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Analysts' stock ownership and stock recommendations☆

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ABSTRACT

Using hand-collected information, we find that analysts who own stock in a company they follow make more informative recommendations and exert more effort in covering the company. However, we also find that analysts with stock ownership issue more optimistic target price forecasts. These findings suggest that analysts' stock ownership enhances the credibility of their recommendations by conveying their superior information, but also induces analysts to bias upwards their target price forecasts. Surprisingly, we find that 56% of analysts owning stock terminate their ownership while having a buy recommendation outstanding, suggesting a potentially widespread violation of the regulations on analysts' research.

1. Introduction

How financial analysts' stock ownership in the companies they cover affects their stock recommendations has long been controversial. Regulators (e.g., SEC, 2001, 2010; FINRA, 2016a) have repeatedly pointed to analysts' stock ownership as a potential source of conflicts of interest and have publicly warned investors that analysts' stock ownership can impair the objectivity of their recommendations. The financial press has voiced a similar concern (e.g., Opdyke, 2001; McNeal, 2012; Morgenson, 2016), with some asserting that analysts' stock ownership "has been perhaps the most fundamental conflict of interest for all Wall Street analysts" (Schack, 2001). This concern is reinforced by anecdotal evidence that analysts owning stock intentionally issue overly optimistic recommendations to mislead investors (Solomon, 2005).

According to this conflict-of-interest view, because stock recommendations influence stock prices, analysts' stock ownership directly links analysts' personal wealth to their own recommendations, creating a conflict of interest between their responsibility to provide clients with unbiased recommendations and their incentive to maximize the value of their own investments. Thus, when analysts issue recommendations on firms they invest in, this conflict can lead analysts to issue overly optimistic recommendations that hurt investors. In addition, stock ownership may cause analysts to take the "inside view" of the invested companies and induce cognitive biases in their recommendations (Boni and Womack, 2002a).

However, proponents of analysts' stock ownership argue that analysts' stock ownership can enhance the credibility of their

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recommendations. As the research head of a major broker put it, "if you're going to recommend it for your clients, then why on earth don't you own it yourself?" (Schack, 2001). By putting their money where their mouth is, analysts' stock ownership conveys to investors their conviction regarding the investment value of the recommended company. Analysts likely invest in companies for which they have more positive or more accurate information, and having "skin in the game" can also motivate analysts to collect more information. Thus, analysts' ownership could serve as a credible signal to investors that their buy recommendations are based on superior information. This enhanced credibility view has led some commentators to propose letting analysts "bet their own money" as "a better way to instill investor confidence in analyst picks," because "actions speak louder than words. And money talks even louder, especially when it is your own." (Newmark, 2008). In line with these competing views, investors' opinions and brokers' policies differ greatly. Boni and Womack (2002b) find that buy-side professionals' opinions are almost evenly split as to analysts' stock ownership. Brokers also vary substantially in their policies, with some banning analysts' stock ownership altogether while others allowing or even encouraging it (e.g., Schack, 2001).

Despite these long-standing concerns, to date no large-sample, systematic evidence exists on the relation between analysts' stock ownership and their recommendations. In this paper we take a first step by exploring a large, hand-collected sample of research reports issued by analysts who own stock in the firm. The regulations on sell-side research (NASD Rule 2711, 2008 and NYSE Rule 472, 2007) in 2002 mandate that analysts disclose in research reports whether they, or any household members, own any shares in the firms they cover. This mandated ownership disclosure allows us to identify reports issued by analysts who own shares in the firm (though we cannot observe the magnitude of analysts' holdings). We check disclosures pertaining to analysts' stock ownership in reports over 2003–2012 from 74 brokers covered by both ThomsonOne and IBES databases, and identify 29,108 reports containing a disclosure that analysts or their family members own stock in the firm (i.e., ownership reports).[1]

We begin by describing the extent and characteristics of analysts' stock ownership. First, analysts' stock ownership remains "a common industry practice" (Schack, 2001). In an average year over our sample period of 2003–2012, 13% of analysts own stock in covered firms, and among these ownership analysts, they invest in 18% of all covered firms. Additional data collection reveals that 12% of analysts own stock in covered firms in 2016, indicating that analysts' stock ownership continues to be prevalent today. Second, analysts' stock ownership is associated with more favorable recommendations. 66% of ownership reports contain a favorable (buy) recommendation, compared to 44% for all recommendations from the same broker-periods. Third, analysts' stock ownership tends to be long-term. The average ownership string (i.e., a series of consecutive ownership reports) contains 13 reports and spans about 16 months. Fourth, among the 74 brokers in our sample, 60 allowed analysts' ownership. In contrast, the remaining14 had virtually no ownership reports and thus likely banned it.

Finally, comparing with analysts without ownership, analysts owning stock are more experienced, cover more firms and more industries, provide fewer types of forecasts, have higher prior forecast frequency and accuracy, and are more likely to work at brokers that are smaller and have no underwriting relationship with the firm. They tend to invest in firms that are larger and more mature, and have higher growth, better financial performance, more analyst following, and higher institutional ownership.

We next test market reactions to ownership versus non-ownership recommendations. We find that favorable ownership recommendations trigger significantly stronger market reactions than favorable non-ownership recommendations. Controlling for a variety of analyst and firm characteristics and analyst, firm, and year fixed effects, the three-day ($[-1, +1]$) reactions are 0.8 percentage points higher for ownership buys than for non-ownership buys. This incremental reaction associated with analysts' stock ownership becomes even larger (1.2 percentage points) for initiations and upgrades, and continues to hold (0.7 percentage points) after excluding recommendations possibly overlapping with other information events. Further analysis of returns in the longer post-recommendation period ($[+2, +63]$) indicates no overreaction or underreaction to the information conveyed by analysts' stock ownership. Overall, these results suggest that ownership buy recommendations are more informative, consistent with analysts' ownership enhancing the credibility of their recommendations. Additional tests show that analysts with ownership also issue more informative unfavorable (hold/sell) recommendations, suggesting that these analysts also have superior negative information or require a higher threshold (i.e., more negative expected returns) for issuing unfavorable recommendations.

We then examine analysts' effort as a potential mechanism through which analysts' stock ownership can lead to superior information. Using both forecast frequency and timeliness to capture effort (e.g., Chen and Matsumoto, 2006; Bradley et al., 2017), we find that analysts' stock ownership is associated with more effort in covering the firm. This result is consistent with the notion that having "skin in the game" motivates analysts to exert more effort in covering the company, which helps them obtain superior information about the company.

To provide more evidence on the influences of analysts' stock ownership on their research, we next examine the accuracy and bias of analysts' earnings and target price forecasts. Analysts' information sets, incentives and cognitive bias can exert a different effect on forecasts than on recommendations. Given the discreteness of recommendations, forecasts also allow us to better detect analysts' bias associated with their ownership. We find no relation between analysts' stock ownership and the accuracy or optimism of their earnings forecasts. However, when we examine analysts' target price forecasts, which reflect a more abstract and complex task and are less monitored by investors (Bradshaw et al., 2013), we find that ownership target price forecasts are less accurate and more optimistic, and this ownership-related upward bias holds even after holding forecast accuracy constant. These results are consistent with analysts' stock ownership inducing a strategic and/or cognitive optimistic bias in their forecasts of target prices.

Finally, we conduct two analyses of the trading behavior of analysts who own stock in covered firms, based on over-time changes

[1] Throughout the paper we use ownership (non-ownership) reports, recommendations, and forecasts to refer to the reports, recommendations, and forecasts issued by analysts who (do not) own stock in the covered company.

in analysts' ownership status (the presence or absence of stock ownership). We identify 822 initial share purchases (initiations) and 763 final share sales (terminations) to test two commonly voiced concerns on analysts' stock trading. First, we examine whether analysts trade against their own recommendations – a trading behavior explicitly banned by the regulations on analyst research (NASD Rule 2711, 2008 and NYSE Rule 472, 2007). We find that 3% of analysts initiated ownership while having a sell recommendation outstanding, and 56% terminated ownership while having a buy recommendation outstanding. This finding is surprising, suggesting a potentially widespread violation of the regulations. Further tests provide some weak evidence that experienced and all-star analysts are more likely to be involved in such trading behavior in firms with lower institutional ownership. However, we cannot rule out the possibility that these analysts may have traded against their recommendations due to unanticipated financial hardships – the only exception provided by the regulations.

Second, we examine whether analysts trade upon information before releasing it to investors. If an analyst buys (sells) before releasing positive (negative) information, we expect upward (downward) revisions of recommendations or forecasts after ownership initiations (terminations). In general, we do not find clear evidence of such patterns, except for some weak evidence that analysts revise earnings forecasts downward in the 30-day period immediately after they terminate ownership. However, an important caveat for this test is low power, because we do not have the exact date for ownership initiations or terminations and analysts may purchase most shares after the initiations and sell most shares before the terminations.

Our study contributes to the literature on analysts' conflicts of interest. Prior work has focused mainly on conflicts arising from services provided by analysts' employers, such as investment banking (e.g., Lin and McNichols, 1998; Michaely and Womack, 1999; O'Brien et al., 2005), trading (e.g., O'Brien and Bhushan, 1990; McNichols and O'Brien, 1997; Cowen et al., 2006), and asset management (e.g., Mola and Guidolin, 2009; Firth et al., 2013). We extend this literature by examining analysts' personal investments in covered companies. To our knowledge, Johnston (2013) is the only prior archival study that examines analysts' stock ownership.[2] Constrained by data unavailability during his sample period (1993–2001), he analyzes two small samples and finds little difference between ownership and non-ownership recommendations. In contrast, using mandated ownership disclosures, we provide the first large-sample evidence on the effects of analysts' stock ownership on their recommendations as well as their earnings and target price forecasts.

Our findings shed light on the long-standing debate over analysts' stock ownership in covered firms. They suggest that analysts' stock ownership can have both positive and negative effects on analysts' research. In line with the conflict-of-interest view, we find evidence that analysts' stock ownership induces analysts to issue more upward-biased target price forecasts and to trade against their own recommendations, especially when unloading their holdings. However, consistent with the credibility enhancement view, we also find evidence that analysts' stock ownership increases the informativeness of their stock recommendations by conveying their superior information and induces analysts to spend more effort in covering the firm. Our findings provide insights potentially relevant to investors, brokers and regulators who are concerned with effects of analysts' stock ownership on analysts' research.

Section 2 discusses background and hypotheses. Section 3 describes our design. Section 4 presents sample and descriptive statistics. Section 5 reports results. Section 6 concludes.

2. Institutional background and hypotheses

2.1. Institutional background

Prior to the 2002 regulatory changes, very few brokers disclosed analysts' stock ownership in covered companies. However, reports from the financial press and the SEC indicate that analysts' stock ownership was "a common industry practice" at that time (Schack, 2001). For example, Gasparino and Opdyke (2001) report that about 120 out of Merrill Lynch's 600 stock analysts worldwide owned shares of the companies they covered.

The stock market crash during 2000–2001 triggered widespread concerns that investors might have been misled by analysts' biased and overly optimistic research. The SEC identified several potential sources of conflicts of interest that might have tainted analysts' research, including their dependence on investment banking business and trading commissions for compensation and their ownership interest in covered companies (SEC, 2001). In her testimony to the U.S. Congress, Laura S. Unger, the Acting Chairwoman of the SEC, stated that the SEC's inspection revealed that approximately 25% of the investigated analysts owned shares in their covered companies. Further, the inspection also found that disclosure of analysts' ownership interests in recommended companies was incomplete or even nonexistent and that analysts often traded contrary to their own recommendations and even sold stocks short on which they had a buy recommendation outstanding (Opdyke, 2001; Unger, 2001).

In May 2002, the SEC approved National Association of Securities Dealer Rule 2711 (NASD 2711), which aims to reduce analysts' conflicts of interests and enhance the independence and credibility of analysts' research.[3] The SEC also approved similar amendments to NYSE Rule 472, 2007. Among other measures,[4] the regulations establish disclosure requirements for analysts' ownership interests

[2] Taha and Petrocelli (2014) and Marley and Mellon (2016) conduct experimental studies of investors' perception of analysts' stock ownership disclosure.

[3] This regulation was revised multiple times over our sample period (2003–2012). The discussion in this section is based on the version effective from April 7, 2008 to October 11, 2012.

[4] Other measures include limiting the relationships between investment banking and research personnel, banning the compensation of analysts based on specific investment banking transactions, and prohibiting analysts' reports from being reviewed by the firms they cover.

in the stocks they cover and restrict "research analyst account" trading in these stocks unless these transactions are authorized by legal or compliance personnel (NASD 2711 (g)(4)).[5] More specifically, the regulations require research reports to clearly disclose whether analysts or any household members have financial interests in the securities of the companies they follow, as well as the nature of the financial interests, including options, rights, warrants, futures, and long or short positions (NASD 2711 (h)(1)(A)).[6] However, the regulations do not require disclosure of the magnitude of analysts' stockholding. The regulations prohibit analysts from purchasing an issuer's securities prior to an initial public offering (IPO) (NASD 2711 (g)(1)). The regulations also generally prohibit analysts from trading the securities of covered companies (1) during a "blackout period," defined as a period of 30 days prior to, and 5 days after, the release of their research reports or (2) in a manner inconsistent with their recommendations in their most recent published research reports (NASD 2711 (g)(2) and (g)(3)).

However, it is important to note that the regulations also provide exceptions to these restrictions. For example, the legal or compliance personnel of a broker may authorize analysts to trade within blackout periods if (1) analysts sell the stocks they follow within 30 calendar days after they begin covering the stocks for the broker (NASD 2711 (g)(2)(A)); (2) analysts buy or sell the stocks they follow in response to significant news or a significant event concerning these stocks (NASD 2711 (g)(2)(B)); or (3) there is an unanticipated change in analysts' personal financial circumstances (NASD 2711 (g)(4)). Similarly, with authorization from legal or compliance personnel, analysts may trade stocks they follow in a manner inconsistent with their recommendations if there is an unanticipated change in analysts' personal financial circumstances (NASD 2711 (g)(4)(A)). However, brokers are required to maintain written records about these transactions and the justification for permitting these transactions for three years following the approval date (NASD 2711 (g)(4)(C)).

