

## Article

# Sustainable Media and Green Innovation: The Impact of Sustainable Atmosphere and Environmental Regulation on Manufacturing Enterprises

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**Abstract:** This study proposes a research framework for media attention towards green innovation of manufacturing enterprises based on the theory of stakeholders and legitimacy. We examine the potential effect of media attention on the manufacturing industry and make a multidimensional heterogeneity analysis with a sample of Chinese manufacturing enterprises during 2011–2019. Our results show an inverted U-shaped relationship between various attentions of media and green innovation. We find that the early attention of the media can expand the green innovation ability of manufacturing enterprises. However, the excessive attention of the media later may decrease the green behavior of enterprises. The legitimacy pressure of media attention on enterprises helps enterprises carry out green innovation and reduce false green innovation activities. In addition, the sustainable construction, environmental regulations, and sustainable social atmosphere focused on by the media will have a positive effect on the green innovation of enterprises. We suggest that recognizing the importance and potential power of sustainable media, environmental regulations, and sustainable atmosphere in green technology is a key component of the ecological inclusive path to promote the achievement of sustainable development goals.

**Keywords:** media attention; green innovation; sustainable atmosphere; environmental regulation; green transformation



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## 1. Introduction

Many enterprises struggle to implement green innovation due to a lack of information and transparency [1–3]. The pressure to innovate and the associated R&D costs have become increasingly essential for businesses to transition to a more eco-friendly approach [4,5]. Even after acknowledging the importance of green innovation for competitiveness, the high costs often deter them from doing so [6]. Some enterprises even presumptuously use false innovations or outer information activity packaging to seek recognition in the green market. With the high-quality construction of informatization and digitalization channels, the destructive green innovation activities of “bad money expelling good money” are gradually eliminated [7]. False or simple green innovation activities are progressively eliminated. The high attention of the media has triggered the high-quality construction of enterprise green innovation [8]. Today’s information exchange is very developed and fast. Countries vigorously advocate modern green development. The media’s high degree of attention towards and supervision of green environmental protection essentially strengthen the legitimacy of the green innovation of manufacturing enterprises; the media plays a vital role in the green transformation of manufacturing enterprises [9].

On the one hand, media attention reduces the trend of rational ignorance of enterprises and guides scientific and practical green innovation; on the other hand, media attention, based on the perspective of stakeholders, strips away the intangible gray behaviors of enterprises and enhances the legitimacy pressure on enterprises to constrain their green

innovation behaviors [10]. As a monitoring mechanism between ethics and law, media attention becomes an external power of society at a certain level to push enterprises to carry out excellent green innovation behaviors [11]. It is essential to recognize that the key to a company's foothold in the market and society is still word-of-mouth and competitiveness, so positive green innovations can often expand a company's influence with the help of a high level of media attention. Therefore, under the trend and effect of media attention, the occurrence mechanism of green innovation will be more positive and clear [12–14].

In addition, in green manufacturing enterprises, institutional mechanisms have always been an essential driving force in promoting the green transformation of industries. On the one hand, China has utilized a comprehensive green development assessment system to strictly implement the enterprises' primary responsibility and the government's supervisory responsibility. It has formed a green synergy framework led by central and local governments and actively participated in by enterprises. Short-term environmental inspection activities run parallel to regularized regulatory activities in this process. This forms an environmental regulatory system with Chinese characteristics, i.e., multi-frequency environmental protection inspections by the central government and environmental regulatory behavior understanding assessment.

On the other hand, an excellent ecological environment is the most universal welfare of people's livelihood. China and its people synergize to promote high-quality economic and social development and high-level protection of the ecological environment. Therefore, a sustainable social atmosphere always has a multi-dimensional impact on enterprise green activities. A positive social atmosphere, high public awareness of environmental protection, and strong public participation in environmental protection tend to press enterprises' environmental responsibility and green thinking. Manufacturing companies' green behaviors and innovations often undergo significant changes in this process.

In summary, will media attention, as an essential influence on the governance of manufacturing enterprises, promote green innovation in manufacturing enterprises in the form of an informal system? In this process, will the heterogeneous characteristics of manufacturing firms influence the impact of media attention on green innovation in manufacturing firms? For example, will different types and sizes of firms receive different levels of attention, triggering different levels of green innovation? This article aims to establish a framework model for media attention on green innovation in manufacturing enterprises, analyze the mechanism of sustainable social atmosphere and environmental regulations, and promote green innovation in enterprises.

## 2. Literature Review

For a long time, media has been an essential medium of information exchange and a core carrier of public opinion dissemination. The media is critical for social governance, enterprise development, and organization construction. Although the media's attention and reports do not have the absolute power of the law, they can still regulate enterprises' lousy behavior or society's negative mechanisms [15]. Through information disclosure and black box exposure, the media exposes the violations of various organizations, thus achieving the positive significance of social and behavioral correction. This means that the media can be a favorable wind for society, guiding all kinds of organizations to approach or transform by the trend of society [16].

