Analyst Tracking and Enterprise ESG Performance -- Empirical Evidence from China

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Abstract. ESG investment has increasingly become a mainstream investment concept. As the external supervisor and the carrier of "business signals", the analyst's analytical opinions have a great impact on investors' investment decisions. Based on China's Shanghai and Shenzhen A-share listed companies from 2009 to 2022 as research samples, this paper empirically tests the effect and mechanism of analyst tracking on enterprise ESG performance. It is found that analyst tracking can significantly improve the ESG performance of the enterprise. This conclusion is still robust after a series of tests, while the conclusion is still valid after the endogeneity problem is taken into account by the cross-cross term test. The mechanism shows that analyst tracking can improve the environmental, social and governance performance of enterprises by increasing the transparency of enterprises. The results of heterogeneity analysis show that the effect is more significant in state-owned enterprises, large-scale enterprises and companies that are not part of the CSI 300 index or are followed by non-star analysts. This paper provides a theoretical basis for investors to make investment decisions and for enterprises to improve their sustainable development capabilities.

Keywords: Analyst tracking; Enterprise ESG performance; Information transparency.

1. Introduction

At present, enterprise ESG performance has gradually become an important reference point to evaluate the high-quality development of enterprises and investors' investment decisions. In recent years, the Chinese government has focused on promoting sustainable economic development, emphasizing the development concept of "lucid waters and lush mountains are invaluable assets", and further emphasising the development concept of "promoting green development and harmonious coexistence between man and nature" at the 21st CPC National Congress in 2022. Since the ESG sustainable development concept, which is composed of "Environment, Social and Governance", is highly consistent with the concept of high-quality development, Therefore, ESG evaluation has become an important index reflecting the level of sustainable development of enterprises (Lokuwaduge and Heenetigala, 2017). Thus, with the in-depth promotion of the green development concept, the ESG's investment concept and evaluation system are highly respected in the investment market in China (Giese G et al., 2019). Existing studies have testified that enterprise ESG performance has become an important reference basis for investors to assess corporate operating risks (Duuren et al.,2016). Listed companies with better ESG performance have attracted more attention from investors. Its stock return rate is also positively correlated with its ESG performance (Glooner, 2017). Therefore, corporate ESG performance plays an extremely important role in investors' investment decisions and corporate development.

The cultural quality of analysts is generally higher, and their investment suggestions often play a decisive role in the securities market. As the stock market gets hotter and hotter, the public's interest in making profits by buying and selling stocks is becoming more and more frequent. As external supervisors and "business signal" transmitters, analysts are equipped with professional knowledge and high professional quality, able to dig out and analyze various information about the enterprise. Therefore, their tracking of the behaviours of listed companies, the research reports and the investment recommendations they release all transmit information-rich investment "signals" to investors, and the investment "signals" also play an extremely important role in the stability of listed companies' stock prices.

Therefore, in order to pass on good business information and attract more investors through the objective third party of analysts, enterprises will have a tendency to improve and build a good corporate image. Considering that analysts can identify self-interested behaviours of enterprises that do not fulfill their social responsibilities and damage the environment by virtue of their own professional knowledge and years of experience (Chen et al., 2016), and once such information is exposed, the enterprise's reputation and the stock price will inevitably be affected (Xu et al., 2023). Therefore, tracking by analysts can, to a certain extent, play a role in supervising corporate norms of conduct and reducing violations, and urge enterprises to form the consciousness of improving ESG performance independently.

The existing literature studies on enterprise ESG and enterprise value (Gillan et al., 2021) and financial risks (Alareeni et al., 2020), and the influencing factors of enterprise ESG performance are also more limited to digital transformation (Zhong et al., 2023), there is a lack of research on enterprise ESG performance from the perspective of influencing factors. Therefore, based on China's Shanghai and Shenzhen A-share listed companies from 2009 to 2022 as research samples, this paper empirically tests the effect and mechanism of analyst tracking on enterprise ESG performance. There are two main contributions to this paper. First, the research results of this paper can enrich the theoretical and practical research of external analysts and ESGs. On the one hand, most current studies on analyst tracking are related to corporate earnings management (Velte, 2019), corporate financing (Liu et al., 2023), audit (Lin and Wang, 2023) and other relevant corporate financial behaviour, and this paper can enrich the theory of analyst tracking and corporate social responsibility performance. On the other hand, most of the studies on ESG are considered as an influencing factor (Ge et al., 2022) to study its impact on corporate financial performance. The research conclusions of this paper can enrich the research content on influencing factors of enterprise ESG performance. Secondly, the research results of this paper are helpful to guide investors to make correct investment decisions and enterprises to develop in high quality.

From the perspective of analyst tracking, this paper innovatively discusses the influence of analyst tracking on enterprise ESG performance and its mechanism. The arrangement of the paper is as follows: First, this paper summarizes and reviews the research results of the existing literature, and gradually deduces the research hypothesis of this paper from the existing literature research. Secondly, after the data and variables are explained, the panel fixed effect model was used to complete the basic regression to verify the basic hypothesis that "analyst tracking can significantly improve the ESG performance of enterprises", and then the robustness test was completed by replacing the core explanatory variables, measuring the explained variables, the Heckman two-stage test, the PSM test and other methods. It was found that the results of the basic regression were still robust after considering the endogeneity problem. Further, the heterogeneity test is conducted according to the property right nature, enterprise scale, whether the enterprise belongs to the CSI 300 component stock and the analyst reputation. What's more, the intermediary variable "information transparency" is introduced to explore the mechanism action mechanism in the research content, and the conclusion is that "analyst tracking can improve enterprise ESG performance by improving the enterprise's information transparency". Finally, based on the results of the overall research and verification, the conclusion is drawn and practical suggestions are put forward.