The Financial Industry Regulatory Authority (FINRA) (formerly NASD) has taken actions to enforce the rules on analysts' stock ownership and charged a number of brokers and analysts with disclosure or trading violations. For example, Citigroup was fined twice ($350,000 in 2006 and $725,000 in 2012) for violations of numerous portions of NASD 2711, including failing to disclose multiple analysts' financial interests in the companies they followed (FINRA, 2012). Morgan Stanley paid $800,000 in penalties in 2010 for similar violations that occurred between November 2007 and June 2010 (FINRA, 2010). In 2006, Sanford C. Bernstein and its star analyst, Brad Hintz, were fined a combined $550,000 for trading in six securities contrary to his own recommendations (Craig, 2006). Further, there are at least 24 more actions against smaller brokers (10 cases) and individual analysts (14 cases) for similar violations between 2002 and 2016. Most of these individual analysts failed to disclose their securities accounts at other brokers and trading through these accounts. Some analysts also failed to disclose joint accounts in which they traded in securities they covered during the mandated blackout period. Nine out of the 14 charged analysts were suspended for a period of one to sixteen months. The charged brokers were fined between $15,000 and $200,000 and three were suspended from their business for a period of 15 days to one month.

Besides these regulations, brokers have adopted their own policies and procedures governing analysts' stock ownership. Reputational concerns have led some large brokers such as Merrill Lynch to ban analysts from owning shares of companies they cover (Gasparino and Opdyke, 2001). A survey of the seven largest brokers by Schack, (2001) indicates that brokers allowing analysts' stock ownership adopted internal policies that imposed further restrictions on analysts' ownership in covered companies. The survey shows that the vast majority of these brokers had policies requiring analysts to obtain approval in advance from research directors or compliance officers and to hold the stock for a minimum period of one to six months. A number of the surveyed brokers have also imposed additional blackout periods (e.g., between companies' fiscal quarter-ends and earnings announcements, and two days after companies' SEC filing).[7] As detailed in Section 4, we find that 14 out of the 74 brokers in our sample appear to have banned analysts' stock ownership, while the remaining 60 have allowed it.

On July 16, 2015, the SEC approved FINRA Rule 2241 (FINRA, 2015), which replaced NASD 2711 and NYSE 472 to address conflicts of interest relating to equity research analysts. Generally modeled after NASD 2711, the new rule adopts a policies-and-procedures approach requiring brokers to establish written policies and procedures incorporating specific disclosures and restricted and prohibited activities. Regarding analysts' stock ownership and trading, FINRA 2241 does not impose an explicit blackout period like NASD 2711, but rather adopts a more flexible supervisory approach to require brokers to establish policies and procedures restricting analysts' trading. Further, FINRA 2241 also explicitly requires policies and procedures that ensure that analysts, their supervisors, and any others with abilities to influence analysts' research reports do not trade upon their knowledge of the content or timing of the research reports.[8]

[5] Analyst research account is defined as "any account in which a research analyst or member of the research analyst's household has a financial interest, or over which such analyst has discretion or control" (NASD 2711, (a)(7)). NASD 2711 g(5)(A) and g(5)(B) further explain that the trading prohibition does not apply to (1) any investment company registered under the Investment Company Act of 1940 and (2) any other investment funds over which neither analysts nor their household members has any investment discretion or control."

[6] Household member is defined as "any individual whose principal residence is the same as the research analyst's principal residence." However, it does not include "an unrelated person who shares the same residence as a research analyst provided that the research analyst and unrelated person are financially independent of one another" (NASD 2711 (a)(4)).

[7] To gain knowledge of brokers' current policies, we contacted by phone and email the investor relations and compliance departments of 31 active brokers in our sample. We simply inquired about whether their policy allowed analysts to own stock in covered companies and if so, what approval and monitoring procedures are required. Only two brokers were willing to share part of the information, with one claiming that it banned analysts' stock ownership and the other claiming that it allowed for analysts' ownership but had some undisclosed trading restrictions.

[8] The new rule also introduces additional requirements to restrict the relationship between analysts and investment banking and trading and sales personnel, subject companies, and customers. For example, brokers are required to establish information barriers or other institutional safeguards

2.2. Hypotheses

This section derives testable predictions from the conflict-of-interest versus enhanced credibility views about the relation between analysts' stock ownership and the informativeness of their favorable recommendations. As discussed in the introduction, the conflict-of-interest view contends that the incentive to maximize the value of their personal investments in covered companies will lead analysts to issue overly optimistic recommendations that hurt investors.

Further, analysts' stock ownership can also create a cognitive and unintentional bias (Boni and Womack, 2002a). The ownership can cause analysts to be emotionally attached to the invested company and subject to the "inside view" (Kahneman and Lovallo, 1993). Like parents who view their children as special, analysts may view the stocks they own favorably, even when their statistical information suggests otherwise. In contrast, analysts without ownership may take an "outside view" and analyze the firm more objectively.

Therefore, favorable recommendations issued by analysts with ownership (ownership buy recommendations) may be contaminated by intentional and/or cognitive upward biases and thus convey less information about the recommended companies' future prospects compared to buy recommendations from analysts without ownership (non-ownership buy recommendations):

H1A. (The conflict-of-interest view): Ownership buy recommendations are less informative than non-ownership buy recommendations, *ceteris paribus*.

In contrast, the enhanced credibility view argues that by putting their money where their mouths are, analysts' stock ownership sends a credible signal to the market that they are truly convinced about the investment value of the companies they recommend. Analysts' stock ownership thus enhances the credibility of their recommendations by signaling analysts' superior information to investors. Analysts' stock ownership can be linked to their superior information through at least two mechanisms. First, analysts are more likely to invest in companies for which they have better information. Second, having "skin in the game" can motivate analysts to gather more information about the firm, for example, by conducting more careful and diligent research or gaining better access to firm management. Indeed, proponents often contend that one important benefit of stock ownership is to make analysts more careful or more diligent about valuing a stock (e.g., Schack, 2001; Boni and Womack, 2002a).

Further, we note that the enhanced credibility view does not require that analysts intentionally use stock ownership to convey information. It only requires that analysts' ownership has implications for their information about the recommended company. As long as this information cannot be fully and credibly conveyed through other means, analysts' stock ownership in the recommended companies could serve as an incremental signal that enhances the informativeness of their buy recommendations:

H1B. (The enhanced credibility view): Ownership buy recommendations are more informative than non-ownership buy recommendations, *ceteris paribus*.

However, there are also reasons to believe that analysts' stock ownership may not impact their recommendations. On the one hand, reputation costs, regulations, and broker policies may prevent potential conflicts of interest. On the other hand, analysts may invest in covered companies primarily for non-information-based reasons such as portfolio diversification (Schack, 2001), and thus their ownership may not signal any superior information.

In contrast to favorable recommendations, neither view generates a clear prediction for the informativeness of unfavorable ownership recommendations. Under the conflict-of-interest view, analysts owning stock are reluctant to issue unfavorable recommendations. Thus, their unfavorable recommendations can send a more negative signal if they require a higher threshold (i.e., more negative expected returns) for issuing unfavorable recommendations. However, their unfavorable recommendations can also be less informative if they delay the disclosure of negative information and the information becomes partially incorporated into prices before the issuance of recommendations. Similarly, under the enhanced credibility view, unfavorable ownership recommendations can be less informative because the fact that analysts still hold the stock may signal that their negative information is not as severe. However, if analysts invest in firms for which they have better information or exert more effort in following owned firms, they may have superior negative information, which improves the informativeness of their unfavorable recommendations. Therefore, we do not form predictions about unfavorable ownership recommendations but examine them for completeness in our analyses.

3. Research design

We use market reactions to measure the informativeness of stock recommendations, and test our hypotheses by estimating the following regression for buy recommendations :[9]

(*footnote continued*)

that insulate analysts from the influence of persons involved in investment bank services and other persons who might be biased in their judgment or supervision. A new FINRA rule (Rule 2242, FINRA, 2016b) was also introduced to address conflicts of interest relating to debt research reports.

[9] Most brokers switched from the traditional five-tier rating system to a three-tier system after the 2002 regulations (Kadan et al., 2009). We find 76% of recommendations from our sample brokers use the three-tier system. We convert the recommendations using the five-tier system to the three-tier system (i.e., coding "strong buy" as "buy" and "strong sell" as "sell"). Our results are robust to adding a control for "strong buy" in regressions (untabulated).

$$CAR_{ijt} = \beta_1 OWNERSHIP_{ijt} + \sum_{m=2}^{19} CONTROL_m + Analyst\ effects + Firm\ effects + Year\ effects + \varepsilon_{ijt} \quad (1)$$

where CAR_{ijt} is cumulative abnormal (size-adjusted) returns around the date of analyst j's recommendation for firm i in year t. Following prior research (e.g., Lin and McNichols, 1998; Kadan et al., 2009), we measure market reactions using *CAR* over the three trading days ($[-1, +1]$) centered around the recommendation date (day 0).[10] $OWNERSHIP_{ijt}$ is an indicator for ownership recommendations. A positive (negative) coefficient on $OWNERSHIP_{ijt}$ would indicate that ownership buys are more (less) informative than non-ownership buys, supporting H1B (H1A).

CONTROL refers to two sets of control variables for analyst and firm characteristics that may relate to market reactions to recommendations. Based on prior research (e.g., Stickel, 1992; Clement, 1999; Jacob et al., 1999; Clement and Tse, 2003; Malloy, 2005; Jung et al., 2012), our first set of controls includes ten analyst characteristic variables that proxy for analysts' general and firm-specific experiences (*GENEXP* and *FIRMEXP*), broker resources (*BSIZE*), portfolio complexity and time constraints (*NUMFIRM* and *NUMIND*), effort (*FREQ*), provision of different types of forecasts (*NUMPROD*), reputation and research ability (*ALLSTAR* and *R_ACCURACY*), and investment banking relations (*UNDERWRITER*):

$GENEXP_{jt}$ number of years analyst j issued at least one annual earnings forecast through year t;
$FIRMEXP_{ijt}$ number of years analyst j issued at least one annual earnings forecast for firm i through year t;
$BSIZE_{jt-1}$ number of analysts employed by analyst j's broker in year $t-1$;
$NUMFIRM_{jt-1}$ number of firms analyst j follows in year $t-1$;
$NUMIND_{jt-1}$ number of industries (two-digit SIC codes) analyst j follows in year $t-1$;
$FREQ_{ijt-1}$
number of analyst j's annual earnings forecasts for firm i in year $t-1$;
$NUMPROD_{ijt}$ number of different types of forecasts (cash flow forecasts, target price forecasts, and long-term growth forecasts) analyst j issues for firm i during the half-year ending on the day of the analyst's recommendation;
$ALLSTAR_{jt-1}$ equals one if analyst j is identified as an "all-star" in *Institutional Investor* magazine in year $t-1$, and zero otherwise;
$R\_ACCURACY_{ijt-1}$ relative forecast accuracy for analyst j's forecast for firm i's year $t-1$ earnings (defined below);
$UNDERWRITER_{ijt-1}$ equals one if analyst j works for a broker that was a lead underwriter for firm i in an initial or seasoned public offering prior to issuing the recommendation, and zero otherwise.

Consistent with prior research (e.g., Ke and Yu, 2006; Jung et al., 2012; Bradley et al., 2017), we convert all analyst characteristic variables (except for indicator variables, *ALLSTAR* and *UNDERWRITER*) to their relative values among all analysts covering the same firm-year to control for differences across firm-years. Specifically, following Clement and Tse (2003) and Jung et al. (2012), we compute $R\_ACCURACY_{ijt-1}$ by scaling absolute forecast errors ($AFE_{ij,t-1}$) to fall between 0 and 1, with larger values indicating higher accuracy, using the following equation:

$$R\_ACCURACY_{ijt-1} = \frac{Max(|AFE_{it-1}|) - |AFE_{ijt-1}|}{Max(|AFE_{it-1}|) - Min(|AFE_{it-1}|)} \quad (2)$$

where $Max(|AFE_{it-1}|)$ and $Min(|AFE_{it-1}|)$ are the maximum and minimum of absolute forecast errors for all analysts following firm i in year $t-1$. Similarly, we use the following equation to scale *GENEXP, FIRMEXP, BSIZE, NUMFIRM, NUMIND, FREQ, NUMPROD* to fall between 0 and 1 within the same firm-year:

$$R\_Variable_{ijt} = \frac{Variable_{ijt} - Min(Variable_{it})}{Max(Variable_{it}) - Min(Variable_{it})} \quad (3)$$

where $Max(Variable_{it})$ and $Min(Variable_{it})$ refer to the maximum and minimum values of a variable among all analysts following firm i in year t. We use the "R_" prefix to denote the relative value of the variable (e.g., *R_GENEXP* for *GENEXP*).[11]

Our second set of controls includes the following eight firm characteristic variables:

MV_{it-1} natural log of firm i's market capitalization at the end of year $t-1$;
$FIRMAGE_{it-1}$ number of years firm i has been publicly traded through year $t-1$;
$FOLLOWING_{it-1}$ number of analysts issuing forecasts for firm i in year $t-1$;
BM_{it-1} firm i's book-to-market ratio at the end of year $t-1$;
RET_P6m_{it} buy-and-hold return for firm i in the prior 6 months;
ROA_{it-1} return on assets (net income/total assets) for firm i in year $t-1$;
$LEVERAGE_{it-1}$ total liabilities divided by total assets for firm i at the end of year $t-1$;
$INST_{it-1}$ percent of firm i's common shares held by institutional investors at the end of year $t-1$.

