WEP Warwick Evans Publishing

Transactions on Economics, Business and Management Research
ISSN: 2960-1789, eISSN: 2960-2254 | Volume 7
EDMI 2024

Corporate Participation in ESG Ratings and the Accuracy of Analysts' Surplus Forecasts: Based on the Perspective of Green Finance Policy Implementation

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Abstract. The article takes China's A-share listed companies from 2012to 2022 as the research target, using the different-in-difference model, and investigate the impact of ESG rating on the accuracy of analysts' forecast accuracy under China's green finance policies. This study finds that under green finance policies, ESG rating companies significantly have higher analysts' forecast accuracy, which is manifested in the reduction of analysts' forecast error and optimism bias. In terms of the mechanism, ESG-rated companies are more likely followed by security analysts and are willing to provide better quality of information disclosure, and thus have higher analysts' forecast accuracy. This study also examines firm heterogeneity. Under the green finance policies, the positive impact of ESG rating on the analysts' forecast accuracy is more significant in non-state-owned enterprises and enterprises in ESG-sensitive industries.

Keywords: ESG Ratings; Analyst Surplus Forecasts; Green Finance Policies; Surplus Forecast Accuracy.

1. Introduction

The intensification of climate change, resource depletion, and other global ecological and environmental issues are becoming increasingly prominent, posing serious challenges to sustainable human development. In this context, environmental ethics and corporate social responsibility (CSR) have begun to receive attention, requiring companies to go beyond traditional profit maximization concepts and focus on contributing to the environment and society. Afterwards, the concept of responsible investment gradually entered the vision of investors. As an important component of investment analysis, analyst earnings forecasting has always been widely concerned by market participants and plays a significant role in influencing investor decisions.

With the improvement and implementation of the domestic green finance system The continuous deepening of ESG concepts and the continuous promotion of ESG investment practices, from the perspective of policy implementation, further explore the impact of enterprise participation in ESG ratings on the quality of analyst earnings forecasts and its underlying mechanisms, which has certain research significance.

2. Theoretical Analysis and Research Hypotheses

2.1. Under the Implementation of Green Finance Policies, The Impact of ESG Ratings on Analyst Forecasts

Firstly, the signal transmission theory (Michael, 1973) [11] suggests that companies can transmit signals representing their quality to the outside world through appropriate mechanisms, enabling the market to reasonably anticipate the true situation of the company and make decisions, helping the company obtain good development opportunities. Secondly, according to the theory of information asymmetry (George, 1970), there is an information gap between market participants and companies, and companies participating in ESG ratings have a stronger willingness and more comprehensive information disclosure, which can alleviate the information asymmetry between investors, analysts, and companies. Finally, the legitimacy theory (Suchman, 1995) [12] suggests that companies must

comply with relevant policies and disclose relevant information to demonstrate compliance with established norms and values, in order to gain recognition from stakeholders and thereby obtain the legitimacy of their operations. Based on the above analysis, this article proposes the first research hypothesis:

H1: After the implementation of green finance policies, companies participating in ESG ratings will significantly improve the accuracy of their analyst earnings forecasts.

2.2. With the Participation of Enterprises, The Impact of ESG Ratings on Analyst Forecasts

Previous studies have shown that receiving more attention from analysts can help improve the accuracy of earnings forecasts for listed companies. Analyst attention is usually measured by tracking the number of analysts. The more analysts track the same company and release earnings forecasts, the more information they will obtain (Bhushan, 1989) [14], and their earnings forecasts will also be more accurate (Shi Guifeng et al., 2007) [5]; The increase in the number of analysts tracking can also intensify competition among analysts, further improving the accuracy of earnings forecasts (Coen et al., 2005) [15]. There is also a herd effect in analyst earnings forecasts. For companies that receive more market attention, tracking analysts tends to obtain relatively consistent earnings forecast opinions, which may be closer to the actual situation of the enterprise (Tamura, 2002).Based on this, combined with the relevant analysis that enterprise participation in ESG rating can help increase analyst attention, this article proposes a second hypothesis:

H2a: Enterprise participation in ESG ratings can increase analyst attention, thereby improving the accuracy of analyst earnings forecasts.

In addition, participating in ESG ratings can help improve information transparency for businesses. On the one hand, ESG rating can more intuitively convey a company's ESG concept to the market, demonstrate the company's practices and achievements in environmental protection, social responsibility, and corporate governance, and provide important information about the company's future development potential and direction; On the other hand, companies participating in ESG ratings have a stronger willingness to disclose information, The publication of ESG ratings will attract more external attention and supervision to enterprises, forcing them to proactively improve their management level and information disclosure quality, and provide investors with more transparent and reliable financial information. Both domestic and foreign studies have found that companies that fulfill social responsibility well, such as Kim et al. (2012), tend to engage in less earnings management. Wang Xia et al. (2014) found that companies that disclose social responsibility reports tend to engage in less earnings management and financial restatement. Based on this, this article proposes a third hypothesis:

H2b: Companies participating in ESG ratings have higher disclosure quality, thereby improving the accuracy of analyst earnings forecasts.

