ESG, Green Innovation and Corporate Value: A Conditional Process Analysis Moderated by External Pressure

Yixuan Liu[1,a], Wenhua Hou[1,b]

[1] School of Management Science and Real Estate, Chongqing University, Chongqing;

[a] liuyixuan@stu.cqu.edu.cn, [b] whhou@cqu.edu.cn

Abstract. Using 2,372 A-share listed companies from 2009 to 2020 as research samples, this paper empirically examines the effect of corporate ESG performances on corporate value using a conditional process analysis model. The paper finds that: ESG has a significant positive effect on corporate value, and green innovation can partially mediate the path; corporate external pressure, mainly media attention and analysts' attention, can positively moderate the path of ESG on green innovation, and thus positively moderate the mediation effect played by green innovation. This paper concludes that corporate ESG performance and green innovation activities help companies achieve their goals of economic value growth and sustainable development ultimately.

Keywords: ESG; Corporate Value; Green Innovation; External Pressure, Conditional Process Analysis.

1. Introduction

In recent years, faced with the challenges of the continuous downturn of the world economy, the "three-phase superposition" of the domestic economy, and the complex situation of the unprecedented changes of a century, the Communist Party of China (CPC) has put forward the new development philosophy, promoted the economic structure to innovation-driven, and endeavored to achieve economic structure's continuous optimization and upgrading, and promote high-quality and sustainable economic development. In this context, ESG (Environmental, Social and Governance) has gradually become an important focus point reflecting the pursuit of sustainable development by companies and investors. In order to attract the attention of investors and enhance companies' own value, more and more companies improve ESG performance to release the signal of their efforts in sustainable development.

ESG is a new evaluation system that pays comprehensive attention to the sustainable development of companies, which is a key point of achieving high-quality economic development and sustainable development of companies. With the continuous development of ESG evaluation system and the gradual deepening of ESG concept in the process of corporate development strategy and operation management, investors are more and more concerned about corporate ESG performance, and a large number of theoretical and empirical studies of ESG, which mainly focus on the effect between ESG and corporate financial performance, have appeared in academia but still no unified conclusion.

Most scholars, both domestic and foreign, believe that ESG can enhance companies' business performance[1] or market valuation[2], thereby improving corporate value, and that there is a difference in the role of environmental, social and governance on corporate value. The reason is that carrying out ESG activities and disclosing relevant information by companies can not only reduce corporate financing costs by enhancing corporate transparency and mitigating information asymmetry and agency problems, but also enhance corporate reputation, accumulate social capital, and strengthen competitive advantage, increase corporate value by establishing a good image of social responsibility and strengthening friendly relations with stakeholders. Scholars have explored the path and found that there are some factors that mediate the positive relationship between ESG and corporate value, and the positive relationship can be affected by heterogeneity in regional development characteristics and in company property rights.

However, some scholars believe that the greatest social responsibility of companies should be to maximize shareholders' interests, so ESG is negatively correlated with corporate value[3]. The reason is that investing company resources in strong external factors, such as environment and social responsibility, will increase expenses, waste resources, and reduce competitiveness, thereby harm shareholders' interests and reduce corporate value. And the negative relationship is significantly moderated by geographical location and policy environment of the company[4].

There are also few scholars who believe that ESG does not significantly affect corporate value[5], or that this effect has some threshold effect[6] and lagged effect[7].

Existing studies have not yet clarified the effects of ESG on corporate value[6, 8, 9], and most of them are based on companies in mature capital markets in Western countries[10, 11], while a few studies with samples of companies in developing countries have only discussed the effects of ESG on corporate value but not deeply exploring the path[4, 12]. In order to clarify the effects and paths of ESG on corporate value of listed companies in emerging capital markets in developing countries, for example, Chinese A-share market, and to examine the roles of local green development policies and other participants in the capital market, this paper constructs a conditional process analysis model[13] that includes both mediating and moderating components, firstly introducing green innovation and external pressure into the relationship of ESG on corporate value. Finally, the paper makes relevant recommendations to capital market participants based on the findings of the paper.