[10] Inferences are unchanged if we use a 5-day ($[-2, +2]$) window (untabulated).

[11] If an analyst does not follow the firm in year $t-1$ (i.e., initiating coverage in year t), we measure the raw and ranked values of $FREQ_{ijt-1}$ and $ACCURACY_{ijt-1}$ using the average of the same variable for all firms she covers in year $t-1$ (i.e., the average raw or ranked forecast frequency and accuracy for firms she covers in year $t-1$). Results are similar if we use the average of the same variable for all other analysts following the company (untabulated).

Similar to analyst characteristic controls, we also convert these firm characteristic variables into relative values among all firms covered by an analyst in a year to control for differences across analyst-years. That is, we use an equation similar to Eq. (3) to scale each variable (e.g., *MV*) to fall between 0 and 1 within the same analyst-year (e.g., *R_MV)*.[12]

Finally, we include analyst fixed effects and firm fixed effects in Eq. (1) to account for any time-invariant analyst or firm characteristics. We also include year fixed effects to control for any common time-varying shocks. We adjust standard errors by double-clustering by firm and analyst (results are similar if we cluster by firm and year or by analyst and year).

4. Sample and descriptive statistics

4.1. Ownership report sample

The regulations in 2002 mandate that analysts disclose in reports their ownership interests in covered companies. Utilizing this mandated disclosure, we collect analysts' research reports from ThomsonOne over 2003–2012 containing a disclosure that the analysts (or their household members) own stock in covered companies. Our sample period ends in 2012 since it was the most recent year of data when we started working on this project. To start, we first identify all broker-periods covered by both ThomsonOne and IBES over 2003–2012. We begin with 158 brokers in IBES with a minimum of 300 recommendations over 2003–2012, and then for each broker we manually identify the period when it was covered by both databases. This process yields 80 brokers covered by both databases, representing a wide array of brokers ranging from the largest investment banks (e.g., JP Morgan and Morgan Stanley) to small research shops (e.g., Hudson Securities and JM Dutton & Associates).[13] Note that the sample period (i.e., the period covered by both databases) differs across brokers, ranging from 3 months for Collins Stewart to the entire 2003–2012 period (e.g., JP Morgan).

For each of these 80 brokers, we randomly select 200 reports (or all reports if the total is fewer than 200) during its sample period from ThomsonOne and read all the reports to identify the disclosures pertaining to analysts' stock ownership. Six small brokers provide uninformative disclosures and are thus excluded.[14] For the remaining 74 with informative disclosures, the disclosure format is generally standardized within each broker, but differs considerably across brokers. When disclosing the presence of analysts' ownership, about two-thirds of brokers explicitly stated that analysts (or their household members) own shares of common stock (e.g., see Example 1 in Appendix A), while the rest were inexplicit about the security type and stated that analysts have a "financial interest" (e.g., see Example 2 in Appendix A).[15,16] On the other hand, to indicate the absence of analysts' ownership, about two-thirds of brokers simply provided no disclosure pertaining to analysts' ownership in reports (e.g., see Example 2 in Appendix A), while the rest provided a disclosure stating that neither analysts nor their households have any ownership interests (e.g., see Example 1 in Appendix A).[17]

We use two methods to identify and download ownership reports, depending on how brokers indicate the absence of analysts' ownership. For those providing a disclosure of analysts having no ownership, we download all their reports during their sample periods from ThomsonOne. We write a JAVA program for each broker based on that broker's report format to collect the disclosures pertaining to analysts' ownership and report information (i.e., the unique report number assigned by ThomsonOne, report dates, analyst names, company names and tickers, and recommendations) from its downloaded ownership reports.[18] We then manually check the disclosure in each report to identify the ownership reports. For those using no disclosure to indicate the absence of analysts' ownership, we identify the keywords used by each broker to disclose the presence of analysts' ownership, and then search ThomsonOne and download all reports from that broker that contain *any* of the broker-specific keywords.[19] We also write broker-specific

[12] Our results are robust to using the raw variables (rather than their relative values) for all controls (untabulated).

[13] The 158 brokers provide 92% of all recommendations in IBES over 2003-2012. Untabulated tests show that the broker-type (i.e., full-service banks, syndicate banks, brokers with trading service, and research-only brokers) distribution of the brokers not covered by ThomsonOne is similar to that of our sample brokers.

[14] For example, all reports from Leerink Partners stated: "The Firm, its officers, directors, employees, proprietary accounts and affiliates may have a position, long or short, in the securities referred to in this report."

[15] Four small brokers switched between the two formats, with two switching from the "inexplicit" format to the "explicit" format, and the other two switching in the opposite direction. Excluding these brokers does not affect our results (untabulated).

[16] We find very few (<1%) reports disclosing that analysts own options, rights, warrants, and futures, and no reports disclosing a short position. Only one small broker (Gabelli Securities) voluntarily disclosed the size of analysts' stock holdings in 314 out of totally 318 ownership reports. The average dollar value of these disclosed holdings is about US $28,975. Consistent with the regulations effectively banning pre-IPO shares, we find only 66 ownership reports issued within the first year after the covered company's first trading day on CRSP.

[17] Six brokers switched between the two formats, with three switching from "including a disclosure of analysts having no ownership" to "including no disclosure pertaining to analysts' ownership," and the other three switching in the opposite direction. Results are similar if we exclude those brokers (untabulated).

[18] For each broker, we check the accuracy of the information collected by the program using a randomly selected sample of 30 firms, and revise the program if the accuracy rate is lower than 95%. For a few brokers with the revised program still giving a lower accuracy rate, we manually collect the information from reports.

[19] For example, we use "a long position in" and "owns shares" for Oppenheimer because its ownership reports contain either "The analyst/associate/member of the analyst's or associate's household owns a long position (*Stock name*)" or "(*Analyst name*) owns shares in (*Stock name*)." We have tested and revised the keywords for each broker to ensure the completeness. Specifically, for each broker and its keywords, we randomly select 30 reports containing none of the keywords, and manually check if all these reports are indeed non-ownership. If any ownership report is found, we then revise the keywords, and use the same procedure to test the revised keywords.

JAVA programs to collect the disclosures pertaining to analysts' ownership and the report information from each of these ownership reports.

To exclude non-ownership reports misclassified as ownership, we manually check a random sample of 50 ownership reports for each broker, and find that virtually all "false positives" are reports from certain brokers containing a disclosure of the analyst's ownership in other companies she covered (i.e., a report on one company disclosing the analyst's ownership in another covered company). We manually check all ownership reports from these brokers and exclude the "false positives."

Next, for each pair of broker and covered company (e.g., JP Morgan and IBM) in our sample of ownership reports, we search for all reports on the company from that broker in ThomsonOne over 2003–2012, and then download the "table of contents" (containing report numbers, report dates, and analyst names) in the search results to obtain a complete time-series of report records (e.g., all reports on IBM from JP Morgan). Using these complete report records, we arrange all ownership reports into ownership strings (a series of consecutive ownership reports from an analyst for a covered company), and also identify the pre-string (post-string) non-ownership report (if available), i.e., the last (first) non-ownership report prior to (following) the string.[20] We collect the report information for these non-ownership reports as well.

To further ensure the accuracy of our data, for each ownership string we manually check the first and last ownership reports in the string, the pre-string and post-string non-ownership report, and two randomly selected ownership reports in the middle of the string (if there are more than two). If the ownership status (ownership versus non-ownership) or the collected report information is incorrect for any of these reports, we check all reports for that string. After this extensive check, our final sample contains 29,108 ownership reports, belonging to 2263 ownership strings, issued by 806 analysts on 1112 companies. Virtually all ownership reports were issued by 60 brokers. The remaining 14 brokers had no or very few ownership reports, and we thus infer that they likely banned analysts' stock ownership during the sample period.[21]

Table 1 presents descriptive statistics on ownership reports in our sample over 2003–2012. In an average year, 35 brokers have ownership reports (i.e., allowing analysts' stock ownership). The 29,108 ownership reports in our sample constitute 2.6% of the total of over 1.1 million reports from our sample brokers over their sample periods. In an average year, 13% of all analysts own stock in at least one covered company, and these ownership analysts on average invest in 18% of their covered companies (about 2.5 companies). These statistics show that analysts' stock ownership remains a common industry practice over our sample period.

Over time, the number of ownership analysts declines substantially (from 284 in 2003 to 138 in 2012), partly driven by the large decrease in the total number of analysts (from 1807 in 2003 to 1367 in 2012).[22] However, looking at the percentage of ownership analysts, which controls for the change in the total number of analysts, we still observe a significant decrease, from 3.2% in 2003 to 1.7% in 2012. This trend likely reflects more restrictive broker policies and increasing regulator attention on insider trading (Strasburg and Albergotti, 2012).[23]

To provide evidence on the prevalence of analysts' stock ownership in a more recent period, we hand-collect data on ownership analysts for 2016, following the same procedure as described above. Among the 74 brokers in our sample, 49 have IBES and ThomsonOne data for 2016. We identify 140 ownership analysts in 2016, representing 12.0% of the total number of 1170 analysts in 2016 from these brokers. Thus, compared with 2012 (10.1%), the percentage of ownership analysts has actually increased in recent years. Interestingly, we also find that one of the largest brokers, Morgan Stanley, appears to have changed its policy from banning ownership over 2003–2012 to allowing ownership in 2016,[24] indicating that the over-time change in brokers' policy on analysts' stock ownership is not one-directional. Overall, these findings based on the additional data collection suggest that analysts' stock ownership remains prevalent today.

Unsurprisingly, analysts with ownership in covered companies issue significantly more favorable recommendations. On average, 66% of ownership reports contain a buy recommendation, compared to 44% for all recommendations from the same brokers over the

[20] For example, assume that an analyst issued two ownership reports for a company on April 21st and May 25th, and over this year, the complete record shows that this analyst issued a total of 6 reports on the company, dated February 1st, March 10th, April 21st, May 25th, August 30th, and October 5th. Thus, the two ownership reports issued on April 21st and May 25th are consecutive and thus form an ownership string, with the March 10th report being the pre-string non-ownership report and the August 30th report being the post-string non-ownership report. Note that we cannot identify the pre-string or post-string non-ownership report for a string, when the string starts or ends outside the sample period or the analyst owns the stock before initiating coverage or drops coverage while owning the stock.

[21] Morgan Stanley, the largest among these 14 brokers, included the following policy statement in all reports over our sample period: "Morgan Stanley policy prohibits research analysts, strategists and research associates from investing in securities in their sub industry as defined by the Global Industry Classification Standard."

[22] The decrease in the total number of analysts in our sample is due to the decrease in (1) the number of large brokers (e.g., the number of brokers with more than 30 analysts decreases from 18 in 2003 to 11 in 2012 due to liquidations, mergers, and loss of database coverage) and (2) the number of analysts hired by large brokers (Merkley et al., 2017). For example, the big drop in the number of ownership analysts in 2009 is mainly due to two large brokers (Bear Sterns and Lehman Brothers) dropping out of the sample in that year and the average number of analysts hired by large brokers declining significantly after the financial crisis.

[23] We find that seven small brokers (contributing to less than 2% of our sample) stopped having ownership reports during their sample periods, implying they had possibly changed their policies to ban analysts' stock ownership. For example, one of these brokers, CIBC, started to include a disclosure in the middle of its sample period that they "generally prohibits" analysts' stock ownership. Results are similar if we exclude these brokers (untabulated).

[24] We find no ownership analysts from Morgan Stanley over 2003–2012, but four ownership analysts, each owning stock in multiple covered firms, in 2016. Further, Morgan Stanley included a policy statement that it prohibits analysts' ownership in its 2003–2012 reports (see footnote 21), but removed this statement in its 2016 reports.

Table 1
Descriptive statistics on ownership reports: January 2003–December 2012.

Year	Number of brokers with ownership reports	Number of ownership reports	Number of all reports from sample brokers	Ownership reports as a % of all ((3)/(4))	Number of ownership analysts	Number of total analyst in sample brokers	Ownership analysts as % of all ((6)/(7))	% of covered companies in which ownership analysts invest	% of ownership reports with a buy rating	% of buys in sample brokers' all ratings
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
2003	34	3911	120,814	3.2%	284	1807	15.7%	24.0%	59.7%	41.4%
2004	35	3914	129,563	3.0%	272	1875	14.5%	20.7%	66.2%	43.4%
2005	38	4100	138,101	3.0%	268	1902	14.1%	20.9%	63.7%	44.1%
2006	39	3286	109,797	3.0%	229	1732	13.2%	22.1%	65.9%	44.1%
2007	39	3090	113,667	2.7%	247	1749	14.1%	16.1%	65.3%	45.5%
2008	37	2948	109,965	2.7%	219	1601	13.9%	17.0%	65.0%	41.9%
2009	36	2129	90,806	2.3%	159	1365	11.7%	16.0%	66.7%	43.1%
2010	31	1964	97,329	2.0%	137	1357	10.1%	14.3%	71.9%	47.8%
2011	29	1849	111,279	1.7%	140	1390	10.1%	14.3%	73.9%	49.4%
2012	30	1917	114,446	1.7%	138	1367	10.1%	12.5%	72.1%	44.9%
Total/Ave	35	29,108	1,135,767	2.6%	2093	16,145	13.0%	17.8%	66.0%	44.3%

This table presents, by year (Column (1)), the number of brokers with ownership reports (Column (2)), the number of ownership reports (Column (3)), the number of all reports from sample brokers in ThomsonOne (Column (4)), ownership reports as a percentage of all reports (Column (5)), the number of analysts who own stock in any covered company, i.e., ownership analysts (Column (6)), the number of all analysts from sample brokers in IBES (Column (7)), analysts owning stock in any covered company as a percentage of all analysts (Column (8)), the percentage of covered companies in which ownership analysts (analysts who own stock in any covered company) invest (Column (9)), the percentage of ownership reports containing a favorable (buy) recommendation (Column (10)), and the percentage of buys in all recommendations in IBES from sample brokers (Column (11)).

sample period in IBES.[25] Interestingly, the percentage of ownership reports containing a buy recommendation increases steadily over time, from 59.7% in 2003 to 72.1% in 2012, compared to the relatively stable buy percentage for all recommendations from the same broker-periods.

