Handelshøyskolen BI

GRA 19703 Master Thesis

Thesis Master of Science 100% - W

Predefinert informasjon

Startdato:	09-01-2023 09:00 CET	**Termin:**	202310
Sluttdato:	03-07-2023 12:00 CEST	**Vurderingsform:**	Norsk 6-trinns skala (A-F)
Eksamensform:	T		
Flowkode:	202310||11184||IN00||W||T		
Intern sensor:	(Anonymisert)		

Deltaker

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Informasjon fra deltaker

Tittel *:	Do Institutions Put Their Money Where Their Mouths Are? Empirical evidence from analysts' stock recommendations, their firms' ex-ante holding and ex-post trading
Navn på veileder *:	Ivan Alfaro

Inneholder besvarelsen konfidensielt materiale?:	Nei	**Kan besvarelsen offentliggjøres?:**	Ja

Gruppe

Gruppenavn:	(Anonymisert)
Gruppenummer:	314
Andre medlemmer i gruppen:	Deltakeren har innlevert i en enkeltmannsgruppe

Do Institutions Put Their Money Where Their Mouths Are?

Empirical evidence from analysts' stock recommendations, their firms' ex-ante holding and ex-post trading

Master Thesis

by

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MSc in Finance

Supervised by Prof. Ivan Alfaro

Oslo, July 3, 2023

Abstract

I empirically study the relationship between analysts' stock recommendations and their affiliated institutions' ex-ante holding and ex-post trading. I use data of 1,014,720 stock recommendations issued by analysts from 80 institutions for a total of 4,219 stocks from the years 1993 to 2021 collected from the Institutional Brokers' Estimate System (I/B/E/S) Database and the Institutional Holdings (13F) Section of Thomson/Refinitiv Database. I find that (i) institutions' trading aligns with their analysts' recommendations, (ii) these recommendations are based on objective judgment which is less likely to be influenced by their affiliated institutions' ex-ante stock ownership, and (iii) following analysts' stock recommendations outperform the market during the past 29 years.

Acknowledgement

I would like to express my sincere gratitude to BI Norwegian Business School for their generous provision of resources and unwavering support, which have been instrumental in the completion of this master's thesis.

I would also like to extend my deep gratitude my supervisor, Prof. Ivan Alfaro, for his exceptional guidance, invaluable expertise, and support throughout the entire thesis. His mentorship has been truly invaluable in shaping the direction and quality of this research.

I would also like to extend my profound appreciation to Prof. Deniz Okat for providing crucial inspiration and precious guidance for this paper and to Prof. Tingjun Liu for valuable comments and extensive guidance for this paper.

I sincerely thank Prof. Jan Kudlicka, Bin Hung, Ferdinand Feet, Hajra Noor, Prashanth Manda, Sabrina Zia, Till Himmelsbach, Tom Dragebo, Xinchen Ma, and Yan Li for thoughtful comments and great supports.

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"Wall Street is the only place that people ride to in a Rolls-Royce to get advice from those who take the subway."

-Warren Buffett

1. Introduction

The Efficient Market Hypothesis (EMH) (Fama, 1970) suggests that prices completely reflect all available information and therefore immediately provide unbiased estimates of the underlying values. However, there is also substantial empirical evidence that questions the validity of EMH (Basu, 1977) and shows that the markets are not fully efficient. The fact that market prices can not immediately reflect all available information makes information gatherers, i.e., security analysts, compensated for their information-collecting activities (Grossman and Stiglitz (1980)). A renowned investment strategist Philip Fisher once said that "the stock market is filled with individuals who know the price of everything, but the value of nothing". We also know from many similar articles and research that technical analysis, fundamental analysis, and insider information are of value (Orlov, (2020)). Moreover, information gathering and processing are expensive. It costs hundreds of millions of dollars annually for brokerage firms to analyze stocks (Womack, (1996)). This allows financial analysts to be more professional at processing markett information than an average investor who does not have access and/or does not have the resources to process such large amounts of information. Mikhail et al., (2007) find that small traders generate negative returns form their trading strategies while large traders generate positive returns from their trading strategies. Analysts' research is built on evaluative and predictive information. For instance, firm and industry-specific information that includes annual reports, earnings announcements, merger and acquisition news, etc., (Womack, (1996)) and macroeconomic information that includes economic indicators, market sentiment, interest rate, etc.; which might not be readily available for small investors. Analysts' reports aim to persuade investors that specific stocks are more or less attractive than others (Womack, (1996)). The information that analysts' research conveys impacts investors' financial decision-making. (Aiguzhinov et al. (2015).

In April 2003, 10 of the largest securities firms in Wall Street, including well known firms such as Citigroup, Merrill Lynch and Goldman Sachs, faced accusations of misleading investors through fraudulent stock market research, which gained considerable attention from mainstream financial media. Their tainted analysts' report, which lacked integrity and honesty in the research. This was intended to secure investment banking fees while publishing biased information about the firms they review. Their conflicts of interest and other related wrongdoing led to significant financial losses during the stock market boom. (CNN 2003). A wealth of articles in popular press have also presented anecdotal evidence suggesting the potential manipulation of forecasts by analysts. (Fox (1997), McGee (1997), and Vickers (1997), Chan et al. (2007)). Specifically, analysts react to the conflicts by inflating their stock recommendations. Therefore, whether analysts' reports are credible or not holds significant importance to investors and remains a key concern of regulators (Mikhail et al. (2007)).

Institutions, such as mutual funds, pension funds, and other large investors, play a crucial role in the stock market since they hold substantial positions in a wide range of companies. The study of Institutional stock holdings has been a focal point in finance research ever since the inception of the Efficient Markets Hypothesis (Campbell et al. (2009)). Institutional investors, responsible for managing relatively large portfolios, are often regarded as highly knowledgeable and sophisticated compared to individual investors. Their expertise and access to adequate information enable them to conduct in-depth analysis and make profitable investment decisions (Bernile & Wang (2015); Holden and Subrahmanyam (1992); Sias and Starks (1997); Boehmer and Kelley (2009)). This information asymmetry also allows institutional investors engage in actions that are linked to their self-interest. In late 2003, the scandal over favouritism in mutual fund trading spread rapidly that caused significant upheaval within the securities industry, and prompting regulators to closely scrutinize the matter. More than 30 institutions that sell mutual funds were investigated by brokerage regulators due to their widespread and improper trading practices that directly harmed ordinary long-term investors. It is reported that conflicts of interest in the case of senior executives at Putnam Investments and Strong Financial Corp., two prominent fund companies, led them to maximize their personal profit at the expense of their investors' well-being. (The Washington Post (2003)). Therefore, it's crucial to study institutional investors'

trading and holdings, as their actions can have a substantial impact on market dynamics and investor outcomes.

In this paper, I study the credibility of sell-side analysts' stock recommendations by extending prior research to focus on recommendation by the institution which is collective opinion of the individual analysts' recommendation in the respective institutions. Previous studies by Mikhail et al., (2007) have found that there are more trades being placed (volume) by institutional investors than by individual investors when there is a public stock recommendation. This paper builds on this focal point. I analyze the relationship between analysts' stock recommendations and their affiliated institutions' ex-ante holding and ex-post trading. Previous study by Mikhail et al. (2007) utilizes the direction and magnitude of upgrade-downgrade adjustment of the recommendation to explain report credibility. However, I define the credibility of recommendations within two criteria: (1) they are based on analysts' objective judgement by analysts that are free from self-interests impacts, and (2) they are consistent with the ex-post trading and holdings of their affiliated institutions. I use data on analysts' stock recommendations from the Institutional Brokers' Estimate System (I/B/E/S) and data on institutional trading and holdings from 13F under Thomson/Refinitiv Database. I examine two hypotheses: 1) analysts' affiliated institutions are more likely to purchase stocks for which their analyst reports made optimistic recommendations, compared to those stocks for which their analyst reports didn't make optimistic recommendations; 2) analysts' affiliated institutions' ex-ante ownership of stocks induces an optimistic bias in their analysts' recommendations for those stocks due to either analysts' or analyst affiliated companies' self-interests in increasing the value of their investment.

First, I regress analysts' affiliated institutions' ex-post trading on their recommendations to test Hypothesis I. Inspired by Jegadeesh & Kim (2006) where they employ the frequency of different recommendation levels among the active recommendations each month; I generate the percentage for the 5 categories of stock-recommendation for a specific stock, by each analysts' affiliated institution, for each quarter - as the measurement of the stock recommendation. I/B/E/S rates analysts' stock recommendations stocks as "Strong Buy", "Buy", "Hold", "Underperform", and "Sell". I find a significantly positive relation between analysts' affiliated companies' ex-post trading and the percentage of optimistic stock

recommendation, i.e., “Strong Buy” and “Buy”. This suggests analysts’ affiliated companies’ ex-post trading speaks for their analysts’ stock recommendations. Furthermore, the performance of each portfolio of stocks created with each of the 5 stock recommendations shows that the portfolio with optimistic recommendations not only beat the pessimistic recommendation portfolio but also outperform the stock market in long term (29 years). This is consistent with the prior research indicating that security analysts possess predictive capabilities, as demonstrated by their ability to time the market and select profitable stocks in short-term which is evidenced by the positive excess returns observed after buy recommendations are made. (Womack, (1996)).

Second, I regress analysts’ four categories of stock recommendations, i.e., “Strong Buy”, “Buy”, “Underperform”, and “Sell” individually on their affiliated institutions’ ex-ante ownership to test Hypothesis II. I find a statistically significantly positive relation between analysts’ optimistic stock recommendations, i.e., “Strong Buy” and “Buy”, and their affiliated institutions’ ex-ante ownership, and their affiliated institutions’ ex-ante ownership. This indicates that institutions’ skin in the game, namely, institutional ex-ante ownerships does affect their analysts’ recommendations, which reflects the conflict-of-interest issue. However, there might be endogeneity caused by reverse causality in this second regression. To address this problem, I utilize the differential effects of purchasing quarters of ex-ante holding stocks on analysts' recommendations. If analysts' affiliated institutions’ stock ownership is the main reason for more favorable recommendation, ownership of stocks purchased long time ago should affect recommendations in a similar way to ownership of stocks purchased recently. Otherwise, there should be differences in the effect of ownership on recommendations. If the analyst’s recommendation is solely motivated by self-interest, then the coefficient on lagged ownership will be positive and time-invariant. However, if the analyst's recommendation is not entirely motivated by his own or his affiliated institution’s self-interest, the coefficient on lagged ownership will decrease with time lag lags. This is my main innovation to address endogeneity. I find a downward sloping trend in the coefficient as it varies with the time lags. This suggests that analysts' recommendations are not solely motivated by the self-interest of their affiliated institutions. Rather, they appear to be at least partially influenced by objective factors and considerations. Combined with the outstanding performance of

portfolios created from optimistic stock recommendation mentioned the above, we can see that analysts' stock recommendations are credible.

I draw three conclusions from the empirical results. (1) Analysts' affiliated institutions do invest in stocks that individual analysts' recommendation aggregated at the institutional level shows optimism. (2) Analysts' stock recommendations are based on objective judgment that is less likely influenced by their affiliated institutions' ex-ante stock ownership. (3) Investors can benefit from analysts' stock recommendation for the past 29 years. Overall, analysts do put their money where their mouths are.

The rest of the paper is structured as follows. Next section reviews relevant literature. Section 3 illustrates my hypotheses and empirical designs. Section 4 introduces methodology for testing these hypotheses. In section 5, I describe the data used in my paper. Section 6, "Results and Analysis", presents the key results and core analysis of the paper. I conclude in Section 7.

2. Related Literature

My research mainly relates to four strands of literature: The Efficient Market Hypothesis, analyst's stock recommendation, institutional holdings and trading and agency problems between affiliated analysts and investors.