Green innovation is an essential trend in society; at some level, the media's attention can trigger the behavioral preference of enterprises to carry out more innovative activities [17]. As an exogenous force for comprehensive enterprise governance, the media is essential for optimizing enterprise environmental governance and empowering enterprise green innovation [18]. In addition, researchers have found that media attention harms outward investment. Although there are two possibilities of "monitoring" and "collusion" between the media and firms, media attention has a significant monitoring and governance function at all listed firms in China [19]. Differences in media attention and its attributes may also lead to changes in the results. Online media cannot effectively reveal the internal

mechanisms of enterprise governance, and the uneven level of online reporting can lead to reduced governance effectiveness [20]. Policy-oriented and market-oriented media help improve enterprises' inner control ability, expand the connection between the market, government, enterprises, and mass organizations, and produce positive social benefits. However, no matter what kind of media, the key for media attention to have a practical effect is still to expose accurate information and to produce a stakeholder role with the target of attention [21]. If media attention ignores the actual situation, it will not resonate with society and enterprises; that is to say, it will form useless work. If media attention does not change the interest or economic dimensions, it will have a relatively limited impact on the target audience [22]. This is due to the organization being mostly a combination of rational interests. Still, attention to producing a positive orientation or acceptance of engagement can increase organizational benefits, and enterprises will naturally accept this action-oriented [23]. Therefore, positive actions of media attention at the green level help firms to make up their minds to open up green innovations and thus expand their earning power [24].

However, wrong or ill-timed media attention may also trigger bad decisions by firms. Intense market pressure from negative media coverage may also cause enterprise decision-makers to become more short-sighted in their pursuit of short-term performance metrics, thus over-catering to the media and leading to imbalanced decision-making on their part [25]. For firms with more media attention, outside investors can obtain more information about the firm through media reports, which reduces information asymmetry and makes the overall offer level closer to its actual value. Media attention to the disclosure of enterprise information has a significant negative effect on investors' information search costs and the degree of information asymmetry [26]. With the increasing severity of environmental pollution problems, the governance role of media attention in enterprise ecological protection has received significant attention [27]. Generally speaking, the media's adequate environmental information disclosure has actively assisted the government's public governance [28]. Forced by the claim of legitimacy, enterprises also adopt green behaviors in response to media attention [29]. In addition, the linkage effect of media attention on the public also contributes to increasing green awareness in society, thus expanding the force of action on enterprises. Overall, media attention breaks down the information barriers between various organizations and realizes the occurrence of organizational behaviors under benign orientation [30].

Current research on green innovation mainly focuses on the government–business perspective [31]. Green innovation is a complex technological and market process, and enterprises, as the bearers of innovation activities, bear the heavy responsibility of leading technology research and development and market allocation of resources. Due to the significant external diseconomies at the initial stage of green innovation, a negative effect that cannot be dissipated through the market mechanism, coupled with the market regulation, it is difficult to share the risk of green innovation of enterprises, which enables the government to appear in the field of green innovation as a principal, indirectly supplementing innovation resources for enterprises through the signal transmission and certification effect of incentive functions [32,33].

The others emphasize that the government, as a stakeholder of SMEs, should resolve the risk crisis of enterprise technological innovation and respect the maximization of enterprise interests and rights by designing incentive-compatible rights contracts [34]. The introduction of agency theory into government regulatory decision making further optimizes the incentive capacity and effectiveness of the government, weakening the government's role in market mechanism failures and the smoothing effect of fiscal policy innovations on the premise of sustainably securing the supply of innovation resources [35]. Acemoglu et al. also further confirm that environmental taxes as a representative regulatory tool and R&D subsidies as the primary incentive strategy are the two core driving forces of green innovation, but the use of tax regulation is much narrower. There is a conflict with the incentive function. Over-regulation will inhibit the willingness to innovate, so optimizing

the incentive contract is essential to promote green innovation. Therefore, optimizing the incentive contract is a crucial way to facilitate the formation of green innovation patterns [36]. Government regulation is also the main force driving green innovation in enterprises [37–40].

The driving force behind local government behavior is the central government. Considering that the initiator of green innovation activities is the central government, and at the same time, the central government bears the double burden of spirit and supervision, and the local government faces moral hazards and the possibility of liquidation after the fact, the contract of green innovation management can be shifted from the government–enterprise side to the internal government, i.e., a principal–agent relationship can be formed between the central government and the local government, and the funds used initially for supervision and risk-avoidance reserve can be shifted to the “ex-ante” incentive means [41]. Incentives to guide the behavior of local governments with the prior contract, constituting a green innovation system under the decentralization of the central and local governments. Green innovation is an enterprise behavior under a complex mechanism, and its driving source is unclear. In this complex environment, it is essential to identify the triggering mechanism of green innovation to regulate and actively guide it.

This paper investigates the mechanism of enterprise green innovation activities based on the perspective of media attention. It considers the heterogeneity within firms to construct a normative regulatory framework for enterprise green innovation. In this process, the activities of a sustainable atmosphere and central environmental regulation are fully considered to deconstruct the influence of media attention on green innovation.