3. Research Design

3.1. Sample Selection and Data Description

This article takes A-share listed companies in China from 2012 to 2022 as the research sample and conducts the following processing: (1) Excluding financial listed companies, these companies have significant differences compared to other listed companies in terms of main business, company size, information disclosure, etc; (2) Excluding ST and ST * listed companies, these listed companies have significant differences in financial indicators and information disclosure compared to other companies; (3) Excluding companies listed in the current year; (4) Excluding companies that joined or exited the rating during the period; (5) Remove samples with missing data. To avoid the influence of extreme values, this article applied a 1% truncation to all continuous variables. After the above screening and processing, this article ultimately retained 9585 samples, including 1885 listed companies.

3.2. Variable Definition

3.2.1. Dependent Variable: Accuracy of Analyst Earnings Forecast

Drawing inspiration from Yang Qing's (2019) research, the analyst earnings prediction error (FERROR) is used to represent it. The calculation method is to take the average of the absolute difference between the predicted earnings per share and the actual earnings per share of all analysts in a listed company for each year, and then divide it by the absolute value of the actual earnings per share. This indicator can measure the degree of deviation between the analyst's predicted value and the actual value. The larger the prediction error, the lower the prediction accuracy. The calculation formula is as follows:

$$FERROR_{it} = \frac{Mean[|FEPS - AEPS|]}{|AEPS|} \quad (1)$$

Where FEPS is the analyst's predicted earnings per share, AEPS is the actual earnings per share.

In addition, this article draws on the selection of Optimistic Bias (FOPT) as a substitute variable. The calculation method is to take the average of the difference between the predicted earnings per share and the actual earnings per share of all analysts of listed companies in each year, and then divide it by the absolute value of the actual earnings per share. This indicator is positive, indicating that there is an optimistic bias. The larger the optimistic bias, the lower the accuracy of the prediction. The calculation formula is as follows:

$$FOPT_{it} = \frac{Mean[FEPS - AEPS]}{|AEPS|} \quad (2)$$

This article collects annual forecast data from all analysts on the earnings per share of sample companies, and processes it as follows: (1) Only retain analyst forecasts for the accounting year, that is, exclude samples with forecast release dates earlier than the previous year's annual report release date and later than the current year's annual report release date; (2) If the same analyst makes multiple forecasts for the same company during the accounting year, only the last forecast value will be retained; (3) Exclude samples with missing or abnormal actual earnings per share.

3.2.2. Explanatory Variables:

This article takes the interaction term between the grouped dummy variable (Treated) and the time dummy variable (Post) as the explanatory variable, and its coefficient represents the difference in analyst earnings prediction accuracy between the experimental group and the control group. The meaning of grouping dummy variables is whether the enterprise participates in ESG rating, and the meaning of time dummy variables is whether it is affected by green finance policies. The experimental group consists of companies that participated in Bloomberg ESG ratings continuously from 2012 to 2022, with Treated being 1; The companies that did not participate in Bloomberg ESG rating during this period were in the control group, where A was set to 0. If the time is after 2016, Post takes 1, otherwise Post takes 0. When obtaining ESG rating data, this article selected Bloomberg, a foreign rating agency with authority, credibility, and market influence. In addition, this article also selected the Business Road Rong Green Rating, which is widely used in academic research in the ESG field, to conduct a robustness test on the regression results.

3.2.3. Control Variables

Select the following control variables: company size, company lifespan, company leverage, company profitability, company growth, book to market ratio, price to earnings ratio, institutional shareholding ratio, equity concentration, board size, dual role, property rights nature, and audit institution type. In addition, the model also introduces industry dummy variables and annual dummy variables to control for fixed effects, and the industry classification standards mainly refer to the 2001 code of the China Securities Regulatory Commission. The specific definitions of each variable are shown in Table 1 on the following page.

Table 1. Variable Symbols and Definitions

Variable type	Variable Name	Variable symbols	Variable definition
Dependent variable	Analyst earnings forecast accuracy	*FERROR*	The absolute error ratio of earnings forecasting
		FOPT	Optimistic bias in earnings forecasts
Explanatory variables	Group dummy variables	*Treated*	The enterprise's continuous participation in ESG rating is 1, otherwise it is 0
	Time dummy variable	*Post*	1 for 2016 and beyond, otherwise 0
Control variable	Company size	*FSIZE*	The natural logarithm of the total assets of the company at the end of the period
	The duration of the company's existence	*FAGE*	The difference between the predicted year and the year of establishment of the company
	Corporate leverage	*LEV*	The ratio of the company's total liabilities to total assets at the end of the period
	Company profitability	*ROE*	The ratio of the company's net profit to net assets for the year
	Company growth potential	*GROWTH*	The growth rate of the company's annual operating revenue
	Book to market ratio	*BM*	The ratio of the company's book value to market value
	P/E ratio	*PE*	The ratio of the company's ending stock price to earnings per share
	Institutional investor shareholding	*INHOLD*	The shareholding ratio of institutional investors
	Equity concentration	*TOP*10	The shareholding ratio of the top 10 shareholders
	Board size	*BOARD*	Number of directors of listed companies
	Serving both positions simultaneously	*DUAL*	When the chairman concurrently serves as the general manager, take 1; otherwise, take 0
	Nature of Property Rights	*SOE*	State owned enterprises take 1, non-state-owned enterprises take 0
	Audit institution type	*BIG*4	When the auditing agency is one of the Big Four, take 1; otherwise, take 0

3.3. Model Construction

This article uses a double difference model to evaluate the impact of corporate participation in ESG ratings on the accuracy of analyst earnings forecasts in the context of green finance policy implementation. The principle of the double difference model is to divide all samples into an experimental group and a control group, with the sample receiving policy intervention as the experimental group and the sample not receiving policy intervention as the control group. The changes in the dependent variable before and after policy implementation are calculated separately. The difference in changes between the experimental group and the control group before and after policy implementation can be used as an estimate of policy effects. Compared to traditional regression methods, this model can better identify causal relationships between variables and largely avoid endogeneity issues.