2.1. Efficient Market Hypothesis

Security prices completely reflect available information immediately in an efficient capital market. Laffont & Maskin (1990) pointed out that in stock markets where there are significant informational asymmetries, equilibrium prices aggregate information effectively. They also find that a large trader will intentionally conceal his private information to induce an equilibrium price that is advantageous to them. This is consistent with their finding that EMH may well fail if there is imperfect competition. As a result, there is a time gap between the publication of the new information and the corresponding adjustment of the price. This is proved by Chordia et al. (2005) where they find that price adjustments to new information occur substantially within thirty minutes. Therefore, the uncertainty caused by the reaction time for absorbing the new information makes information gathering valuable, which is the right work of financial analysts. Grossman and Stiglitz (1980) conjuncture that there must be returns to information search costs, which is against the assumption of EMH that information search is of no value. Johnston (2013) suggests that analysts play a significant role as information intermediaries in the stock markets.

2.2. Institutional Ownership and Trading

Institutional investors, as one of the major investor group, have dominated US equity markets since last century. In 1989, institutional investors held approximately half of equities in the United States. During that time, both their trading activities and the trading volume accounted for approximately 70% of the total trading volume on the New York Stock Exchange (Schwartz and Shapiro (1992), Lakonishok (1992)). In 1996, institutional investors held over 50% of the equity in U.S. industrial firms, which marked an pronounced increase from 35% a

decade earlier. Gompers and Metrick (2001) observe that institutional ownership of US stocks has grown remarkably since the 1980s. Institutional investors hold about 50% of the equities in the United States since 1992 (Lakonishok et al., 1992). Brancato and Rabimov (2008) find that by the end of 2007, institutional investors accounted for 76.4% of the ownership in the top large-cap 1000 US firms. This trend toward higher institutional holdings has been observed in both small and large firms.

Managing large portfolios grants institutional investors a perception of being more sophisticated as they have access to superior market data and professional research capabilities compared to individual investors. Goldstein et al. (2009) suggests that institutional investors often have privileged access to sell-side analysts through soft-dollar arrangements, which allows institutional investors to exchange commissions for research services provided by brokerage firms. As reported by the Securities and Exchange Commission (SEC) in 1998, almost all institutional investors utilize soft-dollar arrangements to acquire research. Additionally, trade commissions related to soft-dollar arrangements accounted for approximately 27 percent of the total trade commissions. Chen, Jegadeesh, and Wermers (2000) find that the stocks bought by institutional investors tend to outperform the stocks they sell by approximately 2 percent annually, while Odean (1999) find that stocks purchased by individual investors consistently underperformed the stocks they sold. This further emphasize the institutional investors are better at information collecting than small investors.

How the corporate value is affected by institutional investors trading and holdings receives remarkable attention by previous scholars and market practitioners (Grinstein & Michaely (2005)). Chen & Cheng (2006) suggests that the influence of recommendation has economically significance on institutional trading. The trading activities of institutional investors can have a significant influence on market prices. (Bernile & Wang (2015); Holden and Subrahmanyam (1992); Sias and Starks (1997); Boehmer and Kelley (2009)). Gompers and Metrick (2001) find that the level of institutional ownership in a stock can serve as a useful indicator for predicting its future return. Nofsinger and Sias (1999) document that firms experiencing significant growing in institutional ownership tend to beat firms with significant reduces in institutional ownership by approximately 5.43 percent in the

following year, which indicates the positive impact of institutional ownership changes on stock performance.

Lakonishok et al. (1992) examine the trading patterns of institutional investors focusing particularly on the prevalence of herding and positive-feedback trading. Their finding suggests that institutional trading neither stabilizes nor the destabilizes stock prices, because averagely they appear to follow neither positive- nor negative- feedback strategies. They found that the excess demand by institutions for a stock in a given quarter, which is a potential reason that institution trading activities may affect stock prices, correlates extremely weakly to the price change of the stock in that quarter. They concluded that institutional investors pursue a broad diversity of trading styles. Therefore, to a large extent, different institutional investors' influences on stock prices offset each other, which protects the stock prices from moving by institutional investors.

Former research also studies the preference of institutional investors through their holdings and trading behaviour. Gompers et al. (2001) suggests that institutional preferences are concentrated, and institutions are interested in stocks that are larger, more liquid and have had relatively low most recent historical returns compared to other investors. They found that following the tendency that large institutional investors almost doubled their share of the stock market from 1980 to 1996, institutional demand for the stock of large companies is increased and institutional demand for the stock of small companies is decreased. Falkenstein (1996) and Gompers and Metrick (2001) observe that institutions avoid investing in low-priced stocks. Such biased behavior may be due to the illiquidity of low-priced stocks (McInish and Wood, 1992; Brennan and Subrahmanyam, 1996; Gompers and Metrick, 2001) or due to a positive relation between price and size (Stoll and Whaley, 1983). Fernando et al. (2012) mention that the benefits of institutional investment will vary widely across firms, depending on the extent and proprietary nature of firms' private information and the moral hazard problems associated with disclosing it (Brennan and Hughes, 1991), the cost of obtaining information through other channels (Diamond, 1985), the governance of the firm and the extent to which managerial behavior can be positively influenced by institutional investors (Denis and Serrano, 1996), and the costs incurred by firms due to institutional monitoring (Bushee, 1998).

Numerous studies have investigated the interaction between institution behaviour and analyst forecasts. Bhushan (1989) found that institutional ownership positively correlates to analyst following. O'Brien (1990) also suggests that institutions' decisions to hold firms' common stock is associated with prior analyst following. Brennan and Hughes (1991) and Angel (1997) found that high-value firms tend to have more institutional investors and fewer analysts than similar sized low-value firms. Previous research (e.g., Womack (1996); Barber et al. (2001)) study whether institutional investors trade upon sell-side analysts' stock recommendations. Chen and Cheng (2006) found that institutional investors do trade on stock recommendations since quarterly change in institutional ownership positively correlates to consensus recommendations. They observe the increased holdings of firms with favourable recommendations and decreased holdings of firms with unfavourable recommendations. Further, they find that there are more buyer-initiated than seller-initiated large trades around favourable recommendations and vice versa for unfavourable recommendations. Finally, they also show that stock recommendations positively relate to abnormal returns in the future.

2.3. Analyst Stock Recommendation

In early 1957, a well-known successful financier and a famous advisor to US Presidents for four decades, Bernard M. Baruch, said "the emergence of this new profession of disinterested and careful investment analysts, who have no allegiance or alliances and whose only job is to judge a security on its merits, is one of the more constructive and healthy developments of the last half century". Literature has shown a significant increase in academic interest whether analysts' stock recommendations add value to the market. Several studies have documented that analyst recommendations either reveal information or otherwise lead to abnormal returns (e.g. Ivkovic and Jegadeesh (2004); Jegadeesh et al. (2006); Krische and Lee (2000)). Previous studies show that analysts stock recommendations have investment value. One of the prominent strands of research includes findings that favorable (unfavorable) recommendations are correlated with positive (negative) abnormal returns (Womack (1996); Barber et al. (2001); Juergens (1999)). Womack (1996) analyses 1,573 recommendations in 1989-199. He finds that the average three-day abnormal returns are 3 percent for positive recommendations and -4.7 percent for negative recommendations, which indicates that stock prices are

significantly influenced by analysts' recommendations. However, previous studies also find opposite results. Cowles (1933) suggests that following most analysts' recommendations do not generate an abnormal return in spite of the criticisms of selection bias that impacts the findings. Malmendier and Shanthikumar (2007) find that taking a long (short) position simply based on analysts' insurance of optimistic (pessimistic) recommendations produces negative buy-and-hold abnormal returns. U.S. Securities and Exchange Commission (SEC) states that analysts' recommendations or reports can have an effect on the price of a company's stock - especially when the recommendations are widely circulated through medias where a wide range of market participants can be exposed to the information that analysts' reports released. Therefore, as long as a popular analyst mentions a company briefly, its stock could rise or fall sharply even if nothing about the company has changed. (SEC, 2010). These studies show that analyst recommendations have return-predicting power and may reveal information that has yet to be incorporated into market prices.

The credibility of analyst's recommendation also attracts previous scholars' attention. Womack (1996) finds that post-recommendation excess returns are significantly in the direction forecasted by the analysts. Cliff (2007) suggests that affiliated analyst recommendations are viewed as more credible compared to independent analysts.

Additionally, previous studies have also identified various characteristics associated with analysts' stock recommendations. O'Brien (1990) finds that analysts tend to prefer industries with growing numbers of firms, as well as regulated industries. They also tend to avoid industries characterized by high volatility and strong competition from existing analysts. Additionally, this study also finds that institutions appear to favour firms whose level of risk has increased. Womack (1996) Suggests that recommendations from major brokerage firms in the United States primarily focus on well-followed, large-capitalization stocks.

2.4. Agency Problem between Affiliated Analysts and Investors

Womack (1996) documents that brokerage firms spent considerable money in gathering and processing information to publish research reports and

recommendations. Correspondingly, they tend to be compensated for the resources they have put into the research. Brokerage firms usually funded research through underwriting fees, trading profits, and commissions from securities trading. SEC documented that many analysts work for investment banks or other financial brokerage firms, of which the major business is to underwrite securities offering or provide other investment banking services. Therefore, analysts have pressure to make positive stock recommendations in order to generate more purchases and sales of covered stocks, which will produce additional brokerage income for their affiliated institution and additional brokerage commissions of the analyst (SEC, 2010). Previous research have shed lights on the reason for this pressure. Womack (1996) suggests that issuing sell recommendations poses greater risks for analysts due to their higher recognition and relative infrequency compared to buy recommendations. A inaccurate judgment on a sell recommendation is likely to cause more severe consequences for an analyst's reputation compared to an incorrect buy recommendation, especially when other analysts are more likely to be conservative and issuing buy recommendations. According to Pratt (1993), there are several costs caused by issuing sell recommendations. Firstly, sell recommendations can damage a brokerage firm's existing and future investment banking relationships with client companies, which stops the brokerage firm from supporting such recommendations. Secondly, management department of brokerage firm, along with analysts' contacts within the firm, may restrict analysts issues unfavourable recommendations. This implies that analysts may face consequences, for instance, limited access to critical information, if they express negative opinions, which further highlights the challenges and pressures they encounter when making sell recommendations.

Plenty of studies have documented the evidence of this pressure faced by analysts in their recommendation practices. Womack (1996) documents that during the period of 1989-1991, the ratio of new buy recommendations to new sell recommendations issued by these 14 major brokerage firms was approximately 7:1. Mokoaleli et al. (2009) found that sell-side analysts are prone to behavioural bias in issuing recommendations. Opdyke (2002) and Santoli (2001) suggest that analysts reluctant to issue negative recommendations for their client companies. Apparently, there’s agency problem between affiliated analysts and investors. The conflict of interest that analysts face can be analyzed from two perspective: analysts’

affiliated institutions and analysts themselves. However, they are usually linked together.