### 3. Research Model and Data Sources

#### 3.1. Research Hypothesis

The nature of media attention is an external monitoring and governance function of enterprises by external stakeholders. There are two kinds of relationships between the media and enterprises: “monitoring” or “collusion (i.e., media bias)”, and media attention, as a pressure and feedback mechanism of external stakeholders, can effectively govern and monitor and govern the behavior of enterprises [42]. Specifically, the more media attention a company receives, the better its enterprise performance, enterprise productivity, and enterprise social responsibility, and the number of irregularities in these companies, such as enterprise surplus manipulation and connected transactions that measure the hollowing out of significant shareholders, become significantly lower. The potential reasons why the occurrence mechanism of green innovation may be more active under media attention are: (i) media attention cuts down the possibility of information asymmetry and expands the ability of firms to draw information so that they can choose the right tool at the right point in time to carry out green innovation; (ii) the high level of media attention triggers the consideration of the firms’ stakeholders, and (iii) for market value and image management, manufacturing enterprises will take the initiative to convey a positive image of environmental protection and social responsibility to the outside world through green innovation [43]. Media attention drives manufacturing firms to strengthen green innovation by increasing the legitimacy pressure on manufacturing firms. It is worth noting, however, that media attention only happens after some time, and its effect on green innovation tends to have a non-linear relationship. This is due to the quantitative variation in media attention itself. That is, the initial weak attention may need to draw firms’ attention to green innovation. With the surge of media attention, firms’ green innovation behavior may start with a lag.

Along with the attenuation of media attention, if the green innovation behavior of the enterprise suddenly loses the power of the external environment, it may transiently stagnate or cancel, or it may keep the inertia to continue [44]. Therefore, this staggered relationship needs to be further explored. As a result, this paper proposes the potential hypothesis:

**H1:** *There is a U-shaped relationship between media attention and green innovation in manufacturing firms.*

Some studies have shown that the efficiency of media attention on enterprise governance also depends on the dominant atmosphere of society. In the context of a sustainable atmosphere, the media's coverage of sustainability, the shaping of sustainable cases, and the size of the readership will determine the efficiency of media influence. The public's perception of a sustainable atmosphere will determine the direction of media attention. In practice, a sustainable social atmosphere is a collection of public environmental awareness. Due to the legitimacy and reputation of management in manufacturing enterprises, public environmental awareness will strengthen the influence of media on enterprise behavior. The formation of public social awareness has promoted the construction of social trust in sustainable activities. With the improvement of trust mechanisms, the sense of responsibility of various social entities has gradually become prominent. With this virtuous cycle, public environmental awareness has formed the core of a sustainable social atmosphere.

Therefore, this paper will study the difference in media attention's influence on enterprise's green innovation in different contexts of high and low sustainable atmosphere [45]. Media coverage and publicity can increase the exposure of enterprises, but the feedback on exposure depends on the public's perception. Therefore, when the public's sustainable atmosphere is better, the ability to disclose media attention is vital and firms will care more about green innovation. Therefore, this paper proposes the hypothesis:

**H2:** *Social sustainable atmosphere has a positive moderating effect between media attention and the green innovation of manufacturing enterprises; i.e., when the socially sustainable atmosphere is stronger, media attention promotes the green innovation of manufacturing enterprises more strongly.*

China is adopting a variety of frequency and depth of environmental governance policies, including short-term high-frequency environmental protection inspection activities and regularized environmental monitoring. As these policies and institutions come from the central government, introducing central environmental regulation marks the beginning of "party, government, enterprise" environmental governance [46]. Central environmental regulation has unprecedented stringency, authority, and deterrence compared to other environmental regulatory policies. Central environmental regulations can strengthen the motivation for green innovation in manufacturing enterprises under the media's attention through the legitimacy mechanism. When central environmental regulation is implemented and accountable, the behavior of manufacturing firms will be rapidly amplified by the media and, therefore, forced into green innovation activities. As a result, this paper proposes the following hypothesis:

**H3:** *Central environmental regulation has a positive moderating effect between media attention and manufacturing firms' green innovation.*

### 3.2. Research Design

This study employs a panel data structure to examine the influence of the new media environment and different environmental regulation devices on businesses' innovations in green technologies [47]. There are several justifications for employing a panel information model. The model for panel data is a statistical approach that interprets data from multiple cross-sectional units and periods. This allows for a thorough analysis of the impact of factors such as the new media environment and regulations related to the environment on the advancement of environmentally friendly technologies by corporations [48]. Furthermore, the panel data model commonly interprets diversity within the dataset, which can be accounted for by including specific impacts together with time impact. In addition, it can offer a more effective estimate along with data regarding the influence of the new media environment and environmental regulations on creating green technologies within corporations. This study utilizes an analysis of panel data to investigate the effects and un-

derlying mechanisms of the new media environment and diverse environmental regulation equipment on creating environmentally friendly technologies within corporations [49].

This paper adopts a panel fixed effects model for regression, i.e., using individual fixed and time-fixed effects (fixed effect) for testing. To test the effect of media attention on the green innovation of manufacturing enterprises, we take the number of green authorized patents as an explanatory variable, the number of online media reports as an explanatory variable, and at the same time, according to the existing literature on related green innovation, we take other influencing factors as control variables.

