[7] We acknowledge that this choice probably introduces survivorship bias in our data, especially in the pre-2010 period. To the extent that that some hedge funds possibly switch prime brokers throughout our sample period, this choice results in us attributing some recommendation revisions by prime brokers to hedge fund incorrectly. So, this choice introduces noise to our analysis and makes it harder for us to obtain significant results.

finding in Goldstein et al. (2009) that the relations between institutional client and prime brokers are remarkably sticky.

We cull our main variable of interest, each prime broker's hedge fund client equity trades (excluding short sales), from the Thomson Financial 13F institutional database. Institutions with more than $100 million in equities must report their equity ownership in quarterly 13F filings to the Securities and Exchange Commission (SEC). The majority of institutions (such as pension funds, endowments, mutual funds, and hedge funds) are required to report equity positions in excess of ten thousand shares or $200,000 in market value for all firms traded on an exchange or quoted on the Nasdaq National Market System. The institutions report aggregate holdings for their firm, e.g., hedge fund family, regardless of how many individual fund portfolios they manage. Since each hedge fund's stock holding data are not available, we use the stock holding data of these hedge fund families available in the Thomson Financial 13F institutional database. These institutional data certainly have a limitation for our analysis. An institution in the 13F data can have funds that are not hedge funds under its umbrella, and thus, the change in the aggregate holdings will not purely reflect the hedge fund trades. Hence, the use of 13F data requires an assumption that the change in the aggregate institutional holdings has a strong positive correlation with the hedge fund trades. Given that hedge funds are considered to be most frequent and active traders in the market, the change in the aggregate holdings will be mostly affected by the hedge fund trades, making this assumption likely valid. Furthermore, the non–hedge fund trades included in the change in the aggregate holdings will only work against finding significant results in our analyses.[8]

[8] The Barclayhedge, Hedge Fund Research, and Lipper TASS union identifies 929 institutions having hedge funds under their umbrella in our sample period. Out of these institutions, 832 institutions are used in our final sample.

During our sample period, the I/B/E/S dataset records 166,245 recommendations for 5,891 unique companies made by 6,559 analysts at 509 brokerages. The Thomson Financial 13F database reports holdings data on 7,380 unique companies. The intersection of the five databases contains 2,124 unique companies.[9] I/B/E/S codes recommendations from one (Strong Buy) to five (Sell). As is standard in the literature, we reverse the order so that larger numbers indicate more favorable recommendations. One issue is that new, reiterated, or revised recommendations arrive and are recorded by I/B/E/S irregularly and relatively infrequently when compared with earnings forecasts. We therefore follow the algorithm outlined in Ljungqvist, Malloy, and Marston (2009) and Loh and Stulz (2011) to compute recommendation revisions.[10]

Table 1 reports summary statistics on our data. It includes information on the size of the quarterly change in stock holdings of hedge funds that are prime brokerage clients, the change in non-client hedge fund holdings, the change in other institutional holdings, analysts' recommendation revisions, stock market capitalization, stock book-to-market ratio, stock volume, and stock returns over the last six months, recommendation levels prior to the recommendation revisions, averaged across prime brokers, stocks, and quarters.

[Insert Table 1 here]

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[9] Since the large institutional investors and hedge funds with equity holdings in excess of $100 million that we analyze are unlikely to invest in penny stocks and other very small stocks, we omit stocks with prices below $5 from our sample. None of our baseline inferences change when we include these stocks in the analysis.

[10] Specifically, to compute the recommendation revisions, we follow those two studies and use a recommendation that has prior recommendation by the same analysts in the last one-year window. Newly initiated recommendations are eliminated because revision computation is not possible in such a case. When an analyst issues two recommendations at different dates, if the first recommendation has not been confirmed by the analyst in the one-year window before the second recommendation issuance, we consider the second recommendation a newly initiated recommendation. The I/B/E/S review data field shows whether or not an outstanding recommendation is confirmed by the analysts. Additionally, if an analyst issues a recommendation on a company and stopped covering it (based on the I/B/E/S Stopped File), and reissues another recommendation on the same firm company, we regard the second recommendation issuance as a re-initiation of the coverage and delete it.

3. Empirical results

3.1. Tests of analyst recommendation revisions

Our first set of tests focuses on the effect of changes in hedge fund long equity positions on the recommendation revisions of analysts who work for the prime broker of the hedge fund. We ask whether the prime broker analysts of hedge funds are more likely to upgrade stocks purchased and downgrade stocks sold by hedge funds in the last quarter. Our tests control for the impact of purchases and sales by other hedge funds (excluding the prime brokers' clients) and other institutional investors (excluding hedge funds) to understand the differential impact of client hedge funds versus other hedge funds and traditional asset management on the behavior of prime broker analysts.

Other prior studies have examined analyst conflicts of interest using analyst earnings forecast optimism. However, investors often prefer positive earnings surprises. As shown in O'Brien (1988), this provides analysts an incentive to shade their earnings estimates so that the company can exceed the forecast. As a result, there are competing optimistic and pessimistic influences on analyst earnings forecasts. No such competing influences exist for analyst recommendations. Moreover, unlike earnings forecasts, analyst recommendations readily translate into a direct course of action for investors, that is, buy versus sell. Therefore, hedge funds are more likely to appreciate inflated recommendations, as opposed to optimistic earnings forecasts, on the stocks that they hold. Since it is easy to evaluate the accuracy of analyst forecasts by comparing the forecast estimates with actual earnings, the cost of a biased earnings forecast may also be greater than that of a biased recommendation. In line with this reasoning, Agrawal and Chen (2007) and Cowen, Groysberg, and Healy (2006) do not find evidence of investment banking–induced conflicts of interest when examining analyst earnings forecasts, while Irvine (2004) finds that analysts are more likely to respond to trading incentives through their recommendations than through biasing their earnings forecasts.

The baseline OLS regression that we estimate can be expressed as follows:

$$\Delta REC_{i,j,t} = a + b\ \Delta HCLIENT_{i,j,t-1} + c\ \Delta NON\_CLIENT\_HEDGE_{i,j,t-1}$$
$$+ d\ \Delta NON\_HEDGE_{i,j,t-1} + e\ Log(ME)_{i,j,t-1} + f\ (BE/ME)_{i,j,t-2}$$
$$+ g\ LAG\_RETURN_{i,j,t-1} + h\ VOLUME_{i,j,t-1} + i\ LAG\_REC_{i,j,t-1} + \varepsilon_{i,j,t} \qquad (1)$$

where $\Delta REC_{i,j,t}$ is the change in the recommendation of the prime broker analyst *i* for a stock *j* in quarter *t*. $\Delta HCLIENT_{i,j,t-1}$ is the change in the sum of shares of a firm held by hedge funds that are prime brokerage clients of analyst *i* 's bank at quarter *t*-1. $\Delta NON\_CLIENT\_HEDGE_{i,j,t-1}$ is the change in the sum of shares of a firm held by hedge funds that are *not* prime brokerage clients of the analyst's bank at quarter *t*-1. $\Delta NON\_HEDGE_{i,j,t-1}$ is the change in the sum of shares of a firm held by other institutional investors at quarter *t*-1 (excluding hedge funds). All three of these variables ($\Delta HCLIENT$, ΔNON_CLIENT_HEDGE, and ΔNON_HEDGE) are scaled by the number of shares outstanding. In addition, for stock *j*, $ME_{j,t-1}$ is market equity, $(BE/ME)_{j,t-2}$ is book-to-market ratio, $LAG\_RETURN_{i,j,t-1}$ is past six-month buy-and-hold return, and $VOLUME_{j,t-1}$ is daily volume scaled by shares outstanding and averaged over the last six months. $LAG\_REC_{i,j,t}$ is the prior recommendation level to the change in the recommendation of the prime broker analyst *i* for a stock *j* in quarter *t*.

We control for the stock-specific variables to account for the potential impact of stock size on analyst recommendations and in response to Jegadeesh et al.'s (2004) findings that analysts generally recommend high-volume, extreme growth, and positive momentum stocks. The independent variables *ΔNON_CLIENT_HEDGE* and *ΔNON_HEDGE* cater for the possible moderating influence of other hedge funds that are not the prime brokerage clients and institutional investors who do not manage hedge funds (Ljungqvist et al., 2007). The accounting variable *BE/ME* is measured with a two-quarter lag following Jegadeesh et al. (2004). Other than the stock-specific variables, we control for the prior recommendation level to the prime broker's recommendation revision. If a prior recommendation was "Strong Buy," the revision after the recommendation would be either reiteration of Strong Buy or downgrade. Likewise, if a broker's recommendation before the revision was "Sell," the revision is more likely to be an upgrade. The regressions include controls for broker fixed effects to allow for the possibility that the propensity of analysts to issue upgrades and downgrades differs systematically across brokers and quarter fixed effects to avoid the influence of quarter-specific factors on analysts' recommendation revisions. The standard errors are clustered by firm to account for within-firm correlations in residuals.

