Analysis of the Impact of Social Concern on Corporate Responsibility Based on Panel Model and Machine Learning Model

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Abstract: This paper based on Panel Model and Machine Learning Model explores the impact of social concern on corporate ESG performance by using data of Chinese A-share listed companies and explores the heterogeneous impact of the relationship between social concern and corporate fulfillment of ESG responsibility under different nature of social concern, corporate external and internal environments. This paper find, firstly, the increase of social concern has a significant positive impact on corporate fulfillment of ESG responsibility, and the results are robust. Secondly, negative feedback from the society has a greater effect on the enhancement of corporate ESG performance compared to non-negative feedback from society on corporations. Thirdly, the incentive effect of social concern on firms' ESG responsibility relies not only on good government-market relations but also is related to the independence of corporate directors' decision making. The findings of the article have implications for relying on informal institutions to promote corporate ESG behavior.

1 INTRODUCTION

China's long-standing crude development strategy, while fueling rapid economic growth, has also given rise to various social conflicts, with environmental change, climate warming, and lack of corporate social responsibility arising one after another. China proposed that high-quality development is the primary task of comprehensively building a modern socialist country and the focus of economic development should be placed on the real economy, and puts forward the goals of promoting people's well-being and green and low-carbon development. Under the new normal of China's economic development, the dual objectives of "carbon neutrality and carbon peaking" and the context of Chinese modernization, changing the economic model, and promoting green transformation of production have become the new focus for achieving high-quality development.

As a basic unit in the social economy, enterprises mainly produce what society wants, which plays an important role in the process of achieving high-quality development. Guided by relevant policies and systems, social concern about corporate ESG performance continues to rise, especially in the information age, where the public has a variety of channels to obtain information, and public awareness is becoming a key strategy for addressing the issue of environmental pollution (Qin and Peng, 2016), indicating that the socialization of corporate performance issues requires corporate governance to rely not only on internal company supervision and control, but also to accept social supervision. Independent of the formal legal system, external concerns and evaluations play an important role in corporate information disclosure. Therefore, it is crucial to clarify the potential relationship between social concerns and corporate ESG, and to explore the drivers of corporate ESG performance, in order to promote corporate ESG responsibility and achieve high-quality economic development.

The focus of current corporate ESG research has been on how corporate responsibility for ESG affects financial performance (Chen and Xie, 2022), financial flexibility (Zhang and Liu, 2022), market value and consumer intentions (AI-Haddad et al., 2022). The predominant belief is that corporate ESG performance is an important consideration for stakeholders when deciding whether or not to invest (Du et al., 2010), and that companies tend to increase socially responsible and environmentally friendly

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behaviors in line with stakeholders' demands (Qi et al., 2013), and that fulfilling social and environmental responsibilities can help companies develop a good image and positive evaluation among consumers and investors, increasing consumers' willingness to buy and stakeholders' intention to invest (Pongpaew et al., 2017). The fulfillment of ESG responsibility improves corporate financing capacity, makes stock prices more resilient, provides greater financial flexibility, effectively offsets the negative effects of an uncertain environment (Zhang and Liu, 2022), stabilizes market values, and enables better resilience to economic turbulence However, negative corporate ESG performance can also make them the subject of media attention and regulatory vigilance, which has a negative effect on firm value (Lyon and Maxwell, 2011). Some studies have also concluded that corporate ESG activities are detrimental to the financial performance of firms, because corporate investment in ESG activities has a crowding-out effect on other firm profit-related behaviors, which in turn affects financial performance negatively.