The baseline econometric model constructed in this paper is:

$$Green_{i,t} = \beta_0 + \beta_1 Media_{i,t} + \beta_2 Media_{i,t}^2 + \beta_3 ROA_{i,t} + \beta_4 Lev_{i,t} + \beta_5 Age_{i,t} + \beta_6 RD_{i,t} + \beta_7 Top1_{i,t} + \beta_8 Cash_{i,t} + \beta_9 Size_{i,t} + \beta_{10} SOE_{i,t} + \mu_{i,t} + \gamma_i \quad (1)$$

$Media_{i,t}$  represents media attention,  $ROA_{i,t}$  represents firm profitability,  $Lev_{i,t}$  represents gearing ratio,  $Age_{i,t}$  represents the number of years the firm has been listed,  $RD_{i,t}$  represents the firm's R&D investment,  $Top1_{i,t}$  represents the proportion of shares held by the first largest shareholder, and  $SOE_{i,t}$  represents the judgment on the nature of state-owned enterprises (SOEs), where 1 means SOEs and 0 means non-SOEs. Size is the size of the firm, i.e., the total assets of the firm at the end of the year, and Cash is the cash flow ratio of the firm.  $\beta_0$  represents the intercept term, the rest are the correlation coefficients of the variables, which are used to capture unobservable fixed effects, and  $\gamma_i$  is the random disturbance term.

The model of the moderating effect of social sustainable atmosphere constructed in this paper is shown in formula 2, which is used to test the hypothesis H2.  $SusP$  represents social sustainable atmosphere,  $CER$  represents central environmental regulation,  $Media_{i,t} \times SusP_{i,t}$  represents the interaction term of media attention and sustainable atmosphere, and  $SusP_{i,t} \times CER_{i,t}$  represents the interaction term of sustainable atmosphere and central environmental regulation. If the coefficient  $\beta_1$  of  $Media_{i,t} \times SusP_{i,t}$  is significantly positive, it indicates that social sustainable atmosphere can strengthen the positive effect of media attention on green innovation of manufacturing enterprises, i.e., there is a significant positive regulation, and Hypothesis 2 is verified.

$$Green_{i,t} = \beta_0 + \beta_1 Media_{i,t} \times SusP_{i,t} + \beta_2 Media_{i,t} + \beta_3 SusP_{i,t} + \beta_4 ROA_{i,t} + \beta_5 Leverage_{i,t} + \beta_6 Age_{i,t} + \beta_7 RDSpendSum_{i,t} + \beta_8 LargestHolderRate_{i,t} + \beta_9 SusP_{i,t} \times CER_{i,t} + \beta_{10} CER_{i,t} + \mu_{i,t} + \gamma_i \quad (2)$$

The model of the moderating effect of central environmental regulation is shown in formula 3, which is used to test hypothesis H3.  $Media_{i,t} \times CER_{i,t}$  represents the interaction term of media attention and central environmental regulation. If the coefficient  $\vartheta_1$  of  $Media_{i,t} \times CER_{i,t}$  is significantly positive, it indicates that the central environmental regulation can strengthen the positive effect of media attention on green innovation of manufacturing enterprises, i.e., there is a significant positive regulation, and Hypothesis 3 is verified.

$$Green_{i,t} = \vartheta_0 + \vartheta_1 Media_{i,t} \times CER_{i,t} + \vartheta_2 Media_{i,t} + \vartheta_3 CER_{i,t} + \vartheta_4 ROA_{i,t} + \vartheta_5 Leverage_{i,t} + \vartheta_6 Age_{i,t} + \vartheta_7 RDSpendSum_{i,t} + \vartheta_8 LargestHolderRate_{i,t} + \vartheta_9 SusP_{i,t} \times CER_{i,t} + \vartheta_{10} SusP_{i,t} + \mu_{i,t} + \gamma_i \quad (3)$$

### 3.3. Variables Selection and Measurement

Our dependent variable, green innovation performance, is calculated as the log of a firm's yearly output of the sum of green inventions and green utility novel patents obtained independently and jointly with other entities. Innovation performance is a continuous

variable with 44% zero values, and we used log transformation to normalize its distribution. We obtained the data from the Chinese Research Data Services (CNRDS) Platform.

**Explanatory variables**—We measured media attention as the sum of negative news about the company appearing in news content daily for a year from the Chinese Research Data Services (CNRDS) Platform. The attitude of news this database provides is evaluated by a supervised learning algorithm model with an accuracy of over 85%.

**Control variables**—We include firm-level control variables that might affect a firm's green innovation performance. First, we included R&D expenditure (log of the total R&D expenditures of a firm), firm size (log of total product output of a firm), and firm age (the difference between the current year and the founding year of the firm). Firms with more R&D expenditures tend to have higher innovation performance. Large and old firms have more knowledge, management expertise, or financial resources for innovation activities but might have less incentive to break the status quo. Thus, the effects of firm size and age are uncertain. We also controlled for firm performance or return on assets (the ratio of net income to total assets), leverage (the ratio of total debt to total equity), Top1 (percentage of shareholding of the largest shareholder), cash and state-owned enterprise (a dummy variable equal to 1 if the company is classified as a state-owned enterprise in the census data set and equal to 0 otherwise). Existing studies suggest that firms with better performance and more financial resources tend to develop more innovations. Although a state-owned enterprise gains more resources to conduct innovation activities, it may suffer from low innovation efficiency. Thus, its net impact on innovation is uncertain. We obtained the data from the China Stock Market & Accounting Research Database (CSMAR) Platform.