2. Theoretical analysis and research hypotheses

2.1 Analysis of the relationship between ESG, green innovation and corporate value

2.1.1 ESG and Corporate Value

According to stakeholder theory, signaling theory and reputation theory, making good ESG performance can satisfy stakeholders' expectations, mitigate information asymmetry[14] and transmit positive and richer information, thereby enhance trustworthiness and recognition, reduce operating cost, improve turnover efficiency and create value for companies[15].

In order to survive and grow, companies must obtain various resources from outside to ensure their competitive advantage[16]. According to resource dependence theory and competitive strategy theory, good ESG performance implies that the company has a relatively sound organizational structure and production and operation mode, and is willing to perform contracts with high quality. Good ESG performance not only helps to obtain key strategic resources necessary for sustainable development, but also helps to establish a favorable corporate reputation and image, thus providing potential to increase sales revenue and reduce operating costs, and laying foundation for sustainable development and value growth for companies.

The survival and growth of companies also need to gain social recognition. According to institutional theory, good ESG performance helps to gain wide public recognition and priority support from relevant policies. These moral capitals can provide protection for companies in the event of a crisis and reduce business risks, so they play an important role in the growth of corporate value.

Based on above analyses, this paper proposes hypothesis H1: ESG positively affect corporate value.

2.1.2 The mediating role of green innovation

As the universal form and the first power to achieve high-quality development, "green" and "innovation" include both "social responsibility" and "economic development". So green innovation will become the key factor to promote comprehensive green transformation of economic and social development. As one of the important means for companies to achieve sustainable development[17], it will provide effective tools and resources to improve market performance and competitiveness[18].

According to stakeholder theory and signaling theory, good ESG performance can motivate management to disclose more truthful and reliable reports[19] so as to obtain stakeholders' trust and attract investors. Adequate resources obtained in this way can, to a certain extent, enhance companies' green innovation willing and ability[20]. In addition, a company's organizational values system, internal environmental identity and environmental ethics also promote green innovation[21].

Therefore, this paper argues that ESG can promote companies to carry out green innovation.

According to Porter Hypothesis, green innovation can generate positive benefits by improving product quality and reducing production costs, which can partially or completely offset the costs invested by companies, and finally improve corporate value[22]. Numerous scholars have found that green innovation can directly affect corporate value from product innovation[23], technological innovation[24], management innovation[25] and employee participation[26]. It also can indirectly affect corporate value through certain factors, such as obtaining governments' preferential policy support[27].

As environmental problems become more and more serious, there is a growing demand for environmental protection from various stakeholders, including governments, investors and the public. According to stakeholder theory, reputation theory and institutional theory, companies should carry out green innovation and develop new technologies in order to effectively reduce environmental pollution, which will reduce cost of non-compliance by enhancing legitimacy of the company and win key resources by obtaining stakeholders' support, so as to achieve steady increase in corporate value[28]. According to ecological modernization theory, the first step of improving a country or a region's modernization level is to recognize the importance of ecological civilization construction at the ideological level, and thus achieve a win-win situation for the economy, environment and society. Therefore, the government set hard constraints on companies in environmental protection and set certain subsidy policies. Carrying out green innovation helps to effectively improve ecological efficiency, obtain government financial and tax subsidies and enhance corporate value.

Therefore, this paper argues that carrying out green innovation can enhance corporate value.

In summary, this paper believes that green innovation can play a mediating role in the relationship between ESG and corporate value, and accordingly proposes hypothesis H2: green innovation plays a mediating role in the relationship between ESG and corporate value.

2.2 Analysis of the moderating role of external pressure on companies

As the fundamental driving force for companies to meet the expectations of market participants, external pressure can form a certain guideline for the public and investors, leading to changes in their expectations of companies. The external pressure on companies mainly comes from the legal system, market regulation, the public, investors and media monitoring. Since the first two constitute hard constraints on companies, they are not discussed in this paper. However, media news and financial analysts' reports, as a third-party endorsement, are widely trusted by the public and investors because of its independence. And they may re-disseminate the information released by media and analysts, which leads to an exponential explosion of external pressure on companies. Therefore, the influence of external pressure, mainly media attention and analysts' attention, on corporate decision-making should not be underestimated.