In addition, we examine whether a prime broker analyst upgrades (or downgrades) the recommendation following the client stock purchase (or sales) with the following regressions:

$$\begin{aligned} UPGRADE_{i,j,t} = a &+ b\ HCLIENT\_BUY_{i,j,t-1} + c\ NON\_CLIENT\_BUY_{i,j,t-1} \\ &+ d\ NON\_HEDGE\_BUY_{i,j,t-1} + e\ Log(ME)_{i,j,t-1} + f\ (BE/ME)_{i,j,t-2} \\ &+ g\ LAG\_RETURN_{i,j,t-1} + h\ VOLUME_{i,j,t-1} + i\ LAG\_REC_{i,j,t-1} + \varepsilon_{i,j,t} \end{aligned} \quad (2)$$

$$\begin{aligned} DOWN_{i,j,t} = a &+ b\ HCLIENT\_SELL_{i,j,t-1} + c\ NON\_CLIENT\_SELL_{i,j,t-1} \\ &+ d\ NON\_HEDGE\_SELL_{i,j,t-1} + e\ Log(ME)_{i,j,t-1} + f\ (BE/ME)_{i,j,t-2} \\ &+ g\ LAG\_RETURN_{i,j,t-1} + h\ VOLUME_{i,j,t-1} + i\ LAG\_REC_{i,j,t-1} + \varepsilon_{i,j,t} \end{aligned} \quad (3)$$

where $UPGRADE_{i,j,t}$ is an indicator variable that takes a value of one when analyst *i* upgrades stock *j* in quarter *t*, and a value of zero otherwise. $HCLIENT\_BUY_{i,j,t-1}$ is an indicator variable that is equal to one if $\Delta HCLIENT_{i,j,t-1}$ is positive, and is equal to zero otherwise. $NON\_CLIENT\_BUY_{i,j,t-1}$ is an indicator variable that is equal to one if $\Delta NON\_CLIENT\_HEDGE_{i,j,t-1}$ is positive, and is equal to zero otherwise. $NON\_HEDGE\_BUY_{i,j,t-1}$ is an indicator variable that is equal to one if $\Delta NON\_HEDGE_{i,j,t-1}$ is positive, and is equal to zero otherwise. *DOWN*, *HCLIENT_SELL*, *NON_CLIENT_SELL*, and *NON_HEDGE_SELL* are the analogous indicator variables for prime broker analyst downgrades, their prime brokerage client stock sales, other hedge fund stock sales, and other institution stock sales. Since we use indicator dependent variables in the model (2) and (3), logit regressions are estimated. Table 2 reports the results of the above regressions.

[Insert Table 2 here]

The coefficient estimates on *ΔHCLIENT*, *HCLIENT_BUY*, and *HCLIENT_SELL* reported in columns (1), (2), and (3) of Table 2 are consistent with the view that prime broker analysts revise their recommendations in sympathy with the stock purchases and sales of their client hedge funds. Controlling for co-variation with other variables, the coefficient estimates on *ΔHCLIENT*, *HCLIENT_BUY*, and *HCLIENT_SELL* are all significantly positive at the one percent level. These results suggest that those prime broker analysts upgrade their recommendations on a firm one quarter after their client hedge funds purchased the stock, and downgrade their recommendations one quarter after their clients sold the stock.[11]

[11] Irvine, Lipson, and Puckett (2007) and Juergens and Lindsey (2009) show that analysts reward institutional investors by "tipping" them up to five days *before* the public announcement date regarding the contents of their forthcoming reports. These institutional investors subsequently process their trades through the analysts' brokerages. To investigate whether our results are driven by the prime broker's sharing information *immediately* before recommendation changes, we impose a generous two-week gap between hedge fund trade date (i.e., quarter end) and the prime broker's recommendation revision date. We find that recommendation revisions of prime brokers made more than two weeks after the prime brokerage client trades continue to be sympathetic to the investment views of the clients. Therefore,

Two explanations are possible for this finding. One explanation is that prime broker analysts upgrade their recommendations to maintain the price of a stock their clients purchased a quarter before and maintain the favorable recommendations until the clients unwind their positions. Another explanation is that, simply, both analysts and hedge funds are acting on the same information set, but hedge funds are faster in information acquisition than those prime broker analysts. Hence, it is important to investigate whether such a quarterly lead-lag relation exists between the change in the stock position of other hedge funds that are *not* the prime brokerage client and the prime broker recommendation revisions. We do not find such a relation in other hedge funds. The coefficient estimates on *ΔNON_CLIENT_HEDGE* and *NON_CLIENT_SELL* have negative signs. The coefficient estimate on *NON_CLIENT_BUY* is statistically insignificant. These results generally supports the first "conflict of interest" explanation.[12]

For the other control variables, no significant association exists between prime brokers' recommendation revisions and other non–hedge fund institutional investors (*ΔNON_HEDGE* and *NON_HEDGE_BUY*). The exception is *NON_HEDGE_SELL* in column (3). The coefficient on *NON_HEDGE_SELL* is significantly negative. The coefficients on *Log(ME)* and *LAG_RETURN* are significantly positive in columns (1) and (2) and negative in column (3), indicating that analysts

our results do not appear to be driven by prime brokers' information sharing *immediately prior* to a recommendation change, as is usually the case in "tipping." Rather, our findings can only suggest that the broker analysts change their recommendations *following* the trade of the client funds. We, however, admit that it is not possible for us to comprehensibly test "tipping" of the prime broker to its hedge fund client in the absence of high-frequency data and communications between hedge fund clients and prime brokers closer to analyst recommendation changes.

[12] There is no study that directly compares the information acquisition and stock selection abilities of sell-side analysts with those of hedge funds, but Womack (1996) shows that sell-side analysts' buy and sell recommendations embody valuable information. Conversely, Griffin and Xu (2009) document using hedge fund equity holdings that hedge funds, on average, do not possess stock selection skills. In addition, Griffin and Xu (2009) rarely find differential ability among hedge funds, while several prior studies show the differential ability among sell-side analysts (e.g., Hobbs, Kovacs, and Sharma 2012). Thus, it is difficult to presume that the whole body of sell-side analysts follows the stock selection of hedge funds.

tend to upgrade their recommendations in large firms and stocks with favorable prior returns. Finally, as expected, the coefficients on *LAG_REC* are all significantly negative. Analysts are likely to upgrade their recommendations if their prior recommendation level is low and downgrade if their prior recommendation is high.

3.2. Tests of stock returns on recommendation revisions

Having shown that prime broker analysts revise their recommendations following their client stock purchases or sales, we now turn to tests of stock returns to understand whether those revised recommendations following the client stock trades are biased. The test on post-announcement stock returns will also allow us to distinguish from the information story, which predicts that the updated recommendations on stocks that the client purchased in the prior quarter should engender higher stock returns in the post-announcement period, as they are based on supposedly valuable information embedded in the change in hedge fund holdings.

First, we examine the post-announcement returns following the recommendation revisions conditional on the client ownership changes in the previous quarter. We estimate regressions on abnormal stock returns after the recommendation revision announcement period, and analyze the impact of the interaction of the change in the client hedge fund holdings. Specifically, we run the following OLS regression:

$$\begin{aligned} MAR_{i,j,t} = {} & a + b\,\Delta REC_{i,j,t} + c\,\Delta HCLIENT_{i,j,t-1} + d\,\Delta REC_{i,j,t} \times \Delta HCLIENT_{i,j,t-1} \\ & + d\,Log(ME)_{i,j,t-1} + f\,(BE/ME)_{i,j,t-2} + g\,LAG\_RETURN_{i,j,t-1} + h\,ANALYST_{i,j,t-1} \\ & + i\,ANALYST_{i,j,t-1} \times \Delta REC_{i,j,t} + \varepsilon_{i,j,t} \end{aligned} \qquad (4)$$

where *MAR* is either *3MAR* or *6MAR*. The dependent variable *3MAR* (*6MAR*) is three-month (six-month) market-adjusted buy-and-hold stock returns measured starting two trading days after the recommendation revision announcement date; we use CRSP value-weighted index as the market benchmark (Brown and Warner, 1985). The rest of the variables are as defined previously. We control for size, book-to-market ratio, six-month lagged returns, and level of analyst following (see Banz, 1981; Fama and French, 1992; and Jegadeesh and Titman, 1993).[13] We also include quarter fixed effects to control for time specific market characteristics and broker fixed effects to control for any time invariant broker characteristics. We also estimate a regression with *UPGRADE* and *DOWN* in place of *ΔREC* so as to explore the possible differential effect of the recommendation upgrade and downgrade.

[Insert Table 3 Panel A here]

The results from the stock return regressions are reported in Panel A of Table 3. The coefficient estimates on *ΔREC* is significant but that on the interaction variables (*ΔREC* × *ΔHCLIENT*) reported in column (1) of Panel A is not. So, ownership changes of the analysts' prime brokerage clients do not seem to significantly impact the three- or the six-month future market-adjusted returns.

Columns (3) and (4) report the regression results with *UPGRADE*. The coefficients on *UPGRADE* and *UPGRADE* × *ΔHCLIENT* are 0.047 (*t*-value: 3.40) and -0.004 (*t*-value: -2.38), respectively, with *3MAR*. The magnitude of the coefficients is much larger than the coefficients in column (1) with *ΔREC*. Given that the standard deviation of the *ΔHCLIENT* is 2.102 (see Table

[13] The regression equation (4) includes an interaction term between *ANALYST* and the change in recommendation variables. We do this to control for the effect that stocks with large analyst following might have on returns when the broker recommendations are changed at the same time by multiple brokers. We repeat these market-adjusted return regressions without the interaction and find that sign and significance of all variables are same without the interaction term. These results are available upon request.