2. Literature Review and Research Hypothesis

2.1 Literature Review

2.1.1 Literature on Analyst Tracking

Most of the literature work on analyst tracking starts from earnings management, corporate financing, auditing and other aspects, paying more attention to the financial behavior of enterprises. At present, scholars have not reached a unified conclusion on analyst tracking preference and earnings management: Yu (2018) believe that analysts prefer to track companies with low earnings

management, but Chen et al. (2021) put forward the opposite conclusion. At the same time, Li (2020) and other scholars believe that analyst tracking can deliver more real earnings management information to investors and significantly reduce the degree of information asymmetry between managers and stakeholders. In particular, Li et al. (2022) conducted in-depth research on the type of earnings management and found that analysts could produce supervision effect on accrual earnings management, so analyst tracking could reduce accrual earnings management and strengthen real earnings management.

In terms of corporate financing, scholars describe the relationship between analyst tracking and financing from different industries and positions. For example, Bradshaw (2006) analyzed from the perspective of commercial credit financing and debt financing respectively, and found that analyst tracking can promote the commercial credit financing of enterprises, and the number of analysts tracking is negatively correlated with corporate debt financing. YUAN et al. (2019) proposed that analyst tracking has a moderating effect on the relationship between market mispricing and M&A financing mode selection, and it weakens the significant positive influence of overvaluation of M&A companies' stock prices on M&A companies' tendency to choose stock financing mode.

From the perspective of analyst tracking and audit, different scholars have studied the impact of analyst tracking on the purchasing tendency of audit opinions of companies, and found that the more analysts are accurate, the more inclined companies are to purchase audit opinions. Especially, when there are star analysts among the tracked analysts, the more obvious the purchasing tendency of audit opinions will be (Zhai et al., 2016).

2.1.2 Literature on Enterprise ESG Performance

After reading the literature on ESG, it is found that scholars mainly study from the financial perspectives of ESG's impact on enterprise performance and financing cost. Even if there are several articles on the impact factors of ESG, most of them start from the digital aspect (Yang et al.,2022). Among them, in the aspect of enterprise performance, Yuan et al. (2022) found that within a certain level of financial risk, improving ESG performance can indeed reduce financial risk. The disclosure of ESG can restrain the risk of stock price collapse by reducing agency costs and improving agency efficiency (Murata and Hamori, 2021). Finally, many scholars have found that ESG information disclosure is conducive to reducing corporate financing costs. Crifo et al. (2015) believe that ESG information disclosure of enterprises can reduce the cost of equity financing through the information effect and reputation effect. Eliwa et al. (2019) explored the impact of enterprise ESG performance on debt financing costs and found that good enterprise ESG performance can affect debt financing costs by reducing corporate financial risk, information risk and agency risk.

In terms of digitalization and enterprise ESG performance, the mainstream view is that enterprise digital transformation can significantly improve enterprise ESG performance. Zhong et al. (2023) through research, the causal mechanism between digital transformation and ESG performance of enterprises is expounded from the perspective of "resource allocation".

All in all, with the rise of ESG investment, there has been a lot of literature on the causal relationship of enterprise ESG performance from different perspectives, but relatively few studies on the influencing factors of enterprise ESG performance. At the same time, as a party with an important say in the investment market, the importance of analysts is increasing, but there is a lack of research combined with an ESG investment perspective. Therefore, based on the current situation of ESG investment development in China, this paper intends to examine the relationship between analyst tracking and ESG performance of enterprises and its causes, which will enrich the relevant research of external analysts and ESG field, and provide ideas for guiding investors to make better investment decisions and achieve high-quality development of enterprises.

2.2 Research Hypothesis

Analyst tracking can have an impact on how transparent a enterprise is. As an important external supervision role in the capital market, analysts can effectively help external investors to mine the internal information of enterprises (Hou et al., 2020). In order to make research reports and stock

recommendations, analysts need to actively search for enterprise information to grasp its operating conditions (Altschuler et al.,2015). Mandatory information disclosure is a public resource in the market, which weakens the comparative advantages between companies. Therefore, analysts have a strong tendency to ask for more information from insiders through telephone consultation and other means. External information demand brings pressure to enterprises to a certain extent, so that enterprise insiders are motivated to convey signals about the enterprise's characteristic advantages through voluntary disclosure of more information (Chen et al., 2008). Make external personnel have a more accurate and comprehensive understanding of the enterprise's operation (Healy et al., 2001). Therefore, after synthesizing the research content of Hutton (2005) and Ajinkya and Gift (1984), this paper holds that firms with greater analyst following will make more information disclosure and have higher information transparency.