Table 2 Panel A provides the distribution of the number of reports in and the length (the number of days) of the 2263 ownership strings in our sample. Before discussing these statistics, note they provide only a lower bound for analysts' ownership period for two reasons. First, we use the first and last ownership report dates in each ownership string to determine the ownership period, but the ownership can be initiated any time between the pre-string non-ownership report date and the first ownership report date and terminated any time between the last ownership report date and the post-string non-ownership report. Second, 1061 of the ownership strings in our sample start before the broker's sample period or end after the broker's sample period, so our ownership strings only capture part of analysts' ownership period for these cases.

As shown in Panel A, in an average ownership string, the analyst issues 13 (median = 6) ownership reports during her ownership period, and holds the ownership position for 472 (median = 219) days. 21% of ownership strings contain only one ownership report, and we assign a zero-day length to these shortest strings as we cannot determine the starting and ending dates for them. In contrast, 36% of ownership strings contain more than 10 ownership reports and last on average 1078 days. Overall, these statistics show that analysts' stock ownership tends to be long-term, though there is substantial variation in the length of holding periods across analysts.

Panel B presents the distribution of brokers allowing versus banning analysts' ownership. We first classify brokers as investment banking, trading, and research-only using the Nasdaq IPO offering history and SDC databases. A broker is coded as investment banking if it served as an underwriter in US equity offerings during the sample period. All investment banks are then divided into full-service versus syndicate banks, based on whether they served as lead or co-lead underwriter in more than half of the sample years. For the remaining non-banking brokers, we classify them as trading versus research-only based on the main business activities and services disclosed by their own websites and financial media (i.e., Bloomberg and Institutional Investor).

Because we focus on relatively larger brokers (with at least 300 recommendations), most of our sample brokers are investment banks. Among the 60 brokers allowing analysts' ownership, 53 (88%) are investment banks, including 33 (55%) full-service banks (six of them sanctioned in the Global Settlement) and 20 (33%) syndicate banks, five (8%) are brokers with trading services, and only two (3%) are research-only brokers. The vast majority (89%) of ownership strings come from the 53 investment banks, with only 6% from brokers with trading services and 6% from research-only brokers. For the 14 brokers that likely banned analysts' ownership, ten (71%) are investment banks, including six full-service banks (one of them sanctioned in the Global settlement) and four syndicate banks, two (14%) are brokers with trading services, and two (14%) are research-only brokers. Untabulated tests show no significant difference in the distribution across these broker types between brokers allowing ownership and brokers banning ownership. Further,

[25] These rating distribution differences are not driven by analyst or firm differences. In untabulated tests, we compare the favorableness of ownership versus non-ownership recommendations after controlling for analyst, firm, and year fixed effects and all controls in Eq, (1). We continue to find that ownership recommendations are significantly more favorable than non-ownership recommendations.

Table 2
Descriptive statistics on ownership strings and brokers.

Panel A: Ownership strings

Number of reports in the string (1)	Mean length (days) (from 1st to last report in the string) (2)	Number of strings (3)	Percentage of all strings (4)	Accumulative number of strings (5)	Accumulative percentage of all strings (6)
1	0	484	21.4%	484	21.4%
2	57	203	9.0%	687	30.3%
3	109	146	6.5%	833	36.8%
4	158	134	5.9%	967	42.7%
5	213	104	4.6%	1071	47.3%
6	242	94	4.2%	1165	51.5%
7	312	73	3.2%	1238	54.7%
8	348	85	3.8%	1323	58.5%
9	400	68	3.0%	1391	61.5%
10	365	64	2.8%	1455	64.3%
>10	1,078	808	35.7%	2263	100.0%
Mean = 13	Mean = 472				
Median = 6	Median = 219				

Panel B: Brokers

Broker type	Allowing Ownership		Banning Ownership	
	Number of brokers (1)	Number of strings (2)	Percentage of all strings (3)	Number of brokers (4)
Investment Banking				
– Full-service banks				
○ Global Settlement banks	6	494	21.8%	1
○ Other full-service banks	27	1131	50.0%	5
– Syndicate banks	20	387	17.1%	4
– Total	53	2012	88.9%	10
Trading	5	125	5.5%	2
Research-only	2	126	5.6%	2
Total	60	2263	100.0%	14

This table presents summary statistics on the number of reports and the length (in days) of ownership strings (Panel A) and the distribution of sample brokers across types. The sample for Panel A (B) includes 2263 ownership strings (74 brokers) in our sample. Panel A presents, by the number of reports in each ownership string (Column (1)), the average days from the first to the last ownership report (inclusive) in each string (Column (2)), the number of strings (Column (3)), the percentage of strings (Column (4)), the accumulative number of strings (Column (5)), and the accumulative percentage of strings (Column (6)). Panel B presents, by brokers allowing ownership versus brokers that likely banned it, the distribution across investment banking (i.e., brokers providing investment banking and trading services), trading (i.e., brokers providing trading services but no investment banking services), and research-only (i.e., brokers providing research only). Brokers in the "investment banking" category are divided into full-service banks (who underwrite new issues and offer trading services) versus syndicate banks (who mainly distribute new issues and offer trading services), with full-service banks further divided into those sanctioned by the Global Settlement and others.

a logistic analysis at the broker-year level shows that after controlling for broker size (measured by the total number of analysts) and broker type, more reputable brokers (measured by the number of all-star analysts) are weakly more likely to ban ownership, consistent with reputation concerns inducing brokers to ban ownership (untabulated).

4.2. Ownership and non-ownership recommendation sample

To compare the informativeness of ownership versus non-ownership recommendations (Eq. (1)), we classify all recommendations from our sample brokers over their sample periods in IBES into ownership and non-ownership recommendations using the ownership strings we collect. We use IBES for both ownership and non-ownership recommendations to avoid any biases introduced by database differences between IBES and ThomsonOne.[26] More specifically, we classify a recommendation as ownership if the recommendation

[26] There is no one-to-one match between ThomsonOne reports and IBES recommendations. Over 2003-2012, our sample brokers have over one million reports in ThomsonOne, but only 144,000 recommendations in IBES. The primary reason is that IBES does not create a recommendation record for each analyst report. According to IBES: "The Review Date (REVDATS) is the most recent date on which IBES called the analyst and verified that particular estimate as still valid for that analyst. If an analyst confirms that a previous estimate is still valid, the original database record for that estimate is retained and only the REVDATS variable is updated. If an analyst changes their estimate for a given company, a new record is entered in the database with a new ANNDATS. The old record of the analyst (containing the previous estimate) is retained in the database." Thus, IBES are much more likely to create a record for recommendations that represent an upgrade or downgrade, which we also confirm by comparing recommendations across the two databases for our sample brokers. Alternatively, we could use ThomsonOne reports for both ownership and non-

is issued within an ownership string (i.e., between the first and the last ownership report dates, inclusive, in the string). We exclude all recommendations issued (1) between the pre-string non-ownership report date and the first ownership report date in the string or (2) between the last ownership report date in the string and the post-string non-ownership report date, because we cannot determine whether or not the analyst owns the stock at the time of issuing these recommendations. We classify the rest of recommendations as non-ownership. To construct the controls in Eq. (1), we further require analyst forecast data from IBES, price and financial data from the Compustat/CRSP merged database, institutional holding data from Thomson Reuters, and underwriting data from SDC Platinum. The final sample consists of 134,222 recommendations from IBES, including 2226 ownership recommendations and 131,996 non-ownership recommendations.

Table 3 compares analyst and firm characteristics associated with ownership (Column (1)) versus non-ownership recommendations (Columns (2) and (3)). We report all analyst and firm characteristic variables (both raw and relative if available) in Eq. (1). Because differences between ownership and non-ownership recommendations can reflect both analysts' investment decisions and brokers' policies on banning versus allowing ownership, we compare ownership recommendations with both all non-ownership recommendations (Column (2)) and only the non-ownership recommendations from brokers allowing analysts' ownership (Column (3)). Since the two non-ownership comparison groups yield similar inferences, we focus our discussion on the comparison between Columns (1) and (3).

Focusing on analyst characteristics, we observe that analysts with stock ownership have 0.3 more years of general experience and 1.3 more years of firm-specific experience, issue more frequent and more accurate earnings forecasts over the prior year (25% more frequent, 0.104/0.419; 2.6% more accurate, 0.016/0.627), follow more (2.5) firms and more (1.1) industries, issue fewer types of forecasts, and are less likely to work at a broker which has prior investment banking relationships with the covered companies. These results provide mixed evidence on a potential substitute relationship between analysts' credibility and stock ownership (i.e., more credible analysts have a lesser need to use stock ownership to signal credibility). A possible explanation could be that analysts who value more the opportunity to trade stocks may have attributes (e.g., better analytical skills) that make them a better fit for some brokers. Further, analysts owning stock are more likely to work at smaller brokers (with 21 fewer analysts), possibly because larger brokers have more stringent restrictions on analysts' ownership due to higher reputational and litigation costs and/or smaller brokers offer analysts more trading flexibility to compete with larger brokers in the labor market. These results largely hold for both the raw and relative variables.

Turning to firm characteristics, analysts tend to invest in firms with larger market cap (63% larger, EXP(0.487) - 1), longer history being listed (7 years older), higher analyst coverage (1.6 more analysts), and higher institutional ownership (4% higher). Based on the relative measures, firms owned by analysts also tend to have higher growth (lower book-to-market) and better recent financial performance (ROA). We see no difference in leverage or recent stock returns. Overall, these results show that analysts owning stock are more experienced, more reputable, and more capable, and they tend to invest in covered firms with larger size, higher growth, better performance, more analyst following, and higher institutional ownership.

5. Results

5.1. Tests of the informativeness of recommendations

Table 4 Panel A reports the results of estimating Eq. (1), which examines the relation between analysts' stock ownership (*OWNERSHIP*) and the informativeness (*CAR* over $[-1, +1]$) of their buy recommendations, holding constant a variety of analyst and firm characteristics, and analyst, firm, and year fixed effects. Column (1) reports results using the full sample of buy recommendations. We find that the coefficient on *OWNERSHIP* is significantly positive (0.008, $p < 0.01$), indicating that ownership buys trigger a 0.8 percentage point higher market reaction than non-ownership buys. This result suggests that favorable recommendations issued by analysts with stock ownership in covered firms are more informative, supporting H1B. Turning to the controls, we find that market reactions are generally larger for analysts with longer firm-specific experience, more types of forecasts, and higher prior forecast frequency and accuracy, and for firms with smaller size, higher analyst coverage, higher book-to-market ratios, higher leverage, and lower institutional ownership.[27]

Recommendation initiations and changes are generally more informative than reiterations, so we sharpen our test by re-estimating Eq. (1) after excluding reiterated buy recommendations. As reported in Column (2), the incremental reaction to first-time ownership buys relative to first-time non-ownership buys is larger (0.012, $p < 0.01$), thereby providing even stronger evidence in support of H1B.[28]

Prior research (e.g., Ivković and Jegadeesh, 2004; Loh and Stulz, 2011) shows that recommendations are often issued around the same time as other news events such as earnings announcements and management forecasts. To ensure that our results are not

(*footnote continued*)
ownership recommendations. However, this would require us to collect recommendations for over one million non-ownership reports in ThomsonOne.

[27] The insignificant result for broker size (*R_BSIZE*) is driven by including analyst fixed effects. The coefficient on *R_BSIZE* becomes significantly positive (0.004, $p < 0.01$) if we exclude analyst fixed effects (untabulated).

[28] Results are similar if we control for initiations and the magnitude of upgrade (i.e., including indicator variables for initiations, upgrades from hold to buy, and upgrades from sell to buy, respectively) (untabulated).

contaminated by concurrent news events, we re-estimate Eq. (1) after excluding recommendations issued in the three-day window surrounding quarterly earnings announcements or management forecasts and recommendations issued on dates with multiple analysts issuing recommendations (Loh and Stulz, 2011). As shown in Column (3), our results continue to hold (0.007, $p < 0.05$).

In addition to the immediate reactions, we also examine the relation between analysts' stock ownership and *CAR* over the following 62 trading days (about 3 months), i.e., [+ 2, + 63], to test for potential delayed reactions or return reversals (results are similar if we use a 123-day ([+ 2, + 124]) window). As shown in Column (4), the coefficient on *OWNERSHIP* is insignificant (−0.004, $t = -0.56$), indicating that analysts' stock ownership is not associated with any subsequent price drift or return reversal. This result suggests that the stronger market reactions to ownership buys we document are not investor overreactions, and investors incorporate most of the information conveyed by analysts' stock ownership in their initial reactions.[29]

While we do not form any prediction on the relation between analysts' stock ownership and their unfavorable (hold/sell) recommendations, we also test it for completeness. Panel B repeats the tests in Panel A using unfavorable recommendations (controls are untabulated for brevity). We find that analysts' stock ownership is also associated with stronger (i.e., more negative) reactions to unfavorable recommendations (the coefficient on *OWNERSHIP* = −0.009, −0.008, and −0.010 in Columns (1)–(3), respectively; $p < 0.05$ for all), and no subsequent price drift or return reversal (Column (4)). These results show that analysts owning stock also issue more informative unfavorable recommendations, possibly because they have superior negative information or require more negative expected returns for issuing unfavorable recommendations.