1), those coefficients suggest that one standard deviation change in *ΔHCLIENT* reduces the average three-month post *UPGRADE* announcement return by an economically significant 56% (2.102×0.004/0.015). Hence, the inference is that following analyst upgrade is not as profitable if the upgrade follows the stock purchase of the analyst's prime brokerage clients. The coefficient on *UPGRADE* × *ΔHCLIENT* is also significantly negative in column (4) with *6MAR*. The magnitude of the coefficient (-0.006; *t*-value: -2.15) is even larger than the coefficient on the interaction variable with *3MAR*.[14] Columns (5) and (6) show the regression results with *DOWN*. The coefficients on *DOWN* is negative and significant in both columns. The coefficient on *DOWN* × *ΔHCLIENT* are all insignificant. These insignificant results show that the prime broker's recommendation downgrade following the client stock sales is not as biased as the upgrade following the client stock purchase.[15]

[14] We also investigate how the stock position changes of other non-client hedge funds and other non–hedge fund institutional investors affect the post-announcement buy-and-hold abnormal returns of the revised recommendations by replacing *ΔHCLIENT* with *ΔNON_CLIENT_HEDGE* and *ΔNON_HEDGE* in the same regression model. In this revised regression model, the main variables of interest are *UPGRADE* ×*ΔNON_CLIENT_HEDGE* and *UPGRADE* ×*ΔNON_ HEDGE.* None of these interaction variables are significant regardless of whether we use *3MAR* or *6MAR* as the dependent variable in the regression model. Thus, it is only the change in the stock position of the prime brokerage clients that affects the broker's recommendation revision returns.

[15] In an untabulated analysis, we investigate stock returns during the recommendation announcement period to test whether investors de-bias the optimistic recommendations issued by analysts on stocks their prime brokerage clients purchased in the previous quarter. For prime brokerage clients to benefit from sympathetic analyst recommendations on the stocks that they recently purchased, it is a prerequisite that investors do not completely de-bias such favorable recommendation revisions. Specifically, we measure the cumulative market adjusted stock returns from one trading day before to one trading day after the recommendation revision announcement date (which are *not* included in the measurement of *3MAR* and *6MAR*), and use it as a dependent variable in the regression model (4). We find significantly positive coefficients on *ΔREC* and *UPGRADE*. These significant coefficients prove that analyst recommendation revisions significantly impact the market. However, we do not find any significant coefficient on the interaction variables (*ΔREC* × *ΔHCLIENT* and *UPGRADE* × *ΔHCLIENT*). Thus, investors do not de-bias the recommendations on stocks purchased by the analyst's prime brokerage clients since information on each prime broker's client equity position is not readily available in a timely fashion.

We also estimate a regression with *R_ΔHCLIENT* in place of *ΔHCLIENT* so as to better evaluate the economic significance of our results. *R_ΔHCLIENT* is a decile-ranked variable of *ΔHCLIENT* scaled by nine. Since the decile-ranked variable takes values from zero to nine, *R_ΔHCLIENT* takes values between zero and one. We focus our analysis on *UPGRADE* because we get only significant results in *UPGRADE* in the previous table.

[Insert Table 3 Panel B here]

Columns (1) and (2) of Table 3, Panel B report the result when *R_ΔHCLIENT* is interacted with *UPGRADE*. Although the coefficient estimates of the interaction variables are all negative, only the three-month return result is statistically significant (-0.022; t-value -2.09). From the viewpoints of client hedge funds, it will be the upgrade to Buy or Strong Buy recommendations that helps to maintain the price of the stocks they purchased. Thus, we create an indicator variable of one if the recommendation upgrade is to either Strong Buy or Buy, and zero otherwise (*BUY_UP*), and interact *BUY_UP* with *R_ΔHCLIENT*. The results are reported in columns (3) and (4) of Panel B. The coefficients on the interaction variables are -0.026 (*t*-value: -2.48) and -0.028 (*t*-value: -2.01), respectively. The coefficient estimates in the *3MAR* regression in column (3) indicate that three months after the announcement date, Strong Buy and Buy recommendations issued on the top decile of stocks in terms of the change in the stock holdings of prime brokerage clients underperform those issued on the bottom decile of stocks by 2.6 percent. We further investigate the case that the prime broker's recommendation is upgraded to Strong Buy. The results are reported in columns (5) and (6) of Panel B. *SBUY_UP* is an indicator variable of one if the recommendation revision is an upgrade to Strong Buy, and zero otherwise. The coefficient estimates on the interaction variable (*SBUY_UP* × *R_ΔHCLIENT*) in column (5) and (6) are -0.039 (*t*-value: -2.24) and -0.061 (*t*-value: -2.20). These results suggest that the three-month and six-month return performances of the stocks upgraded to Strong Buy by the prime broker analyst are 3.9 percent and 6.1 percent lower, respectively, in the top decile than in the bottom decile. These results suggest dismal performance for stocks with strong positive broker recommendations following larger client purchases.[16]

3.3. Fund-level analyses

In the previous section, we aggregate the stock positions of each prime broker's clients and analyze how the change in this aggregate position influences the recommendations of the analysts who work for the clients' prime broker on the assumption that the prime broker analysts feel pressure to revise their recommendations into the direction of the change in the aggregate position.[17] We perform fund-level analyses in this section. That is, we examine how the change in the ownership of each fund affects its prime broker's recommendation. One advantage of the fund-level analysis is that it is easier to examine the effect of the fund characteristics (e.g., size of a

[16] It is possible that the information in the recommendation revision is already incorporated in the returns before the revision. This would be in line with the information sharing between broker and hedge funds (e.g. see Qian and Zhong, 2017; Kumar et al., 2020). To test this, we calculate the market adjusted returns from the beginning of the current quarter to the day before the prime broker analyst recommendation revision announcement. We then run regressions, similar to those presented in Tables 3, Panels A and B. We do not find any significant results supporting information sharing prior to the recommendation revision in these tests. While we cannot rule out other forms of information sharing around (e.g. about merger events, IPOs, etc. see Goldie (2011), Qian and Zhong (2017)), our evidence does not support a significant information sharing in regards to recommendation revisions.

[17] Our conjecture is that if a prime broker has five clients, and four clients buy a stock (that is, increase their long positions on the stock), while the fifth client sells the stock (that is, decreases its long position on the stock), analysts would be more likely to upgrade their recommendations to curry favor of the four clients unless the client who sells the stock is a much more important client than the other four hedge funds.

fund) on the lead-lag relation between a fund's stock trades and subsequent recommendation revision of its prime broker.[18]

3.3.1. Baseline analyses

First, we examine whether the quarterly lead-lag relation between the stock position change of a client hedge fund and the recommendation revision of its prime broker holds in the fund-level data. We replace *ΔHCLIENT*, *HCLIENT_BUY*, and *HCLIENT_SELL* in the regression models (1), (2), and (3) with *ΔIND_HCLIENT*, *IND_HCLIENT_BUY*, and *IND_HCLIENT_SELL*, respectively. *ΔIND_HCLIENT* is the change in the number of shares of a firm held by an individual hedge fund at quarter *t*-1 and scaled by the number of shares outstanding.[19] *IND_HCLIENT_BUY* is an indicator variable that is equal to one if *ΔIND_HCLIENT* is positive, and is equal to zero otherwise. *IND_HCLIENT_SELL* is defined analogously. These results are shown in Table 4.

[Insert Table 4 here]

The coefficient on *ΔIND_HCLIENT* in column (1) of Table 4 is 0.029 (*t*-value: 3.83), which is 2.6 times the coefficient on *ΔHCLIENT* in Table 2. This is expected in that the average change in the ownership of each client fund is smaller than the average change in the aggregate

[18] In untabulated results we run our analysis limiting our sample to the top 100 funds (based on size of portfolio) and repeat all tests represented in Tables 4 through 7. In doing so, we get results similar to those presented here, although coefficient estimates have higher magnitudes. These results are available upon request.

[19] In line with high trading volume and sudden changes in investment holdings typical of hedge funds (e.g. see Stulz, 2007), we have outliers in our variable measuring individual stock positions held by client firms. To correct for these outliers in our fund-level sample, we winsorize the ΔIND_HCLIENT variable at 1% and 99% level.

stock position of all the clients of a prime broker. Different from Table 2, we do not find significant coefficients on *IND_HCLIENT_BUY* or on *IND_HCLIENT_SELL*.[20]

In the following sections, we investigate the effect of the fund characteristics on association between a fund's stock trades and subsequent recommendation revision of its prime broker.

3.3.2. Size of client funds

The first fund characteristic we explore is the asset size of funds. In general, large funds have greater influence on sell-side analysts than small funds due to trading commission revenue from the large funds. According to Irvine (2004), brokerage commission revenue can affect analyst compensation. If the desire to generate trading commissions drives analyst behavior, then analysts may come under greater pressure to conform to the investment views of the clients with large fund size. Even if some large funds do not trade frequently, expectation from future trading commissions can be substantial. Hence, the trades of large funds may influence the recommendation of the analysts employed by the clients' prime brokers more than trades of small funds.