Information transparency affects enterprise ESG performance. On the one hand, in the case of high information transparency, the information asymmetry between stakeholders and enterprises is reduced, and the external supervision pressure on enterprises is increased, which restrains the utilitarian behaviour of business operators (Luo et al.,2017) to enhance the ESG awareness of enterprises and strengthen the ESG construction. On the other hand, the mainstream investment concept is shifting to the direction of "ESG investment", and investors are gradually paying more attention to enterprise ESG performance. As the basis and value embodiment for evaluating the long-term sustainable development of enterprises, the degree of enterprise ESG performance will become clearer with the improvement of information transparency, which will help investors to better evaluate the sustainable development ability of enterprises, promote the recognition of enterprises in the capital market and attract more long-term investors (He et al., 2020). Enhance enterprise value and reputation. In this case, in order to give consideration to its own image and the enterprise's reputation in the industry, and to coordinate the relationship between the enterprise and investors, the management of the enterprise will be more motivated to actively improve the performance of ESG, and make improvements by actively strengthening the cultivation of ESG concept and the construction of ESG system. Convey to the outside world the enterprise's business philosophy of valuing ESG performance (Mure et al., 2021), so as to better meet investors' expectations of sustainable development and social responsibility. In conclusion, analyst tracking can improve enterprise ESG performance by improving corporate transparency. Therefore, the following hypothesis is proposed in this paper:

H_1: Analyst tracking can significantly improve an enterprise's ESG performance.

H_2: Analyst tracking can improve enterprise ESG performance by improving information transparency.

Moreover, combined with China's specific national conditions, this paper also believes that the impact of analyst tracking on the ESG performance of enterprises will vary depending on the nature of enterprises. It is found that due to the special property right nature, state-owned enterprises have the function of implicit government guarantee (Jin et al.,2022), so state-owned enterprises will get more resource tilt. Thus, the definitive phenomenon of "Too-big-to-fail" is formed. Therefore, the effectiveness of analyst tracking will make a difference. Therefore, this paper proposes a third hypothesis:

H_3: The positive impact of analyst tracking on firm ESG performance is heterogeneous under different firm natures.

Furthermore, the characteristics of the enterprise itself are predicted in this paper to make a difference in the impact of analyst tracking on enterprise ESG performance. Considering that companies with larger economic size tend to disclose more business information (Buzby, 1975) and have more stable business conditions, the size and status of enterprises will have an impact on the attraction of analysts, and thus the promoting effect of analyst tracking on ESG performance of enterprises will be different in different groups. Therefore, this paper proposes the following two hypotheses:

H_4: The positive impact of analyst tracking on firm ESG performance is heterogeneous under different firm sizes.

H_5: The positive impact of analyst tracking on firm ESG performance is heterogeneous under different firm positions.

Finally, considering the influence of analysts' personal characteristics on their published analysis opinions, this paper argues that the impact of analyst tracking on ESG performance of enterprises will vary with the difference of analyst reputation. However, different from existing literature studies in the past (Cheng et al.2021), combined with the current era of knowledge payment, this paper argues that the influence of analysts with high reputation is weakened due to the obvious decline in the availability of their published analysis opinions. Therefore, this paper proposes a final hypothesis:

H_6: The positive impact of analyst tracking on firm ESG performance is heterogeneous under different analyst reputations.

3. Method

3.1 Data Source

In this paper, the data of A-share listed companies in Shanghai and Shenzhen from 2009 to 2022 are selected as the initial research samples, and the initial samples are processed as follows: Firstly, companies and financial institutions in the state of ST and PT are excluded; Secondly, remove the missing samples of relevant variables; Thirdly, a 1% quartile WINSORIZE is performed on all continuous variables. After data processing, a total of 17283 samples were obtained. In addition, in order to reduce the influence of heteroscedasticity and sub-regression on the regression results, this paper carried out clustering processing on the standard error at the enterprise level in the regression analysis. The data on enterprise ESG scores comes from the Wind database, with the rest of the raw data coming from the CSMAR database.

3.2 Variables

3.2.1 Explained Variable

Enterprise ESG performance ($ESG_{i,t}$). The index data used in this paper to measure the ESG performance of enterprises are derived from the ESG rating results released by China Securities. China Securities ESG rating systematically measures the ESG score level of all A-share listed companies through the combination of regular evaluation and dynamic tracking. The ESG rating of China Securities is divided into nine grades from high to low: AAA, AA, A, BBB, BB, B, CCC, CC, and C. The nine grades are assigned 9~1 successively from high to low: ESG=9 when the rating is AAA, ESG=8 when the rating is AA, and so on. This paper takes the rating data at the end of each year as the annual data of ESG performance.

3.2.2 Explanatory Variable

Analyst tracking volume (ACi,t). This paper refers to the measurement method of Gao and Wang (2017), adding 1 to the number of analysts tracking and taking the natural logarithm as the explanatory variable. Considering that the tracking of an enterprise by an analyst is mainly reflected in the analysis of enterprise data, which may be individual or team, this paper uses the number of analysts who have tracked a enterprise within a year as the measurement index of analyst tracking. If it is a team, it is regarded as an analyst.

3.2.3 Control Variables

Referring to the relevant studies of Lawson and Wang (2016) and other scholars, factors such as enterprise size, asset-liability ratio and enterprise growth are controlled in the regression estimation of the model.