As a major information intermediary in the big data era, media news can affect companies' decision-making[29]. Therefore, media has become an important force in corporate governance, which has dual effect of "positive governance[30]" and "negative pressure[31]" on companies, so companies must fully consider its opinions when making innovative decisions.

Analysts have the dual functions of external monitoring and information intermediation. They can effectively mitigate information asymmetry and principal-agent problem[32]. Some scholars have found that analysts have an important influence on the innovation decisions of listed companies[33].

As one of the important components of corporate innovation, green innovation will naturally be affected by media attention and analysts' attention. Therefore, this paper argues that external pressure can moderate the relationship between ESG and green innovation, and accordingly proposes hypothesis H3a and hypothesis H3b:

H3a: Media attention has a moderating role in the relationship between ESG and green innovation.

H3b: Analyst attention has a moderating role in relationship between ESG and green innovation.

2.3 The moderating role of external pressure on the mediating role of green innovation

Based on the above analyses, external pressure moderates the impact of ESG on green innovation, which is an antecedent factor for green innovation to play a mediating role. The complete logic of this paper is that ESG affects green innovation under the moderation effect of external pressure, and in turn affects corporate value. Therefore, this paper proposes a conditional process analysis model, which considers that the external pressure can moderate the path of "ESG → green innovation → corporate value", and accordingly proposes hypothesis H4a and hypothesis H4b:

H4a: Media attention plays a moderating role in the mediation process of "ESG → green innovation → corporate value".

H4b: Analysts attention plays a moderating role in the mediation process of "ESG → green innovation → enterprise value".

2.4 Research theoretical model

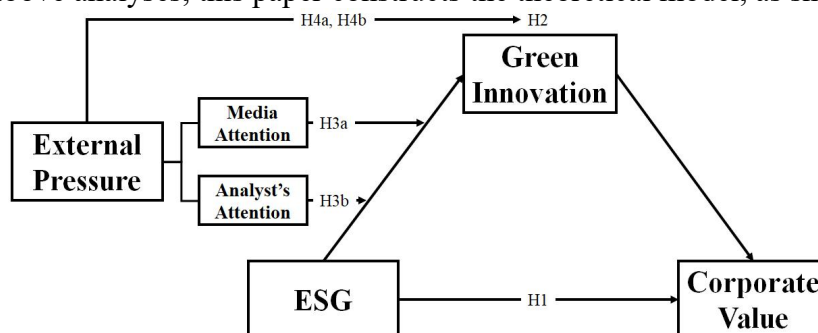Based on the above analyses, this paper constructs the theoretical model, as shown in Figure 1:

Fig.1 Research Theoretical Model

3. Research Design and Selection of Variables

3.1 Research methods and tools

In this paper, the conditional process analysis model based on Bootstrap sampling method proposed by Preacher et al.[34, 35] is used to test the above hypotheses. The conditional process analysis model can examine mediation and moderation effects at the same time and identify the mechanisms by which the moderator variables influence the mediation effect[36].

The basic data processing was completed using EXCEL 2019 and the testing of conditional process analysis was completed using Process 3.4.1 Plug-in in SPSS 26.0.

3.2 Sample selection and data processing

This paper constructs unbalanced panel data with a sample of A-share non-financial listed companies on the Shanghai and Shenzhen stock exchanges from 2009 to 2020, and treats as follows:

(1) excluding companies labelled ST and *ST;

(2) excluding companies listed in the financial sector;

(3) excluding samples with main variables are missing;

(4) in order to avoid the impact of possible outliers of individual indicators on the model estimation, this paper winsorizes the continuous variables at their upper and lower 1% to shrink the tails;

(5) in order to mitigate the endogeneity caused by mutual causality among main variables, this paper uses green innovation t+1 as mediator variable and corporate value t+2 as dependent variable;

(6) in order to ensure data continuity and completeness, this paper excludes listed companies with less than three years of continuous data.