This paper selects the data of China A-share-listed manufacturing firms from 2011 to 2019, before the epidemic, for the study. The primary explanatory variable in this paper is media attention or Media, obtained from the China Research Data Service Platform (CNRDS). This database provides statistical data on the quantity and sentiment of listed companies' online and newspaper financial news. Social Sustainable Climate draws on scholarly practice and is measured using China's Baidu's Public Environment Index, which is processed using data for each prefecture-level city. Central environmental regulation considers the dual mechanism of normality and non-normality and is measured using a combination of the two indicators. The central environmental supervision measures using 0–1 dummy variables.

In contrast, the central standing environmental regulation uses the number of accountable people in the year for calculation and eventually transforms into the merger proportion. The dependent variable in this paper is Green Innovation Green, which is obtained from the China Research Data Service Platform (CNRDS) by summing up the number of green inventions and the number of green utility models received independently and jointly with other entities in the year. The microfinance data of manufacturing firms are obtained from the CSMAR database. This study drew on the practices of existing research and screened 2649 initial manufacturing enterprise samples according to the following steps: (1) excluding manufacturing enterprise samples labeled as S and ST; (2) excluding manufacturing enterprise samples with a listing year later than 2011; and (3) excluding manufacturing enterprise samples with missing variables. After the screening, the final balanced panel data of 1149 listed manufacturing firms, totaling 10,327 year-manufacturing firm sample observations, are obtained.

## 4. Empirical Analysis

### 4.1. Basic Analysis

This paper uses Stata for empirical analysis. Descriptive statistics and correlation analysis are shown in Table 1. As shown in Table 1, the difference between each enterprise's green innovation and media attention is significant; some enterprises lack media attention, and many enterprises lack green innovation behavior. By organizing the whole data, this paper helps to clarify the reality of China's manufacturing industry and thoroughly examine the green innovation mechanism of enterprises in different media environments. In

addition, from the results of the remaining control variables, differences among enterprises exist. Still, the overall standard deviation is slight, indicating that the heterogeneity of enterprises is helpful for fully exploring under a finer degree of differentiation.

**Table 1.** Descriptive statistics results of Chinese manufacturing companies.

	Mean	SD	Min	Max
Green	3.70	16.78	0.00	782.00
Media	132.78	174.60	1.00	3738.00
ROA	0.04	0.06	−0.24	0.19
LEV	0.37	0.19	0.05	0.86
Age	2.79	0.34	1.71	3.45
Top1	0.34	0.14	0.09	0.72
RD	4.79	3.80	0.08	23.47
SOE	0.26	0.44	0.00	1.00
Size	21.96	1.18	17.81	27.47
Cash	0.05	0.07	−1.94	0.49

Note:  $N = 10,327$ .

Table 2 reports the correlations between the main variables. Specifically, media attention and enterprise green innovation are positively correlated (0.29), and the rest of the relevant control variables are positively correlated with the green innovation coefficient. The variance inflation factor (VIF) test results show that all VIF values are below 3.60, indicating that multicollinearity is not a problem in our regression analysis.

**Table 2.** Correlation analysis of data for Chinese manufacturing companies.

	Green	Media	ROA	LEV	Age	Top1	RD	SOE	Size
Green	1.00								
Media	0.29	1.00							
ROA	−0.03	0.01	1.00						
LEV	0.17	0.15	−0.41	1.00					
Age	0.02	−0.03	−0.08	0.18	1.00				
Top1	0.00	−0.00	0.13	0.01	−0.06	1.00			
RD	0.02	−0.01	−0.04	−0.23	−0.10	−0.12	1.00		
SOE	0.08	0.04	−0.14	0.31	0.20	0.14	−0.15	1.00	
Size	0.32	0.31	−0.06	0.55	0.21	0.11	−0.20	0.37	1.00
Cash	0.01	0.03	0.41	−0.16	0.06	0.10	−0.06	−0.03	0.08