This has been the interest of previous studies. 1) From the perspective of analysts' affiliated institutions, the "Global Settlement" has garnered significant attention as an prominent discussion regarding the issue of bias in sell-side analysts' research. This controversial debate arises from the accusation that some star Wall Street analysts make recommendations based on self-interest, as their compensation is linked to the success of ensuring profitable business opportunities such as mergers and acquisitions (M&A) and initial public offerings (IPOs) for their affiliated investment banks. Cowen et al. (2006) finds that analyst optimism is at least partially driven by trading incentives. Lin and McNicholas (1998) found that affiliated analysts may be pushed to make positively biased recommendation to favor their clients in order to protect client relationships and attracts potential clients. Irvine (2004) document that sell-side analysts have strong desire to maintain good relations with institutional clients who guarantee the commission revenue to their affiliated institution and to obtain underwriting mandates for their affiliated institution. Furthermore, Loughran and Ritter (2004) and Ljungvist et al. (2006) also found that analysts who face conflicts of interest do not stop at favouring its existing client, but also extended to attracting future investment banking deal flow from non-clients as the importance of research coverage to firms grew through time (Bradley, 2018). that recommendation levels are indeed positively related to conflict magnitudes. Agrawal (2008) finds that the more the magnitude of conflicts of interest is, the more positive recommendation levels are. The study also highlights that the optimistic bias induced by stock offerings was particularly prominent during the late-1990s stock market bubble. 2) From the perspective of analysts themselves, as some brokerage firms link compensation and bonuses to the number of investment banking deals analysts could bring to affiliated institutions, brokerage firms' compensation arrangements can put pressure on analysts as well to publish favorable recommendations (SEC, 2010). For instance, Konrad (1989) documents that 2.5 percent of the brokerage's trading commissions goes to sell-side analysts who obtain this trading activity for Morgan Keegan earned. Dorfman (1991) also finds some brokerage firms have been found to provide analysts with contracts that include incentives tied to trading activities. Additionally, analysts' performance at brokerage firms is predominantly evaluated based on their capacity to generate

trade, and this ranking system directly correlates with their bonuses. (Dorfman (1991); Laderman (1998); Irvine (2000); Lauricella (2001)) In addition, analysts have strong incentive to build a good reputation for their career development which motivates analysts to make favorable recommendations to satisfy their clients (Michaely and Womack, 1999). However, previous study has acknowledged the existence of biases associated with this agency issue: i) strategic bias: are analysts biased due to banking ties, and ii) selection bias: do managers select investment banks according to the favourableness of their analysts' research? (Carapeto & Gietzmann (2011)). O'Brien et al. (2005) find that except the case that issuers aim to delay the disclosure of negative information to investors, they don't exceptionally prefer a underwrite whose analysts are seldomly downgrade stocks. This finding denies the selection bias.

However, previous scholars also find results that do not support the occurrence of agency problem between affiliated analysts and investors. Cowen et al. (2006) find that analysts at firms that perform underwriting and trading activities actually make less optimistic forecasts and recommendations than those who work for brokerage firm performed no underwriting. Agrawal (2008) finds that analysts who face conflicts of interest are not able to pronouncedly mislead investors with biased optimistic stock recommendations.

Once the existence of the agency problem between affiliated analysts and investors is recognised, it becomes crucial to investigate how investors respond to analysts' reports. Some of previous research find that as affiliated analysts' are motivated to acquire or maintain investment banking clients, their recommendations tainted by such investment banking relationships can lead to money-losing investment decisions hurting the confidence of investors. Cliff (2007) find that buy or hold recommendations issued by affiliated analysts underperform stocks recommended by independent analysts during 1994-2005. Furthermore, some of previous research have offered explanations for this outcome from the perspective of information processing ability. Mikhail et al. (2007) documents that small investors often fail to fully consider the impact of analysts' incentives on the credibility of analyst reports. They also noted that small investors not only tend to trade more frequently than large investors after receiving upgrade and buy recommendations, but they also exhibit higher trading activity compared to downgrade and hold/sell

recommendations. This is consistent with regulators' belief that small "naive" investors are not aware of the conflicts sell-side analysts face and may, as a result, be misled into making suboptimal investment decisions. Similar result is found by Womack (1996) that small investors significantly reacts to recommendations more than large investors.

3. Testable Hypotheses

To investigate the credibility of analysts' recommendations, I put forward two hypotheses originally where I focus more on Hypothesis II. In the analysis of Hypothesis II, the endogeneity issue is encountered. I first address Hypothesis II ignoring the endogeneity issue. Then, I take the endogeneity problem into account and propose a method to address it. My hypotheses are as follows:

Hypothesis I:

Institutions are more likely to purchase stocks for which their analyst reports made favourable recommendations than those for which their analyst reports didn't make favourable recommendations.

Hypothesis II

Institutions' ex-ante ownership of stocks induces an optimistic bias in their analyst recommendations for those stocks due to self-interests in increasing the value of their investment.

4. Methodology

4.1. Hypothesis I

In the first hypothesis, I suggest that institutions are more likely to purchase stocks for which their analyst reports made favourable recommendations, compared to those stocks for which their analyst reports didn't make optimistic recommendations. The purpose of Hypothesis I is to test whether institutions align their actions with their words. I focus on studying how analyst's recommendations affect their affiliated institutions' trading activity on the stocks that analysts' reports cover. The following regression shows my research design of Hypothesis I:

$$Trade_{i,j.t+1} = \alpha + \beta_{i,i,t}, Recommendation_{i,j,t} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t+1},$$

Where:

i – *analyst's affiliated institution* ($i \geq 1, i \in Z$)

j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)

t – *stock recommendation issue date* ($t \geq 1, t \in Z$)

$t+1$ – *1 quarter after stock recommendation issue date* ($t \geq 1, t \in Z$)

The dependent variable $Trade_{i,j.t+1}$ indicates the analyst's affiliated institution *i*'s trading behaviour of stock j one quarter after the stock recommendation announcement date *t*. To analyse the trading behaviour of institutions thoroughly, I study it from two folds: (1) I investigate the relationship between stock recommendations from individual analysts aggregated at the institution level and the ex-post stock holding of analysts' affiliated institutions. (2) I investigate how stock recommendations from individual analysts aggregated at the institution level relates to the speed of ex-post stock holding of analysts' affiliated institutions. I will discuss them individually below.

The independent variable $Recommendation_{i,j,t}$ is measured by variables $Dk_{i,j,t}$ *(k = 1, 2, 4, 5)* mentioned in Section 3.

$Analyst's\ Affiliated\ institution \times Time\ Fixed\ Effects$ and $Firm \times Time\ Fixed\ Effects$ control for time-varying characteristics of analysts' affiliated institutions and time-varying characteristics of firms that analysts' recommendations cover. Note that controlling for them means I limit the comparison between different stocks that are covered by the same analyst's affiliated institution at the same time only. This largely rules out the impact of other covariates. For example, analyst affiliated institutions tend to have distinct work style, with some being more aggressive and others more conservative in their trading strategies. Additionally, it's well-known that investors tend to prefer stocks from large companies that demonstrate outstanding market performance, while stocks from smaller companies that lack market popularity may receive comparatively less attention from investors. Therefore, taking into account those two fixed effects guarantees a more robust analysis that focuses on the effect of analysts' recommendations while getting rid of the potential confounding effects of analysts' affiliated institutions, firm characteristics, and market-related factors.

Unlike the literature which include lags in the dependent variable $Trade_{i,j.t+1}$ since the regulations generally prohibit analysts from trading the securities of covered companies during a "blackout period" from 30 days prior to and 5 days after the release of their research reports in a manner inconsistent with their recommendations in their most recent published reports (NASD 2711 (g)(2) and (g)(3)), I do not take this into account since the trading I identify in data is at quarterly frequency.

4.2. Hypothesis II - Ignoring the Endogeneity Problem

In the second hypothesis, I suggest that analysts' affiliated institutions' ex-ante ownership of stocks induces an optimistic bias in their recommendations for those stocks due to their self-interests of increasing the value of their personal investment. The purpose of Hypothesis II is to examine whether analysts face a conflict of interest while making their recommendations when they have skin in the game. The

concern that underlies this hypothesis is that analysts may be prone to make optimistic recommendations for stocks that their affiliated institutions held, out of motives that such recommendations would boost the value of their affiliated institutions' investments. To test this hypothesis, I study the relationship between analysts' affiliated institutions' ex-ante (before recommendation) stock ownership and analysts' recommendations and determine whether the former has an influence on the latter. I use the following regression to test Hypothesis II:

$$\begin{aligned} Recommendation_{i,j,t} \\ &= ¡ \times Ownership_{i,j,t-1} \\ &+ \ Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects \\ &+ Firm \times Time\ Fixed\ Effects + \ \varepsilon_{i,j,t}, \end{aligned}$$

Eq. 4-1

Where:

i – *analyst's affiliated institution* ($i \geq 1, i \in Z$)

j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)

t – *stock recommendation issue date* ($t \geq 1, t \in Z$)

$t-1$ – *1 quarter before stock recommendation issue date* ($t \geq 1, t \in Z$)

The dependent variable $Recommendation_{i,j,t}$ is constructed following a similar methodology as described in Hypothesis I and is measured by variables $Dk_{i,j,t}$ *(k = 1, 2, 4, 5)* mentioned in Section 3. I study it in two folds: (1) how the ex-ante ownership relates to each category of stock recommendation individually, and (2) how the ex-ante stock ownership relates to optimistic stock recommendation and to pessimistic stock recommendation respectively. I will discuss them individually below.

The independent variable $Ownership_{i,j,t-1}$ is measured by the ratio of stock holding $Shares_{i,j,t-1}$ relative to outstanding shares $Outstanding\ Shares_{i,j,t-1}$ one quarter before the issuance of stock recommendation.

$Analyst's\ Affiliated\ Company \times Time\ Fixed\ Effects$ and $Firm \times Time\ Fixed\ Effects$ are the same as described in Hypothesis I, which control for

time-varying characteristics of analysts' affiliated institutions and time-varying characteristics of firms that analysts' recommendations cover.

Importantly, there is a potential endogeneity problem that complicates the analysis. For example, an analyst may think that stock A, an existing stock held by his affiliated institution, will go up. Then he suggests his affiliated institution keep or increase the holding of this stock and makes an optimistic recommendation for it. In this case, the reason for an optimistic recommendation is not the mere fact that his affiliated institution had bought stock A, but instead, it is because he truly believes the stock will go up. Such cases are not what Hypothesis II refers to. Instead, what is relevant for Hypothesis II are cases in which an analyst's affiliated institution's holding of stock was not related to (or not entirely driven by) his beliefs about the stock's profitability at the time of the recommendation. Next, I will take a closer look at it.

4.3. Hypothesis II - Addressing the Endogeneity Problem

The issue of endogeneity can be addressed by investigating the differential effects of different purchase dates. I use a simple example to illustrate the intuition: suppose there are two stocks, A and B, both of which the analyst's affiliated institution had at time $t-1$, where stock A was purchased not long before $t-1$, and stock B was purchased much longer before $t-1$. For stock B, the analyst held it until time $t-1$. In such a case, the reason for the analyst's affiliated institution's holding of stock B at time $t-1$ is less likely to be due to the their analysts' opinion of this stock (compared to the reason for their holding of A), as the analyst's views of the stock are likely to have changed after a long-time lag. In contrast, the analyst's affiliated institution might hold the stock due to frictions from exogenous reasons (for example, rebalancing or trading costs, limited attention, diversification, etc.). For stock A, the reason for the holding is more likely to be based on their analysts' opinions. By comparing recommendations issued for stocks A and B, I can identify the reason for issuing the recommendation.

More specifically, to detect the bias of analysts' stock recommendations caused by ex-ante stock ownership, I include indicators of ownership in previous periods of ownership *m* to capture their differential effects on the recommendation. The lagged

period is marked as *m*, which indicates that the analyst's affiliated institution held the stock at time $t-1$ but purchased it the *m-th* quarter prior to $t-1$; i.e., the analyst's affiliated institution purchased the stock within the time window *(t-1-m-1, t-1-m)*. I will allow *m* to take values 2, 3, 4, and 5 meaning that I look at analyst's affiliated institution's stock ownership 1, 2, 3, and 4 quarter prior to one quarter before the issuance of stock recommendation. I execute the following enhanced version of regression analysis for every *m*:

$$\begin{aligned} Recommendation_{i,j,t} \\ &= ¡_m \times Ownership_{i,j,t-1-m} \\ &+ Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects \\ &+ Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t} \end{aligned}$$

Eq. 4-2

Where:

- i – *analyst's affiliated institution* ($i \geq 1, i \in Z$)
- j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)
- t – *stock recommendation issue date* ($t \geq 1, t \in Z$)
- m – *the lagged period since one quarter before stock recommendation issue date* ($m \geq 1, m \in Z$)
- $t-1$ – *1 quarter before stock recommendation issue date* ($t \geq 1, t \in Z$)
- $t-1-m$ – *m+1 quarter before stock recommendation issue date* ($t \geq 1, t \in Z$)

The dependent variable $Recommendation_{i,j,t}$ and $Analyst's\ Affiliated\ Company \times Time\ Fixed\ Effects$ and $Firm \times Time\ Fixed\ Effects$ are the same as described for Eq. 4-1. The independent variable $Ownership_{i,j,t-1-m}$ is the independent variable $Ownership_{i,j,t-1}$ in Eq. 4-1 lagged for extra m periods.