We examine how the equity portfolio size of a fund affects the association between hedge fund trades and the recommendation revisions of their prime brokers. We measure the sum of the dollar value of a client hedge fund's stock portfolio at quarter t-1, and create an indicator variable of one if the sum is above the sample-median, and zero otherwise (*FUND_SIZE*). This indicator variable is interacted with the main variables of interest (*ΔIND_HCLIENT*, *IND_HCLIENT_BUY*,

[20] In an untabulated test, the coefficient on IND_HCLIENT_BUY becomes statistically significant when we limit the sample to the largest 100 funds, indicating that buy decisions of bigger funds yield bigger influence on recommendation upgrades of the prime broker analysts.

and *IND_HCLIENT _SELL*) in the baseline regressions to investigate the effect of size of client funds. Table 5 reports the regression results.

[Insert Table 5 here]

The interaction variables with *ΔIND_HCLIENT* and *IND_HCLIENT_BUY* are not significant. However, the coefficient on *FUND_SIZE* × *IND_HCLIENT_SELL* is significantly positive. This indicates that for large clients, their prime broker analysts tend to downgrade stock recommendations one quarter after the large clients unwind their positions on the stock. On average, it should take more time for large funds to unwind their positions without impacting the stock price than small funds. Thus, these large clients seem to pressure their prime brokers to downgrade a stock slowly when the clients are selling it.

3.3.3. Dollar turnover of client funds

In this section, we employ the actual dollar turnover of client funds as a conditioning variable in place of the size of the funds to explore the effect of trading commissions. Specifically, we measure the sum of the dollar value of the *change* in a prime brokerage client's stock holdings across all the firms at quarter *t*-1. As in the previous section, we create an indicator variable of one if the trading volume measured at *t*-1 is greater than the sample-median, and zero otherwise (*TRADING_AMT*). Then, we interact *TRADING_AMT* with *ΔIND_HCLIENT*, *IND_HCLIENT_BUY*, and *IND_HCLIENT _SELL*.

[Insert Table 6 here]

Columns (2) and (3) of Table 6 report the regression results when we use *UPGRADE* and *DOWN* as dependent variables. The coefficients on the interaction variables (*TRADING_AMT* × *IND_HCLIENT_BUY* and *TRADING_AMT* × *IND_HCLIENT_SELL*) are both positive and significant. The interaction term between *TRADING_AMT* and *ΔIND_HCLIENT*, as shown in column (1), is not significant. The categorical decision to upgrade or downgrade thus appears to be more sensitive to the trading amount of the client fund. These results also suggest that the positive lead-lag association between the trades of hedge funds and their prime brokers' recommendation revisions documented in Table 2 is, in fact, mostly driven by the high-dollar-turnover funds.

3.3.4. Client's stock position and portfolio

If hedge funds pressure their prime brokers to revise the recommendations in line with their recent trades, a hedge fund that has a large bet on a stock would more pressure on its prime broker to issue revise recommendation to suit the client. Performance of this stock must be crucial to the fund's overall performance. Another probable factor that might influence the prime broker and hedge fund relation is the degree of concentration of clients that a prime broker has – a broker with many small clients might feel less pressurized to revise recommendations than another one with a few large clients. To explore these two conjectures regarding the client-broker relation, we perform the following two tests.

First, we measure the ratio of the dollar value of a client's investment in a specific stock relative to the dollar value of the same fund's overall stock portfolio at quarter *t*-1. The higher this ratio, the more important the stock is to the client. Then, as in Tables 5 and 6, we perform a test with an indicator variable of one if this ratio is above the sample-median, and zero otherwise. We name this indicator variable *LARGE_BET*. If our view that hedge funds pressure their prime brokers more to get a favorable recommendation on a stock with a relatively large position is true, we will find a significantly positive coefficient on the interaction variable between *ΔIND_HCLIENT* and *LARGE_BET* in the regression.

[Insert Table 7, Panel A here]

Panel A of Table 7 reports the regression results. In column (1), we do not find a significant coefficient on the interaction variable (*LARGE_BET* × *ΔIND_HCLIENT*), but when the dependent variable is *UPGRADE* in column (2), the coefficient estimate on *LARGE_BET* × *IND_HCLIENT_BUY* is significantly positive (0.066, *t*-value 2.72). It appears that clients with a large bet on a stock exert influence on the prime broker analysts to revise the recommendation upward after the client stock purchase.

The coefficient estimate on the interaction variable *LARGE_BET* × *IND_HCLIENT_SELL* in column (3) is not significant. This insignificant result in column (3) is, in a sense, expected. *LARGE_BET* is an indicator variable that takes a value of one if a client has over the sample-median concentrated bet in a stock relative to the client's overall portfolio at quarter *t*-1, and zero otherwise. Thus, in the observations with *LARGE_BET* being one, clients still have a large ownership in a firm at quarter *t*-1 regardless of whether the clients purchase the stock additionally or sell it in the same quarter. If a client purchased a stock and ends up with a concentrated bet on the stock at quarter *t*-1, the client will pressure its prime brokers to upgrade the recommendations to support the stock price. However, if a client sells a stock at quarter *t*-1 but still has a large ownership in the stock (*LARGE_BET* being one), the client would not pressure the prime brokers to downgrade the stock.

For the second test exploring the client-broker relationship, we use a different variable. Instead of measuring how large a particular stock position is in a client's own portfolio, we measure the importance of a particular hedge fund client to a prime broker. To capture the relative importance of a hedge fund to a prime broker, we calculate the weight of a hedge fund in the broker's overall portfolio, *CLIENT_WT*, by dividing the dollar value of a hedge fund's stock portfolio by the sum of the values of all hedge fund stock portfolios associated with a prime broker. This variable takes a high value for relatively large funds at a prime broker and low values for smaller funds, thus capturing the relative importance of funds to a broker. We measure this for every fund that a prime broker has, based on a client hedge fund's stock portfolio at quarter *t-1*. Panel B of Table 7 reports the regression results with *CLIENT_WT*.

[Insert Table 7 Panel B here]

The coefficient estimate on *CLIENT_WT* × *ΔIND_HCLIENT* in column (1) is not statistically significant, but the coefficient estimates on *CLIENT_WT* × *IND_HCLIENT_BUY* and *CLIENT_WT* × *IND_HCLIENT_SELL* are significant in columns (2) and (3), with values of 0.036 (*t*-value: 1.85) and 0.059 (*t*-value: 3.10), respectively. This indicates that a prime-broker is more likely to upgrade (downgrade) a stock if a relatively important client buys (sells) that stock in the prior quarter. These results suggests that the likelihood of a recommendation revision in line with the client's trade increases as the relative size of the hedge fund increases. [21]

[21] In untabulated results, we also investigate if the hedge fund characteristics influence the relation between hedge fund portfolio changes, broker recommendation revisions and future stock returns (beyond what we show in Table 3 results). For these tests, we interact fund characteristics investigated in the section 3.3 (e.g. size of the fund, trading volume in the prior quarter, large bet on a particular stock, and CLIENT_WT) with the prime broker's change in recommendation variables, and add these interaction variables in the return regression similar to those in Table 3. For the most part, fund characteristics do not appear to significantly influence these results. TRADING_AMT is the only fund-characteristic variable that loads with a significantly negative coefficient in some on the interaction variables (and only when the broker issues a strong-buy recommendation revision). This result shows that only the equity trading from hedge funds with large trading volumes significantly modifies the relationship between broker's recommendation revisions and the future stock returns documented in Table 3. These results are available upon request.

4. Stock characteristics

It is difficult for large hedge funds to move in and out of small capitalization stocks without moving prices. Therefore, small stocks tend to be less interesting to hedge funds with significant assets under management. At the same time, our results will be less meaningful if they were confined to stocks that are rarely covered by analysts. To check that our findings are not confined to small capitalization and low analyst coverage stocks, we split the sample of firms equally by median market capitalization and analyst coverage, and re-estimate the regressions in Table 2. Panel A of Table 8 reports the regression results in small versus large firms, and Panel B present the results in low versus high analyst following firms.

[Insert Table 8 here]

The coefficient estimates on *ΔHCLIENT*, *HCLIENT_BUY*, and *HCLIENT_SELL* in Panel A indicate that our findings are not primarily driven by small stocks; coefficient on *ΔHCLIENT* and *HCLIENT_SELL* are significant in both groups while *HCLIENT_BUY is* marginally significant *(t*-value of 1.71) for small stocks while insignificant for large stocks (*t*-value of 1.54). In Panel B, we still find positive and significant coefficients on *ΔHCLIENT* and *HCLIENT_SELL* in both low and high analyst following firms. The exception is *HCLIENT_BUY*. We only find a significant coefficient on *HCLIENT_BUY* in the sub-sample where analyst following is high – interestingly, higher analyst following creates an opening for hedge funds in line with the interpretation of influence over analysts.