Table 3
Descriptive statistics on analyst and firm characteristics associated with analysts' stock ownership.

	$OWNERSHIP_{ijt} = 1$	$OWNERSHIP_{ijt} = 0$			
		Full	Excluding brokers banning ownership	Differences	
	(1)	(2)	(3)	(1)-(2)	(1)-(3)
Analyst characteristics (mean)					
$GENEXP_{jt}$	5.438	5.129	5.095	0.309***	0.343***
R_GENEXP_{jt}	0.775	0.652	0.654	0.124***	0.122***
$FIRMEXP_{ijt}$	4.122	2.862	2.850	1.259***	1.272***
$R\_FIRMEXP_{ijt}$	0.712	0.545	0.546	0.166***	0.166***
$BSIZE_{jt-1}$	59.100	80.030	80.530	−20.930***	−21.430***
R_BSIZE_{jt-1}	0.307	0.437	0.436	−0.129***	−0.129***
$NUMFIRM_{jt-1}$	15.930	13.710	13.460	2.220***	2.469***
$R\_NUMFIRM_{jt-1}$	0.509	0.450	0.441	0.060***	0.068***
$NUMIND_{jt-1}$	5.054	4.028	3.981	1.026***	1.073***
R_NUMIND_{jt-1}	0.535	0.450	0.445	0.086***	0.090***
$FREQ_{ijt-1}$	3.943	2.934	2.929	1.010***	1.014***
R_FREQ_{ijt-1}	0.524	0.420	0.419	0.103***	0.104***
$NUMPROD_{ijt}$	1.136	1.178	1.211	−0.042***	−0.075***
$R\_NUMPROD_{ijt}$	0.507	0.514	0.527	−0.007	−0.020***
$ALLSTAR_{jt-1}$	0.056	0.072	0.065	−0.016***	−0.009
$R\_ACCURACY_{ijt-1}$	0.643	0.627	0.627	0.016**	0.016**
$UNDERWRITER_{ijt-1}$	0.029	0.060	0.053	−0.030***	−0.024***
Firm characteristics (mean)					
MV_{it-1}	7.949	7.452	7.463	0.497***	0.487***
R_MV_{it-1}	0.546	0.491	0.493	0.055***	0.054***
$FIRMAGE_{it-1}$	24.280	17.190	17.350	7.097***	6.937***
$R\_FIRMAGE_{it-1}$	0.437	0.371	0.372	0.066***	0.065***
$FOLLOWING_{it-1}$	17.210	15.660	15.630	1.544***	1.574***
$R\_FOLLOWING_{it-1}$	0.498	0.460	0.462	0.038***	0.036***
BM_{it-1}	0.488	0.484	0.485	0.004	0.003
R_BM_{it-1}	0.404	0.431	0.433	−0.027***	−0.029***
RET_P6m_{it}	0.086	0.087	0.087	−0.001	−0.000
$R\_RET\_P6m_{it}$	0.460	0.463	0.465	−0.003	−0.005
ROA_{it-1}	0.028	0.032	0.034	−0.004	−0.006
R_ROA_{it-1}	0.539	0.528	0.525	0.012*	0.014**
$LEVERAGE_{it-1}$	0.538	0.535	0.535	0.003	0.003
$R\_LEVERAGE_{it-1}$	0.473	0.463	0.463	0.010	0.010

(*continued on next page*)

[29] We also compare the post-recommendation returns for ownership versus non-ownership recommendations using a calendar-time portfolio test as in Cohen et al. (2010), which adds recommended stocks into portfolios on the day after the recommendation date and estimates the four-factor abnormal returns for each portfolio per Carhart (1997). Consistent with the finding of no price drift in Table 4, we find no evidence that the post-recommendation abnormal returns differ between the ownership and non-ownership buy (or hold/sell) portfolios (untabulated).

Table 3 (*continued*)

	$OWNERSHIP_{ijt} = 1$	$OWNERSHIP_{ijt} = 0$			
		Full	Excluding brokers banning ownership	Differences	
	(1)	(2)	(3)	(1)-(2)	(1)-(3)
$INST_{it-1}$	0.624	0.585	0.582	0.039***	0.042***
R_INST_{it-1}	0.561	0.545	0.544	0.016**	0.017**
N	2226	131,996	108,921		

This table presents mean analyst and firm characteristics associated with ownership versus non-ownership recommendations. Column (2) (Column (3)) includes all non-ownership recommendations (non-ownership recommendations after excluding the 14 brokers that likely banned analysts' ownership). All continuous raw variables are winsorized at the 0.5% and 99.5% level. ***, **, * indicate significance at the 1%, 5%, and 10% level, respectively. See variable definitions below.

Definition of variables:

Analyst characteristics:

$GENEXP_{jt}$
number of years analyst j issued at least one annual earnings forecasts through year t;
$FIRMEXP_{ijt}$ number of years analyst j issued at least one annual earnings forecasts for firm i through year t;
$BSIZE_{jt-1}$ number of analysts employed by analyst j's broker in year $t-1$;
$NUMFIRM_{jt-1}$ number of firms analyst j follows in year $t-1$;
$NUMIND_{jt-1}$ number of industries (two-digit SIC codes) analyst j follows in year $t-1$;
$FREQ_{ijt-1}$ number of analyst j's annual earnings forecasts for firm i in year $t-1$(if year t is the first year analyst j covers firm i, we use the average number of analyst j's annual earnings forecasts to all of her covered companies in year $t-1$);
$NUMPROD_{ijt}$ number of different types of forecasts (cash flow forecasts, target price forecasts, and long-term growth forecasts) analyst j issues for firm i during the half-year ending on the day of analyst j's recommendation;
$ALLSTAR_{jt-1}$ equals one if analyst j is identified as an "all-star" in *Institutional Investor* magazine in year $t-1$, and zero otherwise;
$R\_ACCURACY_{ijt-1}$ relative forecast accuracy for analyst j's forecast for firm i's year $t-1$ earnings, defined as the absolute forecast error of each analyst's last forecast prior to earnings announcements scaled to fall between 0 and 1 among analysts following firm i in year $t-1$ (within the same firm-year) using Eq. (2); if year t is the first year analyst j covers firm i, we use the average accuracy of analyst j's annual earnings forecasts to all of her covered companies in year $t-1$);
$UNDERWRITER_{ijt-1}$ equals one if analyst j works for a broker that was a lead underwriter for firm i in an initial or seasoned public offering prior to issuing the recommendation, and zero otherwise.
R_GENEXP_{jt}, $R\_FIRMEXP_{ijt}$, R_BSIZE_{jt-1}, $R\_NUMFIRM_{jt-1}$, R_NUMIND_{jt-1}, R_FREQ_{ijt-1}, and $R\_NUMPROD_{ijt}$ are the relative analyst characteristic variables, which are constructed by scaling the raw variables ($GENEXP_{jt}$, $FIRMEXP_{ijt}$, $BSIZE_{jt-1}$, $NUMFIRM_{jt-1}$, $NUMIND_{jt-1}$, $FREQ_{ijt-1}$, and $NUMPROD_{ijt}$) to fall between 0 and 1 among analysts within the same firm-year using Eq. (3).

Firm characteristics:

MV_{it-1} natural log of firm i's market capitalization at the end of year $t-1$;
$FIRMAGE_{it-1}$ number of years firm i has been publicly traded until year $t-1$;
$FOLLOWING_{it-1}$ number of analysts issuing forecasts for firm i in year $t-1$;
BM_{it-1} firm i's book-to-market ratio at the end of year $t-1$;
RET_P6m_{it} buy-and-hold return for firm i in the prior 6 months;
ROA_{it-1} return on assets (net income/total assets) for firm i in year $t-1$;
$LEVERAGE_{it-1}$ total liabilities divided by total assets for firm i at the end of year $t-1$;
$INST_{it-1}$ proportion of firm i's common shares held by institutional investors at the end of year $t-1$.
R_MV_{it-1}, $R\_FIRMAGE_{it-1}$, $R\_FOLLOWING_{it-1}$, R_BM_{it-1}, $R\_RET\_P6m_{it}$, R_ROA_{it-1}, $R\_LEVERAGE_{it-1}$, and R_INST_{it-1} are the relative firm characteristic variables, which are constructed by scaling the raw variables (MV_{it-1}, $FIRMAGE_{it-1}$, $FOLLOWING_{it-1}$, BM_{it-1}, RET_P6m_{it}, ROA_{it-1}, $LEVERAGE_{it-1}$, and $INST_{it-1}$) to fall between 0 and 1 among firms followed by the same analyst during the same year (within the same analyst-year) using an equation similar to Eq. (3).

5.2. Tests of analysts' effort

Analysts' stock ownership can be linked to superior information through two potential mechanisms. First, analysts are likely to invest in companies for which they have better information. Second, stock ownership can motivate analysts to exert more effort in covering the firm. While the first mechanism is not directly testable, we examine the second by testing the relation between analysts' ownership and two firm-period-specific measures of analyst' effort.

Our first measure, R_FREQ_{ijtm}, is based on forecast frequency (e.g., Jacob et al., 1999; Chen and Matsumoto, 2006), defined as the number of annual earnings forecasts analyst j issues for firm i during year t and month m, scaled to fall between 0 and 1 within the same firm-year using Eq. (3).[30] We measure frequency at the monthly level because analysts' ownership period rarely coincides with

[30] Results are similar if we use both annual and quarterly earnings forecasts to measure frequency (untabulated).

Table 4
The relation between analysts' stock ownership and market reactions to stock recommendations.

Panel A: Market reactions to favorable (buy) recommendations

Dep var =	CAR [−1, + 1]			CAR[+ 2, 63]
	All	Upgrading/ Initiation	Excluding overlapping events	
	(1)	(2)	(3)	(4)
$OWNERSHIP_{ijt}$	0.008***	0.012***	0.007**	−0.004
	(2.62)	(3.02)	(2.14)	(−0.56)
R_GENEXP_{jt}	−0.002	−0.001	−0.003	0.009
	(−1.09)	(−0.57)	(−1.46)	(1.51)
$R\_FIRMEXP_{ijt}$	0.004***	0.005***	0.004***	0.015***
	(2.75)	(3.70)	(3.06)	(3.92)
R_BSIZE_{jt-1}	−0.001	−0.002	−0.002	−0.002
	(−0.41)	(−1.20)	(−1.22)	(−0.44)
$R\_NUMFIRM_{jt-1}$	−0.002	−0.002	−0.002	0.002
	(−1.19)	(−0.83)	(−0.94)	(0.30)
R_NUMIND_{jt-1}	0.002	0.002	0.001	−0.003
	(1.23)	(1.25)	(0.92)	(−0.58)
R_FREQ_{ijt-1}	0.007***	0.014***	0.005***	−0.003
	(5.27)	(9.48)	(3.98)	(−0.92)
$R\_NUMPROD_{ijt}$	0.002**	0.002**	0.001	−0.003
	(2.21)	(2.42)	(0.70)	(−1.08)
$ALLSTAR_{jt-1}$	0.002	−0.000	0.005***	−0.022***
	(1.00)	(−0.17)	(2.61)	(−3.26)
$R\_ACCURACY_{ijt-1}$	0.002**	0.005***	0.002**	−0.008***
	(2.16)	(3.47)	(2.01)	(−2.62)
$UNDERWRITER_{ijt-1}$	0.000	0.003	−0.000	−0.002
	(0.14)	(1.59)	(−0.22)	(−0.37)
R_MV_{it-1}	−0.026***	−0.025***	−0.017***	−0.069***
	(−11.48)	(−10.26)	(−8.25)	(−10.96)
$R\_FIRMAGE_{it-1}$	0.001	0.002	−0.001	0.010
	(0.41)	(0.69)	(−0.38)	(1.33)
$R\_FOLLOWING_{it-1}$	0.004**	0.004*	0.002	−0.000
	(2.17)	(1.75)	(1.07)	(−0.05)
R_BM_{it-1}	0.005***	0.006***	0.003*	0.041***
	(3.20)	(3.16)	(1.89)	(8.23)
$R\_RET\_P6m_{it}$	−0.000	−0.000	−0.001**	−0.002*
	(−0.65)	(−1.32)	(−2.05)	(−1.85)
R_ROA_{it-1}	−0.001	−0.001	0.002	0.001
	(−0.74)	(−0.59)	(1.29)	(0.18)
$R\_LEVERAGE_{it-1}$	0.004**	0.005**	0.002	0.022***
	(2.27)	(2.30)	(1.03)	(4.14)
R_INST_{it-1}	−0.005**	−0.003	−0.005***	−0.023***
	(−2.37)	(−1.46)	(−2.75)	(−4.05)
Year effects	Yes	Yes	Yes	Yes
Analyst effects	Yes	Yes	Yes	Yes
Firm effects	Yes	Yes	Yes	Yes
N	56,411	44,615	42,876	56,425
Adj. R-squared (%)	6.1%	8.4%	7.5%	9.9%

Panel B: Market Reactions to unfavorable (hold/sell) recommendations

Dep var =	CAR [−1, + 1]			CAR [+ 2, 63]
	All	Downgrading/ Initiation	Excluding overlapping events	
	(1)	(2)	(3)	(4)
$OWNERSHIP_{ijt}$	−0.009***	−0.008**	−0.010***	−0.009
	(−2.62)	(−2.12)	(−3.03)	(−1.27)
Controls included	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes
Analyst effects	Yes	Yes	Yes	Yes
Firm effects	Yes	Yes	Yes	Yes
N	71,127	53,601	50,038	71,109

(*continued on next page*)

Table 4 (*continued*)

Panel B: Market Reactions to unfavorable (hold/sell) recommendations Dep var =	CAR [−1, + 1]			CAR [+ 2, 63]
	All (1)	Downgrading/ Initiation (2)	Excluding overlapping events (3)	(4)
Adj. R-squared (%)	13.8%	20.4%	9.4%	10.1%

This table reports results of examining the relation between analysts' stock ownership and market reactions to stock recommendations (Eq. (1)). Panel A reports market reactions to favorable (buy) recommendations and Panel B reports markets to unfavorable (hold/sell) recommendations. In both panels, *CAR* is the cumulative abnormal (size-adjusted) return over the 3-day ([−1, + 1]) announcement period in Columns (1)–(3), and the subsequent 62-day period ([+ 2, + 63]) in Column (4), where day 0 is the recommendation date. In Panel A (B), Column (1) reports results of estimating Eq. (1) using all recommendations in the sample. Column (2) reports results of estimating Eq. (1) using only recommendations that represent initiations or rating changes (i.e., upgrades or downgrades). Column (3) reports results of estimating Eq. (1) after excluding recommendations issued in the three-day window surrounding quarterly earnings announcements or management forecasts and recommendations issued on dates with multiple analysts issuing recommendations. Column (4) reports results of estimating Eq. (1) using *CAR* over [+ 2, + 63]. Two-tailed *t*-values based on standard errors clustered by both firm and analyst are reported in parentheses. All other variables are as defined in Table 3. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

a calendar or fiscal quarter or year. We identify a firm-year-month as (not) in an analyst's ownership period if the entire month falls within (outside) any ownership string from that analyst. We exclude any month that partially falls within an ownership string. Our model regresses R_FREQ_{ijtm} on $OWNERSHIP_{ijtm}$, an indicator variable equal to one if analyst *j* owns firm *i*'s shares for month *m* of year *t*, and all controls in Eq. (1).