Existing research on the relationship between informal institutions and corporate behavior has focused on the effects of media coverage on corporate innovation (Wang et al., 2019), corporate governance (Dai et al., 2015), environmental protection investment (Cheng and Liu, 2018), social responsibility (Zyglidopoulos et al., 2012) and other unilateral influence, which propose that media coverage not only reduces the information asymmetry between investors, consumers, other stakeholders and the company, but also influences public opinion and helps the public to form rational perceptions and evaluations of the company (Du et al., 2010). And when external stakeholders express their demands through media and public attention, it creates more pressure on the company, thus forcing the company to change behavior (Shipilov et al., 2019), increase innovation activities, and improve innovation performance (Wang et al., 2019). Hales et al. (2018) showed that the behavior of company employees posting on social media motivates companies to increase the importance of financial disclosure, and companies are more motivated to carry out corporate reform when they face high levels of attention, reflecting the monitoring role of public attention, while Cheng and Liu (2018) argue that pressures associated with economic development limit the relationship between public attention and corporate environmental performance.

The existing literature mainly focused on the economic impact of corporate ESG responsibility and the impact of external attention on a single dimension of corporate innovation, environmental protection, social responsibility and corporate governance from the media standpoint. However, there is a lack of research on the connection between social concern and corporate ESG performance from the public perspective. Based on this, this paper examines the precise impact of social concern on corporate ESG performance based on the public participation perspective, as well as explores the internal and external channels that motivate corporate ESG performance under social concern. The potential innovations of this paper are: first, on the basis of information from Chinese A-share listed companies' GUBA postings, we explore the specific impact of social concerns on ESG performance of Chinese listed companies; second, we further classify social concerns into positive and negative evaluations and discuss the heterogeneous effects of different types of social concerns on corporate ESG performance; finally, from the perspective of internal and external environments of companies, we explore the role of social concerns in ways to motivate companies to fulfill their ESG responsibilities.

The remainder of the paper is divided into the following sections: the second part presents the research design; the third part presents the empirical results; the fourth is further analysis; the fifth ends the entire paper and offers pertinent recommendations.

2 EMPIRICAL STRATEGY

2.1 Empirical Model

We use the data of Chinese A-share listed companies from 2008 to 2020 to construct the research sample, and screen out the samples with more missing values and those marked ST, *ST, and PT. Considering the validity of the results, we do not include the financial and insurance companies in the research scope. The data used are obtained from different databases, among which, the data related to social concern come from Chinese Research Data Services Platform, the data of ESG score of listed companies are obtained from Bloomberg, and the other data of companies are mainly obtained from CSMAR database.

2.2 Regression Model

The model is constructed to explore the effect of social concerns on ESG performance.

$$ESG_{it} = \alpha_0 + \alpha_1 Public_{it} + \beta control_{it} + Firm + Industry + Year + Industry * year + \eta_{it} \quad (1)$$

Where, i represents firm; t denotes year; ESG_{it} Indicates firm ESG score; $Public_{it}$ denotes social concern, measured by the logarithm of the number of Gub postings of listed companies. $control_{it}$ denotes the control variables related to the firm's ESG performance, specifically: net profit ratio of total assets (roa); listing time ($list$); gearing ratio (lev); the shareholding ratio of the company's largest shareholder (top); cash flow ratio ($cash$). $Firm$, $Industry$, $Year$ and $Industry * year$ denote firm fixed effects, industry fixed effects, year fixed effects and industry-year fixed effects, respectively.

2.3 Random Forest Model

In previous studies econometric regression models are mostly linear models with stringent requirements for correlations between explanatory variables and suffer from weak overall explanatory strength and are limited by the model's own assumptions. This paper therefore innovatively introduces a random forest model in machine learning to verify the relationship between social concerns and corporate ESG performance, and to rank the importance of the explanatory variables to further identify the key factors affecting corporate ESG.

$$ESG_{it} = \Theta(Public_{it}, control_{it}, \lambda_i, \eta_{it}, \mu_{it}) \quad (2)$$

The definitions of the variables ESG_{it}、$Public_{it}$ and $control_{it}$ remain the same as in Section 2.2, λ_i and η_t denote the inclusion of individual and time dummy variables, $\mu_{it}$is residuals. $\Theta(x)$ describes the non-linear relationship between the effect of social concern and control variables on the ESG scores of firms. At the same time, we further describe the marginal effect of social concern on digital finance by inscribing a skewed dependency plot with the expression.