5. Data

This section describes the data and variables used in the empirical analysis. My dataset combines information from the Detail File under Recommendations Section of the Thomson Financial Institutional Brokers' Estimate System (I/B/E/S) Academic Database, the Master File under Institutional Holdings (13F) Section of Thomson/Refinitiv Database, and Monthly Stock File under Stock - Version 2 (CIZ) Section of the Centre for Research in Security Prices (CRSP) Database provided by the Wharton's WRDS system. My data covers the period of 29 years from 1993 to 2021. The 29 years are chosen by the longest common duration available among those three datasets.

5.1. Analysts' stock recommendations

My analysis focuses on the stock recommendations of analysts belonging to the brokerage units of financial institutions. The analysts' stock recommendations are collected from the "Detail File" under Recommendations Section of the Thomson Financial Institutional Brokers' Estimate System (I/B/E/S) Academic Database. The "Detail File" provides data on analyst-by-analyst recommendations (identified by "IRECCD") for stocks (identified by "CUSIP") on quarterly basis (identified by analysts' recommendations' activation date "ACTDATS"). Each actual recommendation received from the analysts is mapped to one of the Thomson Reuters standard ratings by assigning a numeric value, i.e., 1 – "Strong Buy", 2 – "Buy", 3 – "Hold", 4 – "Underperform", 5 – "Sell". In this way, each analyst's text recommendation is converted to the Thomson Reuters consensus recommendation format with a uniform scale and is comparable across analysts. I/B/E/S masks the institution names ("ESTIMID") in the data. This allows me to aggregate the individual analysts' recommendations at the institution level. I will discuss this in details below. I mainly use this variable as a proxy for stock recommendations.

My main analysis is based on the individual analysts' stock recommendations aggregated at the level of their affiliated institutions. In contrast, the recommendation from I/B/E/S is the individual analyst's recommendation. Besides,

there's the situation that multiple analysts from the same institution issue recommendation for a certain stock at the same time. Therefore, to capture the recommendation aggregated at the institution level, I generate five variables $Dk_{i,j,t}$ *(k = 1, 2, 3, 4, 5)*, which capture the percentage of different categories of recommendations provided by analysts (identified by 'IRECCD") from the same institution (identified by "ESTIMID") for a specific stock (identified by "CUSIP") at a given time (identified by "ACTDATS"). For example, $D1_{i,j,t}$ means the percentage of analysts from institution *i* who give "strong buy" recommendation ("IRECCD" = 1) for stock *j* at time *t*. They are calculated by integrating recommendations from individual analysts from the same institution *i* who issue the recommendation for stock *j* as *k* divided by the total number of analysts from institution *i* who issue recommendations on stock *j*. For instance, suppose that there are 5 analysts from institution *i* who issue recommendations for stock *j* at time *t*, among which 2 analysts issue "strong buy" recommendations ("IRECCD" = 1) and 3 analysts issue "buy" recommendations ("IRECCD" = 2). $D1_{i,j,t}$ is 0.4 (=2/5), $D2_{i,j,t}$ is 0.6(=3/5), $D3_{i,j,t}$, $D4_{i,j,t}$, $D5_{i,j,t}$ are 0 (=0/5).

Additionally, to examine the prudence of analysts' stocks recommendations through testing whether they are consistent with abnormal stocks returns, I analyse the stock recommendation aggregated at the stock level. Similarly, I generate five variables, $DSk_{j,t}$ *(k = 1, 2, 3, 4, 5)*, which capture the percentage of different categories of recommendations provided by all analysts (identified by 'IRECCD") for a specific stock (identified by "CUSIP") at a given time (identified by "ACTDATS"). For example, $DS1_{j,t}$ means the percentage of analysts who issue "strong buy" recommendation ("IRECCD" = 1) for stock *j* at time *t*. These variables are calculated by dividing the number of analysts who issue recommendations of *k* for stock *j* by the total number of analysts who issue recommendations for stock *j*. For instance, suppose that there are 5 analysts who issue recommendations for stock *j* at time *t*, and 2 of these analysts issue "strong buy" recommendations ("IRECCD" = 1) and 3 issue "buy" recommendations ("IRECCD" = 2). Then, $DS1_{j,t}$ is 0.4 (=2/5), $DS2_{j,t}$ is 0.6 (=3/5), $DS3_{j,t}$, $DS4_{j,t}$, $DS5_{j,t}$ are 0 (=0/5).

5.2. Institutional holding and trading of stocks

My data on stock holdings and trading of institutional investors come from the Master File under Institutional Holdings (13F) Section of Thomson/Refinitiv Database. According to the Securities and Exchange Commission (SEC) 13F regulations, any institutional managers whose investing discretion exceeds $100 million must register their securities and report holdings on a quarterly basis. I use the dataset from "Master File". The "Master File" provides data on quarterly holdings (identified by shares held at the end of each quarter "SHARES") and trading (identified by Net Change in Shares Since Prior Report "CHANGE") of stocks (identified by "CUSIP") by the institutions (identified by manager name "MGRNAME").

5.3. Stock characteristics

To supplement my analysis, I use stock-related information, i.e., share price, quarterly stock return with dividends and quarterly index returns with dividends.

Data on share prices ("PRC") at the end of each quarter come from 13F. Monthly Stock File of the Centre for Research in Security Prices (CRSP) Database provides monthly total return (with dividends) of individual stocks ("MthRet") and monthly index return with dividends (value-weighted return including dividends "vwretd" and equal-weighted return including dividends "ewretd"). I filter them to be on quarterly basis by monthly calendar date ("MthCalDt").

5.4. Data Merging

5.4.1. Merging data on stock recommendations with data on stock holding and trading

My main analysis is based on individual analysts' recommendations aggregated on their affiliated institution level. I use three variables to identify it: 1) analysts' affiliated institutions, 2) stock identifier, and 3) time. The analysis on the relationship between their stock recommendations and their affiliated institutions' ex-ante holding and ex-post trading requires to merge data on stock recommendations with data on stock holding and trading. To do so, I group both stock recommendation dataset from I/B/E/S and stock holdings and trading dataset

from 13F by three variables mentioned above. Specifically, I use the institution names ("ESTIMID"), the stock identifier ("CUSIP") and the year and quarter extracted from analysts' recommendations' activation date ("ACTDATS") of stock recommendation dataset from I/B/E/S and use the manager's name ("MGRNAME"), the stock identifier ("CUSIP") and the year and quarter extracted from file date ("FDATE"). I first use fuzzy string matching in python to match "ESTIMID" with "MGRNAME" filtering for a matching ratio above 95%. This allows me to find the best match for each "ESTIMID" and "MGRNAME" pair. I then proceed to match "CUSIP" and time variables from two datasets. Finally, I merged recommendation dataset with stock holding and trading dataset.

5.4.2. Merging data on stock recommendations with data on stock returns

The analysis the prudence of analysts' stock recommendation requires to merge data on stock recommendations with stock returns. Before merging the data, I compounded monthly stock return data obtained originally from CRSP to a quarterly basis to fit the frequency of my analysis. I then use two variables of stock recommendation dataset from I/B/E/S, i.e., the stock identifier ("CUSIP") and the year and quarter extracted from analysts' recommendations' activation date ("ACTDATS"), to match with the stock identifier ("CUSIP") and the year and quarter extracted from monthly calendar date ("MthCalDt").

6.Results and analysis

6.1. Testing Hypothesis I

6.1.1. The Relationship between Percentage Ownership and Aggregated Stock Recommendations

6.1.1.1. The Impact of Aggregated Stock Recommendations on Ex-Post Stock Holding by Analysts' Affiliated Institutions

Following research design presented in Section 4, the regression below analyse the relationship between stock recommendations from individual analysts aggregated at their affiliated institutions' level and the ex-post stock holding of analysts' affiliated institutions.

$$\frac{Shares_{i,j,t+1}}{Outstanding\ Shares_{j,t+1}} = \alpha + \beta_1 D1_{i,j,t} + \beta_2 D2_{i,j,t} + \beta_4 D4_{i,j,t} + \beta_5 D5_{i,j,t} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t+1},$$

Eq. 6-1

Where:

i	–	*analyst's affiliated institution* ($i \geq 1, i \in Z$)
j	–	*stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)
t	–	*stock recommendation issue date* ($t \geq 1, t \in Z$)
$t+1$	–	*1 quarter after stock recommendation issue date* ($t \geq 1, t \in Z$)

The dependent variable is percentage ownership of stock j by analyst's affiliated institution i relative to the total outstanding shares of stock j at time $t+1$ $\frac{Shares_{i,j,t+1}}{Outstanding\ Shares_{j,t+1}}$, where $Shares_{i,j,t+1}$ stands for the holding of stock j held by analyst's affiliated institution i at time $t+1$. Importantly, the idea of using this ratio is to scale the stock holding by corresponding outstanding shares to rule out the inconsistency of the size of shares among different stocks allowing for meaningful comparisons. For instance, one share of a stock of a company of which the market capital is large, is not comparable to one share of a stock of a company of which

the market capital is significantly smaller. The percentage ownership enables a comparable evaluation of the institution's stock holding, which takes into consideration the characteristics of stocks. The independent variables $Dk_{i,j,t}$ $(k = 1, 2, 4, 5)$is the percentage stock recommendation of category *k* within an institution, determined by dividing the number of stock recommendation of category *k* for a specific stock within an institution by the total number of stock recommendations for that particular stock within the same institution. Due to multicollinearity issue, I omit $D3_{i,j,t}$ since "hold" recommendation is not the focus of this research. $Analyst's\ Affiliated\ institution \times Time\ Fixed\ Effects$ and $Firm \times Time\ Fixed\ Effects$ control for time-varying characteristics of analysts' affiliated institutions and time-varying characteristics of firms that analysts' recommendations cover.

Table 2 Column 1 reports coefficients and test statistics (clustered at the level of analysts' affiliated institutions) for the above regression, using about 15,802 institution-stock-quarter observations. The coefficients β_1 and β_2 are positive and significant at the 1% level, which means that a 1 standard deviation increase in the percentage of analysts who give a "strong buy" recommendation for a certain stock within their affiliated institutions is associated with a $0.04 \times$ standard deviation increase in the percentage ownership of that stock in the next quarter and a 1 standard deviation increase in the percentage of analysts who give a "buy" recommendation is associated with a $0.06 \times$ standard deviation increase in the percentage ownership of that stock in the next quarter. These results indicate that when more analysts from the same institutions issuing optimistic recommendations, i.e., "strong buy" recommendation and "buy" recommendation, for a stock, their affiliated institutions are more inclined to purchase that stock, as evidenced by the increase in the percentage of the stock holding relative to outstanding shares. In other words, analysts' recommendations aggregated at their affiliated institutions' level are in line with the trading strategies adopted by their affiliated institutions.