#### 4.2. Basic Regression Analysis

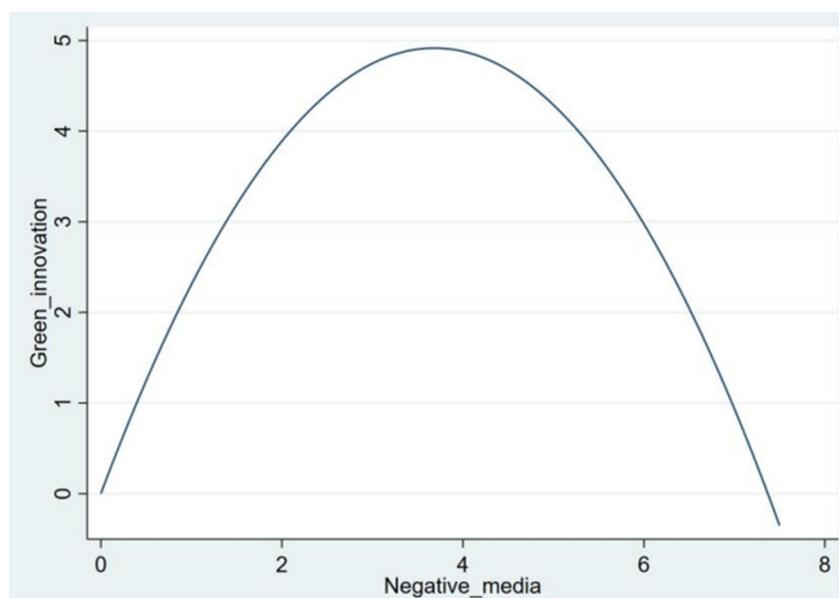
Table 3 reports the fixed-effect OLS model estimation results for the main effects. Model 1 includes the control variables only. Model 2 introduces the main effect of negative media attention on green innovation performance. Hypothesis 1 predicts that negative media attention has an inverted U-shaped relationship with green innovation performance in manufacturing firms. Model 2 shows that the negative media attention is positively related to green innovation performance ( $b = 3.49$ ,  $t = 6.73$ ,  $p < 0.001$ ). The coefficient of its squared term is negative ( $b = -0.49$ ,  $t = -7.15$ ,  $p < 0.001$ ), indicating an inverted U-shaped relationship between negative media attention and green innovation performance and supporting Hypothesis 1 (see Figure 1).

Further, the inverted U-shaped relationship between the two is tested in this paper. From the U-test results, the extreme point is 3.580, and media takes the value range of [0, 8.226]. Therefore, the decisive moment is within the data range. The left slope is 1.815 with a  $p < 0.001$ , which is significantly positive, and the right slope is  $-2.356$  with a  $p < 0.001$ , which is significantly negative. The model rejected the original hypothesis at the 1% level that an inverted U-shaped relationship exists.

**Table 3.** Results for the effect of negative media on green innovation performance.

Model	(1)	(2)
Media_negative		3.49 *** (6.73)
Media_negative <sup>2</sup>		−0.49 *** (−7.15)
SOE	1.41 (1.50)	1.33 (1.42)
Size	2.53 *** (7.77)	2.67 *** (8.25)
ROA	−2.46 (−1.07)	−2.55 (−1.64)
LEV	−1.26 (−1.05)	−1.05 (−0.90)
Age	4.16 *** (4.87)	3.43 *** (4.16)
RD	0.01 (0.16)	0.00 (0.16)
Cash	1.32 (0.76)	1.91 (1.08)
Constant	−64.24 *** (−5.71)	−73.09 *** (−6.51)
Industry		
Firm	Yes	Yes
Year		
N	10,327	10,327
R <sup>2</sup>	0.06	0.05
F	12.06 ***	11.97 ***

Note: \*\*\*  $p < 0.001$ , t statistics in parentheses.

**Figure 1.** Negative media attention and green innovation performance.

Specifically, the paper indicates an inverted U-shaped relationship between negative media attention and green innovation performance and supports Hypothesis 1 (see Figure 1).

Combing the results in Table 1, it can be seen that when there is less negative news, enterprise green innovation is not significant. Along with the increase in negative news, the activity of enterprise green innovation increases rapidly [50]. Moreover, after breaking through the marginal utility of media attention, the enterprise green innovation activity

does not increase, but on the contrary, there will be a rapid decay [51–53]. Optimizing the internal and external information environment of enterprises and promoting the coordinated development of the two can better alleviate information asymmetry, bring into play the supervisory effect and financing effect of information, and help to enhance the enterprise's innovation willingness and innovation ability and realize innovative development. From the inverted U-shaped trend, in the early stage of media attention, enterprises are more sensitive to it [54–56].

On the one hand, enterprises will focus first on their reputation. When media attention grows [57], companies spontaneously engage in introspection and correction activities. At this point, there is a rapid increase in behavior around innovation and greenness [58,59], thus reversing their lousy reputation (in the face of negative news). In the front of positive news, companies will focus on building their image, hoping to capitalize on the media attention to expand their influence and thus demonstrate their competitiveness and strengths, contributing to the accumulation of green innovation activities. After the high point of media attention, in other words, after the media “hype”, enterprises tend to produce a specific immunity, i.e., they do not want their decision-making behavior to be excessively interfered with by the outside world [60]. Therefore, at this time, green innovation activities tend to decrease and return to normal rationality. Especially in the face of negative attention, companies tend to stop paying attention after the hotspots have faded. Some enterprises that “show off” with innovative behavior are more affected by it [61,62]. They will quickly return to the primary state once their negative behavior has been covered. Considering the high number of non-green behaviors in the manufacturing sector and the fact that the target of this paper is listed companies, they are particularly concerned about media attention, which can lead to their “hurry” in dealing with media attention at an early stage, thus further expanding the inverted U-shape trend [63]. Green innovation activities can help companies establish competitive advantages and enhance long-term value. Still, the uncertainty and irreversibility of innovation investment leads to the self-interested motivation of significant shareholders, and management would have been inclined to reduce innovation investment, coupled with the fact that most of the innovation projects are related to cutting-edge technology and are more complex, which provides an opportunity for the management to reduce the investment in innovation [64]. Therefore, the rapid penetration of media attention, if any, will likely motivate firms to make up their minds to engage in green innovation behaviors [65]. As an information intermediary, the media, due to its advantages of wide dissemination and timeliness, conducts all-around supervision of enterprises' operation and investment and financing activities in the interests of the public and thus can urge enterprises to improve the efficiency of rectification of significant defects in internal control. Moreover, this improves the quality of green innovation activities of enterprises [66].