This paper finally identifies 2,372 A-share listed companies as sample, forming an unbalanced panel data set with 19,354 observations.

3.3 Definitions and descriptions of variables

See Table 1 for variable definitions and descriptions.

Table 1 Variable Definition Table

Variables Type	Variables Name	Variables Symbol	Data Sources	Variables description
Dependent variable	Corporate value	TQ	CSMAR	Market value/(Total assets - Net intangible assets - Goodwill)
Independent variable	ESG	ESG	SSI ESG	Assigned values from 1 to 9 according to the nine levels of ratings from low to high (C~AAA)
Mediator variable	Green innovation	GI	CNRDS	The natural logarithm of the "green patent applications of companies +1"
Moderator variables	Media attention	MA	CNRDS	The natural logarithm of the "sum of the number of reports on the company by online media and paper newspapers +1"
	Analyst attention	AA	CSMAR	The natural logarithms of the "number of analysts following the company +1"
Control variables	Return on net assets	Roe	CSMAR	Net profit/average balance of shareholders' equity
	Current ratio	Lr	CSMAR	Current assets/current liabilities
	Gearing ratio	Lev	CSMAR	Total liabilities/total assets
	Cash-to-assets ratio	Flow	CSMAR	Cash and cash equivalents balance/total assets at end of period
	Top Ten Shareholding	Topten	CSMAR	Sum of Shareholding of Top Ten Shareholders
	Company size	Size	CSMAR	The natural logarithmic of total assets
	Company age	Age	CSMAR	Year of surveyed minus year of establishment
	Company nature	Stateown	CSMAR	Dummy variable State-owned companies take 1, non-state-owned companies take 0
	Industry dummy variable	Ind	CSMAR	Industry attributes of the company according to the Standard Industrial Classification of the National Economy to control the industry effect
	Year dummy variable	Year	CSMAR	Statistical year variables to control the impact of the macroeconomic environment in different years

3.4 Modelling

Based on the previous research hypotheses, this paper constructs the multiple linear regression model (1) to test hypothesis H1, which is to test the direct effect between ESG and TQ.

$$TQ_{t+2} = \alpha_0 + \alpha_1 ESG_t + Controls + \sum Ind + \sum Year + \varepsilon_1 \qquad （1）$$

For hypothesis H2, this paper conducts a Bootstrap mediation effect test using Simple Mediation Model from Hayes' Conditional Process Analysis, as shown in model (2).

$$TQ_{t+2} = \alpha_0 + \alpha_1 ESG_t + \alpha_2 GI_{t+1} + Controls + \sum Ind + \sum Year + \varepsilon_2 \qquad （2）$$

For hypotheses H3a and H3b, this paper respectively introduces the moderator variables MA and AA as well as the interaction terms ESG*MA and ESG*AA, and conducts the Bootstrap moderation effect test by using Simple Moderation Model from Hayes' Conditional Process Analysis as shown in model (3) and model (4).

$$GI_{t+1} = \alpha_0 + \alpha_1 ESG_t + \alpha_2 MA_t + \alpha_3 ESG_t * MA_t + Controls + \sum Ind + \sum Year + \varepsilon_3 \qquad （3）$$

$$GI_{t+1} = \alpha_0 + \alpha_1 ESG_t + \alpha_2 AA_t + \alpha_3 ESG_t * AA_t + Controls + \sum Ind + \sum Year + \varepsilon_4 \qquad （4）$$

For hypotheses H4a and H4b, this paper constructs models (5) and (6) by respectively introducing the moderator variables MA and AA as well as the interaction terms ESG*MA and ESG*AA on the basis of model (2), and conducts the moderated mediation effect test by using PATTERN 7 (which assumes that the moderator variable has a moderation effect on the first half of the mediation effect) of the Hayes' Conditional Process Analysis.

4. Empirical analysis and discussion of results

4.1 Descriptive statistics

Prior to conducting hypothesis testing, the paper first used SPSS 26 to standardize variables and performed descriptive statistics to get a preliminary idea of the broad distributional characteristics. The results are shown in Table 2.