6.1.1.2. The Impact of Lagged Stock Holdings on the Relationship between Aggregated Stock Recommendations and Analysts' Affiliated Institutions' Stock Holdings

To control for the influence of stock holding in the previous period on current stock trading and recommendations, I extend the analysis by including the ratio of stock holding relative to outstanding shares in the previous period $\frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$ as an additional independent variable to capture the potential impact of it on ex-post stock holding after current stock recommendations. Additionally, I incorporate interaction terms of this ratio and $Dk_{i,j,t}$ *(k = 1, 2, 4, 5)* as independent variables to capture potential impacts of this ratio on current stock recommendations. By doing so, I isolate the effect from previous stock holding and the joint effect from both previous stock holding and current stock recommendations. Therefore, the coefficient of $Dk_{i,j,t}$ *(k = 1, 2, 4, 5)* would explain the pure effect of stock recommendation on ex-post stock trading. The regression is as follows:

$$\frac{Shares_{i,j,t+1}}{Outstanding\ Shares_{j,t+1}} = \alpha + \beta_1 D1_{i,j,t} + \beta_2 D2_{i,j,t} + \beta_4 D4_{i,j,t} + \beta_5 D5_{i,j,t} + \psi \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + \theta_1 D1_{i,j,t} \times \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + \theta_2 D2_{i,j,t} \times \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + \theta_4 D4_{i,j,t} \times \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + \theta_5 D5_{i,j,t} \times \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t+1},$$

Where:

i – *analyst's affiliated institution* ($i \geq 1, i \in Z$)

j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)

t – *stock recommendation issue date* ($t \geq 1, t \in Z$)

$t+1$ – *1 quarter after stock recommendation issue date* ($t \geq 1, t \in Z$)

Table 2 Column 2 reports coefficients and test statistics (clustered at the level of analysts' affiliated institutions) for the above regression, using about 15,802 institution-stock-quarter observations. The coefficient ψ is significantly positive suggesting a strong correlation between current stock holdings and those of the previous period. This indicates it's necessary to include this ratio in lagged period as an explanatory variable. I focus on the coefficients of interaction terms. The coefficients θ_1 and θ_2 are positive and significant at the 10% level, which means the optimistic recommendations, i.e., "strong buy" and "buy", are more relevant to ex-post stock holding when there's already stock holding in previous period. In other words, the previous stock holding has a reinforcing effect on the relationship between the optimistic recommendations and the ex-post stock holding. This reveals that there is no moral hazard concern since behavior is consistent with recommendation.

Additionally, the coefficients β_1 and β_2 are significantly positive and smaller than in *Eq. 6-1* by 20.82 % (=0.0441/0.0365-1) and by 53.52% (=0.0588/0.0383-1) suggesting that 1) institutions' trading strategies are in line with their positive stock recommendations, i.e., "strong buy" and "buy"; 2) the shrunken part of β_1 and β_2 compared to in *Eq. 6-1* can be attributed to θ_1 and θ_2, which is the joint effect of previous stock holding and current stock recommendation on the ex-post stock trading; 3) θ_1 is larger than θ_2 by 44.01 % (=0.0625/0.0434-1), which means the previous stock holding has apparently stronger strengthening effect on the relationship between $D1$ (the percentage of analysts from the same institution who give the recommendation as "strong buy") and the ex-post stock holding compared to on the relationship between $D2$ (the percentage of analysts from the same institution who give the recommendation as "buy") and the ex-post stock holding. This further indicates that analysts' favourable recommendations are reliable.

The coefficients θ_4 and θ_5 are not significant. The potential reason to explain this is that when institutions make negative recommendations on the stocks that they held in previous period, their trading strategies differ substantially meaning that sell-off is not the only way of reaction that is consistent with their recommendations. Due to the existence of transaction fees, traders prefer to trade less frequently when the price volatility or liquidity increases, or when it takes longer time for the prices to revert to their mean (Huberman & Stanzl [2005]). For instance, it's possible to

implement hedging techniques, such as utilizing options or futures contracts, to mitigate the potential downside risk associated with the stock receiving negative recommendations. The advantage of using derivatives lies in their cost-effectiveness compared to the transaction fees involved in selling off stocks. Hence, what's worthwhile to mention is, although the coefficients θ_4 and θ_5 are not statistically significant, they are negative. I interpret them in the perspective of economics instead. This suggests that 1) institutions tend to sell stocks for which they provide negative recommendations, i.e., "underperform" and "sell"; 2) the magnitude of the coefficient θ_5 is approximately 9 times larger than that of θ_4, indicating that the previous stock holding has a notably stronger strengthening effect on the relationship between $D5$ (the percentage of analysts from the same institution who give the recommendation as "sell") and the ex-post stock holding compared to its effect on the relationship between $D4$ (the percentage of analysts from the same institution who give the recommendation as "underperform") and the ex-post stock holding.

6.1.2. The Impact of Aggregated Stock Recommendations on the Change of Ex-Post Stock Holding by Analysts' Affiliated Institutions

Further, I investigate how the ratio of the net changes of shares held since prior report relative to the total number of shares held by an institution in previous period, reacts to the stock recommendations. Namely, I focus on how stock recommendations shape the rate of the change in shares held. By doing so, I aim to study whether stock recommendations have notable effects on institutions' trading behaviours. The regression is as follows:

$$\frac{Change_{i,j,t}}{Shares_{i,j,t-1}} = \alpha + \beta_1 D1_{i,j,t} + \beta_2 D2_{i,j,t} + \beta_4 D4_{i,j,t} + \beta_5 D5_{i,j,t} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t+1},$$

Where:

i – *analyst's affiliated institution* ($i \geq 1, i \in Z$)

j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)

t – *stock recommendation issue date* ($t \geq 1, t \in Z$)

$t-1$ – *1 quarter before stock recommendation issue date* ($t \geq 1, t \in Z$)

The dependent variable is percentage change in stock holding of stock *j* by analyst affiliated institution *i* at time *t* $\frac{Change_{i,j,t}}{shares_{i,j,t-1}}$, where $Change_{i,j,t}$ is the net changes in shares of stock *j* by analysts' affiliated institution *i* since the previous report at time *t*, which takes a positive value for buy, a negative value for sell, and zero otherwise. The independent variables $Dk_{i,j,t}$ $(k = 1, 2, 4, 5)$ is the percentage stock recommendation of category *k* within an institution, determined by dividing the number of stock recommendation of category *k* for a specific stock within an institution by the total number of stock recommendations for that particular stock within the same institution. Due to multicollinearity issue, I omit $D3_{i,j,t}$ since "hold" recommendation is not the focus of this research. $Analyst's\ Affiliated\ institution \times Time\ Fixed\ Effects$ and $Firm \times Time\ Fixed\ Effects$ control for time-varying characteristics of analysts' affiliated institutions and time-varying characteristics of firms that analysts' recommendations cover.

Table 2 Column 3 reports coefficients and test statistics (clustered at the level of analysts' affiliated institutions) for the above regression, using about 15,802 data points. The coefficients β_1 is positive and significant at the 1% level. This suggests that "strong buy" recommendation has a remarkable effect in accelerating the rate of change in shares held. This result held aligns with the market principles that "strong buy" recommendation is consistent with a positive prediction indicating that the stock is currently undervalued and has a strong growth potential.

6.1.3. Do Stock Recommendations correspond to Abnormal Stock Returns?

The findings above suggest that the trading behaviour of analysts' affiliated institutions are consistent with analysts' stock recommendation aggregated at their affiliated institutions' level if the aggregated recommendations are optimistic. Next, I will evaluate the prudence of analysts' recommendations by examining the

relationship between analysts' recommendations and the subsequent performance of stocks. Specifically, I will investigate whether optimistic recommendations are aligned with promising stock performance, and conversely, whether pessimistic recommendations are associated with poor stock performance. This analysis aim to test analysts' recommendations reflect the actual performance of stocks. I study it in three folds: (1) how each category of stock recommendations relates to abnormal stock returns, (2) how optimistic and pessimistic recommendations relates to abnormal stock returns, and (3) how average stock recommendations relates to abnormal stock returns. I will discuss them individually below.

6.1.3.1. How Each Category of Stock Recommendations Relates to Abnormal Stock Returns?

The following OLS regression analyse how each category of recommendations relates to abnormal stock returns. Due to the dynamic nature of stock market, stock returns in one quarter may not reflect effective information of stock recommendation today. I study the immediate repones of stock return to the stock recommendation within the same quarter. This allows me to analyse the prompt reactions and fluctuations in stock prices that occur more frequently in the market.

$$\begin{aligned} return_{j,t} - return_{MKT,t} &= \alpha + \sigma_1 DS1_{j,t} + \sigma_2 DS2_{j,t} + \sigma_4 DS4_{j,t} + \sigma_5 DS5_{j,t} \\ &+ Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects \\ &+ Firm \times Time\ Fixed\ Effects + \epsilon_{j,t}, \end{aligned}$$

Eq. 6-2

Where:

j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)

t – *stock recommendation issue date* ($t \geq 1, t \in Z$)

The empirical analysis regresses the abnormal return on each category of stock recommendations aggregated at stock level, while controlling for time-varying characteristics of analysts' affiliated institutions and time-varying characteristics of firms that analysts' recommendations cover.

The dependent variable, abnormal return, is computed by subtracting market return with dividends $return_{MKT,t}$ from stock return with dividends $return_{j,t}$. I utilize the return of value-weighted market portfolio with dividends to proxy for $return_{MKT,t}$. I then utilize the return of equal-weighted market portfolio with dividends to proxy for $return_{MKT,t}$ again as a double check. The independent variables, $DSk_{j,t}$ *(k = 1, 2, 3, 4, 5)*, capture the percentage of different categories of recommendations provided by all analysts for a specific stock at a given time. $Analyst's\ Affiliated\ institution \times Time\ Fixed\ Effects$ and $Firm \times Time\ Fixed\ Effects$ control for time-varying characteristics of analysts' affiliated institutions and time-varying characteristics of firms that analysts' recommendations cover.

Table 3 Column 1 and 2 report coefficients and test statistics (clustered at the level of analysts' affiliated institutions) for the above regression, using about 6,192 data points. In Column 1, the equal-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. The coefficients σ_1 and σ_4 are positive and significant at the 10% level, which means that a 1 standard deviation increase in the percentage of analysts who give a "strong buy" recommendation for a certain stock in stock market is associated with 0.47 × standard deviation increase in abnormal stock returns, whereas a 1 standard deviation increase in the percentage of analysts who give a "underperform" recommendation for a certain stock in stock market is associated with 0.330.47 × standard deviation decrease in abnormal stock returns. In Column 2, the value-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. The coefficients σ_1, σ_2 and σ_4 are positive and significant at the 10% level, which means that a 1 standard deviation increase in the percentage of analysts who give a "strong buy" recommendation for a certain stock in stock market is associated with 0.47× standard deviation increase in abnormal stock returns, a 1 standard deviation increase in the percentage of analysts who give a "buy" recommendation for a certain stock in stock market is associated with 0.34× standard deviation increase in abnormal stock returns, and a 1 standard deviation increase in the percentage of analysts who give a "underperform" recommendation for a certain stock in stock market is associated with 0.25 × standard deviation decrease in abnormal stock returns. In sum, the results of Column 1 and 2 are

consistent suggesting that the immediate market reaction is consistent with analysts' stock recommendations.

6.1.3.2. How Optimistic and Pessimistic Recommendations Relates to Abnormal Stock Returns

After analysing the relationship between the abnormal return and each category of stock recommendations, the following OLS regression analyse from a broader perspective how optimistic and pessimistic recommendations relates to abnormal stock returns.

$$\begin{aligned} return_{j,t} - return_{MKT,t} &= \alpha + \sigma_1 DS\_posi_{j,t} + \sigma_2 DS\_nega_{j,t} \\ &+ Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects \\ &+ Firm \times Time\ Fixed\ Effects + \epsilon_{j,t}, \end{aligned}$$

Eq. 6-3

Where:

j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)

t – *stock recommendation issue date* ($t \geq 1, t \in Z$)

The independent variables $DS\_posi_{j,t}$ is optimistic stock recommendations ($DS1_{j,t}$ = 1 or $DS2_{j,t}$ = 1) aggregated at stock level and $DS\_nega_{j,t}$ is pessimistic stock recommendations ($DS4_{j,t}$ = 1 or $DS5_{j,t}$ = 1) aggregated at stock level.

Table 3 Column 3 and 4 report coefficients and test statistics (clustered at the level of analysts' affiliated institutions) for the above regression, using about 6,192 data points. In Column 3, the equal-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. The coefficient σ_1 is positive and significant at the 5% level. In Column 4, the value-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. The coefficient σ_1 is positive and significant at the 1% level. These results are consistent with results from Eq. 6-2.