By using a double difference model, it is possible to test whether the accuracy of analyst earnings forecasts is influenced by green finance policies and whether companies participate in ESG ratings, thereby helping to infer the impact of corporate participation in ESG ratings on analyst forecasting accuracy. The regression model used in this article can be specifically represented as:

$$FERROR_{it} = \beta_0 + \beta_1 Treated_i \times Post_t + \beta_2 Treated_i + \beta_3 Post_t + \rho' \cdot X_{it} + \gamma_i + \mu_t + \varepsilon_{it} \quad (3)$$

$$FORT_{it} = \beta_0 + \beta_1 Treated_i \times Post_t + \beta_2 Treated_i + \beta_3 Post_t + \rho' \cdot X_{it} + \gamma_i + \mu_t + \varepsilon_{it} \quad (4)$$

4. Empirical Analysis

4.1. Descriptive Statistics

Table 2 provides descriptive statistics for all variables, and the results show that the average analyst prediction error for the dependent variable is 0.514, with a minimum value of 0 and a maximum value of 2.518, indicating significant fluctuations in analyst prediction errors among different companies; The average optimistic bias of the dependent variable analyst is 0.422, with a minimum value of -0.731 and a maximum value of 2.478, indicating that the analyst tends to overestimate earnings per share; The average value of the interaction term of the explanatory variable is 0.128, representing 13% of the total sample of companies participating in ESG rating.

Table 2. Descriptive Statistics of Variables

Variable	Observations	Average value	Standard deviation	Minimum value
FERROR	9585	0.514	0.594	0
FOPT	9585	0.422	0.691	-0.731
Treated × *Post*	9585	0.128	0.334	0
FSIZE	9585	3.835	1.301	1.469
FAGE	9585	16.74	5.605	2
LEV	9585	0.430	0.206	0.049
ROE	9585	0.045	0.0490	-0.140
GROWTH	9585	0.182	0.358	-0.458
BM	9585	1.044	1.053	0.106
PE	9585	66.08	114.7	-79.84
INHOLD	9585	0.457	0.248	0.005
*TOP*10	9585	0.586	0.144	0.258
BOARD	9585	8.790	1.735	4
DUAL	9585	0.256	0.436	0
SOE	9585	0.400	0.490	0
*BIG*4	9585	0.064	0.245	0

4.2. Pearson Correlation Analysis

Table 3 shows the Pearson correlation coefficients between variables. The analyst prediction bias and analyst optimism error of the dependent variable are significantly negatively correlated with the

interaction term of the explanatory variable, preliminarily verifying the research hypothesis H1. Except for a significant positive correlation between company size and company leverage with a coefficient greater than 0.5, the absolute correlation coefficients between other variables are all less than 0.5. In the VIF test of the main regression, the coefficient of variance inflation is 1.80, indicating that the variables selected in this article do not have serious multicollinearity issues.

Table 3. Pearson correlation analysis of variables

	FERROR	*FORT*	*Treat × Post*	*FSIZE*	*FAGE*	*LEV*	*ROA*	*GROWTH*
FERROR	1							
FORT	0.885***	1						
Treat × Post	-0.037***	-0.061***	1					
FSIZE	-0.048***	-0.064***	0.367***	1				
FAGE	0.038***	-0.00100	0.217***	0.229***	1			
LEV	0.100***	0.055***	0.089***	0.582***	0.191***	1		
ROA	-0.479***	-0.423***	0.043***	-0.122***	-0.073***	-0.395***	1	
GROWTH	-0.157***	-0.194***	0.00500	-0.057***	-0.041***	0.030***	0.187***	1
BM	0.058***	0.026***	0.126***	0.654***	0.152***	0.634***	-0.315***	-0.048***
PE	0.416***	0.363***	-0.071***	-0.168***	-0.018*	-0.060***	-0.169***	-0.036***
INHOLD	-0.131***	-0.123***	0.091***	0.434***	0.066***	0.288***	0.058***	0
*TOP*10	-0.134***	-0.102***	-0.0110	0.101***	-0.202***	-0.048***	0.168***	0.074***
BOARD	-0.046***	-0.044***	0.032***	0.290***	0.024**	0.180***	-0.0130	-0.045***
DUAL	0.0150	0.020*	-0.044***	-0.197***	-0.118***	-0.134***	0.042***	0.037***
SOE	-0.031***	-0.050***	0.073***	0.419***	0.171***	0.331***	-0.097***	-0.078***
*BIG*4	-0.064***	-0.065***	0.046***	0.351***	0.051***	0.136***	0.019*	-0.036***
	BM	*PE*	*INST*	*TOP*10	*B SIZE*	*DUAL*	*SOE*	*BIG*
BM	1							
PE	-0.142***	1						
INHOLD	0.250***	-0.085***	1					
*TOP*10	0.030***	-0.087***	0.460***	1				
BOARD	0.188***	-0.058***	0.244***	0.025**	1			
DUAL	-0.150***	0.036***	-0.212***	0.0120	-0.200***	1		
SOE	0.332***	-0.028***	0.467***	-0.0110	0.309***	-0.290***	1	
*BIG*4	0.198***	-0.064***	0.227***	0.155***	0.135***	-0.077***	0.162***	1