Tables 4 and 5 validate the results of the moderating effects of social sustainable atmosphere and central environmental regulation, respectively. Table 6 feeds back the results of the moderating effect of sustainable atmosphere and the short-term regulation of central environmental regulation (environmental protection inspection); Table 5 feeds back the results of the moderating effect of sustainable atmosphere and the standing mechanism of central environmental regulation (environmental supervision). In addition to adding the control variables involved in the baseline regression, the model also takes the interaction terms of social sustainable atmosphere, central environmental regulation short-term policy, and social sustainable atmosphere and central environmental regulation short-term policy as control variables. Model 1 verifies the effect of media attention (Media) on enterprise green innovation, and the coefficient of media attention is significantly positive, reaching 1.253. At this point, it shows that the effect of media attention on green innovation shows a linear relationship after introducing adjustment variables. Model 2 adds the interaction terms of media attention and sustainable atmosphere based on Model 1, and its coefficient is significantly positive (0.042 \*\*\*), which indicates that the sustainable atmosphere of the society strengthens the positive influence of media attention on green innovation of

manufacturing enterprises, and verifies Hypothesis 2. Model 3 adds the interaction terms of media attention and short-term supervision of central environmental regulations based on Model 2. Its coefficient is also significantly positive (0.186 \*\*\*), indicating that the short-term activities of central environmental regulation also strengthen the positive impact of media attention on green innovation of manufacturing enterprises, which verifies Hypothesis 3.

**Table 4.** Regression analysis of the joint moderating effect of social sustainability climate and central environmental regulation short-term policy.

	(1)	(2)	(3)
Media	1.253 *** (6.72)	1.372 *** (3.28)	−0.027 *** (−4.2)
SusP	−0.021 (−1.03)	−0.037 *** (−3.02)	−0.011 ** (−2.22)
CER	−0.006 (−1.03)	−0.004 (−1.21)	−0.002 *** (−7.21)
SusP×CER	0.051 *** (5.18)	0.066 *** (5.72)	0.058 *** (4.38)
Media×SusP		0.041 *** (3.72)	0.029 ** (2.11)
Media×CER			0.186 *** (9.36)
Firm Year	Yes	Yes	Yes
Constant	−0.365 *** (−5.32)	−0.371 *** (−4.16)	−0.337 *** (−3.96)
N	10327	10327	10327
R <sup>2</sup>	0.04	0.04	0.06
F	12.782	11.639	19.875

Note: \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

**Table 5.** Regression analysis of the joint moderating effect of sustainable climate and central environmental regulation standing policies.

	(1)	(2)	(3)
Media	0.073 *** (6.27)	0.046 *** (3.88)	0.051 *** (3.71)
SusP	−0.001 ** (−2.17)	−0.001 *** (−3.15)	−0.001 ** (−2.08)
CER	−0.001 (−1.06)	−0.001 * (−1.89)	−0.001 *** (−7.21)
PubP×CER	0.066 *** (5.13)	0.072 *** (5.42)	0.031 *** (3.98)
Media×SusP		0.021 *** (3.02)	0.016 * (1.85)
Media×CER			0.133 *** (7.91)
Firm Year	Yes	Yes	Yes
Constant	−0.436 *** (−3.63)	−0.272 *** (−3.78)	−0.181 *** (−3.69)
N	10327	10327	10327
R <sup>2</sup>	0.04	0.04	0.08
F	11.351	12.783	17.266

Note: \*  $p < 0.05$ , \*\*  $p < 0.01$ , \*\*\*  $p < 0.001$ .

**Table 6.** Results for the robustness check (with adjustment time window).

	(1) 2011–2019	(2) 2013–2017	(3) 2013–2019
Media_negative	3.49 *** (6.73)	4.52 *** (4.87)	2.55 *** (4.82)
Media_negative <sup>2</sup>	−0.49 *** (−7.15)	−0.53 *** (−5.04)	−0.33 *** (−4.86)
Industry			
Firm	Yes	Yes	Yes
Fear			
N	10327	3361	8551
R <sup>2</sup>	0.05	0.03	0.05
F	11.97 ***	2.66 ***	8.67 ***

Note: \*\*\*  $p < 0.001$ , t statistics in parentheses.