6.1.3.3. How Average Stock Recommendations Relates to Abnormal Stock Returns

After analysing the relationship between the abnormal return and both detailed and broader category of stock recommendations respectively, the following OLS regression analyse how average stock recommendations in the market relates to abnormal stock returns.

$$\begin{aligned} return_{j,t} - return_{MKT,t} &= \alpha + \beta avg\_Recommendation_{j,t} \\ &+ Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects \\ &+ Firm \times Time\ Fixed\ Effects + \epsilon_{j,t}, \end{aligned}$$

Eq. 6-4

Where:

j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)

t – *stock recommendation issue date* ($t \geq 1, t \in Z$)

The independent variable $avg\_Recommendation_{j,t}$ is the average of all available recommendations in the market for stock j at time t. This variable captures the consensus sentiment of analysts' recommendations for a particular stock at a specific point in time. Since each category of stock recommendation is assigned an integer based on a 5 standardized Thomson Reuters Recommendation scale, i.e., 1 - "Strong Buy", 2 – "Buy", 3 – "Hold", 4 – "Underperform", 5 – "Sell", the average of each category of stock recommendation is 3 (= (1+2+3+4+5)/5). Therefore, If the actual average stock recommendation is greater than 3, it suggests that the consensus recommendation tends to be negative. Conversely, if the actual average stock recommendation is smaller than 3, it indicates that the consensus recommendation tends to be positive. The negative relationship between the stock return and the average stock recommendation indicates a consistent correlation between the two variables.

Table 3 Column 5 and 6 report coefficients and test statistics (clustered at the level of analysts' affiliated institutions) for the above regression, using about 16,538 data points. In Column 5, the equal-weighted market portfolio with dividends is used as

the proxy for $return_{MKT,t}$. In Column 6, the value-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. The coefficients β in both columns are negative and significant at the 5% level, which means the more pessimistic the average stock recommendation is, the less the abnormal stock return is. This is consistent with the results from Eq. 6-2 and Eq. 6-3.

To further identify the prudence of analysts' stock recommendations, I generate two plots to visualize the annual average return of 5 portfolios created from each category of stock recommendation over time. In Figure 1 , I use the equal-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. In Figure 2 , I use the value-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. These plots provide insights into the extent to which the performance of recommended stocks outperforms the overall market performance, and how this varies across different recommendation categories. We can tell from Figure 1 and Figure 2 that 1) stocks that receive optimistic recommendations, i.e., "strong buy" and "buy" recommendations, generally exhibit better performance compared to the overall market, whereas stocks that receive pessimistic recommendations, i.e., "underperform" and "sell" recommendations, normally don't outperform the market. 2) stocks that receive optimistic recommendations have significantly better performance, as indicated by a positive abnormal stock return, compared to stocks that receive pessimistic recommendations, as indicated by a negative abnormal stock return.

I also generate two plots to visualize the annual cumulative return of 5 portfolios created from each category of stock recommendation over time. These plots indicates whether investors could make money by following analsyts' recommendation. In Figure 3 , I use the value-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. In Figure 4, I use the equal-weighted market portfolio with dividends is used as the proxy for $return_{MKT,t}$. Figure 3 and Figure 4 show that the performance of each portfolio of stocks created with one of the 5 recommendations. We find that portfolio with optimistic recommendations outperform pessimistic recommendation portfolio in long term (29 years).

Overall, Eq. 6-2, Eq. 6-3, Eq. 6-4, **Error! Reference source not found.** as well as Figure 1 and Figure 2 show that analysts' recommendations are prudent as they accurately identify stocks that have a higher potential for positive performance. This is evident from the significantly better performance and positive abnormal stock returns observed for stocks that receive recommendations as "strong buy" or "buy". It suggest the prudence and expertise of analysts in identifying profitable investment opportunities.

6.2. Testing Hypothesis II - Ignoring the Endogeneity Problem

6.2.1. How the Ex-Ante Ownership Relates to Each Category of Stock Recommendation

The following OLS regressions assess whether there is a systematic association between ownership levels and each category of stock recommendations, i.e., "strong buy", "buy", "underperform", or "sell".

$$DK_{i,j,t} = \gamma_1 \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t}$$

$$D2_{i,j,t} = \gamma_2 \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t}$$

Eq. 6-5

$$D4_{i,j,t} = \gamma_4 \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t}$$

Eq. 6-6

$$D5_{i,j,t} = \gamma_5 \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t}$$

Where:

i – *analyst's affiliated institution* ($i \geq 1, i \in Z$)

j – *stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)

$k.$ – *1, 2, 4, 5*

t – *stock recommendation issue date* ($t \geq 1, t \in Z$)

$t-1$ – *1 quarter before stock recommendation issue date* ($t \geq 1, t \in Z$)

Table 5 Column 1 – 4 report coefficients and test statistics (clustered at the level of analysts' affiliated institutions) for the above regressions, using about 14,771 data points. The coefficients γ_2 is positive and significant at the 10% level, which means that the more prior stock ownerships, the more likely analyst's affiliated institution makes optimistic recommendations for those stocks. Based on Figure 3 and Figure 4, we can see that recommendation is objective which is less likely influenced by the conflicts of interest that analysts face since following analysts' recommendations could beat the market index return. The coefficients γ_4 is negative and significant at the 5% level, which means the more prior stock ownerships, the less likely analyst's affiliated institution makes pessimistic recommendations for those stocks. These results are consistent suggesting that as the amount of prior stock ownership increases, there is an increased tendency for the affiliated institution to provide optimistic recommendations that may be influenced by their existing ownership positions.

6.3. Testing Hypothesis II - Addressing the Endogeneity Problem

The following OLS regression studies the relationship between analysts' affiliated institutions' ex-ante (before recommendation) stock ownership and analysts' recommendations. By assigning different values to m, I further investigate how ¡$_m$ varies with *m* to identify whether analysts face conflict of interest when making stock recommendations.

$$D\_nonnega_{i,j,t} = \text{i}_m \times \frac{Shares_{i,j,t-1-m}}{Outstanding\ Shares_{j,t-1-m}} + Analyst's\ Affiliated\ Institution \times Time\ Fixed\ Effects + Firm \times Time\ Fixed\ Effects + \varepsilon_{i,j,t}$$

Eq.6-7

Where:

i	–	*analyst's affiliated institution* ($i \geq 1, i \in Z$)
j	–	*stocks that analysts make recommendations for* ($j \geq 1, j \in Z$)
t	–	*stock recommendation issue date* ($t \geq 1, t \in Z$)
m	–	*the lagged period since one quarter before stock recommendation issue date* ($m \geq 1, m \in Z$)
$t-1$	–	*1 quarter before stock recommendation issue date* ($t \geq 1, t \in Z$)
$t-1-m$	–	*m+1 quarter before stock recommendation issue date* ($t \geq 1, t \in Z$)

The dependent variable $D\_nonnega_{i,j,t}$ is non-pessimistic stock recommendations ($D1_{i,j,t}$ = 1, $D2_{i,j,t}$ = 1 or $D3_{i,j,t}$ = 1) aggregated at the level of analysts' affiliated institutions.

This improved version includes subscript *m* in the independent variable $\frac{Shares_{i,j,t-1-m}}{Outstanding\ Shares_{j,t-1-m}}$ and the coefficient γ_m. Note that stocks that the analyst held at time $t-1$ but that were acquired outside of the *m-th* quarter prior to time $t-1$ are excluded from this regression. They will be included in regressions corresponding to other *m* values. This is a key feature of the improved version that differs from the simplified version. Thus, I have a coefficient γ_m for each *m*.

Table 6 Column 1 – 4 report coefficients and test statistics (clustered at the level of analysts' affiliated institutions) for the above regressions, using about 13,868, 13,270, 12,572, 11,917 data points respectively. γ_2 equals to 0.0278 and is significant at the 1% level. γ_3 equals to 0.0187 and is significant at the 5% level. γ_4 equals to 0.0150 and is significant at the 1% level. γ_5 equals to 0.0017 and is insignificant at the level less than or equal to 10%. Those coefficients are positive,

which is consistent with the results of Eq. 6-5 and **Error! Reference source not found.**.

The trend in γ_m with respect to m contains crucial information regarding Hypothesis II. To visualize the trend, I create a graph with m on the horizontal axis and γ_m on the vertical axis. That being said, I expect that:

- If the analysts' recommendations are solely motivated by self-interest, then the coefficient γ_m will be positive and time-invariant; that is, the graph of γ_m with respect to m will not exhibit any trend. This is due to the fact that the analysts will make optimistic recommendations anyway as long as their affiliated institutions hold the stock at $t-1$, regardless of why they hold the stock.
- If the analysts' recommendations are not entirely motivated by their affiliated institutions' self-interest (i.e., if it is at least partially based on objective factors), then the graph of γ_m would slope downward. Because expectations of stock performance alter with time, the longer ago analysts' affiliated institutions purchased the stock before $t-1$ (larger m), the less likely it is that analysts' true evaluation of the stock remains good. Thus, γ_m would decrease in magnitude as m increases.

Figure 5 demonstrates a downward sloping trend in γ_m as it varies with m. This finding suggests that analysts' recommendations are not solely motivated by the self-interest of their affiliated institutions. Rather, they appear to be at least partially influenced by objective factors and considerations. It's known that analysts may take into account various aspects such as the fundamental performance of the stock, macroeconomic situation, industry characteristics, financial news and other relevant information when making their recommendations. This implies that the analysts' recommendations have a certain level of credibility and are not purely driven by the interests of their affiliated institutions.

7. Conclusion

Largely motivated by the findings of Chan et al. [2018], in this paper, I shift the focus from individual analyst's stock ownership and holding to the perspective of analysts' affiliated institutions. I find that (1) analysts' stock recommendation is positively correlated to their affiliated institutions' holdings ex-post of the respective stock recommendation publication, (2) these recommendations are based on the objective judgment that is less likely influenced by the consideration of self-interest which is proxied by their affiliated institutions' ex-ante stock ownership, and (3) investors can benefit by following analysts' recommendations during the past 29 years.

Overall, analyst's stock recommendations are reliable. It appears that institutions indeed put their money where their mouths are.

APPENDIX

APPENDIX A

A1

Table 1
Summary Statistics for my Sample

	N	Mean	SD	Median	Min	Max
d1	15784	.194	.391	0	0	1
d2	15784	.285	.446	0	0	1
d3	15784	.433	.487	0	0	1
d4	15784	.077	.264	0	0	1
d5	15784	.011	.101	0	0	1
Shares Held	15784	.607	.945	.12	.008	2.918
Net Change in Shares Since Prior Report	15784	-.023	.186	0	-.431	.299
Shares Held/Outstanding Shares	15784	0	1	-.535	-.686	2.321
Net Change in Shares Since Prior Report/ Outstanding Shares	15784	0	1	.08	-1.809	1.679

Table 1 Descriptive Statistics of the main data

A2

Table 2
Analysts' Stock Recommendations and Affiliated Institutions' ex-post Trading

Independent Variables	(1) $\frac{Shares_{i,j,t+1}}{Outstanding\ Shares_{j,t+1}}$	(2) $\frac{Shares_{i,j,t+1}}{Outstanding\ Shares_{j,t+1}}$	(3) $\frac{Change_{i,j,t}}{Shares_{j,t-1}}$
$D1_{i,j,t}$	0.0441***	0.0365*	0.0726***
	(2.8075)	(1.7857)	(3.3328)
$D2_{i,j,t}$	0.0588***	0.0383***	0.0275
	(3.6792)	(3.4291)	(0.5230)
$D4_{i,j,t}$	-0.0127	0.0383*	0.0068
	(-0.8584)	(1.7832)	(0.1425)
$D5_{i,j,t}$	0.0219	-0.0164	-0.0378
	(0.6192)	(-0.4345)	(-0.5044)
$\frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$		0.6998***	
		(9.0859)	
$D1_{i,j,t} \times \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$		0.0625*	
		(1.8466)	