Notes:*p<0.1,**p<0.05,***p<0.01

4.3. Endogeneity Analysis

The inclusion of enterprises in ESG ratings is likely to be a non random process, which may lead to sample selection bias. Generally speaking, good companies with ESG ratings are more likely to be noticed by analysts, and their financial performance is often better. This section conducted descriptive statistics on all variables for the experimental group and the control group, respectively, and the results are shown in Table 4. Compared to companies that did not participate in ESG rating, analysts

from companies that participated in the rating have higher accuracy in predicting, which is basically consistent with the theoretical assumptions in this article. In terms of controlling variables, companies participating in ESG ratings have larger asset sizes, stronger profitability, higher institutional investor shareholding ratios, book to market ratios, and lower P/E ratios. In terms of corporate governance, the top ten shareholders and board size of companies participating in the rating process have a higher proportion of shares, but there are fewer cases of dual roles, and the proportion of audits by the four major accounting firms is higher. In terms of property rights, the proportion of Chinese owned enterprises participating in the rating is much higher than that of companies not participating in the rating. The above differences indicate that there is a correlation between whether a company participates in ESG ratings and its own characteristics, which can also affect the accuracy of analyst earnings forecasts.

In order to alleviate endogeneity issues, this article has added control variables regarding company characteristics to the model and controlled for annual fixed effects and industry fixed effects. In order to better identify the causal relationship between the independent and dependent variables, this article adopts a double difference model as the benchmark model and regards green finance policies as exogenous shocks. Under the green finance policy, China will place greater emphasis on ESG information disclosure and related practices, and companies participating in ESG ratings are more susceptible to the impact of this policy compared to other companies.

Table 4. Descriptive statistics of grouping by participation in ESG rating

group	Not participating in ESG rating (*N* =4054)		Participate in ESG rating (*N* =5531)	
variable	average value	median	average value	median
FERROR	0.576	0.308	0.429	0.190
FORT	0.491	0.211	0.328	0.106
FSIZE	3.167	3.140	4.745	4.657
FAGE	16.57	16	16.97	17
LEV	0.383	0.369	0.493	0.508
ROA	0.041	0.040	0.051	0.042
GROWTH	0.189	0.125	0.171	0.116
BM	0.808	0.584	1.366	0.886
PE	76.26	39.92	52.19	26.21
INHOLD	0.375	0.384	0.568	0.598
*TOP*10	0.575	0.583	0.601	0.606
BOARD	8.439	9	9.268	9
DUAL	0.317	0	0.171	0
SOE	0.263	0	0.587	1
*BIG*4	0.017	0	0.128	0

4.4. Main Regression Analysis

To test hypothesis H1 and examine whether corporate participation in ESG ratings after the implementation of green finance policies will significantly improve the accuracy of analyst earnings forecasts, this article conducts empirical regression based on equation (3), and the regression results are shown in Table 5.

Table 5. The Impact of ESG Ratings on Analyst's Predictive Performance

	(1)	(2)	(3)	(4)	(5)	(6)
	FERROR	*FERROR*	*FERROR*	*FORT*	*FORT*	*FORT*
Treated × Post	-0.005	-0.044*	-0.056**	-0.013	-0.066**	-0.082***
	(0.030)	(0.023)	(0.023)	(0.033)	(0.026)	(0.026)
Treated	-0.141***	0.014	0.005	-0.163***	0.024	0.015
	(0.019)	(0.018)	(0.018)	(0.020)	(0.021)	(0.022)
Post	0.044**	0.092***	0.094***	-0.042*	0.017	0.014
	(0.019)	(0.016)	(0.032)	(0.022)	(0.019)	(0.038)
FSIZE		-0.010	-0.001		-0.002	0.015
		(0.008)	(0.009)		(0.010)	(0.010)
FAGE		0.000	0.001		-0.001	-0.000
		(0.001)	(0.001)		(0.001)	(0.001)
LEV		-0.046	-0.011		-0.131**	-0.109**
		(0.043)	(0.044)		(0.051)	(0.053)
ROA		-4.979***	-5.036***		-5.538***	-5.716***
		(0.160)	(0.163)		(0.182)	(0.186)
GROWTH		-0.124***	-0.136***		-0.236***	-0.255***
		(0.016)	(0.016)		(0.019)	(0.019)
BM		0.013	0.014		0.001	-0.005
		(0.009)	(0.010)		(0.010)	(0.012)
PE		0.002***	0.002***		0.002***	0.002***
		(0.000)	(0.000)		(0.000)	(0.000)
INHOLD		-0.100***	-0.121***		-0.130***	-0.154***
		(0.031)	(0.031)		(0.034)	(0.035)
*TOP*10		-0.003	0.017		0.090	0.131**
		(0.049)	(0.049)		(0.057)	(0.057)
BOARD		-0.001	-0.001		-0.002	-0.001
		(0.003)	(0.003)		(0.004)	(0.004)
DUAL		-0.004	-0.002		0.002	0.005
		(0.013)	(0.013)		(0.015)	(0.016)
SOE		-0.038**	-0.043***		-0.079***	-0.084***
		(0.015)	(0.016)		(0.017)	(0.018)
*BIG*4		-0.034	-0.029		-0.064**	-0.073***
		(0.024)	(0.025)		(0.025)	(0.027)
_cons	0.558***	0.727***	0.939***	0.508***	0.743***	0.987***
	(0.013)	(0.051)	(0.077)	(0.014)	(0.060)	(0.089)
industry FE			YES			YES
Year FE			YES	9584	9584	9584
N	9584	9584	9584	0.015	0.308	0.336
adj.R^2	0.016	0.360	0.382	0.014	0.306	0.329