Table 1. Variable description

Type	Name	Symbol	Interpretation
Explained Variable	Enterprise ESG Performance	*ESG*	1-9 based on ESG Rating by Shanghai Huazheng Index Information Service Co., Ltd.
Explanatory Variable	Analyst Tracking	*AC*	Ln(1+The number of analysts who have covered the enterprise in a year)
Mediating Variable	Information Transparency	*INFO*	The values of A=4, B=3, C=2 and D=1 are subject to the disclosure of Shenzhen Stock Exchange and Shanghai Stock Exchange
Control Variable	Enterprise Size	*SIZE*	The value of the enterprise's total assets under the natural log
	Return On Total Assets	*ROA*	(Net Profit/Total Assets) *100%
	Asset-Liability Ratio	*LEV*	The ratio of the enterprise's total liabilities to its total assets at the end of the year
	Tobin Q	*Q*	Tobin Q value is used to represent enterprise value
	Nature of Enterprise	*SOE*	If it is a state-owned enterprise, the value is 1; Otherwise, zero
	Enterprise Growth	*GROWTH*	Total Assets Growth Rate, (Total assets at the end of the period -- total assets at the beginning of the period)/(Total assets at the beginning of the period)
	Rate of Return on Common Stockholders' Equity	*ROE*	(After-Tax Profit/Owner's Equity) *100%
	Shareholding Ratio of the Largest Shareholder	*TOP1*	(Number of shares held by the largest shareholder)/total number of shares
	The Proportion of Shares Held by the Top 10 Shareholders	*TOP10*	The sum of the top 10 shareholders' holdings
	Interest Cover Multiple	*EBIT*	The ratio of ebitDA to interest

3.3 Empirical Model

3.3.1 Basic Regression Model

In order to test hypothesis H_1, panel fixed effect model was adopted in this paper to conduct empirical research on variables. The model design is as follows:

$$ESG_{i,t} = \mu_0 + \mu_1 AC_{i,t} + \mu_2 Controls_{i,t} + Year + Industry + Firm + \varepsilon_{i,t} \quad (1)$$

In the formula, Industry and Year are industry and year control variables respectively, and t represents year; ε represents the random disturbance term.

3.3.2 Mediating Effect Model

To test hypothesis H_2, the model design is as follows:

$$INFO_{i,t} = \partial_0 + \partial_1 AC_{i,t} + \partial_2 Controls_{i,t} + Year + Industry + Firm + \varepsilon'_{i,t} \quad (2)$$

Related variables are explained above.

4. Empirical Results and Discussion

4.1 Data Description

Table 2 is the statistical description of the variables. The maximum value of ESG is 6.000 while the minimum value is 1.000. Meanwhile, the standard deviation of ESG is 1.065, which means that there is a big gap in ESG performance between different enterprises. What's more, the standard deviation of AC is 1.178. Such a large number shows that different enterprises receive different attention from analysts. This is consistent with the cognition that "star enterprises" will be followed by more analysts. The distribution of other variables is within a reasonable range, so it will not be described here. In addition, through the correlation coefficient matrix (Table 3), it is found that the correlation coefficients are almost lower than 0.800, so there is no serious multicollinearity problem.

Table 2. Variable description

Variables	Obs.	Mean	SD	Min	Median	Max
ESG	17283	4.197	1.065	1.000	4.000	6.000
AC	17283	1.478	1.178	0.000	1.386	3.761
SIZE	17283	21.609	1.204	19.265	21.442	26.399
Q	17283	2.314	1.419	0.889	1.859	10.123
SOE	17283	0.133	0.340	0.000	0.000	1.000
EBIT	17283	17.673	60.910	-24.020	1.788	496.937
TOP1	17283	34.228	14.729	8.730	31.940	75.400
TOP10	17283	63.575	13.945	23.330	65.550	95.980
LEV	17283	0.346	0.188	0.047	0.324	0.936
GROWTH	17283	0.277	0.440	-0.289	0.133	2.187
ROE	17283	0.077	0.118	-0.607	0.084	0.420
ROA	17283	0.047	0.064	-0.248	0.049	0.283

4.2 Baseline Regression Estimation Result

Table 4 shows the results of baseline regression. The result shown in column (1) is the regression result obtained with only explained variables and explanatory variables, and it is found that the regression coefficient is 0.164 (T-value is 22.635). In column (2), the industry fixed effect is introduced, and the regression coefficient is 0.165 (T-value is 22.772). In column (3), the year fixed effect is introduced, and the regression coefficient is 0.153 (T-value is 19.762). In column (4), control variables are added on the basis of the above, and the regression coefficient of AC to ESG is 0.124 (T-value is 14.097); Finally, column (5) controls for individual fixed effects, and the regression coefficient of AC is 0.115 (T-value is 9.499). All the above regression coefficients were significant at the significance level of 1%. Taking (5) as an example, the regression results show that the ESG performance of enterprises increases by 0.115, or 2.74%, relative to the mean ESG, with each additional unit of analyst tracking. The regression results in Table 5 show that analyst tracking plays a significant role in improving enterprise ESG performance in both statistical and economic sense, which supports H_1 in this paper.

Table 4. Baseline Regression Results

	(1) ESG	(2) ESG	(3) ESG	(4) ESG	(5) ESG
AC	0.164***	0.165***	0.153***	0.124***	0.115***
	(22.635)	(22.772)	(19.762)	(14.097)	(9.499)
_CONS	4.057***	4.061***	4.284***	2.113***	0.431
	(239.675)	(111.902)	(36.675)	(6.798)	(0.572)
Controls	NO	NO	NO	YES	YES
YEAR	NO	NO	YES	YES	YES
INDUSTRY	NO	YES	YES	YES	YES
FIRM	NO	NO	NO	NO	YES
N	17283	17283	17283	17283	17283
Adj. R^2	0.017	0.012	0.129	0.056	0.083

4.3 Robustness Analysis

4.3.1 Replacement of the Explanatory Variable

The measuring method of explanatory variable may affect the reliability of the basic conclusion of this paper. Therefore, according to the practice of Chen et al. (2016), "The number of research REPORTS issued by analysts" (REPORTS) is used to measure analyst tracking and model (1) is reestimated, with the results shown in Table 5. The results show that the coefficient estimates reported by the core explanatory variable are all significantly positive at least at the 1% level. To sum up, the conclusion that analyst tracking can help improve enterprise ESG performance is still valid after changing the measurement method of explanatory variables.