5. Conclusion

This paper leverages prime broker data to directly link analysts to hedge funds and marshals empirical evidence to suggest that the prime brokers of hedge funds issue recommendations that empathize with the investment views of the prime brokerage clients. The behavior of stock returns after recommendation revision announcements suggests that the recommendation upgrades on stocks purchased by the prime brokerage clients are overly optimistic. Compliant analysts appear driven by the desire to generate trading commissions included in prime brokerage fees. The results are stronger for high-dollar-turnover hedge funds that generate significant trading commissions for prime brokers. Prime broker analysts are more likely to upgrade their stock recommendations on stocks purchased by the clients that have a large investment bet on a stock in the last quarter. Results do not appear to be driven solely by stocks of small firms or by firms that have a small analyst following. These results serve as a reminder that in a post-Spitzer era, even though the research departments at Wall Street have been weaned off investment banking revenues, they must still contend with prime brokerage fee–induced conflicts of interest till true unbundling and separate pricing of analyst research and brokerage services is achieved. We leave to future research whether the European Union led directives around Markets in Financial Instruments Directive II (MiFID II) or the eventual adoption of similar laws in the US markets will change the relationship between hedge fund clients and their prime brokers.[22]

[22] The US Securities and Exchange Commission has allowed a "no-action relief" to US brokers from several key aspects of directives associated with the European Union led MiFID (II) related unbundling provisions and fee payments till July 3, 2023. To gauge the range of options that the SEC is considering, see the submitted comments, available at https://www.sec.gov/comments/mifidii/mifidii.htm. Also see Fang et al. (2020) for early evidence on the effect of MiFID (II) unbundling on coverage of European firms.

References

Agrawal, A., Chen, M., 2007. Analyst conflicts and research quality. Unpublished working paper, University of Maryland.

Amadeo, K., 2019. How hedge funds created the financial crisis. The Balance. Available at https://www.thebalance.com/how-hedge-funds-created-the-financial-crisis-3306079.

Aragon, G., Chung, J., Kang, B., 2020. Do prime broker matter for funds of hedge funds? Unpublished working paper, Arizona State University.

Banz, R., 1981. The relationship between return and market value of common stocks. Journal of Financial Economics 9, 3-18.

Brown, S., Warner, J., 1985. Using daily stock returns: The case of event studies. Journal of Financial Economics 14, 3-31.

Chung, J., Kang, B., 2016. Prime broker-level comovement in hedge fund returns: Information or contagion? Review of Financial Studies 29, 3321-3353.

Cowen, A., Groysberg, B., Healy, P., 2006. Which types of analyst firms are more optimistic? Journal of Accounting and Economics 41, 146-199.

Crowe, P., 2016. A definitive breakdown of the gloomy state of Wall Street. Business Insider. Available at http://www.businessinsider.com/wall-street-revenues-according-to-coalition-2016-11.

Dugar, A., Nathan, S., 1995. The effect of investment banking relationships on financial analysts' earnings forecasts and investment recommendations. Contemporary Accounting Research 12, 131-160.

Fama, E., French, K., 1992. The cross-section of expected stock returns. Journal of Finance 47, 427-465.

Fang, B., Hope, OK., Huang, Z. Moldovan, R., 2020. The effects of MiFID II on sell-side analysts, buy-side analysts, and firms. Review of Accounting Studies 25, 855–902.

Firth, M., Lin, C., Liu, P., Xuan, Y., 2013. The client is king: Do mutual fund relationships bias analyst recommendations? Journal of Accounting Research 51, 165-200.

Gerasimova, N., 2016. Do prime brokers induce similarities in hedge funds performance? Unpublished working paper, University of Lausanne.

Goldie, B. A. 2011. Prime brokers and hedge fund investment decisions. Unpublished working paper, Pennsylvania State University [available at: https://pdfs.semanticscholar.org/20d0/68b11955f05d229b109520dcd6e8b3dc38fd.pdf].

Goldstein, M., Irvine, P., Kandel, E., Wiener, Z., 2009. Brokerage commissions and institutional trading patterns. Review of Financial Studies 22, 5175-5212.

Griffin, J., Xu, J., 2009. How smart are the smart guys? A unique view from hedge fund stock holdings. Review of Financial Studies 22, 2531–2570.

Gu, Z., Li, Z., Yang, G.Y., 2013. Monitors or predators: The influence of institutional investors on sell-side analysts. Accounting Review 88, 137-169.

Hirschman, A.O., 1964. The paternity of an Index, American Economic Review 761-762.

Hobbs, J., Kovacs, T., Sharma, V., 2012. The investment value of the frequency of analyst recommendation changes for the ordinary investor. Journal of Empirical Finance 19, 94-108

Irvine, P., 2004. Analysts' forecasts and brokerage-firm trading. Accounting Review 79, 125-150.

Irvine, P., Lipson, M., Puckett, A., 2007. Tipping. Review of Financial Studies 20, 741-768.

Jackson, A., 2005. Trade generation, reputation, and sell-side analysts. Journal of Finance 60, 673-717.

Jegadeesh, N., Kim, J., Kische, S., Lee, C., 2004. Analyzing the analysts: When do recommendations add value? Journal of Finance 59, 1083-1124.

Jegadeesh, N., Titman, S., 1993. Returns to buying winners and selling losers: implications for stock market efficiency. Journal of Finance 48, 65-91.

Juergens, J., Lindsey, L., 2009. Getting out early: An analysis of market making activity at the recommending analyst's firm. Journal of Finance 94, 2327-2359.

Kadan, O, Madureira, L., Wang, R., Zach, T., 2009. Conflicts of interest and stock recommendations: The effects of the Global Settlement and related regulations. Review of Financial Studies 22, 4189-4217.

Kumar, N., Mullally, K., Ray, S., Tang, Y., 2020. Prime (information) brokerage. Journal of Financial Economics 137, 371-391.

Lin, H., McNichols, M., 1998. Underwriting relationships, analysts' earnings forecasts and investment recommendations. Journal of Accounting and Economics 25, 101-127.

Ljungqvist, A., Malloy, C., Marston, F., 2009. Rewriting history. Journal of Finance 64, 1935-1960.

Ljungqvist, A., Marston, F., Starks, L., Wei, K., Yan, H., 2007. Conflicts of interest in sell-side research and the moderating role of institutional investors. Journal of Financial Economics 85, 420-456.

Loh, R., Stulz, R., 2011. When are analyst recommendation changes influential? Review of Financial Studies 24, 593-627.

Michaely, R., Womack, K., 1999. Conflicts of interest and credibility of underwriter analyst recommendations. Review of Financial Studies 12, 653-686.

O'Brien, P., 1988. Analysts' forecasts as earnings expectations. Journal of Accounting and Economics 10, 53-83.

Qian, H., Zhong, Z., 2018. Do hedge funds possess private information about IPO stocks? Evidence from post-IPO holdings. Review of Asset Pricing Studies 8, 117–152.

Stulz, R., 2007. Hedge funds: Past, present and future. Journal of Economic Perspective 21, 175-194.

Unger, L., 2001. Written Testimony Concerning Conflicts of Interest Faced by Brokerage Firms and Their Research Analysts Before the Subcommittee on Capital Markets, Insurance, and Government Sponsored Enterprises. Committee on Financial Services, U.S. House of Representatives.

Williamson, C., 2018. Hedge fund assets end 2017 at record $3.2 trillion – HFR. Pensions & Investments 46, 1.

Womack, K., 1996. Do brokerage analysts' recommendations have investment value? Journal of Finance 51, 137–167.

Table 1: Summary statistics

This table reports descriptive statistics of the variables used in this study. ΔREC is the change in a prime broker analyst recommendation. ΔHCLIENT is the change in the sum of shares of a firm held by hedge funds that are prime brokerage clients of the analyst's bank at quarter *t*-1. ΔNON_CLIENT_HEDGE is the change in the sum of shares of a firm held by hedge funds that are *not* prime brokerage clients of the analyst's bank at quarter *t*-1. ΔNON_HEDGE is the change in the sum of shares of a firm held by other institutional investors at quarter *t*-1 (excluding hedge funds). All these variables are scaled by the number of shares outstanding at quarter *t*-1. ME (in $ millions) is the market value of equity measured at the end of quarter *t*-1. BE/ME is the ratio of book value at quarter *t*-2 to market value of common equity measured at the end of quarter *t*-2. LAG_RETURN is six-month buy-and-hold returns ending in quarter *t*-1. VOLUME is the daily volume scaled by shares outstanding (in percentage) and averaged over the six months preceding the end of quarter *t*-1. LAG_REC is the level of an individual recommendation prior to the change in an analyst's recommendation (ΔREC). 3MAR is the three-month market-adjusted buy-and-hold returns measured starting two trading days after the recommendation revision announcement date and using the CRSP value-weighted index as the market benchmark (Brown and Warner, 1985). Similarly, 6MAR is the six-month market-adjusted returns measured starting two trading days after the recommendation revision announcement date. ANALYST is the log value of one plus number of analyst following a firm at the end of quarter t. UPGRADE is an indicator variable that is equal to one if the recommendation revisions (ΔREC) is an upgrade, and is equal to zero otherwise. DOWN is an indicator variable that is equal to one if ΔREC is a downgrade, and is equal to zero otherwise.