Our second measure, $FIRSTMOVER_{ijt}$, is based on the timeliness of an analyst's first forecast for a period (e.g., Chen and Matsumoto, 2006; Bradley et al., 2017). $FIRSTMOVER_{ijt}$ equals one if among all analysts following firm *i*, analyst *j* issues the first forecast of year *t* earnings following year $t-1$ earnings announcement. We code $OWNERSHIP_{ijt}$ as one if the first annual earnings forecast issued by analyst *j* for firm *i* after the prior year's announcement is an ownership forecast (i.e., analyst *j* owns stock when issuing this forecast).[31] We estimate a linear probability model regressing *FIRSTMOVER* on *OWNERSHIP* and all controls in Eq. (1).[32]

Table 5 reports this analysis. We find that the coefficient on *OWNERSHIP* is significantly positive for both *R_FREQ* (0.005, $p < 0.05$) and *FIRSTMOVER* (0.022, $p < 0.05$). The mean of *R_FREQ* is 0.140 for non-ownership firm-months and the mean of *FIRSTMOVER* for non-ownership earnings forecasts is 0.276 (untabulated). Thus, our results suggest that analysts with stock ownership issue 3.6% (0.005/0.140) more forecasts and are also 8.0% (0.022/0.276) more likely to be the first analyst to forecast earnings. Note that because we control for both analyst fixed effects and analysts' effort in covering the firm in the prior year ($FREQ_{ijt-1}$), our results cannot be attributed to ownership analysts generally exerting more effort for all (owned and not-owned) firms. These findings are consistent with the notion that stock ownership motivates analysts to exert more effort in covering the firm and help establish a potential mechanism linking analysts' ownership to superior information.

These findings also raise an interesting question of whether an analyst's ownership in a firm reduces her effort in covering other firms she does not own. We test for this effect by re-running our market reaction and analyst effort regressions after adding an indicator variable for other stocks that ownership analysts cover but do not own. We find no such effect (untabulated).

5.3. Tests of the accuracy and optimism of earnings and target price forecasts

To further examine the effect of analysts' stock ownership on their research, we examine the relation between analysts' ownership and the accuracy and optimism of their earnings and target price forecasts. Prior research (e.g., Bradshaw, 2004; Ertimur et al., 2007; Ke and Yu, 2009; Malmendier and Shanthikumar, 2009) suggests that analysts' information sets, incentives and cognitive biases can exert a different effect on these forecasts than on recommendations. In contrast to the discreteness of recommendations, forecasts are continuous, enabling us to better detect analysts' optimistic bias (if any) associated with their stock ownership.

We obtain all annual earnings forecasts and target price forecasts in IBES issued by our sample brokers over their sample periods. If an analyst issues multiple annual earnings forecasts during a year, we retain the last forecast (though results are similar if we include all forecasts). Following the same method as is used to classify recommendations, we classify each forecast as ownership or non-ownership based on the ownership strings we collect. The relative accuracy for each earnings forecast, $R\_ACCURACY_{ijt}$, is measured using Eq. (2). Similarly, to calculate the accuracy for each target price forecast, $R\_TPACCURACY_{ijt}$, we first compute absolute forecast errors as the difference between the forecasted target price and the actual price in 12 months (Bradshaw et al.,

[31] Results are robust to coding $OWNERSHIP_{ijt}$ as one if analyst *j* owns firm *i*'s stock in the first 30 days following firm *i*'s year $t-1$ earnings announcement (untabulated).

[32] Given the large number of fixed effects we control for, we do not use a nonlinear model to avoid the incidental parameters problem (Greene, 2004). Results are stronger if we use a logit model without fixed effects (untabulated).

Table 5
The relation between analysts' stock ownership and analysts' effort.

Dep var =	R_FREQ_{ijtm} (1)	$FIRSTMOVER_{ijt}$ (2)
$OWNERSHIP_{ijtm}$	0.005**	
	(2.04)	
$OWNERSHIP_{ijt}$		0.022**
		(2.16)
R_GENEXP_{jt}	0.026***	−0.042***
	(12.73)	(−5.19)
$R\_FIRMEXP_{ijt}$	0.056***	0.089***
	(50.52)	(16.69)
R_BSIZE_{jt-1}	0.001	0.031***
	(0.78)	(4.37)
$R\_NUMFIRM_{jt-1}$	−0.022***	0.016**
	(−11.02)	(2.09)
R_NUMIND_{jt-1}	−0.010***	0.007
	(−5.43)	(1.10)
R_FREQ_{ijt-1}	−0.005***	0.181***
	(−4.54)	(37.19)
$R\_NUMPROD_{ijt}$	0.135***	0.005
	(74.73)	(1.32)
$ALLSTAR_{jt-1}$	0.002	−0.037***
	(0.47)	(−3.11)
$R\_ACCURACY_{ijt-1}$	0.020***	0.006
	(24.40)	(1.37)
$UNDERWRITER_{ijt-1}$	0.005***	0.005
	(4.42)	(0.89)
R_MV_{it-1}	0.001	−0.023**
	(0.28)	(−2.44)
$R\_FIRMAGE_{it-1}$	−0.039***	−0.009
	(−16.91)	(−0.75)
$R\_FOLLOWING_{it-1}$	−0.016***	−0.037***
	(−8.90)	(−4.36)
R_BM_{it-1}	−0.007***	0.009
	(−4.05)	(1.44)
$R\_RET\_P6m_{it}$	−0.026***	0.001
	(−21.43)	(0.80)
R_ROA_{it-1}	−0.001	−0.006
	(−0.44)	(−1.03)
$R\_LEVERAGE_{it-1}$	−0.004**	−0.009
	(−2.56)	(−1.20)
R_INST_{it-1}	0.010***	−0.021**
	(5.25)	(−2.55)
Year effects	Yes	Yes
Analyst effects	Yes	Yes
Firm effects	Yes	Yes
N	2,255,297	150,069
Adj. R-squared (%)	8.7%	16.9%

This table reports the results of examining the relation between analysts' stock ownership in a covered company and their effort in following the firm. Our first measure of analysts' effort is R_FREQ_{ijtm}, defined as the number of annual earnings forecasts analyst *j* issues for firm *i* during year *t* and month *m*, scaled to fall between 0 and 1 within the same firm-year using Eq. (3). To test the relation between R_FREQ_{ijtm} and analysts' ownership, we estimate an OLS model that regresses R_FREQ_{ijtm} on $OWNERSHIP_{ijtm}$, an indicator variable equal to one if analyst *j* owns firm *i*'s shares for month *m* of year *t*, and all controls in Eq. (1). Our second measure of analysts' effort is $FIRSTMOVER_{ijt}$, an indicator variable equal to one if analyst *j* issues the first annual earnings forecast for firm *i* among all analysts following firm *i* after firm *i*'s year $t-1$ earnings announcement, and zero otherwise. To test the relation between $FIRSTMOVER_{ijt}$ and analysts' stock ownership, we estimate a linear probability model that regresses $FIRSTMOVER_{ijt}$ on $OWNERSHIP_{ijt}$, an indicator variable equal to one (zero) if the first annual earnings forecast issued by analyst *j* for firm *i* after prior year's announcement is an ownership (a non-ownership) forecast, and all controls in Eq. (1). Two-tailed *t*-values based on standard errors clustered by both firm and analyst are reported in parentheses. All other variables are as defined in Table 3. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

Table 6
The relation between analysts' stock ownership and the accuracy and optimism of their earnings and target price forecasts.

	Earnings forecasts			Target price forecasts		
Dep var =	$R\_ACCURACY_{ijt}$	R_OPTI_{ijt}		$R\_TPACCURACY_{ijt}$	R_TPOPTI_{ijt}	
	(1)	(2)	(3)	(4)	(5)	(6)
$OWNERSHIP_{ijt}$	−0.003	0.006	0.006	−0.020***	0.035***	0.033***
	(−0.43)	(0.72)	(0.77)	(−3.04)	(5.57)	(5.44)
$R\_ACCURACY_{ijt}$			0.141***			
			(16.37)			
$R\_TPACCURACY_{ijt}$						−0.084***
						−(-7.40)
Controls Included	Yes	Yes	Yes	Yes	Yes	Yes
Year effects	Yes	Yes	Yes	Yes	Yes	Yes
Analyst effects	Yes	Yes	Yes	Yes	Yes	Yes
Firm effects	Yes	Yes	Yes	Yes	Yes	Yes
N	154,364	154,364	154,364	342,299	342,299	342,299
Adj. R-squared (%)	13.8%	1.8%	3.5%	2.1%	4.7%	5.4%

This table reports the results of examining the relation between analysts' stock ownership and the accuracy and optimism of their earnings forecasts (Columns (1)–(3)) and target price forecasts (Columns (4)–(6)). $R\_ACCURACY_{ijt}$ in Column (1) and R_OPTI_{ijt} in Columns (2) and (3) ($R\_TPACCURACY_{ijt}$ in Column (4) and R_TPOPTI_{ijt} in Columns (5) and (6)) are the relative accuracy and the relative optimism of analyst *j*'s annual earnings (target price) forecast for firm *i* in year *t*, respectively. To measure $R\_ACCURACY_{ijt}$ (R_OPTI_{ijt}), we first compute the absolute forecast error as the difference between the last annual forecast prior to earnings announcement and the actual earnings (first calculate the signed difference between the forecasted and actual earnings), and then scale the absolute forecast error (signed difference between forecasted and actual earnings) to fall between 0 and 1 within the same firm-year using Eq. (2) ((3)). Similarly, to measure $R\_TPACCURACY_{ijt}$ (R_TPOPTI_{ijt}), we first compute the absolute forecast error as the difference between the forecasted target price and the actual price in 12 months (first calculate the signed difference between the forecasted target price and actual price in 12 months), and then scale the absolute forecast error (signed difference between forecasted target price and actual price in 12 months) to fall between 0 and 1 within the same firm-year using Eq. (2) ((3)). $OWNERSHIP_{ijt}$ is an indicator variable for ownership forecasts. $R\_HORIZON_{ijt}$ is the number of days between the earnings forecast date and the earnings announcement date, scaled to fall between 0 and 1 within the same firm-year using Eq. (3). For earnings forecast (target price) optimism regressions, we include the accuracy of the focal forecast as an additional control in Column (3) (Column (6)). All control variables in Table 4 are included but not tabulated. Two-tailed *t*-values based on standard errors clustered by both firm and analyst are reported in parentheses. All other variables are as defined in Table 3. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

2013), and then scale the absolute forecast errors to fall between 0 and 1 within the same firm-year using Eq. (2).[33] To test the relation between analysts' ownership and forecast accuracy, we estimate Eq. (1) using $R\_ACCURACY_{ijt}$ or $R\_TPACCURACY_{ijt}$ as the dependent variable. For the $R\_ACCURACY_{ijt}$ test, we add forecast horizon, $R\_HORIZON_{ijt}$, as an additional control, defined as the number of days between the forecast date and the announcement date, scaled within the same firm-year using Eq. (3).

To measure optimism for an earnings forecast (R_OPTI_{ijt}) or a target price forecast (R_TPOPTI_{ijt}), we use the signed difference between the forecast and the actual (i.e., (forecasted earnings – actual earnings) or (forecasted target price – actual price in 12 months)), and then scale the signed difference using Eq. (3).[34] To examine the relation between analysts' ownership and forecast optimism, we estimate Eq. (1) using R_OPTI_{ijt} or R_TPOPTI_{ijt} as the dependent variable. For the R_OPTI_{ijt} test, we add $R\_HORIZON_{ijt}$, as an additional control.

Results are reported in Table 6 (controls are untabulated for brevity). Columns (1) and (3) report the tests of the accuracy of earnings and target price forecasts, respectively. Columns (2) and (4) report the tests of the optimism of earnings and target price forecasts, respectively. Columns (3) and (6) further test the forecast optimism after controlling for the accuracy of current forecasts to account for any potential mechanical relation between ownership and forecast optimism due to analysts with ownership having both more accurate and more favorable information (Cowen et al., 2006). As shown in Columns (1)–(3), there is no evidence that analysts' stock ownership is associated with the accuracy or optimism of their earnings forecasts. However, we find that ownership target price forecasts are less accurate (the coefficient on $OWNERSHIP = -0.020$, $p < 0.01$; see Column (4)), and more optimistic (the coefficient on $OWNERSHIP = 0.035$, $p < 0.01$; see Column (5)), even after holding constant the accuracy of current target price forecasts (the coefficient on $OWNERSHIP = 0.033$, $p < 0.01$; see Column (6)). Given the means of 0.560 and 0.494 for the accuracy and optimism of non-ownership target price forecast (untabulated), these results suggest that ownership target price forecasts are 3.6% (0.020/

[33] Results (for both earnings and target price forecasts) are similar if we measure relative accuracy using the proportional mean absolute forecast error as in Clement (1999) (untabulated).