Notes: *p<0.1, **p<0.05, ***p<0.01

Firstly, regress the analyst's prediction error ($FERROR$), and the regression results are shown in columns (1) - (3). Column (1) represents the regression results without control variables and fixed effects, where the coefficient of the interaction term is not significant; After adding control variables in column (2), the coefficient of the interaction term is significantly negative at a 90% confidence level, which preliminarily verifies the validity of hypothesis H1; Column (3) further controls for industry fixed effects and annual fixed effects, and the coefficient of the interaction term remains significantly negative at a 95% confidence level. The results indicate that after the implementation of green finance policies, companies participating in ESG ratings saw a decrease of 0.056 in analyst earnings prediction error compared to companies not participating in ratings, which is equivalent to 11% of the average level (0.514). Columns (4) - (6) show the regression results of analyst optimistic bias (FOPT). In the regression that only considers control variables and fixed effects, without considering control variables, the coefficient of the interaction term is not significant. In the regression that considers control variables and fixed effects, the coefficient of the interaction term is significantly negative, indicating that after the implementation of green finance policies, companies participating in ESG ratings will also improve their analyst earnings optimistic bias compared to companies not participating in the rating, reducing it by 0.082.

The above regression results indicate that after the implementation of green finance policies, corporate participation in ESG ratings can significantly improve the accuracy of analyst earnings forecasts, which verifies the validity of hypothesis H1.

4.5. Robustness Testing

4.5.1. Parallel Trend Test

The use of the double difference model requires satisfying the "parallel trend hypothesis", which requires the experimental group and the control group to have the same trend change at the forefront of the event occurrence. Dynamic effects testing is a commonly used testing method, which generates time dummy variables for the pre policy period, constructs interaction terms with grouped dummy variables, and introduces them as explanatory variables into the model for regression. If the interaction coefficient in the pre policy period is not significant, it indicates that there was no significant difference between the experimental group and the control group, which is consistent with a "parallel trend"; If the coefficient of the interaction term in the post policy period indicates that the policy shock has had an effect. This article constructs an interaction term for three years before and after the policy for regression analysis.

4.5.2. Replace the Dependent Variable

To replace the dependent variable, this article measures analyst earnings forecast bias by the median of all analyst earnings forecast biases within the same company, and measures analyst earnings forecast optimism bias by the median of all analyst earnings forecast optimism biases. Based on the main regression models (1) and (2), regression is performed using the recalculated prediction bias and optimism bias, and the coefficients of the interaction terms are significantly negative, further supporting hypothesis H1 in this article.

4.5.3. Replace Explanatory Variables

Different rating agencies may provide different rating results. To conduct robustness tests, this article uses ESG rating data from Shangdao Ronglv to reconstruct explanatory variables for main regression. Due to the fact that the agency started rating in 2015, the sample interval was selected from 2015 to 2022. The regression results showed that the interaction coefficient was significantly negative, further supporting the hypothesis H1 in this paper.

4.5.4. Placebo Test

This article conducted placebo tests using pre policy time and randomly generated experimental groups. Firstly, the policy time was advanced to 2012, 2013, 2014, and 2015, and new interaction

coefficient coefficients were generated to regress the benchmark model. It was found that the interaction coefficient coefficients were no longer significant, indicating that the regression results of this article were not accidental. Afterwards, 500 random draws and regressions were conducted. All indicate that the regression results are not caused by other random factors, therefore the placebo test passed.

5. Further Analysis

5.1. Mechanism Verification

The previous text has preliminarily demonstrated that the participation of enterprises in ESG ratings after the implementation of green finance policies can significantly improve the accuracy of analyst earnings forecasts. Next, further mechanism testing will be conducted to analyze the underlying impact mechanisms. Based on the previous theoretical analysis, it can be concluded that corporate participation in ESG rating may improve analyst prediction accuracy by increasing analyst attention and information disclosure quality, and corresponding hypotheses H2a and H2b have been proposed. Based on this, this article adopts the stepwise regression method for mechanism testing. Firstly, regression will be performed on model (3) to test the impact of enterprise participation in ESG rating on mediating variables; Then perform regression on model (4) to test the impact of enterprise participation in ESG ratings and mediating variables on the accuracy of analyst earnings forecasts. The model follows the following formula:

$$Mediate_{it} = \lambda_0 + \lambda_1 Treated_i \times Post_t + \lambda_2 Treated_i + \lambda_3 Post_t + \rho' \cdot X_{it} + \gamma_i + \mu_t + \varepsilon_{it} \quad (5)$$

$$FERROR_{it} / FOPT_{it} = \alpha_0 + \alpha_1 Treated_i \times Post_t + \alpha_2 Treated_i + \alpha_3 Post_t + \alpha_4 Mediate_{it} + \rho' \cdot X_{it} + \gamma_i + \mu_t + \varepsilon_{it} \quad (6)$$

Among them, $Mediate_{it}$ is the mediating variable, representing analyst attention $AFOLLOW_{it}$ and information disclosure quality $OPACITY_{it}$. This article obtained the number of tracking analysts for listed companies each year from the Guotai An database. The analyst attention was measured by adding 1 to the number of analysts and taking the natural logarithm. A large number of tracking analysts indicates high analyst attention. Referring to the research of Sun Guangguo et al. (2022) [13], the quality of information disclosure is measured by the evaluation results of information disclosure published by the exchange. The evaluation results are divided into "excellent", "good", "qualified", and "unqualified". This article assigns them a value of 4 to 1 in sequence. The larger the value, the higher the transparency of company information disclosure and the better the quality of information disclosure.