Variable	N	Mean	Std. Dev.	Lower Quartile	Median	Upper Quartile
ΔREC	18,699	-0.049	1.196	-1.000	0.000	1.000
ΔHCLIENT	18,699	-0.025	2.102	-0.370	0.000	0.430
ΔNON_CLIENT_HEDGE	18,699	-0.390	4.824	-1.716	0.007	1.524
ΔNON_HEDGE	18,699	0.518	7.433	-2.118	0.361	3.088
ME (in $ millions)	18,699	12,312	28,799	1,587	3,969	11,684
BE/ME	18,699	0.556	0.500	0.287	0.467	0.738
LAG_RETURN	18,699	0.030	0.459	-0.182	0.006	0.184
VOLUME	18,699	14.896	12.114	7.744	11.642	18.365
LAG_REC	18,699	3.362	0.866	3.000	3.000	4.000
3MAR	18,458	0.015	0.194	-0.083	0.007	0.099
6MAR	18,458	0.031	0.291	-0.117	0.009	0.142
ANALYST	18,458	2.584	0.595	2.303	2.708	2.996
UPGRADE	18,458	0.345	0.475	0.000	0.000	1.000
DOWN	18,458	0.387	0.487	0.000	0.000	1.000

Table 2: Regressions on the recommendation revisions of prime broker analysts

This table reports results from regressions on the recommendation revisions of prime broker analysts. The dependent variables are ΔREC, UPGRADE, and DOWN. The dependent variables are measured in quarter *t*. The independent variables include the following: HCLIENT_BUY is an indicator variable that is equal to one if ΔHCLIENT is positive, and is equal to zero otherwise. NON_CLIENT_BUY is an indicator variable that is equal to one if ΔNON_CLIENT_HEDGE is positive, and is equal to zero otherwise. NON_HEDGE_BUY is an indicator variable that is equal to one if ΔNON_HEDGE is positive, and is equal to zero otherwise. HCLIENT_SELL, NON_CLIENT_SELL, and NON_HEDGE_SELL are defined analogously. All other variables are defined in Table 1. OLS regression is estimated for ΔREC. Logit regressions are estimated for UPGRADE and DOWN All specifications use quarter and broker fixed effects; reported *z*-statistics and *t*-statistics are clustered by firm. The ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively. Main variables of interest are in bold.

	Dependent variables		
	ΔREC	UPGRADE	DOWN
	(1)	(2)	(3)
ΔHCLIENT	**0.011*** **		
	(4.18)		
ΔNON_CLIENT_HEDGE	-0.002*		
	(-1.65)		
ΔNON_HEDGE	0.001		
	(0.97)		
HCLIENT_BUY		**0.106** **	
		(2.42)	
NON_CLIENT_BUY		0.007	
		(0.15)	
NON_HEDGE_BUY		0.032	
		(0.65)	
HCLIENT_SELL			**0.201*** **
			(4.92)
NON_CLIENT_SELL			-0.139***
			(-3.24)
NON_HEDGE_SELL			-0.127***
			(-2.84)
Log(ME)	0.083***	0.218***	-0.230***
	(13.86)	(11.40)	(-12.89)
BE/ME	-0.026	-0.103	0.002
	(-1.02)	(-1.24)	(0.03)
LAG_RETURN	0.089***	0.254***	-0.426***
	(3.52)	(3.86)	(-5.34)
VOLUME	-0.000	0.005**	0.003
	(-0.14)	(2.17)	(1.46)
LAG_REC	-0.985***	-2.842***	2.433***
	(-105.74)	(-49.21)	(53.44)
Constants	2.869***	6.923***	-7.891***
	(38.80)	(25.25)	(-25.19)

Observations	18,699	18,698	18,698
Adjusted/Pseudo R-Square	0.497	0.440	0.390

Table 3: Regressions of recommendation revisions on stock returns

This table reports regressions results explaining market adjusted returns after the announcement of recommendation revisions by prime brokers of fund clients. Panel A presents the results when ΔHCLIENT (continuous variable) is used as a main independent variable. Panel B presents the regression results when R_ΔHCLIENT (ranked variable) is used as a main independent variable. R_ΔHCLIENT is the decile ranked variable of ΔHCLIENT divided by nine so that R_ΔHCLIENT ranges from zero to one. BUY_UP is an indicator variable of one if the recommendation upgrade is to either Strong Buy or Buy, and zero otherwise. SBUY_UP is an indicator variable of one if the recommendation revision is an upgrade to Strong Buy, and zero otherwise. All other variables are as defined in Table 1. All specifications use quarter and broker fixed effects; reported *t*-statistics are clustered by firm. The ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively. Main variables of interest are in bold.

Panel A: ΔHCLIENT (continuous variable) as main independent variable

	Dependent variables					
	3MAR	6MAR	3MAR	6MAR	3MAR	6MAR
	(1)	(2)	(3)	(4)	(5)	(6)
ΔREC	0.019***	0.019**				
	(3.52)	(2.34)				
ΔREC × ΔHCLIENT	**-0.001**	**-0.001**				
	(-1.51)	**(-1.13)**				
UPGRADE			0.047***	0.031		
			(3.40)	(1.48)		
UPGRADE × ΔHCLIENT			**-0.004****	**-0.006****		
			(-2.38)	**(-2.15)**		
DOWN					-0.043***	-0.043*
					(-2.86)	(-1.84)
DOWN × ΔHCLIENT					**0.001**	**0.002**
					(0.38)	**(0.94)**
ΔHCLIENT	-0.002**	-0.003**	-0.001	-0.001	-0.002**	-0.004**
	(-2.55)	(-2.28)	(-0.69)	(-0.66)	(-2.10)	(-2.22)
Log(ME)	-0.010***	-0.016***	-0.010***	-0.016***	-0.010***	-0.016***
	(-5.97)	(-5.96)	(-6.00)	(-5.99)	(-5.96)	(-5.94)
BE/ME	0.004	0.010	0.003	0.010	0.004	0.010
	(0.55)	(0.71)	(0.54)	(0.70)	(0.55)	(0.70)
LAG_RETURN	-0.008	-0.018*	-0.008	-0.018*	-0.008	-0.018*
	(-1.21)	(-1.92)	(-1.22)	(-1.92)	(-1.22)	(-1.92)
ANALYST	0.009**	0.009	0.014***	0.012	0.004	0.003
	(2.31)	(1.32)	(3.14)	(1.61)	(0.93)	(0.47)
ΔREC ×ANALYST	-0.006***	-0.007**				
	(-3.10)	(-2.24)				
UPGRADE ×ANALYST			-0.014***	-0.009		
			(-2.71)	(-1.15)		
DOWN × ANALYST					0.013**	0.015*
					(2.46)	(1.80)
Constant	0.067***	0.139***	0.050***	0.128***	0.084***	0.155***

	(4.89)	(5.66)	(3.45)	(4.94)	(5.59)	(6.00)
Observations	18,458	18,458	18,458	18,458	18,458	18,458
Adjusted R-square	0.022	0.026	0.022	0.026	0.022	0.026

Panel B: R_ΔHCLIENT (ranked variable) as main independent variable

	Dependent variables					
	3MAR	6MAR	3MAR	6MAR	3MAR	6MAR
	(1)	(2)	(3)	(4)	(5)	(6)
UPGRADE	0.058***	0.043*				
	(3.95)	(1.93)				
UPGRADE × R_ΔHCLIENT	**-0.022****	**-0.023**				
	(-2.09)	**(-1.54)**				
BUY_UP			0.037**	0.030		
			(2.26)	(1.26)		
BUY_UP × R_ΔHCLIENT			**-0.026****	**-0.028****		
			(-2.48)	**(-2.01)**		
SBUY_UP					0.009	0.020
					(0.41)	(0.56)
SBUY_UP × R_ΔHCLIENT					**-0.039****	**-0.061****
					(-2.24)	**(-2.20)**
R_ΔHCLIENT	-0.004	-0.010	-0.009*	-0.015*	-0.010**	-0.016**
	(-0.59)	(-1.05)	(-1.71)	(-1.93)	(-2.01)	(-2.12)
Log(ME)	-0.010***	-0.016***	-0.010***	-0.016***	-0.010***	-0.016***
	(-6.00)	(-5.99)	(-6.02)	(-5.98)	(-5.90)	(-5.94)
BE/ME	0.004	0.010	0.004	0.010	0.004	0.010
	(0.54)	(0.70)	(0.58)	(0.70)	(0.57)	(0.71)
LAG_RETURN	-0.008	-0.018*	-0.008	-0.017*	-0.008	-0.017*
	(-1.21)	(-1.90)	(-1.17)	(-1.86)	(-1.16)	(-1.88)
ANALYST	0.014***	0.012	0.010**	0.010	0.008**	0.009
	(3.15)	(1.61)	(2.44)	(1.38)	(2.13)	(1.26)
UPGRADE × ANALYST	-0.014***	-0.009				
	(-2.70)	(-1.14)				
BUY_UP × ANALYST			-0.006	-0.004		
			(-1.04)	(-0.56)		
SBUY_UP × ANALYST					0.004	0.003
					(0.51)	(0.25)
Constant	0.052***	0.133***	0.066***	0.143***	0.073***	0.149***
	(3.48)	(5.02)	(4.51)	(5.48)	(5.07)	(5.85)
Observations	18,458	18,458	18,458	18,458	18,458	18,458
Adjusted R-squared	0.022	0.026	0.021	0.026	0.021	0.026

Table 4: Regressions of the change in individual client stock holdings on prime broker recommendation revisions (fund-level analysis)

This table reports results from regressions of the change in the individual client's stock holding on the recommendation revisions of the prime broker analysts. ΔIND_HCLIENT is the winsorized, at 1% at both tails, change in the number of shares of a firm held by an individual hedge fund that is a prime brokerage client of the analyst's bank at quarter *t*-1 and scaled by the number of shares outstanding. IND_HCLIENT_BUY is an indicator variable that is equal to one if ΔIND_HCLIENT is positive, and is equal to zero otherwise. IND_HCLIENT_SELL is defined analogously to capture the sell. All other variables are as defined in Table 1. OLS regression is estimated for ΔREC. Logit regressions are estimated for UPGRADE and DOWN. All specifications use quarter and broker fixed effects; reported *z*-statistics and *t*-statistics are clustered by firm. The ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively. Main variables of interest are in bold.