Table 2 Variables descriptive statistical results

Variables	Min	Max	Mean	Median	Mode	SD
TQ	-0.9889	7.7914	0.0082	-0.3214	-0.9889	1.0359
ESG	-5.1241	2.3112	0.0558	-0.4770	-0.4770	0.9583
GI	-0.2997	9.2892	0.0302	-0.2997	-0.2997	1.0903
MA	-3.0441	3.0724	0.0918	0.0963	-1.9832	1.0164
AA	-1.3184	1.9567	0.1126	0.2057	-1.3184	0.9617
Control variables	Omitted due to paper length constraints					

4.2 Pearson correlation analysis

Pearson correlation analyses were performed on variables involved in the paper in order to make a preliminary judgement on the relationship between the variables.

And the absolute value of correlation coefficients among variables does not exceed the threshold 0.5 of multicollinearity, so it can be assumed that there is no multicollinearity among the variables.

4.3 Hypothesis testing analysis

4.3.1 Effect test of *ESG* and *TQ*

According to model (1), SPSS 26 software was used to conduct multiple linear regression analysis on all sample data (regression results are shown in Table 3), and it was found that ESG are

significantly and positively correlated with TQ at the 1% level, which suggests that good ESG can enhance corporate value. Hypothesis H1 is proved.

In addition, in order to ensure robustness of total effect results, this paper also adopts substitution variable method, using the company's market-to-book ratio (PB) as the dependent variable, to test model (1) again. Robustness test finds that ESG are significantly positively correlated with PB at the level of 1%, proving that the total effect in this paper is robust.

Table 3 Multiple linear regression results

Variables	model（1）	
	TQ	PB
ESG	0.046***	0.035***
Control variables	controlled	controlled
Year	YES	YES
Ind	YES	YES
F	378.534***	368.016***
Adj.R²	0.177	0.173
Note: *** indicate significant at the 1% level (two-tailed).		

4.3.2 The mediation effect test of *GI*

According to model (2), Simple Mediation Model in SPSS Process Plug-in was used and set 95% confidence interval and 5000 sampling times for testing to verify whether GI plays a mediating role in the relationship between ESG and TQ. The test results are shown in Tables 4 and 5.

Table 4 Bootstrap method mediation effect test results

Variables	model（2）							
	TQ				GI			
	coeff	se	95% CI		coeff	se	95% CI	
			LLCI	ULCI			LLCI	ULCI
ESG	0.0485	0.0077	0.0333	0.0637	0.0352	0.0085	0.0186	0.0519
GI	0.0254	0.0065	0.0126	0.0382				
Control variables	controlled				controlled			
F	348.4957***				203.3067***			
R²	0.1778				0.1036			

Table 5 Decomposition table for total effect, direct effect and indirect effect

	Effect	BootSE	95% CI	
			BootLLCI	BootULCI
Total effect	0.0494	0.0077	0.0342	0.0646
Direct effect（c'）	0.0485	0.0077	0.0333	0.0637
Indirect effect（a*b）	0.0009	0.0003	0.0004	0.0015

According to the results, it can be seen that the 95% CI of GI does not contain 0, and the indirect effect coefficient is 0.0009, which indicates that GI can exert a significant positive mediation effect.

In addition, the direct effect coefficient has the same sign as the indirect effect coefficient, indicating that GI plays a partial mediating role in the relationship. Hypothesis H2 is proved.

4.3.3 The moderation effect test of *MA* and *AA*

According to model (3) and model (4), this paper centered ESG, MA and AA, then used Simple Moderation Model in SPSS Process Plug-in, set 95% confidence intervals and 5000 sampling times. The paper clarifies the moderation effect of MA and AA on the relationship between ESG and GI by judging the sign and significance of ESG*MA and ESG*AA. The test results are shown in Table 6.