$$\widehat{\Theta}(x) = \frac{1}{n}\sum_{j=1}^{n} f(x_{j1}, x_{j2}, \ldots x_{jp}) \quad (3)$$

3 EMPIRICAL RESULTS

3.1 Regression Results

The regression results for model (1) are shown in Table 1. Columns (1) and (2) report the coefficient of social concern is positive at the 1% significance level. When including control variables. Columns (3) and (4) indicate that the positive relationship between social concern and corporate ESG performance remains significant, indicating that social concern has a certain incentive effect on corporate ESG responsibility. The increase in social concern creates more pressure on companies, and with the gradual increase in public demands for environmental protection and social responsibility, etc., in order to enhance public reputation, build brand effect, increase consumers' willingness to purchase, and attract investors (Zhang and Liu, 2022), companies are more inclined to make actions that are in line with stakeholders' and consumer interests (Qi et al., 2013), thus changing their existing strategies and increasing their motivation to fulfill their ESG responsibilities; therefore, the increase in social concern has a significant positive incentive effect on corporate ESG performance.

Table 1: Baseline regression.

	(1)	(2)	(3)	(4)
public	0.291***	0.266***	0.226***	0.206***
	(0.065)	(0.065)	(0.066)	(0.066)
Control variables	No	Yes	Yes	Yes
Firm-fixed effect	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes
Industry-fixed effect	No	No	Yes	Yes
Industry-year fixed effect	No	No	No	Yes
Observation	10303	10293	10292	10292

3.2 Robust Tests

A number of robust tests are carried out in the paper to make sure the results are valid and reliable. Firstly, in order to eliminate the possible influence of the pre-late correlation of the explanatory variables, the explanatory variables were included in the regression equation with one period lag (Fang et al., 2015); secondly, in addition to the number of posts in the GUBA of the listed company to measure the social concern, this paper also used the reading of the posts in the GUBA of the listed company and the number of comments, which were logarithmically re-examined; thirdly, all variables are subjected to 1% winsorized to remove the impact of extreme values of the sample. The results of robustness test are displayed in Table 2. Results of the one-period lag of explanatory variables included in the regression equation are displayed in column (1); columns (2) and (3) report the regression results of social concern measured by the number of posts read and comments, respectively; column (4) indicates the regression results after 1% winsorized of the data. The findings demonstrate that the social concern coefficients pass all four robust tests with considerably positive values, which is in line with the baseline results.

Table 2: Robustness Test Results.

	(1)	(2)	(3)	(4)
public	0.172***	0.204***	0.120**	0.245***
	(0.059)	(0.063)	(0.052)	(0.066)
Control variables	Yes	Yes	Yes	Yes
Firm-fixed effect	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes
Industry-fixed effect	Yes	Yes	Yes	Yes
Industry-year fixed effect	Yes	Yes	Yes	Yes
Observation	9061	10292	10292	10292
R^2	0.853	0.768	0.768	0.768

4 FUTHER ANALYSIS

4.1 Heterogeneity of the Nature of Social Concerns

To test the heterogeneity of the impact of different nature of social concerns on corporate ESG, this paper regresses the total number of posts into negative and non-negative posts according to the content of the postings on corporate ESG scores, respectively, and columns (1) and (2) display the outcomes. As we can observe, negative concerns have a considerable positive impact on ESG both when control variables are present and absent. While non-negative attention has an insignificant effect on corporate ESG. This is consistent with Cyert and March (1963). Negative attention creates greater pressure and reputational risk for companies, and that increasing negative feedback is more likely to attract the attention of company decision makers. As social concerns about energy conservation and social events increase, corporates will actively fulfill their social and environmental responsibilities and take actions that benefit consumers and stakeholders to address and resolve negative social evaluations. On the other hand, regulators are more sensitive to negative corporate evaluations, and an increase in negative social feedback will make government regulators more alert to corporate misbehavior, thus acting as a supervisory role for companies to fulfill their ESG responsibilities. Contrarily, it is more possible for corporates to rest on their laurels and not change their current behavior when receive positive or neutral feedback from society. Therefore, negative feedback from society is more likely to motivate companies to fulfill ESG responsibilities and improve their ESG performance.