	Dependent variables		
	ΔREC	UPGRADE	DOWN
	(1)	(2)	(3)
ΔIND_HCLIENT	**0.029*** **		
	(3.83)		
ΔNON_CLIENT_HEDGE	-0.001		
	(-0.64)		
ΔNON_HEDGE	0.001		
	(0.45)		
IND_HCLIENT_BUY		**-0.011**	
		(-0.88)	
NON_CLIENT_BUY		0.030	
		(0.46)	
NON_HEDGE_BUY		0.079	
		(1.13)	
IND_HCLIENT_SELL			**-0.008**
			(-0.74)
OTHER_HEDGE_SELL			-0.051
			(-0.83)
NON_HEDGE_SELL			-0.160**
			(-2.45)
Log(ME)	0.086***	0.239***	-0.238***
	(14.26)	(10.29)	(-9.63)
BE/ME	0.012	-0.032	-0.111
	(0.60)	(-0.40)	(-1.56)
LAG_RETURN	0.127***	0.252***	-0.666***
	(3.57)	(2.82)	(-4.11)
VOLUME	0.001	0.007***	0.002
	(1.09)	(2.68)	(0.97)
LAG_REC	-0.869***	-2.644***	2.387***
	(-82.11)	(-38.05)	(42.08)

Constant	2.454***	5.919***	-8.088***
	(33.32)	(18.59)	(-20.34)
Observations	403,994	403,994	403,994
Adjusted/Pseudo R-Square	0.446	0.377	0.334

Table 5: Regressions on recommendation revisions stratified by client size (fund-level analysis)

This table reports the effect of the client fund size on the lead-lag relation between the change in the hedge fund client ownership and the prime broker's recommendation revision. FUND_SIZE is an indicator variable of one if the sum of the dollar value of a prime brokerage client's stock holdings across all the firms measured at quarter *t*-1 is above sample-median, and zero otherwise. All other variables are as defined in Table 1. OLS regression is estimated for ΔREC. Logit regressions are estimated for UPGRADE and DOWN. All specifications use quarter and broker fixed effects; reported *z*-statistics and *t*-statistics are clustered by firm. The ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively. Main variables of interest are in bold.

	Dependent variables		
	ΔREC	UPGRADE	DOWN
	(1)	(2)	(3)
ΔIND_HCLIENT	0.049***		
	(2.91)		
FUND_SIZE × ΔIND_HCLIENT	**-0.024**		
	(-1.27)		
ΔNON_CLIENT_HEDGE	-0.001		
	(-0.64)		
ΔNON_HEDGE	0.001		
	(0.45)		
IND_HCLIENT_BUY		-0.020	
		(-1.20)	
FUND_SIZE × IND_HCLIENT_BUY		**0.031**	
		(1.48)	
NON_CLIENT_BUY		0.030	
		(0.46)	
NON_HEDGE_BUY		0.079	
		(1.13)	
IND_HCLIENT_SELL			-0.033**
			(-2.10)
FUND_SIZE × IND_HCLIENT_SELL			**0.040****
			(2.17)
OTHER_HEDGE_SELL			-0.051
			(-0.83)
NON_HEDGE_SELL			-0.160**
			(-2.44)
FUND_SIZE	-0.016***	-0.069***	0.021*
	(-6.94)	(-5.81)	(1.87)
Log(ME)	0.085***	0.235***	-0.235***
	(14.11)	(10.13)	(-9.56)
BE/ME	0.012	-0.032	-0.111
	(0.59)	(-0.40)	(-1.56)
LAG_RETURN	0.127***	0.252***	-0.665***
	(3.57)	(2.82)	(-4.10)

VOLUME	0.001	0.007***	0.002
	(1.04)	(2.62)	(1.00)
LAG_REC	-0.869***	-2.645***	2.387***
	(-82.14)	(-38.07)	(42.09)
Constant	2.469***	5.978***	-8.115***
	(33.60)	(18.77)	(-20.45)
Observations	403,994	403,994	403,994
Adjusted/Pseudo R-Square	0.446	0.377	0.334

Table 6: Regressions on recommendation revisions stratified by turnover in client portfolio (fund-level analysis)

This table reports the effect of the client dollar turnover on the lead-lag relation between the equity trades of the hedge fund clients and the prime broker's recommendation revisions. TRADING_AMT is an indicator variable of one if the sum of the dollar value of the change in a prime brokerage client's stock holdings across all the firms measured at quarter *t*-1 is above sample-median, and zero otherwise. All other variables are as defined in Table 1. OLS regression is estimated for ΔREC. Logit regressions are estimated for UPGRADE and DOWN. All specifications use quarter and broker fixed effects; reported *z*-statistics and *t*-statistics are clustered by firm. The ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively. Main variables of interest are in bold.

	Dependent variables		
	ΔREC	UPGRADE	DOWN
	(1)	(2)	(3)
ΔIND_HCLIENT	0.033*		
	(1.69)		
TRADING_AMT × ΔIND_HCLIENT	**-0.005**		
	(-0.22)		
ΔNON_CLIENT_HEDGE	-0.001		
	(-0.64)		
ΔNON_HEDGE	0.001		
	(0.45)		
IND_HCLIENT_BUY		-0.036**	
		(-2.15)	
TRADING_AMT × IND_HCLIENT_BUY		**0.054*** **	
		(2.64)	
NON_CLIENT_BUY		0.030	
		(0.46)	
NON_HEDGE_BUY		0.079	
		(1.13)	
IND_HCLIENT_SELL			-0.039**
			(-2.37)
TRADING_AMT × IND_HCLIENT_SELL			**0.059*** **
			(3.05)
OTHER_HEDGE_SELL			-0.051
			(-0.83)
NON_HEDGE_SELL			-0.160**
			(-2.44)
TRADING_AMT	-0.006***	-0.057***	-0.024**
	(-2.96)	(-4.94)	(-2.27)
Log(ME)	0.085***	0.236***	-0.238***
	(14.17)	(10.15)	(-9.63)
BE/ME	0.012	-0.032	-0.111
	(0.59)	(-0.40)	(-1.56)
LAG_RETURN	0.127***	0.252***	-0.666***

	(3.57)	(2.82)	(-4.10)
VOLUME	0.001	0.007***	0.002
	(1.07)	(2.64)	(0.96)
LAG_REC	-0.869***	-2.644***	2.387***
	(-82.11)	(-38.06)	(42.08)
Constant	2.461***	5.967***	-8.075***
	(33.37)	(18.70)	(-20.32)
Observations	403,994	403,994	403,994
Adjusted/Pseudo R-Square	0.446	0.377	0.334

Table 7: Regressions on recommendation revisions stratified by client's oversized stock position and broker's concentration (fund-level analysis)

These tables report the effect of the size of the client position in a stock relative to the client's overall portfolio (Panel A) and prime brokers' client diversification level (Panel B) on the lead-lag relation between the change in the hedge fund client ownership and the prime broker's recommendation revision. LARGE_BET is an indicator variable that takes a value of one if the ratio of the dollar value of a hedge fund client's stock holding in a firm relative to the dollar value of its overall stock portfolio measured at quarter *t*-1 is above sample-median, and zero otherwise. CLIENT_WT is the hedge fund client's portfolio weight in the broker's overall portfolio of clients, calculated as the value of a client's portfolio, in dollars, divided by the total portfolio value of a prime broker measured at quarter *t*-1. All other variables are defined in Tables 1 and 4. Panel A presents the regression results when LARGE_BET is used as a main cross-sectional variable. Panel B presents the regression results when CLIENT_WT is used as a main cross-sectional variable. OLS regression is estimated for ΔREC. Logit regressions are estimated for UPGRADE and DOWN. All specifications use quarter fixed effects; specifications in Panel A also uses broker fixed effects; reported *z*-statistics and *t*-statistics are clustered by firm. The ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively. Main variables of interest are in bold.