4.3.2 Replacement of the Explained Variable

In the robustness test, this paper uses enterprise ESG comprehensive score data (WINDESG) provided by Wind Enterprise to replace the ESG performance data (ESG) by Shanghai Huazheng Index Information Service Co., Ltd. used in the benchmark model for regression. Wind ESG comprehensive score consists of management practice score (total score: 7) and controversial event score (total score: 3), and gives seven grades of "AAA-CCC", which can comprehensively reflect the enterprise's ESG management practice level and major emergency risk. The index system consists of 3 dimensions, 27 topics and 300+ indicators.

Since WINDESG data from 2017 cannot be searched, regression test is only conducted for 2018-2022. The results show that after regression by replacing the measures of explained variables, the conclusion that analyst tracking significantly contributes to firm ESG performance remains robust.

4.3.3 Heckman Two-step Estimation

Since analysts may be selective in whether to track listed companies, the conclusions of this paper may have self-selection bias. To solve this problem, the Heckman two-stage model was adopted. In the first step, the analyst tracking quantity of listed companies is verified by non-zero value, and the enterprise whose number of analyst tracking is greater than 0 is regarded as having analyst tracking. At the same time, considering that the ESG performance of an enterprise may also be affected by the size and age of the enterprise, this paper also included control variables as explanatory variables in

Table 3. Correlation Coefficient Matrix

	AC	SIZE	Q	SOE	EBIT	TOP1	TOP10	LEV	GROWTH	ROE	ROA
AC	1	0.221	0.168	0.001	0.086	0.027	0.102	-0.014	0.317	0.442	0.377
SIZE	0.233	1	-0.266	0.287	0.066	0.017	-0.090	0.521	-0.238	-0.047	-0.186
Q	0.186	-0.177	1	-0.144	-0.000	-0.139	-0.190	-0.237	0.040	0.138	0.231
SOE	0.002	0.366	-0.094	1	-0.043	0.149	0.092	0.190	-0.093	-0.036	-0.104
EBIT	0.047	-0.044	0.036	-0.023	1	0.026	0.022	0.145	0.236	0.277	0.199
TOP1	0.033	0.087	-0.105	0.173	0.026	1	0.611	-0.024	0.043	0.151	0.140
TOP10	0.109	-0.006	-0.134	0.097	0.047	0.619	1	-0.119	0.199	0.286	0.271
LEV	-0.014	0.553	-0.188	0.213	-0.085	-0.011	-0.107	1	0.001	-0.108	-0.408
GROWTH	0.229	-0.314	-0.002	-0.096	0.086	0.006	0.185	-0.141	1	0.511	0.374
ROE	0.351	-0.036	0.105	-0.022	0.177	0.148	0.264	-0.208	0.326	1	0.906
ROA	0.335	-0.123	0.160	-0.054	0.192	0.147	0.268	-0.363	0.269	0.922	1

Table 5. Replacing the Explanatory Variable and Explained Variable

	(1) ESG	(2) ESG	(3) ESG	(4) ESG	(5) ESG		(6) WINDESG	(7) WINDESG	(8) WINDESG	(9) WINDESG	(10) WINDESG
REPORTS	0.126***	0.127***	0.117***	0.096***	0.089***	AC	0.189***	0.189***	0.196***	0.186***	0.234***
	(21.356)	(21.494)	(18.977)	(13.627)	(9.072)		(12.184)	(12.193)	(13.902)	(11.159)	(7.797)
_CONS	4.072***	4.075***	4.363***	2.143***	0.463	_CONS	5.461***	5.479***	5.312***	2.899***	-12.568***
	(241.460)	(112.397)	(37.471)	(6.863)	(0.611)		(198.494)	(98.355)	(94.162)	(6.084)	(-5.965)
Controls	NO	NO	NO	YES	YES	Controls	NO	NO	NO	YES	YES
YEAR	NO	NO	YES	YES	YES	YEAR	NO	NO	YES	YES	YES
INDUSTRY	NO	YES	YES	YES	YES	INDUSTRY	NO	YES	YES	YES	YES
FIRM	NO	NO	NO	NO	YES	FIRM	NO	NO	NO	NO	YES
N	17283	17283	17283	17283	17283	N	9784	9784	9784	9784	9784
Adj. R^2	0.010	0.016	0.010	0.128	0.082	Adj. R^2	0.019	0.020	0.023	0.112	0.308

Table 6. Heckman Two-step Estimation Results & Dynamic Panel GMM Estimation Results & Fixed Effect Control at the Provincial Level

(1) Heckman Two-step Estimation results		(2) Dynamic Panel GMM Estimation		(3) Fixed Effect Control at the Provincial Level	
	ESG		ESG (One stage lag)		ESG
AC	0.115***	L.ESG	0.266***	AC	0.115***
	(9.482)		(23.130)		(9.499)
IMR	0.084	AC	0.104***	_CONS	0.431
	(0.661)		(8.621)		(0.572)
_CONS	0.053	_CONS	-0.295	Controls/YEAR/ INDUSTRY/FIRM	YES
	(0.059)		(-0.437)		
Controls/YEAR/INDUSTRY/FIRM	YES	Controls/YEAR/INDUSTRY/FIRM	YES		
N	17283	N	14126	N	17283
Adj. R^2	0.083	Adj. R^2	0.138	Adj. R^2	0.083

the first stage to conduct Probit regression. In the second step, Inverse Mills Ratios (IMR) estimated in the first stage were added into the model of the second stage for regression (as shown in Table 6), and the result was consistent with the benchmark regression result.