Table 3: Further analysis.

	(1)	(2)	(3)	(4)
	neg1	neg2	high-ratio	low-ratio
public			0.353***	-0.274**
			(0.078)	(0.138)
non-negative	-0.286	-0.358		
	(0.253)	(0.253)		
negative	0.477**	0.531**		
	(0.233)	(0.233)		
Control variables	NO	Yes	Yes	Yes
Firm-fixed effect	Yes	Yes	Yes	Yes
Year-fixed effect	Yes	Yes	Yes	Yes
Industry-fixed effect	Yes	Yes	Yes	Yes
Industry-year fixed effect	Yes	Yes	Yes	Yes
Observation	10302	10292	7590	2501

R2	0.765	0.768	0.775	0.881

Note: Robust standard errors are presented in parentheses, ***, ** and * indicate the significance at 1%, 5% and 10%, respectively. The same in Table 2 and Table 3.

4.2 Heterogeneity of Internal Environment

Studies have shown that board independence is an effective driver of corporate ESG disclosure, the appointment of independent directors improves corporate decision making (Gordon, 2007), and more focus on corporate social responsibility behavior. To analyze how social concerns differ in their effects on company ESG performance among independence of boards, this paper group the sample according to the median of percentage of independent directors, columns (5) and (6) of Table 3 display the effect of social concerns on ESG performance of samples with higher and lower percentage of independence, respectively. We can know from the results that the coefficient of social concern is positive at the 1% significance level for enterprises with a high ratio of independent directors, while social concern has a major negative impact on corporate ESG scores when there aren't enough independent directors. This indicates that with the increase of social concern, independent directors can go beyond the pursuit of corporate profit to better understand the demands of consumers and other stakeholders, and consciously pay attention to the social, environmental and governance responsibilities of the corporate, thus improving the existing decisions and prompting the corporate to respond to social concern with more positive attitudes and actions, enhancing the benefits of social concern. For companies with a low ratio of independent directors, they pay more attention to corporate profits and managers' interests than stakeholders' interests, thus, it is not conducive to social concerns to play a supervisory role, resulting in the inhibitory effect of social concerns on corporate ESG performance.

4.3 Machine Learning Model Analysis

This section uses a regression tree as the basic learner and the minimum mean square error as the optimisation criterion to select split nodes and construct a Random Forest model to test social concern and corporate ESG performance. The predicted and actual values of the model trend broadly in line with each other, but there is a bias in the case of a few firms with high ESG scores. Figure 1 shows the linear fit of the model predictions to the actual values.

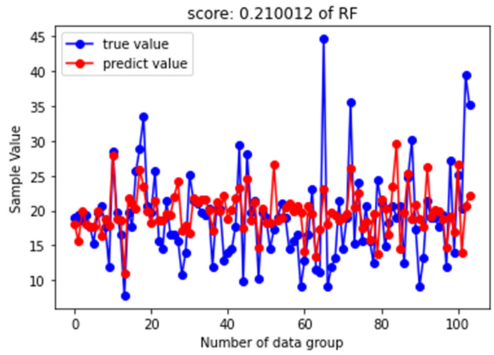

Figure 1: Degree of fit of test values to actual values.

The trained model was used to predict corporate ESG performance using the test set. The importance of each influencing factor in the model is shown in Figure 2. It can be seen that the percentage of shares held by the company's largest shareholder, time to market and social concern are the three most influential factors, far outweighing the influence of other factors, which further validates the causal relationship between social concern and corporate ESG.