Panel A: LARGE_BET as main conditioning variable

	Dependent variables		
	ΔREC	UPGRADE	DOWN
	(1)	(2)	(3)
ΔIND_HCLIENT	-0.000		
	(-0.02)		
LARGE_BET × ΔIND_HCLIENT	**0.029**		
	(1.41)		
ΔNON_CLIENT_HEDGE	-0.001		
	(-0.63)		
ΔNON_HEDGE	0.001		
	(0.44)		
IND_HCLIENT_BUY		-0.066***	
		(-3.15)	
LARGE_BET × IND_HCLIENT_BUY		**0.066*** **	
		(2.72)	
NON_CLIENT_BUY		0.031	
		(0.47)	
NON_HEDGE_BUY		0.079	
		(1.12)	
IND_HCLIENT_SELL			-0.009
			(-0.57)
LARGE_BET × IND_HCLIENT_SELL			**0.003**
			(0.13)
OTHER_HEDGE_SELL			-0.051
			(-0.83)
NON_HEDGE_SELL			-0.163**

			(-2.50)
LARGE_BET	0.012***	0.015	-0.042***
	(3.12)	(0.86)	(-2.72)
Log(ME)	0.085***	0.236***	-0.234***
	(14.03)	(10.12)	(-9.41)
BE/ME	0.012	-0.028	-0.108
	(0.60)	(-0.35)	(-1.51)
LAG_RETURN	0.126***	0.252***	-0.657***
	(3.53)	(2.83)	(-4.00)
VOLUME	0.001	0.007***	0.002
	(1.08)	(2.67)	(0.99)
LAG_REC	-0.870***	-2.648***	2.390***
	(-82.21)	(-38.12)	(42.09)
Constant	2.457***	5.953***	-8.122***
	(33.28)	(18.67)	(-20.37)
Observations	396,743	396,743	396,743
Adjusted/Pseudo R-Square	0.447	0.378	0.335

Panel B: CLIENT_WT as main conditioning variable

	Dependent variables		
	ΔREC	UPGRADE	DOWN
	(1)	(2)	(3)
ΔIND_HCLIENT	0.031*		
	(1.91)		
CLIENT_WT × ΔIND_HCLIENT	**-0.006**		
	(-0.31)		
ΔNON_CLIENT_HEDGE	-0.001		
	(-0.57)		
ΔNON_HEDGE	0.000		
	(0.37)		
IND_HCLIENT_BUY		-0.034**	
		(-2.09)	
CLIENT_WT × IND_HCLIENT_BUY		**0.036***	
		(1.85)	
NON_CLIENT_BUY		0.022	
		(0.37)	
NON_HEDGE_BUY		0.065	
		(1.03)	
IND_HCLIENT_SELL			-0.023
			(-1.41)
CLIENT_WT × IND_HCLIENT_SELL			**0.059*****
			(3.10)

OTHER_HEDGE_SELL			-0.047
			(-0.81)
NON_HEDGE_SELL			-0.147**
			(-2.31)
CLIENT_WT	0.081***	0.185***	-0.248***
	(13.81)	(8.57)	(-9.93)
Log(ME)	0.012	-0.054	-0.123*
	(0.60)	(-0.84)	(-1.86)
BE/ME	0.127***	0.261***	-0.611***
	(3.50)	(3.11)	(-4.06)
LAG_RETURN	0.001	0.006***	0.002
	(1.06)	(2.64)	(0.88)
VOLUME	-0.842***	-2.344***	2.136***
	(-83.34)	(-32.69)	(47.36)
LAG_REC	0.025***	0.100***	-0.018
	(8.13)	(7.10)	(-1.37)
Constant	1.889***	4.542***	-5.200***
	(26.51)	(15.02)	(-17.87)
Observations	403,994	403,994	403,994
Adjusted/Pseudo R-Square	0.430	0.305	0.286

Table 8: Regressions on recommendation revisions stratified by firm size and number of analysts following

These tables report results from regressions on the recommendation revisions of the prime broker analyst by firm size and number of analysts following. Panel A presents the regression results in small versus large firms. SMALL (LARGE) firms are below (above) median market capitalization of sample firms. Panel B presents the regression results in firms with low versus high number of analyst following. LOW (HIGH) ANALYST FOLLOWING represent below (above) median number of analysts following sample firms. All variables are as defined in Table 1. OLS regression is estimated for ΔREC. Logit regressions are estimated for UPGRADE and DOWN. All specifications use quarter and broker fixed effects; reported *z*-statistics and *t*-statistics are clustered by firm. The ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively. Main variables of interest are in bold.

Panel A: Regression results by firm size

	SMALL FIRMS			LARGE FIRMS		
	ΔREC	UP	DOWN	ΔREC	UP	DOWN
	(1)	(2)	(3)	(4)	(5)	(6)
ΔHCLIENT	**0.012*** **			**0.010** **		
	(3.43)			**(2.40)**		
ΔNON_CLIENT_HEDGE	-0.001			-0.004		
	(-0.79)			(-1.55)		
ΔNON_HEDGE	0.001			0.002		
	(0.58)			(1.11)		
HCLIENT_BUY		**0.106***			**0.098**	
		(1.71)			**(1.54)**	
NON_CLIENT_BUY		0.020			-0.013	
		(0.29)			(-0.19)	
NON_HEDGE_BUY		0.018			0.043	
		(0.26)			(0.59)	
HCLIENT_SELL			**0.220*** **			**0.187*** **
			(3.76)			**(3.25)**
OTHER_HEDGE_SELL			-0.129**			-0.129**
			(-2.10)			(-2.13)
NON_HEDGE_SELL			-0.158**			-0.085
			(-2.57)			(-1.28)
Log(ME)	0.092***	0.281***	-0.243***	0.092***	0.232***	-0.239***
	(6.85)	(6.31)	(-5.95)	(7.19)	(5.55)	(-6.53)
BE/ME	-0.059***	-0.203***	0.069	0.031	0.062	-0.106
	(-3.15)	(-3.06)	(1.11)	(0.79)	(0.59)	(-0.80)
LAG_RETURN	0.075***	0.203***	-0.336***	0.113**	0.366***	-0.641***
	(3.77)	(2.94)	(-4.66)	(2.23)	(3.12)	(-2.95)
VOLUME	-0.000	0.004*	0.002	0.000	0.004	0.003
	(-0.31)	(1.83)	(1.15)	(0.20)	(0.99)	(0.82)
LAG_REC	-0.955***	-2.597***	2.367***	-1.019***	-3.191***	2.555***

	(-79.58)	(-37.01)	(41.48)	(-72.40)	(-32.67)	(33.48)
Constant	2.703***	5.998***	-7.503***	2.898***	7.629***	-8.371***
	(23.21)	(13.75)	(-16.62)	(20.08)	(15.34)	(-15.16)
Observations	9,346	9,343	9,346	9,353	9,352	9,352
Adjusted/Pseudo R-Square	0.482	0.408	0.387	0.514	0.482	0.399

Panel B: Regression results by the number of analyst following

	LOW ANALYST FOLLOWING			HIGH ANALYST FOLLOWING		
	ΔREC	UP	DOWN	ΔREC	UP	DOWN
	(1)	(2)	(3)	(4)	(5)	(6)
ΔHCLIENT	**0.012*** **			**0.009** **		
	(3.40)			**(2.36)**		
ΔNON_CLIENT_HEDGE	-0.002			-0.003		
	(-0.99)			(-1.45)		
ΔNON_HEDGE	0.002			0.000		
	(1.22)			(0.24)		
HCLIENT_BUY		**0.086**			**0.134** **	
		(1.35)			**(2.15)**	
NON_CLIENT_BUY		0.023			-0.015	
		(0.34)			(-0.21)	
NON_HEDGE_BUY		0.059			0.015	
		(0.87)			(0.20)	
HCLIENT_SELL			**0.254*** **			**0.149** **
			(4.46)			**(2.56)**
OTHER_HEDGE_SELL			-0.155**			-0.129**
			(-2.53)			(-2.12)
NON_HEDGE_SELL			-0.137**			-0.117*
			(-2.27)			(-1.72)
Log(ME)	0.080***	0.211***	-0.233***	0.089***	0.219***	-0.268***
	(9.17)	(7.42)	(-8.65)	(8.86)	(6.72)	(-9.14)
BE/ME	-0.017	-0.031	-0.016	-0.034	-0.222**	0.039
	(-0.56)	(-0.36)	(-0.16)	(-1.15)	(-2.08)	(0.47)
LAG_RETURN	0.062***	0.202***	-0.331***	0.173***	0.404***	-0.553***
	(2.82)	(2.77)	(-3.41)	(4.46)	(3.22)	(-4.48)
VOLUME	0.001	0.005*	-0.001	-0.001	0.004	0.004
	(1.08)	(1.91)	(-0.28)	(-0.61)	(0.97)	(1.43)
LAG_REC	-0.956***	-2.640***	2.341***	-1.017***	-3.113***	2.582***
	(-76.30)	(-36.74)	(40.80)	(-76.41)	(-33.02)	(36.71)
Constant	2.742***	6.438***	-7.205***	2.982***	7.694***	-8.485***
	(27.05)	(16.99)	(-18.40)	(25.12)	(17.39)	(-17.13)
Observations	9,269	9,269	9,269	9,365	9,364	9,364
Adjusted/Pseudo R-Square	0.481	0.418	0.380	0.514	0.469	0.406