4.3.4 Dynamic Panel GMM Estimation

Considering the problem of reverse causality, this paper draws on the research method of Zhao and Mao(2023) and adopts the one-stage lag method to conduct regression again. The results are shown in Table 6. Among them, L.ESG is significantly positive at the significance level of 1%, indicating that the past ESG performance will have a significantly positive impact on the present ESG performance. Moreover, it is found that the regression coefficient of the core explanatory variable (AC) is 0.104, which is still significantly positive after considering the delayed ESG of one phase, indicating the robustness of the results.

4.3.5 Fixed Effect Control at the Provincial Level

After the fixed effect of model (1) at the control province level, the regression is conducted again, and the results are shown in Table 6. The results showed that AC and ESG were still significant at the significance level of 1%, and the regression coefficient was 0.115, indicating that after controlling the fixed effect at the provincial level, analyst tracking still promoted the ESG performance of enterprises, which was consistent with the basic regression conclusion.

4.3.6 Propensity Score Matching Tests

In order to avoid selectivity bias, propensity score matching test is used to further verify the impact of analyst tracking on enterprise ESG performance. The regression results of matched samples are shown in Table 7. From the first column to the fourth column, cross sections 1:1, 1:2, 1:3 and 1:4 were matched successively; kernel matching was used in the fifth column, and radius matching was used in the sixth column. In the regression results, the coefficient sign and significance level tracked by the analysts do not change fundamentally, which is consistent with the main regression results, and further verifies the reliability of the conclusions in this paper.

Table 7. Propensity Score Matching Tests

	(1) ESG	(2) ESG	(3) ESG	(4) ESG	(5) ESG	(6) ESG
AC	0.111***	0.111***	0.117***	0.116***	0.115***	0.115***
	(5.172)	(6.530)	(7.655)	(8.020)	(9.499)	(9.499)
_CONS	1.954	1.379	1.293	1.161	0.613	0.613
	(1.385)	(1.189)	(1.231)	(1.165)	(0.770)	(0.770)
Controls/YEAR/INDUSTRY/FIRM	YES	YES	YES	YES	YES	YES
N	6091	8838	10464	11621	17283	17283
Adj. R^2	0.089	0.097	0.101	0.101	0.083	0.083

4.3.7 Instrumental Variable Test

Based on the practice of To T et al. (2018), this paper introduces analyst coverage ratio (LARGE) as an instrumental variable, and uses Yu(2008) practice as reference to reflect this indicator with brokerage house size, which is exogenous to the explained variable ESG.

The first is the regression results of LARGE and AC in the first stage of instrumental variable test. Among them, the regression coefficient of LARGE and AC is 0.249, which is significantly positive at the 1% level, indicating that every 1 unit increase of LARGE will increase 0.249 analyst tracking. WALD F value is 30.27, indicating that there is no weak recognition problem. LM value is 29.12 and p-value is 0, indicating that there is no over recognition problem. In the second column, instrumental variables were used to test the regression results of the second stage. The regression coefficient of AC to ESG was 0.391, and was significant at the significance level of 5%, which was consistent with the baseline regression results.

4.3.8 Changes of Clustering Method

In order to alleviate the impact of heteroscedasticity and autocorrelation, clustering at different levels was also carried out in this paper, and the regression results were shown in Table 8 (Right). Column (3) is replaced with industry level clustering, and column (4) is replaced with year level clustering. The results showed that although the clustering level was changed, the regression coefficient of AC and ESG was significantly positive at 0.115, which was consistent with the basic regression conclusion.

Table 8. Instrumental Variable Test & Change the Clustering Method

Instrumental Variable Test Results			Regression after Changing the Clustering Method		
	(1)	(2)		(3)	(4)
	AC	ESG		INDUSTRY Clustering	YEAR Clustering
LARGE	0.249***		AC	0.115***	0.115***
	(3.395)			(9.603)	(7.572)
AC		0.391**	_CONS	-20.108**	-20.108**
		(2.113)		(-3.407)	(-2.660)
_CONS	-16.745***	5.571***	Controls/YEAR/ INDUSTRY/FIRM	YES	YES
	(-17.617)	(2.717)			
Controls/YEAR/ INDUSTRY/FIRM	YES	YES			
N	17283	17283	N	17283	17283
Adj. R^2	0.335	0.089	Adj. R^2	0.456	0.456

4.3.9 Change of Tail Reduction Method

In order to check whether there are outliers that have not been completely eliminated, this paper also uses the method of replacing the tail. Table 9 shows the result of regression after 5% tail reduction of variables. Among them, the result shown in column (1) is the regression result obtained with only explained variables and explanatory variables. Column (2) introduces industry fixed effect; In column (3), the year fixed effect is introduced. In column (4), control variables are added on the basis of the above; Finally, column (5) controls for individual fixed effects. The above regression coefficients are all positive and significant at the significance level of 1%, indicating that analyst tracking can improve the ESG performance of enterprises, which is consistent with the basic regression conclusion.