[34] Untabulated tests show results on the optimism of target price forecasts are robust to (1) measuring relative optimism using the mean-adjusted approach as in Cowen et al. (2006) and (2) measuring optimism using an indicator equal to one if forecasts are higher than actuals. However, results on the optimism of earnings forecasts are robust to (2) only. Using (1) yields evidence that ownership earnings forecasts are significantly more optimistic (the coefficient on $OWNERSHIP = 0.047$, $p = 0.01$), and this result is robust to controlling for current forecast accuracy.

Table 7
Analysts' outstanding recommendations when they initiate or terminate their stock ownership.

Panel A: Distribution of analysts' outstanding recommendations

Outstanding recommendation	Initiating ownership		Terminating ownership	
	Frequency (1)	Percentage (2)	Frequency (3)	Percentage (4)
Buy	569	69.2%	424	55.6%
Hold	217	26.4%	256	33.6%
Sell	26	3.2%	66	8.7%
Not rated	10	1.2%	17	2.2%
Total	822	100.0%	763	100.0%

Panel B: Characteristics of analysts trading against own recommendations

Dep var = TRADEAGAINST	All (1)	Initiation (2)	Termination (3)
R_GENEXP	0.218	0.031	0.379*
	(1.29)	(0.04)	(1.65)
SANCTION	0.040	0.315	−0.006
	(0.23)	(0.34)	(−0.02)
R_BSIZE	−0.115	−0.251	−0.140
	(−0.52)	(−0.22)	(−0.42)
ALLSTAR	0.076	1.653**	−0.290
	(0.31)	(2.18)	(−0.83)
R_INST	−0.414*	−0.074	−0.412
	(−1.88)	(−0.10)	(−1.20)
Constant	−0.828***	−3.648***	0.239
	(−4.18)	(−4.25)	(0.84)
N	1400	709	679
Pseudo R^2	0.3%	5.5%	0.6%

This table presents tests of whether analysts trade against their own outstanding recommendations when they initiate or terminate their stock ownership. Panel A reports the distribution of analysts' outstanding recommendations when they initiate (Columns (1) and (2)) or terminate (Columns (3) and (4)) their ownership. Panel B conducts a logistic regression, where the dependent variable is an indicator, *TRADEAGAINST*, equal to one for the ownership initiations with a sell recommendation outstanding or the ownership terminations with a buy recommendation outstanding, and zero otherwise. *SANCTION* is an indicator variable equal to one for investment banks sanctioned in the Global Settlements, and zero otherwise. Column (1) pools both initiation and termination observations, Column (2) examines initiations only, and Column (3) examines terminations only. Two-tailed *t*-values based on standard errors clustered by both firm and analyst are reported in parentheses. All other variables are as defined in Table 3. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

0.560) less accurate and 7.1% (0.035/0.494) more optimistic, respectively.

In untabulated tests, we further test the relation between analysts' ownership and market reactions (*CAR* over [−1, + 1]) to their forecast revisions. We find no relation for earnings forecasts. In contrast, for target price forecasts, analysts' ownership is associated with a smaller forecast response coefficient and no subsequent price drift or return reversal, consistent with investors recognizing the greater optimistic bias in these ownership target price forecasts.

Overall, these findings suggest that analysts' stock ownership has little effect on their earnings forecasts, but induce an optimistic bias in analysts' target price forecasts. This is possibly because compared to earnings forecasts, target price forecasts reflect a more abstract and complex task and are less monitored by investors (Bradshaw et al., 2013), and are thus more likely to be influenced by analysts' strategic and cognitive biases.

5.4. Tests of analysts' trading behaviors

Analysts' stock ownership has also raised concerns that analysts may trade against their own recommendations and may trade upon their information before releasing it to investors (e.g., Schack, 2001; Moreno, 2017). In fact, the former trading behavior has been explicitly prohibited by the regulations (NASD Rule 2711, 2008 and NYSE Rule 472, 2007). To test these concerns, we analyze analysts' initial share purchases (initiations) and final share sales (terminations).

Analysts disclose only the presence or absence of ownership in a covered company, so the only over-time ownership changes we can observe are analysts' ownership initiations and terminations in the company. A non-ownership report followed by an ownership report (from the same analyst on the same firm) indicates that the analyst may have purchased initial shares between the two report dates. Conversely, an ownership report followed by a non-ownership report indicates that the analyst may have sold final shares between the two report dates. Based on our sample of ownership strings and their pre-string and post-string non-ownership reports, we identify a total of 822 ownership initiations and 763 ownership terminations. Appendix B provides one initiation example and one termination example from our sample.

5.4.1. Do analysts trade against their own outstanding recommendations?

If an analyst trades against her own recommendation, we expect her to have a sell recommendation outstanding when initiating her ownership, or a buy recommendation outstanding when terminating her ownership. Table 7 Panel A reports the distribution of analysts' outstanding recommendations when they initiate and terminate ownership. The outstanding recommendations are collected directly from the pre-string non-ownership report for initiations (e.g., the June 12, 2003 report in the initiation example in Appendix B) and the last ownership report in the string for terminations (e.g., the May 8, 2012 report in the termination example in Appendix B).[35]

Among the 822 ownership initiations, the majority occurred while the analysts had a buy (69.2%) or hold (26.4%) recommendation outstanding. However, we also observe that 3.2% (26) traded against their own recommendations by purchasing initial shares with a sell rating outstanding (e.g., see the initiation example in Appendix B). More strikingly, among the 763 ownership terminations, 55.6% (424) occurred when the analysts had a buy recommendation outstanding, suggesting the majority of analysts traded against their outstanding (buy) recommendations when selling final shares (e.g., see the termination example in Appendix B).

These findings are surprising in that they suggest a potentially widespread violation of the regulations (NASD Rule 2711, 2008 and NYSE Rule 472, 2007). However, there are some possible explanations that do not involve violation of regulations. First, the change from the presence to the absence of ownership may be due to a change in analysts' research teams or household members, rather than share liquidations. To examine this possibility, we randomly select 50 terminations with an outstanding buy and read both the pre- and post-termination reports. We find a change in the analyst's team for only 9 cases. Perhaps more importantly, in 12 cases, the pre-termination report states explicitly that it was the analyst who owned shares, though the other 38 do not specify the owner of the shares. Thus, most of these puzzling terminations are unlikely to be driven by changes in analysts' teams or household members. Second, analysts may have sold their holdings because of "unanticipated financial hardships" – the only exception provided by the regulations. While it is impossible to test this possibility, it is difficult to understand how unanticipated financial hardships could occur so frequently for analysts.

We further conduct a logistic analysis of broker, analyst, and firm characteristics associated with trading against own recommendations. The dependent variable is an indicator for ownership initiations with a sell recommendation outstanding or terminations with a buy recommendation outstanding. We consider analysts' general experience and all-star status (proxies for both analysts' reputational costs and potential trading profit), broker size and an indicator for sanctioned banks in the Global Settlement (proxies for brokers' reputational and legal costs), and institutional ownership of the covered company (a proxy for institutional monitoring). As shown in Table 7 Panel B, we find only weak evidence that more experienced and all-star analysts are more likely to trade against their recommendations and this behavior is more likely to occur in firms with lower institutional ownership.

5.4.2. Do analysts trade upon their information before releasing it to investors?

If an analyst trades upon her information before releasing it to investors, we expect to observe upward recommendation or forecast revisions after initiating her ownership, or downward revisions following terminating her ownership. Table 8 reports analysts' revisions of recommendations and forecasts in the periods before and after they initiate and terminate ownership positions. Revisions -1, -2, -3 ($+1$, $+2$, $+3$) refer to the revisions made in the last (first) three 30-day periods immediately before (after) the initiation period (Panel A) and the termination period (Panel B).[36] Recommendation revisions are changes in recommendations (3, 2, and 1 for buys, holds and sells), and forecast revisions are changes in annual earnings or target price forecasts, scaled by the stock price five days prior to the forecast date. To gauge whether the revisions convey new information to investors, we also examine abnormal revisions, defined as the changes in the difference between raw recommendations/forecasts and the outstanding consensus (the mean of the most recent recommendations or forecasts issued by other analysts in the prior 90 days), and the price reactions (*CAR* over $[-1, +1]$) to the revisions.[37]

In Panel A, we find little evidence that analysts revise upward recommendations or forecasts after initiating ownership. For example, we observe some upward revision of raw target price forecasts (0.008, $p < 0.01$) Revision + 2, but the abnormal revision is insignificant and the 3-day price reaction (*CAR*) is small economically. In the periods prior to the ownership initiations, we see some weak evidence of a downward revision of earnings forecasts (raw revision = -0.011, $p < 0.05$; abnormal revision = -0.008, $p < 0.05$; CAR = -0.007, insignificant at the 10% level). In Panel B, we do not observe clear evidence that analysts revise downward recommendations and forecasts after terminating ownership in Panel B. If anything, we see some weak evidence of a downward revision of earning forecasts in the 30-day period immediately after the ownership termination (i.e., at Revision + 1, raw revision = -0.018, $p < 0.01$; abnormal revision = -0.033, $p < 0.05$; *CAR* = -0.009, $p < 0.10$), consistent with analysts trading upon their negative earnings information before releasing it to investors.

One possible reason for our failure to find strong evidence in Table 8 is that analysts' ownership terminations are mainly driven by reasons other than the exploitation of private information. However, untabulated tests following prior research (e.g., Jin and Kothari

[35] To rule out the possibility that analysts may change their outstanding recommendations without issuing a formal report (though our conversations with two analysts suggest that this is very unlikely), we search IBES for any recommendation change during the initiation or termination periods. We find no such case.

[36] Inferences are similar if we consider 60, 90, 120, 180, or 360-day periods (untabulated).

[37] If an analyst still covers the company but does not issue any recommendation or forecast during a period, the revisions and the price reactions for that period are set to zero.

Table 8
Analysts' revision of recommendations and forecasts around their ownership initiations and terminations.

Panel A: Revisions around ownership initiations

		Recommendations revisions			Earnings forecast revisions			Target price forecast revisions		
		Mean raw revision	Mean abnormal revision	Mean *CAR* [−1, + 1]	Mean raw revision	Mean abnormal revision	Mean *CAR* [−1, + 1]	Mean raw revision	Mean abnormal revision	Mean *CAR* [−1, + 1]
Revision	*N*	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
−3	669	0.016**	0.018**	0.001	0.002	−0.001	0.005*	0.005	0.003	0.002
−2	677	0.007	0.014	−0.001**	0.001	0.000	−0.009**	0.003	0.008	−0.000
−1	721	0.022**	0.020	0.001	−0.011***	−0.008**	−0.007	−0.010	0.004	−0.001
Initiation										
+1	696	−0.004	−0.009	0.000	−0.013***	−0.005	0.001	−0.004	0.001	−0.002
+2	678	−0.012	−0.007	0.000	−0.006***	−0.006***	0.000	0.008***	0.002	0.002
+3	665	−0.009	−0.013	0.000	−0.003***	−0.003*	0.005	0.005	0.005	0.001

Panel B: Revisions around ownership terminations

		Recommendations revisions			Earnings forecast revisions			Target price forecast revisions		
		Mean raw revision	Mean abnormal revision	Mean *CAR* [−1, + 1]	Mean raw revision	Mean abnormal revision	Mean *CAR* [−1, + 1]	Mean raw revision	Mean abnormal revision	Mean *CAR* [−1, + 1]
Revision	*N*	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
−3	655	−0.003	0.005	0.000	−0.001	−0.006***	−0.002	0.000	0.011	−0.001
−2	649	−0.011	−0.002	−0.001	−0.010***	−0.009**	−0.005	−0.005	0.002	0.001
−1	682	−0.048***	−0.037**	0.000	−0.026***	−0.002	0.006	−0.006	−0.005	−0.001
Termination										
+1	636	−0.002	0.007	−0.001	−0.018***	−0.033**	−0.009*	0.010*	0.014	0.001
+2	619	−0.002	−0.002	−0.002***	0.012*	0.004**	0.004	−0.007*	0.005	−0.003*
+3	600	0.007	0.012	−0.001**	−0.006*	−0.005*	0.002	−0.006	−0.012	−0.001

This table reports analysts' revision of their recommendations, earnings forecasts, and target price forecasts around the period when they initiate (Panel A) or terminate (Panel B) their stock ownership. We identify ownership initiations and terminations based on changes in analysts' ownership status (i.e., the presence or absence of ownership). Revisions + 1, + 2, and + 3 (−1, −2, −3) refer to the revision made in the three 30-day periods immediately following (prior to) ownership initiations or terminations. Recommendation revision is the change in recommendations (coded from 1 (sell) to 3 (buy)) over the period. Earnings forecast revision is the change in annual earnings forecasts over the period, scaled by the stock price five days prior to the current forecast. Target price forecast revision is the change in target price forecasts, scaled by the stock price five days prior to the current forecast. Abnormal revisions are the change in abnormal recommendations or forecasts over the period, scaled by the stock price five days prior to the current recommendations or forecasts, where abnormal recommendations or forecasts are the raw recommendations or forecasts minus the outstanding consensus (the average of outstanding recommendations or forecasts issued in the prior 90 days). CAR is the sum of all cumulative abnormal (size-adjusted) returns over the 3-day ([−1, + 1]) window surrounding the recommendation or forecast date. To mitigate the influence of outliers, we exclude target price forecasts with the ratio of target prices to stock price in the bottom one percent of distribution or larger than four (Bradshaw et al., 2013) and winsorize other continuous variables at the 0.5% and 99.5% level. ***, **, * indicate statistical significance at the 1, 5, and 10 percent levels, respectively.