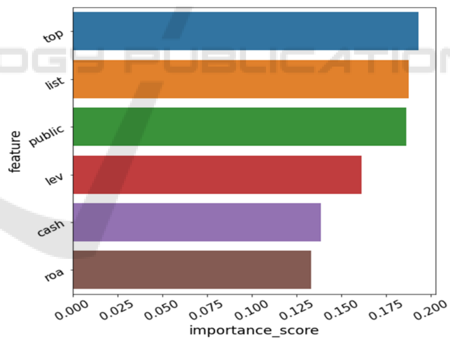

Figure 2: Variable influence ranking.

Figure 3 depicts the biased dependence of social concern on corporate ESG performance. It can be found that the higher the social concern, the higher the corporate ESG score, which indicates that social concern will bring external pressure on corporate operation and decision making, and companies actively or passively spend more time and money to improve corporate ESG performance under the demand of green development and promotion of corporate social responsibility.

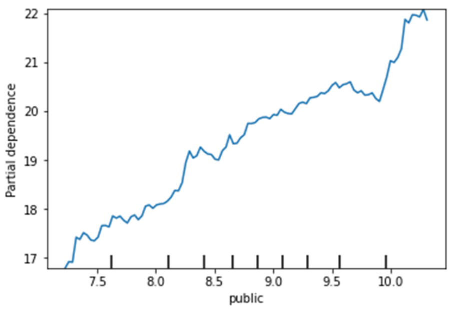

Figure 3: Partial dependent function plot.

5 CONCLUSIONS

The social concern about the fulfillment of corporate ESG responsibilities has gradually increased. The studies on extra-legal systems and corporate responsibility performance have been mainly based on the media perspective, investigating how media coverage affect the single dimension of environmental performance, social responsibility and corporate governance. Therefore, this study based on Panel Model and Machine Learning Model examines the effect of social concern on corporate ESG performance from the viewpoint of the general public using data from Chinese A-share listed companies, employ the number of company stock bar postings to measure social concern, and explores the different impact of social concern on ESG performance in regard to the nature of social concern, internal and external environments. The results of the study demonstrate that, firstly, the growing social concern has a considerable beneficial impact on encouraging corporates to perform ESG obligations, and the findings remain valid after robust tests. Secondly, negative feedback from the public has a greater effect on the enhancement of corporate ESG performance compared to non-negative feedback from society to corporations. Thirdly, the incentive effect of social concern on firms' ESG responsibility relies not only on a good relationship between government and market, but also is related to the independence of corporate directors' decision making.

The study has the following insights: First, under the guidance of China's dual carbon goal, the fulfillment of ESG responsibility by enterprises should not only rely on policy enforcement, but also the incentive effect of the informal system on the fulfillment of responsibility by enterprises should not be ignored. Thereby, the target of government policy implementation should not be limited to enterprises, but also raise public awareness of green development, and use public attention to realize the incentive effect on corporates' fulfillment of ESG responsibility, so as to promote high-quality economic development. Secondly, the public should pay more attention to the negative information of enterprises and use the corporate reputation mechanism to force enterprises to act aligning with the interests of consumers and other stakeholders and take the initiative to fulfill their social, environmental and governance responsibilities, so as to improve their ESG performance. In addition, the government should form a good relationship with the market to create a healthy and high-quality online public opinion environment, increase the transparency of information so that the public can form an objective perception and evaluation of enterprises, ensure the objectivity and accuracy of the content of social concerns, and avoid the phenomenon of rent-seeking behavior and public opinion manipulation by enterprises. Enterprises should also increase the independence of board decisions, appropriately increase the proportion of independent directors, break away from the single goal of pursuing corporate profits, better understand the demands of stakeholders, and improve corporate decision-making, urge enterprises to fulfill their social responsibilities to respond to social concerns with more positive attitudes and actions, thereby strengthening the positive effect of social concerns on corporate ESG performance, which can improve the contribution of enterprises to China's green and high-quality development.

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