$D2_{i,j,t} \times \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$		0.0434*	
		(1.9462)	
$D4_{i,j,t} \times \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$		-0.0075	
		(-0.7475)	
$D5_{i,j,t} \times \frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$		-0.0684	
		(-1.1367)	
Constant	-0.0883***	-0.0346***	-0.0315*
	(-15.8836)	(-3.9991)	(-1.9442)
Observations	6,396	6,396	6,396
R-squared	0.8748	0.9374	0.6842
Analysts' Affiliated Companies × Time FE	YES	YES	YES
Firm × Time FE	YES	YES	YES

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 2 Analysts' Stock Recommendations and Affiliated Institutions' ex-post Trading

Notes: This table reports OLS regressions of the relationship between analysts' stock recommendations and their affiliated institutions' ex-post trading. The sample period starts at the issuance of analysts' stock recommendations and the unit of observation is a quarter. The dependent variables in Columns (1) and (2) $\frac{Shares_{i,j,t+1}}{Outstanding\ Shares_{j,t+1}}$ are identical, represented by the percentage ownership (winsorized at 10% in both tails and normalized) that is determined by dividing the institution's holdings of a specific stock by its total number of outstanding shares. The independent variables

$Dk_{i,j,t}$ $(k = 1, 2, 4, 5)$ are the percentage stock recommendation of category k within an institution, determined by dividing the number of stock recommendation of category k for a specific stock within an institution by the total number of stock recommendations for that particular stock within the same institution. Column (2) includes (a) the percentage ownership in one period prior to the issuance of analysts' stock recommendations $\frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$ and (b) the interaction terms of this lagged percentage ownership and $Dk_{i,j,t}$ $(k = 1, 2, 4, 5)$. The interaction terms are the main independent variables in Column (2). The dependent variable in Column (3) $\frac{Change_{i,j,t}}{Shares_{j,t-1}}$ is the percentage change in stock holding (winsorized at 10% in both tails and normalized). All standard errors are clustered at the level of analysts' affiliated institutions. Analysts' Affiliated Companies × Time FE amd Firm × Time FE are included in all columns. $*$, $**$, $***$ represent significance of 10%, 5%, and 1%, respectively.

A3

Table 3
Analysts' Stock Recommendations and Abnormal Stock Return

Independent Variables	(1) $return_{j,t} - return_{MKT,t}$	(2) $return_{j,t} - return_{MKT,t}$	(3) $return_{j,t} - return_{MKT,t}$	(4) $return_{j,t} - return_{MKT,t}$	(5) $return_{j,t} - return_{MKT,t}$	(6) $return_{j,t} - return_{MKT,t}$
$DS1_{j,t}$	0.465*	0.470**				
	(1.780)	(2.178)				
$DS2_{j,t}$	0.218	0.340*				
	(0.967)	(1.745)				
$DS4_{j,t}$	-0.331*	-0.249*				
	(-2.023)	(-1.764)				
$DS5_{j,t}$	0.329	0.288				
	(0.652)	(0.533)				
$avg\_Recommendation_{j,t}$					-0.0193**	-0.0190**
					(-2.154)	(-2.046)
$DS\_posi_{j,t}$			0.0525**	0.0632***		
			(2.367)	(2.770)		
$DS\_nega_{j,t}$			-0.0515	-0.0414		
			(-1.379)	(-1.122)		

Constant	-0.144*	-0.185***	-0.0223*	-0.0286**	0.0450**	0.0461*
	(-1.888)	(-2.987)	(-1.875)	(-2.358)	(2.019)	(2.001)
Observations	1,075	1,075	1,075	1,075	7,537	7,537
R-squared	0.528	0.528	0.549	0.542	0.645	0.643
Analysts' Affiliated Companies × Time FE	YES	YES	YES	YES	YES	YES
Firm × Time FE	YES	YES	YES	YES	YES	YES

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 3 Analysts' Stock Recommendations and Abnormal Stock Return

Notes: This table reports OLS regressions of the relationship between analysts' stock recommendations and the abnormal return of covered stock. The sample period starts at the issuance of analysts' stock recommendations and the unit of observation is a quarter. The dependent variable in all columns are identical, which is abnormal stock return that is computed by subtracting market return with dividends $return_{MKT,t}$ from stock return with dividends $return_{j,t}$. I utilize the return of equal-weighted market portfolio with dividends to proxy for $return_{MKT,t}$ in Column (1), (3) and (5). I utilize the return of value-weighted market portfolio with dividends to proxy for $return_{MKT,t}$ in Column (2), (4) and (6). The dependent variables in Columns (1) and (2) are winsorized at 10% in both tails and normalized. The independent variables of Columns (1) and (2), $DSk_{j,t}$ *(k = 1, 2, 4, 5),* are the percentage stock recommendation of category *k* within the dataset, determined by dividing the number of stock recommendation of category *k* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset. The independent variables of Columns (3) and (4) are $DS\_posi_{j,t}$, which is the percentage optimistic stock recommendation that is determined by dividing the number of stock recommendation of category *1* and category *2* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset, and $DS\_nega_{j,t}$, which is the percentage pessimistic stock recommendation that is determined by dividing the number of stock recommendation of category *4* and category *5* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset. The independent variable of Columns (5) and (6) is $avg\_Recommendation_{j,t}$, which is the average stock recommendation of a specific stock determined by dividing the sum of the category of stock recommendation for a specific stock, i.e., *k (k = 1, 2, 3, 4, 5),* by the total number of stock recommendation

for that particular stock. All standard errors are clustered at the level of analysts' affiliated institutions. Analysts' Affiliated Companies × Time FE amd Firm × Time FE are included in all columns. ∗, ∗∗, ∗∗∗ represent significance of 10%, 5%, and 1%, respectively.

A4

Table 4

Analysts' Stock Recommendations and Ex-Post Stock Price

Independent Variables	(1) $price_{j,t+1}$
$DS1_{j,t}$	-0.409
	(-0.414)
$DS2_{j,t}$	-2.447*
	(-1.801)
$DS4_{j,t}$	-0.413
	(-0.235)
$DS5_{j,t}$	0.926
	(0.501)
Constant	46.55***
	(110.3)
Observations	1,075
R-squared	0.991
Analysts' Affiliated Companies × Time FE	YES
Firm × Time FE	YES

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4 Analysts' Stock Recommendations and Ex-Post Stock Price

Notes: This table reports OLS regressions of the relationship between analysts' stock recommendations and the ex-post price of the covered stock. The sample period starts at the issuance of analysts' stock recommendations and the unit of observation is a quarter. The dependent variable is the stock price observed one period after analysts' stock recommendation. The independent variables of $DSk_{j,t}$ *(k = 1, 2, 4, 5)*, are the percentage stock recommendation of category *k* within the dataset, determined by dividing the number of stock recommendation of category *k* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset. All standard errors are clustered at the level of analysts' affiliated institutions. Analysts' Affiliated Companies × Time FE amd Firm × Time FE are included. ∗, ∗∗, ∗∗∗ represent significance of 10%, 5%, and 1%, respectively.

A5

	N	Mean	SD	Median	Min	Max
Sub-sample for “Strong Buy” Recommendation	29	0.032	0.020	0.030	-0.005	0.089
Sub-sample for “Buy” Recommendation	29	0.022	0.022	0.020	-0.043	0.068
Sub-sample for “Hold” Recommendation	29	-0.023	0.025	-0.014	-0.083	0.006
Sub-sample for “Underperform” Recommendation	29	-0.049	0.030	-0.041	-0.130	0.007
Sub-sample for “Sell” Recommendation	29	-0.044	0.035	-0.049	-0.097	0.060

	N	Mean	SD	Median	Min	Max
Sub-sample for “Strong Buy” Recommendation	29	0.036	0.033	0.028	-0.003	0.108
Sub-sample for “Buy” Recommendation	29	0.026	0.033	0.014	-0.032	0.120
Sub-sample for “Hold” Recommendation	29	-0.019	0.033	-0.020	-0.101	0.058
Sub-sample for “Underperform” Recommendation	29	-0.044	0.037	-0.047	-0.119	0.049
Sub-sample for “Sell” Recommendation	29	-0.038	0.045	-0.037	-0.103	0.060

A6

Table 5

Affiliated Institutions' Ex-Ante Holdings and Analysts' Stock Recommendations (ignoring the endogeneity problem)

	(1)	(2)	(3)	(4)	(5)	(6)
Independent Variables	$D1_{i,j,t}$	$D2_{i,j,t}$	$D4_{i,j,t}$	$D5_{i,j,t}$	$D\_posi_{i,j,t}$	$D\_nega_{i,j,t}$
$\frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$	0.0045	0.0136*	-0.0320**	-0.0008	0.0181**	-0.0328**
	(0.6354)	(1.7496)	(-2.3708)	(-0.2358)	(2.5786)	(-2.3553)
Constant	0.1795***	0.2578***	0.0810***	0.0160***	0.4373***	0.0970***
	(444.4080)	(560.4950)	(145.2624)	(83.4248)	(1,486.7115)	(161.9023)
Observations	6,016	6,016	6,016	6,016	6,016	6,016
R-squared	0.5782	0.5078	0.4837	0.4722	0.4530	0.4748
Analysts' Affiliated Companies × Time FE	YES	YES	YES	YES	YES	YES
Firm × Time FE	YES	YES	YES	YES	YES	YES

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 5 Analysts' Stock Recommendations and Affiliated Institutions' Ex-Ante Holdings

Notes: This table reports OLS regressions of the relationship between and the ex-ante holdings of analysts' affiliated institutions and their stock recommendations. The sample period starts at the issuance of analysts' stock recommendations and the unit of observation is a quarter. The dependent

variables in Column (1) to (4) $Dk_{i,j,t}$ $(k = 1, 2, 4, 5)$ are identical, represented by the percentage stock recommendation of category *k* within an institution, determined by dividing the number of stock recommendation of category k for a specific stock within an institution by the total number of stock recommendations for that particular stock within the same institution. The dependent variables in Column (5) is $DS\_posi_{j,t}$ is the percentage optimistic stock recommendation, determined by dividing the number of stock recommendation of category *1* and category *2* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset. The dependent variables in Column (6) $DS\_nega_{j,t}$ is the percentage pessimistic stock recommendation, determined by dividing the number of stock recommendation of category *4* and category *5* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset. The independent variable $\frac{Shares_{i,j,t-1}}{Outstanding\ Shares_{j,t-1}}$ is the percentage ownership in one period prior to the issuance of analysts' stock recommendations. All standard errors are clustered at the level of analysts' affiliated institutions. Analysts' Affiliated Companies × Time FE amd Firm × Time FE are included in all columns. *, **, *** represent significance of 10%, 5%, and 1%, respectively.

A7

Table 6

Affiliated Institutions' Ex-Ante Holdings and Analysts' Stock Recommendations (addressing the endogeneity problem)

	(1)	(2)	(3)	(4)
Independent Variables	$D\_nonnega_{i,j,t}$	$D\_nonnega_{i,j,t}$	$D\_nonnega_{i,j,t}$	$D\_nonnega_{i,j,t}$
m	2	3	4	5
$\frac{Shares_{i,j,t-1-m}}{Outstanding\ Shares_{i,j,t-1-m}}$	0.0278***	0.0187**	0.0150*	0.0017
	(4.1708)	(2.6453)	(1.9836)	(0.2975)
Constant	0.8939***	0.8907***	0.8918***	0.8854***
	(3,518.6368)	(4,808.0361)	(5,233.9813)	(7,518.9661)
Observations	5,818	5,625	5,156	4,866
R-squared	0.4689	0.4583	0.4581	0.4685
Analysts' Affiliated Companies × Time FE	YES	YES	YES	YES
Firm × Time FE	YES	YES	YES	YES

Robust t-statistics in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 6 Table21 for Hypothesis

Notes: This table reports OLS regressions of the relationship between and the ex-ante holdings of analysts' affiliated institutions and their stock recommendations. The sample period starts at the issuance of analysts' stock recommendations and the unit of observation is a quarter. The dependent variables in Column (1) to (4) are the same, $DS\_nonnega_{j,t}$ is the percentage pessimistic stock recommendation, determined by dividing the number of stock recommendation of category *1*, category *2*, and category *3* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset. The independent variable $\frac{Shares_{i,j,t-1-m}}{Outstanding\ Shares_{j,t-1-m}}$ is the percentage ownership in 1+m period prior to the issuance of analysts' stock recommendations. All standard errors are clustered at the level of analysts' affiliated institutions. Analysts' Affiliated Companies × Time FE amd Firm × Time FE are included in all columns. $*$, $**$, $***$ represent significance of 10%, 5%, and 1%, respectively.