Table 6 Bootstrap method moderation effect test results

Variables	GI							
	model（3）				model（4）			
	Coeff	BootSE	95% CI		Coeff	BootSE	95% CI	
			BootLLCI	BootULCI			BootLLCI	BootULCI
ESG	0.0171	0.0079	0.0016	0.0325	0.0286	0.0083	0.0125	0.0445
MA	0.1024	0.0086	0.0859	0.1200				
ESG*MA	0.0843	0.0112	0.0620	0.1064				
AA					0.0851	0.0090	0.0678	0.1037
ESG*AA					0.0760	0.0100	0.0567	0.0964
Control variables	controlled				controlled			
F	198.8911***				186.9106***			
R²	0.1179				0.1116			

It can be seen that ESG*MA and ESG*AA are all significantly and positively related to GI, which indicates that the external pressure can positively moderate the relationship between ESG and green innovation. Hypotheses H3a and H3b are proved. This further suggests that external pressure plays more of its information intermediary function in China's capital market and is able to positively govern companies.

In addition, this paper draws a simple slope analysis plot using the Process Plug-in command to classify them into high level of attention (M+1SD) and low level of attention (M-1SD) on the basis of 1 SD above or below the average level of MA or AA, as shown in Figure 2.
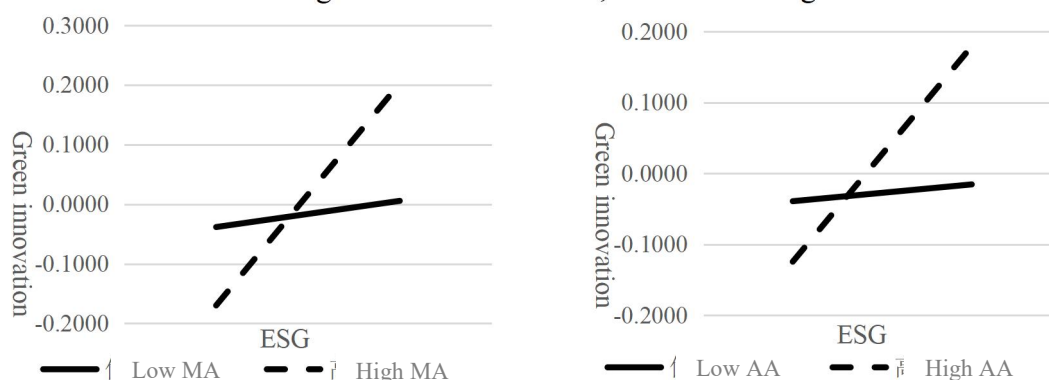

Fig.2 Moderation effect of MA, AA on the relationship between ESG and GI

It can be seen that MA and AA positively moderates the impact of ESG on GI regardless of the level, and the positive moderation effect is stronger (greater slope) at high level of attention. It suggests that high level of external pressure is more likely to positively promote the relationship between ESG and green innovation.

4.3.4 The moderation effect test of *MA* and *AA* on the mediating role of *GI*

A moderated mediation effect is considered to exist, if independent variable influences dependent variable through mediator variable and this path is also influenced by moderator variable[37].

In order to test the moderated mediation effect, this paper uses PATTERN 7 in the Hayes' Conditional Process Analysis. Results are shown in Table 7.

Table 7 Moderated mediation effect test

		GI				TQ			
	Variables			95% CI				95% CI	
		coeff	se	LLCI	ULCI	coeff	se	LLCI	ULCI
With MA as the moderator variable	ESG	0.0171	0.0085	0.0004	0.0338	0.0485	0.0077	0.0333	0.0637
	MA	0.1024	0.0082	0.0862	0.1186				
	ESG*MA	0.0843	0.0075	0.0697	0.0990				
	GI					0.0254	0.0065	0.0126	0.0382
	Control variables	controlled				controlled			
	F	198.8911***				348.4957***			
	R²	0.1179				0.1778			
	Level group			95% CI				95% CI	
		Effect	Boot SE	BootLLCI	BootULCI	Moderated mediation index	Boot SE	Boot LLCI	BootULLCI
	M-1SD -1.0164	0.0003	0.0005	-0.0014	0.0006				
	M 0.00000	0.0014	0.0005	0.0006	0.0024				
	M+1SD 1.0164	0.0032	0.0007	0.0020	0.0048	0.0021	0.0005	0.0013	0.0032
	Differences in mediation effects	0.0029	0.0010	0.0025	0.0065				