2008; Kallunki et al., 2009) yield no evidence that the terminations are related to portfolio diversification or tax motives or the behavioral (disposition) effect. Another reason is the low power of out tests due to two significant data limitations. First, our data only provide a period during which analysts initiate or terminate ownership. We cannot observe the precise timing (date) of the initiations and terminations. Second, we cannot observe the size of analysts' initial purchases or final sales or any trades in between. Analysts may obtain most of the shares after the initial purchase or may have already sold most of the holdings before the final sale.

6. Conclusion

Regulators and the financial press have long expressed concerns that analysts' stock ownership in covered companies is a potential conflict of interest that can compromise analysts' objectivity and lead them to issue overly optimistic recommendations that hurt investors. Yet proponents of analysts' stock ownership argue that owning stock enhances the credibility of analysts' recommendations by putting their money where their mouths are. This study provides the first large-sample evidence on these competing views by examining the relation between analysts' stock ownership and their recommendations and forecasts.

Using hand-collected mandated disclosures of analysts' stock ownership, we find that analysts owning stock in a covered company issue more informative recommendations, as evidenced by stronger price reactions to their recommendations. We then present evidence that one source of such superior informativeness is that "having skin in the game" leads analysts to exert more effort in covering the company. We further find that analysts with ownership issue less accurate and more optimistic target price forecasts. Additionally, we find that the majority of analysts owning stock terminate their ownership when they have a buy recommendation

outstanding. We only find some weak evidence that analysts front-run their clients by selling before revising down earnings forecasts.

Overall, our results suggest that analysts' stock ownership enhances the credibility of their recommendations by conveying their superior information about the recommended companies, but also induces analysts to bias upward their target price forecasts and to trade against their own recommendations. Our results are potentially relevant to regulators, brokers, and investors who seek to understand effects of analysts' stock ownership. However, due to data restrictions, we rely on the completeness and truthfulness of analysts' ownership disclosures, and examine only the presence or absence of analysts' stock ownership. Our results may not hold for stock ownership that analysts fail to disclose, and the results may differ across different sizes of holdings (e.g., larger holdings may be more likely to induce a conflict-of-interest effect). Should the data become available, examining how the effects of analysts' stock ownership vary with the magnitude of their holdings and changes in their holdings would be an interesting avenue for future research. Further, future research may also investigate how brokers' policies on banning versus allowing analysts' ownership influence analysts' incentives and their research quality.

Appendix A

Examples of disclosures pertaining to analysts' stock ownership in research reports

Example #1:	
Broker	Barrington Research
Analyst name	Charley R. Jones
Company	AtriCure, Inc.
Ownership report:	
Date	October 27, 2011
Disclosure	"The analyst responsible for this report, Charley R. Jones, CPA or a member of the analyst's household owns shares of the common stock of this company."
Non-ownership report:	
Date	November 2, 2011
Disclosure	"The analyst responsible for this report, Charley R. Jones, CPA, or a member of the analyst's household doesn't own shares of the common stock of this company."
Example #2:	
Broker	Brean Capital, LLC
Analyst name	Barbara Coffey
Company	Verity Inc.
Ownership report:	
Date	March 28, 2005
Disclosure	"The research analyst who prepared this report, or a member of the research analyst's household, has a financial interest in the securities of the subject company."
Non-ownership report:	
Date	June 17, 2005
Disclosure	None (i.e., no disclosure pertaining to analysts' ownership interests)

Appendix B

Examples of analysts' ownership initiations and terminations

Ownership initiation example:	
Broker	Large broker [A]
Analyst name	Analyst [A]
Pre-string non-ownership report:	
Date	June 12, 2003
Recommendation	"Sell"
Disclosure	"The research analyst, a member of the team, or a member of the research analyst's household does not have a financial interest in any stocks mentioned in this report."
First ownership report in the ownership string:	
Date	June 20, 2003
Recommendation	"Buy"

Disclosure	"The research analyst, a member of the team, or a member of the research analyst's household has a financial interest in Company [A] (common) stock."
Ownership termination example:	
Broker	Large Broker [B]
Analyst name	Analyst [B]
Last ownership report in the ownership string:	
Date	May 8, 2012
Recommendation	"Outperform"
Disclosure	"An analyst or a member of the analyst's household has a long position in the common stock of Company [B]."
Post-string non-ownership report:	
Date	June 20, 2012
Recommendation	"Neutral"
Disclosure	None (i.e., no disclosure pertaining to analysts' ownership interests)

Note: In the above examples real analyst, broker, and company names are masked using a generic pseudonym (e.g., Analyst [A]).

References

Boni, L., Womack, K., 2002a. Wall street's credibility problem: Misaligned incentives and dubious fixes? Brookings-Wharton Papers on Financial Services. pp. 93–101.
Boni, L., Womack, K., 2002b. Solving the sell-side research problem: Insights from buy-side professionals. Working paper.
Bradley, D., Gokkaya, S., Liu, X., 2017. Before an analyst becomes an analyst: Does industry experience matter? J. Finance 72, 751–792.
Bradshaw, M.T., 2004. How do analysts use their earnings forecasts in generating stock recommendations? Account. Rev. 79 (1), 25–50.
Bradshaw, M., Brown, L., Huang, K., 2013. Do sell-side analysts exhibit differential target price forecasting ability? Rev. Account. Stud. 18, 930–955.
Carhart, M., 1997. On persistence in mutual fund performance. J. Finance 52, 57–82.
Chen, S., Matsumoto, D., 2006. Favorable versus unfavorable recommendations: The impact on analyst access to management-provided information. J. Account. Res. 44, 657–689.
Clement, M., 1999. Analyst forecast accuracy: Do ability, resources, and portfolio complexity matter? J. Account. Econ. 27, 285–303.
Clement, M., Tse, S., 2003. Do investors respond to analysts' forecast revisions as if forecast accuracy is all that matters? Account. Rev. 78, 227–249.
Cohen, L., Frazzini, A., Malloy, C., 2010. Sell-side school ties. J. Finance 65, 1409–1437.
Cowen, A., Groysberg, B., Healy, P., 2006. Which types of analyst firms are more optimistic? J. Account. Econ. 41, 119–146.
Craig, S., 2006. Brokerage House, Analyst are fined in conflict case. Wall Street J February 9, 2006, C5.
Ertimur, Y., Sunder, J., Sunder, S.V., 2007. Measure for measure: the relation between forecast accuracy and recommendation profitability of analysts. J. Account. Res. 45 (3), 567–606.
Financial Industry Regulatory Authority (FINRA), 2010. Financial Industry Regulatory Authority Letter of Acceptance. Morgan Stanley & Co Waiver and Consent No. 2008013782301, Retrieved from. https://files.brokercheck.finra.org/firm/firm_8209.pdf.
Financial Industry Regulatory Authority (FINRA), 2012. Financial Industry Regulatory Authority Letter of Acceptance. Citigroup Global Markets Inc. Waiver and Consent No. 20080123101, Retrieved from. http://disciplinaryactions.finra.org/Search/ViewDocument/28488.
Financial Industry Regulatory Authority (FINRA), 2016. Five things investors should know about analyst reports. Retrieved from http://www.finra.org/investors/five-things-investors-should-know-about-analyst-reports.
Financial Industry Regulatory Authority (FINRA), 2015. Rule 2241 - Research Analysts and Research Reports. Retrieved from http://finra.complinet.com/en/display/display_main.html?rbid=2403&element_id=11946.
Financial Industry Regulatory Authority (FINRA), 2016. Rule 2242 – Debt Research Analysts and Debt Research Reports. Retrieved from http://finra.complinet.com/en/display/display.html?rbid=2403&record_id=16357&element_id=11953&highlight=2242#r16357.
Firth, M., Lin, C., Liu, P., Xuan, Y., 2013. The client is king: do mutual fund relationships bias analyst recommendations? J. Account. Res. 51, 165–200.
Gasparino, C., Opdyke, J., 2001. Merrill Lynch prohibits analysts from buying stocks they cover. Wall Street J July 1, C1.
Greene, W., 2004. The behavior of the fixed effects estimator in nonlinear models. Econom. J. 7, 98–119.
Ivković, Z., Jegadeesh, andN., 2004. The timing and value of forecast and recommendation revisions. J. Financial Econ. 73, 433–463.
Jacob, J., Lys, T., Neale, M, 1999. Expertise in forecasting performance of security analysts. J. Account. Econ. 28, 51–82.
Jin, L., Kothari, S.P., 2008. Effect of personal taxes on managers' decisions to sell their stock. J. Account. Econ. 46, 23–46.
Johnston, R., 2013. Does analyst stock ownership affect reporting behavior? Rev. Pacific Basin Financial Mark. Pol. 16, 1–39.
Jung, B., Shane, P., Yang, S., 2012. Do financial analysts' long-term growth forecasts matter? Evidence from stock recommendations and career outcomes. J. Account. Econ. 53, 55–76.
Kadan, O., Madureira, L., Wong, R., Zach, T., 2009. Conflicts of interest and stock recommendations: The effects of the global settlement and related regulations. Rev. Financial Stud. 22, 4189–4217.
Kahneman, D., Lovallo, D., 1993. Timid choices and bold forecasts: a cognitive perspective on risk taking. Manag. Sci. 39, 17–31.
Kallunki, J.P., Nilsson, H., Hellström, J., 2009. Why do insiders trade? Evidence based on unique data on Swedish insiders. J. Account. Econ. 48, 37–53.
Ke, B., Yu, Y., 2006. The effect of issuing biased earnings forecasts on analysts' access to management and survival. J. Account. Res. 44, 965–999.
Ke, B., Yu, Y., 2009. Why don't analysts use their earnings forecasts in generating stock recommendations? Working paper.
Lin, H., McNichols, M., 1998. Underwriting relationships, analysts' earnings forecasts and investment recommendations. J. Account. Econ. 25, 101–127.
Loh, R, Stulz, R., 2011. When are analyst recommendations influential? Rev. Financial Stud. 24, 593–627.
Malloy, C., 2005. The geography of equity analysis. J. Finance 60, 719–755.
Malmendier, U., Shanthikumar, D., 2009. Do security analysts speak in two tongues? Rev. Financial Stud. 27 (5), 1287–1322.
Marley, R., Mellon, M., 2016. The effects of expanded analyst ownership disclosure on nonprofessional investors' judgments and decision-making. Working paper.
McNeal, G., 2012. Do Investors Care About SEC Mandated Disclosures of Analyst Stock Ownership? Forbes.com November 30.
McNichols, M., O'Brien, P., 1997. Self-selection and analyst coverage. J. Account. Res. 35, 167–199.
Merkley, K., Michaely, R., Pacelli, J., 2017. Does the scope of the sell-side analyst industry matter? An examination of bias, accuracy, and information content of analyst reports. J. Finance 72, 1285–1334.

Michaely, R., Womack, K., 1999. Conflict of interest and the credibility of underwriter analyst recommendations. Rev. Financial Stud. 12, 653–686.
Mola, S., Guidolin, M., 2009. Affiliated mutual funds and analyst optimism. J. Financial Econ. 93, 108–137.
Moreno, N., 2017. Financial analyst who worked at chicago firm pleads guilty to insider trading. Chicago Tribune October 18.
Morgenson, G., 2016. When an Analyst Has a Stake in the Stock He Picks. The New York Times March 18.
NASD Rule 2711, 2008. Research Analysts and Research Reports. National Association of Securities Dealers Automated Quotation Retrieved from http://finra.complinet.com/en/display/display.html?rbid=2403&record_id=4352&element_id=3675&highlight=2711#r4352.
Newmark, E., 2008. How much skin in Wall Street's game? Wall Street J. Online Deal J June 25.
NYSE Rule 472, 2007. Communication with the Public. New York Stock Exchange. Retrieved from http://finra.complinet.com/en/display/display_main.html?rbid=2403element_id=6945.
O'Brien, P., Bhushan, R., 1990. Analyst following and institutional ownership. J. Account. Res. 28, 55–76.
O'Brien, P., McNichols, M., Lin, H., 2005. Analyst impartiality and investment banking relationships. J. Account. Res. 43, 623–650.
Opdyke, J.D., 2001. Many analysts found to invest in companies they covered. Wall Street J August 1, C1.
Schack, J., 2001. Should analysts own stocks they cover? Inst. Invest. 4, 60–71.
Securities and Exchange Commission (SEC), 2001. SEC Cautions Investors About Analyst Recommendations. (Investor alert). Securities and Exchange Commission (SEC). https://www.sec.gov/news/headlines/analystalert.htm.
Securities and Exchange Commission (SEC), 2010. Analyzing Analyst Recommendations. Investor Publications August 30, 2010. Retrieved from. https://www.sec.gov/tm/reportspubs/investor-publications/investorpubsanalystshtm.html.
Strasburg, J., Albergotti, R., 2012. Insider targets expanding. Wall Street J February 28, A1.
Solomon, D., 2005. Judge lets SEC proceed with suit against analyst. Wall Street J April 13, C5.
Stickel, S., 1992. Reputation and performance among security analysts. J. Finance 47, 1811–1836.
Taha, A.E., Petrocelli, J.V., 2014. Sending mixed messages: investor interpretations of disclosures of analyst stock ownership. Psychol. Public Policy Law 20, 68–77.
Unger, L.S., 2001. Written testimony concerning conflicts of interest faced by brokerage firms and their research analysts. Retrieved from. https://www.sec.gov/news/testimony/073101tslu.htm.