Table 6 reports the results of mechanism testing. The coefficient of the interaction term in column (1) is significantly positive at the 1% level, indicating that after the implementation of green finance policies, companies participating in ESG rating have significantly increased their analyst attention compared to companies not participating in the rating; The coefficient of the interaction term in column (2) is significantly positive at the 1% level, indicating that after the implementation of green finance policies, enterprises participating in ESG ratings have higher quality of information disclosure; Columns (3) and (4) are regression results for analyst prediction errors. The coefficients of analyst attention and interaction term are significantly negative, while the coefficients of information disclosure quality and interaction term are significantly negative. Columns (5) and (6) are regression results for analyst optimistic bias. The coefficients of analyst attention become significantly positive, the coefficients of information disclosure quality are significantly negative, and the coefficients of interaction term are significantly negative. The above results indicate that corporate participation in ESG ratings under green finance policies can increase analyst attention and further reduce analyst prediction errors. However, this mechanism will increase analyst optimistic bias.

Table 6. Analyst attention mechanism testing

	(1)	(1)	(3)	(2)	(5)	(3)
	AFOLLOW	*OPACITY*	*FERROR*	*FERROR*	*FORT*	*FORT*
AFOLLOW			-0.022***		0.040***	
			(0.008)		(0.009)	
OPACITY				-0.015***		-0.013**
				(0.004)		(0.005)
Treated × Post	0.169***	1.223***	-0.050**	-0.038*	-0.082***	-0.066**
	(0.031)	(0.082)	(0.021)	(0.021)	(0.027)	(0.027)
Treated	0.118***	-0.653***	0.003	-0.005	0.008	0.007
	(0.023)	(0.091)	(0.016)	(0.016)	(0.022)	(0.022)
Post	-0.514***	0.743***	0.086***	0.105***	0.027	0.024
	(0.043)	(0.095)	(0.031)	(0.031)	(0.038)	(0.038)
FSIZE	0.329***	-0.115***	-0.002	-0.002	0.000	0.013
	(0.011)	(0.040)	(0.008)	(0.008)	(0.011)	(0.010)
FAGE	-0.016***	-0.020***	0.001	0.001	0.000	-0.001
	(0.002)	(0.005)	(0.001)	(0.001)	(0.001)	(0.001)
LEV	0.092*	-0.723***	-0.006	-0.022	-0.109**	-0.119**
	(0.054)	(0.155)	(0.040)	(0.040)	(0.054)	(0.052)
ROA	5.708***	3.677***	-5.078***	-4.980***	-5.993***	-5.669***
	(0.185)	(0.447)	(0.143)	(0.137)	(0.195)	(0.186)
GROWTH	0.097***	0.027	-0.139***	-0.135***	-0.264***	-0.255***
	(0.023)	(0.037)	(0.015)	(0.015)	(0.019)	(0.019)
BM	-0.185***	0.096***	0.013	0.015*	0.002	-0.003
	(0.012)	(0.035)	(0.009)	(0.009)	(0.012)	(0.012)
PE	-0.000***	-0.000***	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
PE	0.249***	-0.237**	-0.120***	-0.125***	-0.164***	-0.157***
	(0.043)	(0.107)	(0.029)	(0.028)	(0.035)	(0.035)
*TOP*10	-0.245***	0.846***	0.002	0.030	0.124**	0.142**
	(0.066)	(0.197)	(0.043)	(0.043)	(0.057)	(0.057)
BOARD	0.016***	0.011	-0.002	-0.001	-0.002	-0.001
	(0.004)	(0.017)	(0.003)	(0.003)	(0.004)	(0.004)
DUAL	0.094***	0.165***	-0.005	0.000	0.000	0.008
	(0.017)	(0.047)	(0.012)	(0.012)	(0.016)	(0.016)
SOE	-0.228***	-0.181**	-0.046***	-0.045***	-0.078***	-0.086***
	(0.020)	(0.072)	(0.013)	(0.013)	(0.018)	(0.018)
*BIG*4	0.033	-0.190	-0.023	-0.032	-0.068**	-0.075***
	(0.032)	(0.140)	(0.019)	(0.020)	(0.027)	(0.027)
_cons	1.113***	2.192***	0.954***	0.972***	0.776***	1.015***
	(0.102)	(0.393)	(0.083)	(0.083)	(0.089)	(0.089)
industry FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
N	9491	9585	9490	9584	9584	9584
adj.R^2	0.396	0.359	0.394	0.382	0.336	0.330