	Variables	GI				TQ			
				95% CI				95% CI	
		coeff	se	LLCI	ULCI	coeff	se	LLCI	ULCI
With AA as the moderator variable	ESG	0.0286	0.0085	0.0120	0.0453	0.0485	0.0077	0.0333	0.0637
	AA	0.0851	0.0094	0.0667	0.1036				
	ESG*AA	0.0760	0.0080	0.0603	0.0917				
	GI					0.0254	0.0065	0.0126	0.0382
	Control variables	controlled				controlled			
	F	186.9106***				348.4957***			
	R²	0.1116				0.1778			
	Level group	Effect	Boot SE	95% CI		Moderated mediation index	Boot SE	95% CI	
				BootLLCI	BootULCI			BootLLCI	BootULCI
	M-1SD	-0.9618	0.0012	0.0005	0.0004	0.0022			
	M	0.0000	0.0022	0.0005	0.0013	0.0033	0.0019	0.0005	0.0011	0.0030
	M+1SD	0.9618	0.0032	0.0007	0.0020	0.0048			
	Differences in mediation effects	0.0020	0.0009	0.0022	0.0056				

It can be seen that ESG*MA and ESG*AA both have a significant positive effect on GI, and that GI has a significant positive effect on TQ, which suggest that MA and AA exactly moderate the mediation effect of GI. In addition, there are significant differences in the mediation effects at different levels of MA and AA. Hypotheses H4a and H4b are proven.

It is worth emphasizing that the mediation effect of low levels of MA on GI is not moderated, which suggests that only above a certain level of media attention can have a positive governance effect on companies, reflecting the "conditionality" emphasized in this paper.

4.4 Endogeneity test and robustness test

The endogeneity problem is mainly caused by the mutual causality between independent variable and dependent variable. In this paper, on the one hand, external pressure may prompt companies to carry out ESG and green innovation; on the other hand, good ESG performance and green innovation achievements may attract more media and analysts to report and study the company. And the positive impact of green innovation on corporate value has a lag[38]. Therefore, using the GI_{t+1} and TQ_{t+2} in the data processing can control the endogeneity problem to a certain extent.

In order to test the robustness of hypothesis H4, this paper re-measures the analysts' attention by using the natural logarithm of the "attention of the research reports +1" (AR). With TQ and PB as dependent variable, results are basically the same, which prove robustness of findings of this paper.

5. Conclusions and recommendations

Using 2,372 A-share listed companies from 2009 to 2020 as the research sample, this paper empirically examines the effect and the influence mechanism of ESG on corporate value of Chinese listed companies. The paper finds that good ESG can effectively enhance corporate value and green innovation can partially mediate this influence mechanism, while external pressure, mainly media attention and analysts' attention, can positively moderate the mediating role played by green innovation. Based on these findings, this paper makes the following recommendations:

First, companies should actively engage in ESG and green innovation in order to achieve long-term sustainable development, thereby avoiding environmental risks and enhancing corporate value. With the strengthening of government supervision, environmental regulations and social concerns, companies should consciously do more "good deeds" and attract external attention from the media and analysts, so that the deeds can "spread thousands of miles", thus establishing a good reputation.

Second, government should give full play to the role of market mechanisms, gradually guide companies to participate in ESG on their own initiative and disclose relevant information, and strengthen the supervision of disclosure quality as well as the sharing of information among relevant departments, so as to provide accurate and reliable data for investors.

Thirdly, investors should pay more attention to companies with good ESG performance, and institutional investors can consciously include some green companies in their asset portfolios to give full play to the demonstration effect of institutions.

Fourthly, external market participants, such as media and analysts, should pay more attention to non-financial information and enhance their professional capacities, with the aim of reporting and analyzing the information in a "completely fact-based" manner, so as to improve the operational efficiency of the capital market and promote the benign development of the capital market.

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