A8
Variable Definitions

Variable	Description	Source
$Dk_{i,j,t}$ $(k = 1, 2, 4, 5)$	The percentage stock recommendation of category *k* within an institution, determined by dividing the number of stock recommendation of category *k* for a specific stock within an institution by the total number of stock recommendations for that particular stock within the same institution.	
$\frac{Shares_{i,j,t+1}}{Outstanding\ Shares_{j,t+1}}$	The percentage ownership, determined by dividing the institution's holdings of a specific stock by its total number of outstanding shares	
$DSk_{j,t}$ *(k = 1, 2, 4, 5)*	The percentage stock recommendation of category *k* within the dataset, determined by dividing the number of stock recommendation of category *k* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset.	
$DS\_posi_{j,t}$	The percentage optimistic stock recommendation, determined by dividing the number of stock recommendation of category *1* and category *2* for a specific stock within	

	the dataset by the total number of stock recommendations for that particular stock within the dataset.	
$DS\_nega_{j,t}$,	The percentage pessimistic stock recommendation, determined by dividing the number of stock recommendation of category *4* and category *5* for a specific stock within the dataset by the total number of stock recommendations for that particular stock within the dataset	
$avg\_Recommendation_{j,t}$	The average stock recommendation of a specific stock, determined by dividing the sum of the category of stock recommendation for a specific stock, i.e., *k (k = 1, 2, 3, 4, 5),* by the total number of stock recommendation for that particular stock.	

APPENDIX B

B1

Average Abnormal Returns (Equal-weighted index return)

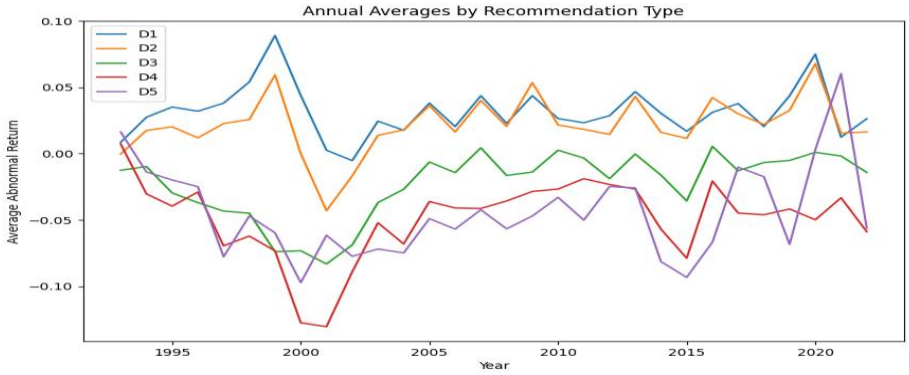

Figure 1 Average Abnormal Returns (Equal-weighted index return)

This figure shows annual average return of 5 portfolios created from each category of stock recommendation. This figure indicates that stocks recommended by analysts outperform market and beat non-recommended stock.

B2

Average Abnormal Returns (Value-weighted index return)

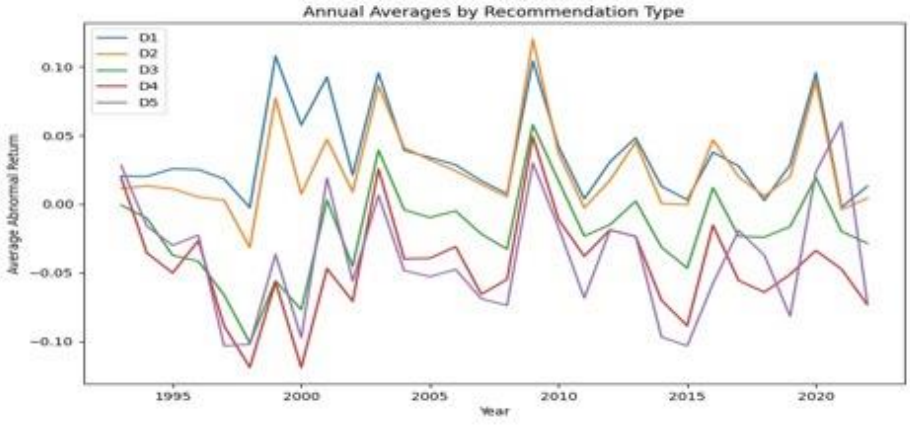

Figure 2 Average Abnormal Returns (Value-weighted index return)

This figure shows annual average return of 5 portfolios created from each category of stock recommendation. This figure indicates that stocks recommended by analysts outperform market and beat non-recommended stock.

Cumulative Abnormal Returns (Value-weighted index return)

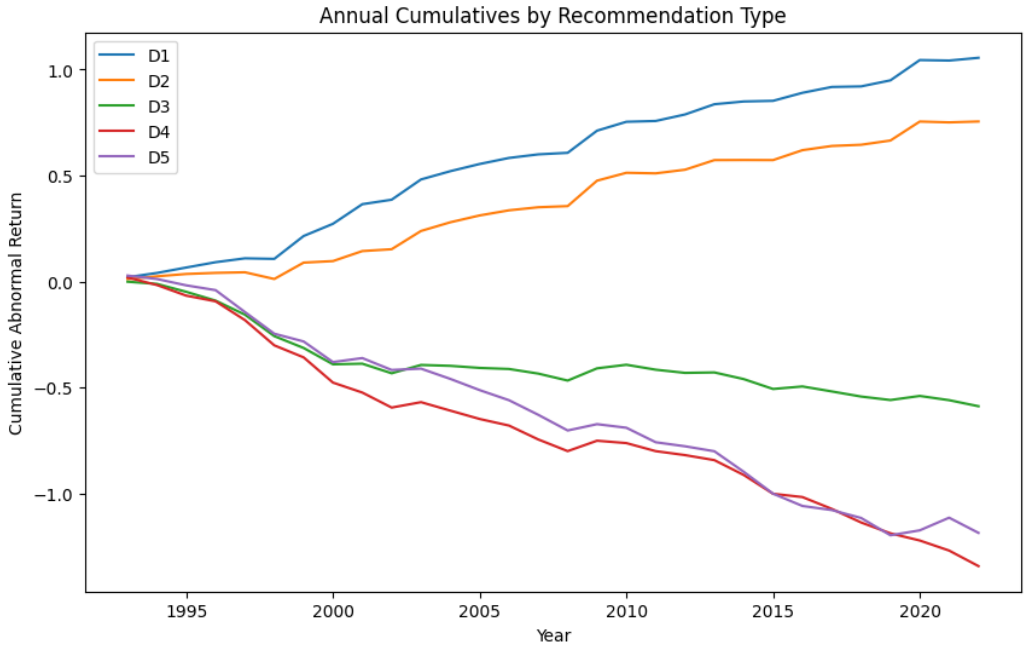

Figure 3 Cumulative Abnormal Returns (Value-weighted index return)

This figure shows annual cumulative return of 5 portfolios created from each category of stock recommendation. This figure indicates that portfolio with optimistic recommendations outperform pessimistic recommendation portfolio in long term (29 years).

Cumulative Abnormal Returns (Equal-weighted index return)

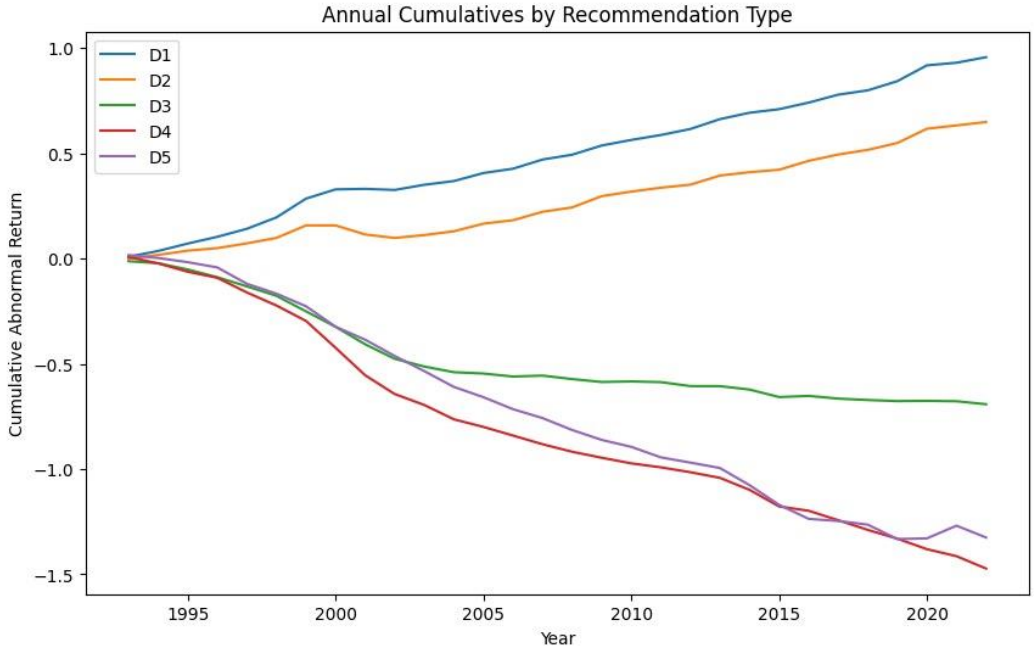

Figure 4 Cumulative Abnormal Returns (Equal-weighted index return)

This figure shows annual cumulative return of 5 portfolios created from each category of stock recommendation. This figure indicates that portfolio with optimistic recommendations outperform pessimistic recommendation portfolio in long term (29 years).

B3

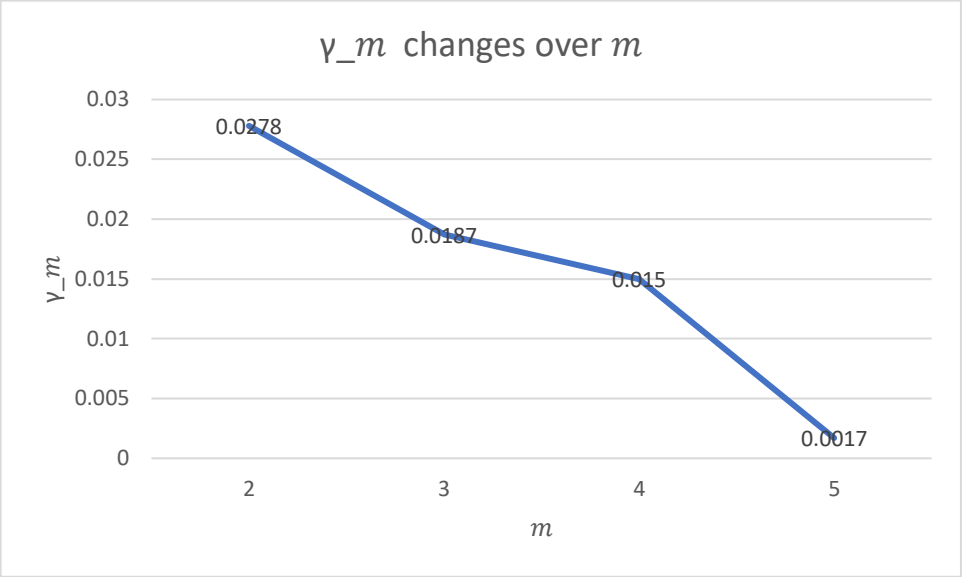

Figure 5 γ_m changes over m

This figure demonstrates a downward sloping trend in γ_m as it varies with m. This finding suggests that analysts' recommendations are not solely motivated by the self-interest of their affiliated institutions. Rather, they appear to be at least partially influenced by objective factors and considerations.

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