Notes: *p<0.1, **p<0.05, ***p<0.01

Table 7. Heterogeneity testing of company property rights

	FERROR		*FORT*	
	Non state-owned enterprises	state-owned enterprises	Non state-owned enterprises	state-owned enterprises
Treated × Post	-0.060**	-0.047	-0.086**	-0.087*
	(0.030)	(0.040)	(0.034)	(0.049)
Treated	0.015	-0.002	0.027	0.013
	(0.024)	(0.027)	(0.029)	(0.032)
Post	0.143***	-0.009	0.079	-0.077
	(0.041)	(0.055)	(0.048)	(0.066)
FSIZE	0.006	-0.005	0.021	0.013
	(0.013)	(0.013)	(0.016)	(0.014)
FAGE	0.001	0.001	-0.001	-0.002
	(0.002)	(0.002)	(0.002)	(0.002)
LEV	-0.074	0.064	-0.177***	-0.011
	(0.056)	(0.076)	(0.068)	(0.087)
ROA	-5.301***	-4.453***	-6.080***	-5.019***
	(0.202)	(0.282)	(0.233)	(0.314)
GROWTH	-0.161***	-0.089***	-0.280***	-0.215***
	(0.020)	(0.027)	(0.024)	(0.032)
BM	0.005	0.018	-0.000	-0.007
	(0.016)	(0.013)	(0.019)	(0.016)
PE	0.002***	0.002***	0.002***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
INHOLD	-0.099***	-0.633***	-0.138***	-0.539***
	(0.033)	(0.148)	(0.037)	(0.188)
*TOP*10	0.045	0.494***	0.213***	0.401*
	(0.059)	(0.164)	(0.068)	(0.209)
BOARD	-0.000	-0.001	0.001	-0.001
	(0.005)	(0.005)	(0.006)	(0.006)
DUAL	0.009	-0.025	0.016	-0.027
	(0.015)	(0.029)	(0.018)	(0.034)
*BIG*4	0.008	-0.038	-0.033	-0.085***
	(0.050)	(0.028)	(0.056)	(0.029)
_cons	0.850***	0.941***	0.791***	1.022***
	(0.090)	(0.114)	(0.098)	(0.132)
industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	5749	3835	5749	3835
adj.R^2	0.377	0.398	0.346	0.303

Notes: *p<0.1, **p<0.05, ***p<0.01

At the same time, under the green finance policy, companies participating in ESG ratings have more comprehensive information disclosure, thereby improving the accuracy of analyst earnings forecasts, manifested in reducing analyst prediction errors and optimistic biases.

5.2. Heterogeneity Analysis

5.2.1. Classification by Property Rights Nature

Many studies have found that the ESG performance of non-state-owned enterprises has a more significant positive impact on corporate performance and value compared to state-owned enterprises (Li Jinglin et al., 2021; Wang Linlin et al., 2022). In China, state-owned enterprises often have a stronger motivation to fulfill their ESG responsibilities due to their political and social attributes. The capital market is less sensitive to their ESG performance, while non-state-owned enterprises are more sensitive to their ESG performance. Therefore, analysts may pay more attention to the ESG performance and ratings of non-state-owned enterprises, There should be heterogeneity in the impact of ESG ratings on state-owned and non-state-owned enterprises. In addition, Zhong Jianyi [9] and Chen Fuyong (2023) found that the implementation of the Shanghai Hong Kong Stock Connect has a more positive effect on the accuracy of earnings forecasts for non-state-owned enterprise analysts than for state-owned enterprises. The Shanghai Hong Kong Stock Connect policy can reduce the cost of information collection for enterprises, and its impact is more significant on smaller and higher cost non-state-owned enterprises. Therefore, ESG rating, as an important signaling behavior, can also reduce the "information gathering cost" of investors for listed companies. Compared to state-owned enterprises with stricter regulation and more complete information, The impact of ESG ratings on the accuracy of earnings forecasting may be more significant in non-state-owned enterprises.

Based on the information on the property rights of enterprises in the Guotai An database, this article grouped the sample companies into non-state-owned enterprises and state-owned enterprises for regression analysis. The regression results are shown in Table 7. For analyst prediction errors, the coefficient of the interaction term is significantly negative in non-state-owned enterprises, but not significant in state-owned enterprises, indicating that after the implementation of green finance policies, participating in ESG ratings has a greater positive impact on the accuracy of earnings prediction in non-state-owned enterprises than in state-owned enterprises. This may be because analysts pay more attention to the ESG ratings of non-state-owned enterprises, and the impact of improving information disclosure quality has a greater marginal effect on non-state-owned enterprises with higher "information collection costs". For analyst optimism bias, the coefficients of the interaction term are significantly negative, indicating that there is no significant difference in the correction effect of ESG rating on analyst optimism bias between the two groups of companies.

5.2.2. Classify ESG Sensitivity by Industry

Li Jinglin et al. (2021) found that the ESG performance of "ESG sensitive" industries has a significant impact on corporate performance compared to "non ESG sensitive" industries, and the market pays more attention to the ESG performance of "ESG sensitive" industries. It can be seen that the impact of obtaining ESG ratings on the analyst attention of listed companies may vary depending on their industry, which in turn can affect the accuracy of earnings forecasts for companies in that industry. This section will investigate the heterogeneity of the impact of ESG ratings of listed companies in different industries on the accuracy of analyst earnings forecasts.