Table 9. Regression after Changing the Tail Reduction Method

	(1) ESG	(2) ESG	(3) ESG	(4) ESG	(5) ESG
AC	0.164***	0.165***	0.153***	0.125***	0.118***
	(22.635)	(22.772)	(19.762)	(13.750)	(9.401)
_CONS	4.057***	4.061***	4.284***	2.340***	0.958
	(239.675)	(111.902)	(36.675)	(6.592)	(1.243)
Controls	NO	NO	NO	YES	YES
YEAR	NO	NO	YES	YES	YES
INDUSTRY	NO	YES	YES	YES	YES
FIRM	NO	NO	NO	NO	YES
N	17283	17283	17283	17283	17283
Adj. R^2	0.010	0.017	0.012	0.136	0.081

5. Mechanism Verification (Mediating Effect Model)

Analysts play the role of information intermediary, and the information conveyed by them will have a great impact on investors' investment judgment. The regression results of analyst tracking (AC) and corporate transparency (INFO) show that the regression coefficient of analyst tracking on

corporate transparency is positive and statistically significant, which indicates that the increase of analyst tracking can effectively promote the improvement of corporate transparency and alleviate the problem of information asymmetry. At the same time, the higher transparency of the enterprise makes it easier for the enterprise to obtain the recognition of the capital market, which can attract and guide more investors' attention (Xiong et al. 2022). According to statistics from Barclays Research, McKinsey and Kotler Consulting, the current enterprise ESG performance has become an important consideration for investors to judge whether the enterprise is sustainable. Therefore, under such circumstances, enterprises with high information transparency will pay more attention to the improvement of ESG performance. In conclusion, this paper concludes that analyst tracking can positively promote enterprise ESG performance by improving corporate transparency.

Table 10. Corporate transparency as the intermediate variable

	(1)	(2)	(3)	(4)	(5)
	INFO	INFO	INFO	INFO	INFO
AC	0.067***	0.067***	0.128***	0.086***	0.106***
	(9.897)	(9.919)	(18.902)	(11.097)	(9.161)
_CONS	2.511***	2.485***	1.260***	-0.741***	-0.593
	(148.739)	(66.481)	(12.484)	(-2.586)	(-0.965)
Controls	NO	NO	NO	YES	YES
YEAR	NO	NO	YES	YES	YES
INDUSTRY	NO	YES	YES	YES	YES
FIRM	NO	NO	NO	NO	YES
N	17283	17283	17283	17283	17283
Adj. R^2	0.009	0.011	0.041	0.116	0.182

6. Heterogeneity Tests

Property right nature and enterprise scale may have a certain impact on enterprise ESG performance. Existing literature shows that state-owned enterprises, due to their high degree of government intervention (Liu and Zhang, 2018), in addition to fulfilling their own business objectives, also assume more social responsibilities and policy tasks. Therefore, on the one hand, the environment and other aspects of capital expenditure of state-owned enterprises are relatively high, and the ESG performance of enterprises itself is better than that of non-state-owned enterprises. On the other hand, as state-owned enterprises receive more and stronger government support, the uncertainty of future operation will be reduced. The implicit guarantee of the government (Faccio, 2006) will lead analysts to make a good judgment on earnings to a certain extent, thus weakening the supervision and promotion role of analyst tracking in improving enterprise ESG performance. In addition, Drempetic et al. (2020) found in the empirical study that analysts prefer to track large-scale companies. Since investors focus on the views of different analysts when making investment decisions, large-scale companies attract more attention from investors. Therefore, this paper speculates that large companies will tend to do more ESG performance improvement in order to maintain corporate image and increase investment.

Cross multiplication terms ($SOE \times AC$ and $BIG \times AC$) were set to verify whether there were differences in regression coefficients. After controlling the fixed effects of year, industry and individual, when the enterprise nature was state-owned, the regression coefficient of AC to ESG was 0.046. When the enterprise is not state-owned, the regression coefficient of AC on ESG is 0.125, that is, the influence of AC on ESG of non-state-owned enterprises is greater than that of state-owned enterprises, and the difference is significant. Similarly, when the size of listed companies is larger than the average level (BIG=1), the regression coefficient of AC to ESG is 0.132. On the contrary, the regression coefficient of AC to ESG is 0.097, that is, the influence of AC on ESG is greater in large listed companies, and the difference is significant.