The definition of "ESG sensitive" industries in this article refers to the methods of Dabbebi et al. (2022) and other articles. Industries such as mining, power, and manufacturing where analysts pay more attention to their ESG performance and have stricter environmental regulations are defined as "ESG sensitive" industries, while the rest are "non ESG sensitive" industries. The impact of each group's ESG ratings on the accuracy of analyst earnings forecasts is tested separately. The regression results are shown in Table 8. For analyst prediction errors, the coefficient of the interaction term is significantly negative in the "ESG sensitive" industry group, while it is not significant in the "non ESG sensitive" industry group.

Table 8. Industry ESG Sensitivity Heterogeneity Test

	FERROR		*FORT*	
	Low ESG sensitivity	High ESG sensitivity	Low ESG sensitivity	High ESG sensitivity
Treated × *Post*	-0.041	-0.055**	-0.078	-0.079***
	(0.054)	(0.025)	(0.061)	(0.029)
Treated	-0.049	0.013	-0.050	0.030
	(0.044)	(0.020)	(0.052)	(0.023)
Post	0.115	0.086**	0.050	0.004
	(0.094)	(0.035)	(0.112)	(0.040)
FSIZE	0.020	-0.004	0.047	0.008
	(0.026)	(0.010)	(0.030)	(0.011)
FAGE	-0.005*	0.003*	-0.010***	0.001
	(0.003)	(0.001)	(0.003)	(0.001)
LEV	-0.127	0.016	-0.196	-0.097*
	(0.105)	(0.049)	(0.133)	(0.056)
ROA	-5.160***	-4.992***	-5.968***	-5.694***
	(0.374)	(0.187)	(0.391)	(0.215)
GROWTH	-0.137***	-0.139***	-0.229***	-0.266***
	(0.033)	(0.019)	(0.042)	(0.022)
BM	0.020	0.011	0.024	-0.009
	(0.029)	(0.011)	(0.032)	(0.013)
PE	0.001***	0.002***	0.001***	0.002***
	(0.000)	(0.000)	(0.000)	(0.000)
INHOLD	-0.103	-0.122***	-0.136	-0.154***
	(0.078)	(0.034)	(0.087)	(0.038)
*TOP*10	-0.166	0.039	-0.050	0.154**
	(0.117)	(0.054)	(0.134)	(0.062)
BOARD	-0.006	-0.001	-0.013	0.001
	(0.009)	(0.004)	(0.011)	(0.004)
DUAL	0.005	-0.002	0.009	0.009
	(0.030)	(0.015)	(0.036)	(0.017)
SOE	-0.086**	-0.032*	-0.111***	-0.076***
	(0.035)	(0.017)	(0.038)	(0.020)
*BIG*4	-0.090	-0.022	-0.101	-0.072***
	(0.079)	(0.026)	(0.092)	(0.028)
_cons	1.260***	0.775***	1.310***	0.910***
	(0.151)	(0.142)	(0.178)	(0.153)
industry FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
N	1689	7895	1689	7895
adj.R^2	0.413	0.379	0.344	0.329

Notes: *p<0.1, **p<0.05, ***p<0.01

This indicates that after the implementation of green finance policies, the positive impact of participating in ESG rating on the accuracy of earnings prediction for "ESG sensitive" industry enterprises is more significant. The regression of optimistic bias in earnings prediction also obtains similar conclusions, indicating that participating in ESG rating has a significantly better correction effect on analyst optimistic bias in "ESG sensitive" industries than in "non ESG sensitive" industries.

6. Conclusion and Inspiration

This article explores the relationship between the participation of listed companies in ESG ratings and the accuracy of analyst earnings forecasts from the perspective of implementing domestic green finance policies. This article takes A-share listed companies in China from 2012 to 2022 as the research object, with the accuracy of analyst earnings forecasts as the dependent variable and the 2016 green finance policy as an exogenous shock, and constructs a double difference model for empirical research.

Research has found that after the implementation of green finance policies, companies participating in ESG ratings have higher analyst prediction accuracy, manifested as lower analyst prediction errors and optimistic biases. In the mechanism testing, it was found that enterprise analysts participating in ESG rating have higher attention and more sufficient information disclosure, thus having higher accuracy in analyst earnings prediction. This article also examines the impact of corporate heterogeneity. After the implementation of green finance policies, the positive impact of participating in ESG ratings on analyst prediction accuracy is more significant in non-state-owned enterprises and ESG sensitive industries. The research results of this article indicate that green finance policies can help enhance the value of ESG rating information in China's capital market. This is reflected in the fact that enterprises participating in ESG rating can receive more market attention and provide higher quality information disclosure, thereby optimizing the capital market information environment and helping analysts and investors to better evaluate performance and make investment decisions.

Since the implementation of the Guiding Opinions on Building a Green Finance System, the construction of the green finance system has gradually begun, and the mandatory environmental information disclosure system for listed companies has been gradually established. Market participants are increasingly concerned about the ESG performance and rating of listed companies, ESG related information disclosure has also enriched the total amount of information disclosure of listed companies, and analysts have more accurate earnings forecasts for companies with ESG ratings after policy implementation. Therefore, this article has the following policy implications. For regulatory agencies, they should further implement green finance related policies, gradually promote the establishment of ESG mandatory and voluntary information disclosure systems, in order to improve the overall quality of market information disclosure. These measures can also better achieve the role of secondary market value discovery. For analysts, ESG information disclosure should be fully utilized in order to better evaluate the performance of the enterprise. For listed companies, they should increase investment in environmental, social, and corporate governance, improve ESG performance, and strengthen ESG information disclosure.

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