Table 11. Corporate transparency as the intermediate variable

	(1) State-owned enterprise	(2) State-owned enterprise	(3) State-owned enterprise	(4) Non-state-owned enterprise	(5) Non-state-owned enterprise	(6) Non-state-owned enterprise
AC	0.179***	0.120***	0.121***	0.150***	0.130***	0.114***
	(7.508)	(4.551)	(3.570)	(18.318)	(13.837)	(8.758)
_CONS	3.420***	-0.037	3.743	4.395***	2.909***	0.386
	(11.273)	(-0.045)	(1.363)	(35.028)	(8.275)	(0.487)
Controls	NO	YES	YES	NO	YES	YES
YEAR/INDUSTRY	YES	YES	YES	YES	YES	YES
FIRM	NO	NO	YES	NO	NO	YES
N	2304	2304	2304	14979	14979	14979
Adj. R^2	0.037	0.046	0.048	0.068	0.086	0.095

Table 12. Grouping Regression According to BIG

	(1) Large-Scale	(2) Large-Scale	(3) Large-Scale	(4) Small-Scale	(5) Small-Scale	(6) Small-Scale
AC	0.220***	0.171***	0.145***	0.099***	0.078***	0.068***
	(18.264)	(12.403)	(7.352)	(9.247)	(6.776)	(4.407)
_CONS	3.047***	-0.434	-4.142***	4.467***	3.855***	0.805
	(7.948)	(-0.678)	(-2.922)	(36.929)	(7.186)	(0.784)
Controls	NO	YES	YES	NO	YES	YES
YEAR/ INDUSTRY	YES	YES	YES	YES	YES	YES
FIRM	NO	NO	YES	NO	NO	YES
N	7585	7585	7585	9698	9698	9698
Adj. R^2	0.038	0.052	0.062	0.079	0.100	0.119

Meanwhile, according to the study of Lin and Wang (2023), the companies that belong to CSI 300 Index attract more attention from the market and pay more attention to their corporate image. For companies that are not part of the CSI 300 index, exposure is affected by the amount of analyst tracking. Therefore, this paper identifies the samples of companies and divides them into stocks that belong to the CSI 300 Index and those that do not. Columns (1) and (4) control industry and year fixed effects; Control variables are added to columns (2) and (5); Column (3) and (6) introduce individual fixation effect. The regression results are shown in Table 13.

Take columns (3) and (6) as examples. The group regression results show that the regression coefficient of AC to ESG of companies not belonging to CSI 300 index is 0.112, which is significant at 1% significance level. The regression coefficient of AC to ESG of CSI 300 companies is positive but not significant. Therefore, analyst tracking of companies that are not part of the CSI 300 Index has a stronger positive impact on enterprise ESG performance than that of companies that are part of the CSI 300 Index.

Table 13. Grouping Regression According to CSI 300

	(1) CSI 300	(2) CSI 300	(3) CSI 300	(4) Not CSI 300	(5) Not CSI 300	(6) Not CSI 300
AC	0.065	0.062	0.036	0.139***	0.123***	0.112***
	(1.491)	(1.275)	(0.489)	(17.079)	(13.710)	(9.183)
_CONS	3.708***	-0.158	2.565	4.405***	3.043***	1.019
	(8.793)	(-0.133)	(1.182)	(36.102)	(8.792)	(1.271)
Controls	NO	YES	YES	NO	YES	YES
YEAR/INDUSTRY	YES	YES	YES	YES	YES	YES
FIRM	NO	NO	YES	NO	NO	YES
N	1049	1049	1049	16234	16234	16234
Adj. R^2	0.113	0.125	0.116	0.059	0.083	0.089

What's more, analyst reputation can also have an impact on enterprise ESG performance. Analysis reports given by analysts with A high reputation may become less accessible due to access rights (Fang and Yasuda, 2014), thus reducing the impact of analysis reports from analysts with a high reputation on investors' investment decisions, resulting in a weak regulatory effect on enterprise ESG performance. Therefore, this paper also makes a grouped regression based on analyst reputation, where analyst reputation is tracked according to whether the enterprise has a "star analyst" (the industry analyst ranked No.1 in the current year). The results show that "star analyst" tracking has no significant effect on enterprise ESG performance.

Table 14. Grouping Regression According to Analyst Reputation

	(1) ESG	(2) ESG	(3) ESG	(4) ESG
AC	0.016	0.042	0.127***	0.117***
	(0.300)	(0.370)	(14.040)	(9.432)
_CONS	-0.352	0.479	2.267***	0.512
	(-0.380)	(0.139)	(7.097)	(0.665)
Controls/YEAR/INDUSTRY	YES	YES	YES	YES
FIRM	NO	YES	NO	YES
N	1078	1078	16205	16205
Adj. R^2	0.069	0.069	0.076	0.083

7. Conclusion

This paper uses the A-share listed companies in Shanghai and Shenzhen from 2009 to 2022 as research samples to empirically test the effect and mechanism of analyst tracking on enterprise ESG performance. The research shows that there is a positive correlation between analyst tracking and enterprise ESG performance. The results of heterogeneity analysis show that the positive impact of analyst tracking on ESG performance is greater in non-state-owned enterprises than in state-owned enterprises, and greater in large companies than in small companies. Moreover, non-star analyst tracking has a more significant positive effect on improving enterprise ESG performance. The intermediary mechanism shows that the increase of analyst tracking can improve the transparency of the enterprise. Combined with the existing literature, it is found that the transparency of the enterprise has a certain restraint effect on the ESG performance of the enterprise by increasing the attention of the enterprise by the investors, so as to achieve positive regulation.

To this end, some suggestions are put forward as follows. For enterprises, they should attach importance to analyst tracking, actively improve information transparency, strengthen the construction of ESG systems, fully demonstrate their comprehensive ability of sustainable development, meet the needs of stakeholders for the corporate environment, social responsibility and corporate governance information, cater to the current ESG investment concept, and build trust between enterprises and stakeholders. For investors, they should attach importance to the tracking results of analysts, predict the ESG performance of enterprises by following the tracking results of analysts, and consider it in investment decisions, so as to choose more sustainable companies as investment objects and improve the effectiveness of investment.

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