Looking specifically at Table 5, the following three models, in addition to incorporating the control variables involved in the baseline regression, also include the interaction terms of socially sustainable atmosphere, central environmental regulation normative policy, socially sustainable atmosphere, and central environmental regulation normative policy as control variables. Model 1 verifies the effect of media attention (Media) on green innovation in manufacturing companies, and the coefficient of media attention is significantly positive. Model 2 adds the interaction terms of media and sustainable atmosphere based on Model 1, and its coefficient is significant and reaches 0.046, which indicates that a sustainable atmosphere strengthens the positive influence of media on green innovation in manufacturing enterprises and verifies Hypothesis 2. Model 3 adds the interaction terms of Media and the central environmental regulation standing policy based on Model 2. Its coefficient reaches 0.051, which indicates that the central environmental regulation standing policy also reaches 0.051. It indicates that the central environmental regulation standing policy also strengthens the positive influence of media attention on the green innovation of manufacturing enterprises, which verifies Hypothesis 3.

Overall, a sustainable social climate significantly enhances the role of media attention in promoting green innovation in manufacturing firms. When the socially sustainable atmosphere is stronger, the effect of the promotion of media attention on manufacturing enterprises' green innovation will be more obvious. Both normal and short-term policies of central environmental regulation significantly enhance the role of media attention in promoting green innovation in manufacturing firms. Overall, both a sustainable social climate and central environmental regulation can have a positive moderating effect. The positive support of a sustainable atmosphere and the multi-dimensional pressure of central environmental regulation will reduce the cost of public participation, enhance the efficiency of public participation in monitoring, and thus strengthen the role of the public in the media's role in public opinion, thus providing institutional safeguards for environmental democracy. The central environmental regulation should not be ignored for the improvement of the efficiency of "soft" supervision by informal organizations such as the media and the public, and the deterrent effect and authority of the central environmental regulation itself have an essential role to play in strengthening the media to promote the green innovation of manufacturing enterprises.

#### 4.3. Robustness Tests

We checked the robustness of our results in several different ways. First, we tried to adjust the time window. We tested our model from 2013 to 2017 and from 2013 to 2019 in Table 6 (Models 2 and 3). The results of the initial model (Model 1 in Table 6) from 2011 to 2019 show that all significant results hold.

Next, we lagged our dependent variable by one year. Comparing the results in the initial model (Model 1 in Table 7), Model 2 shows that all significant results hold.

**Table 7.** Results for the robustness check (with lagged dependent variable).

	(1) Green	(2) Green
Media_negative	3.49 *** (6.73)	
Media_negative <sup>2</sup>	−0.49 *** (−7.15)	
L.Media_negative		1.24 *** (2.85)
L.Media_negative <sup>2</sup>		−0.18 *** (−3.33)
Industry		
Firm	Yes	Yes
Year		
N	10,327	7953
R <sup>2</sup>	0.05	0.05
F	11.97 ***	12.16 ***

Note: \*\*\*  $p < 0.001$ , t statistics in parentheses.

Based on the robustness analysis, media attention maintains a positive and significant effect on enterprise green innovation regardless of the scenario. The inverted U-shaped trend is quite robust. It suggests that society should use this trend relationship to guide enterprises to carry out active and large-scale green innovation activities. The higher the level of media attention, the more the management of the enterprise fears the adverse market reaction triggered by the dissemination of material weaknesses in internal control by the media; thus, the stronger the management's motivation to hide the material weaknesses and the more passive the disclosure of the material weaknesses, which may further exacerbate the negative impact of the disclosure of the material defects in internal control on the enterprise's investment in innovation. As the degree of media attention increases, the information dissemination effect of media attention will expand and aggravate the financing constraints triggered by the disclosure of material weaknesses in internal control, thus exacerbating its negative impact on firms' investment in innovation.

Regarding the market pressure effect of media attention, investors generally have speculative motives due to the imperfect development of China's capital market. They cannot interpret information, resulting in negative news about a company that may trigger a drop in stock prices. Green innovation activities require large and continuous financial support, and their risk is much higher than the general investment projects in tangible assets. The slightest carelessness may lead to a return on innovation investment, bringing huge losses to the enterprise in the short term. Therefore, this reverse trend determines the critical role of media attention.

#### 4.4. Heterogeneity Test

First, we compared the inverted U-shaped effect in state-owned enterprises and otherwise. It shows that the inverted U-shaped relationship in state-owned firms still existed while others did not (Models 1 and 2 in Table 8). Then, we compared the main effects in different regions (East, Middle, and West regions of China). The inverted U-shaped relationship is only significant in the east area (Models 3–5 in Table 8). Finally, we classified the sample into two groups; one group is significant, and the other is small. It shows that the inverted U-shaped relationship between negative media attention and green innovation performance will be significant in firms with bigger sizes. In contrast, in small firms, it is not (Models 6 and 7 in Table 8).

Specifically, eastern, state-owned, and large enterprises are more sensitive to media attention. This may be explained by the fact that the East region is the most economically developed in China and the most active part of media information. When economic and

data exchanges become more intense, the external role often triggers disruptive activities within the enterprise. This brings a better foundation of conditions for green innovation. The promotion of green innovation in manufacturing enterprises by media attention can be affected by differences in the location of manufacturing enterprises. Again, reputation management is essential for large firms and state-owned enterprises. This makes them pay more attention to media attention. In addition, green innovation is advocated by all levels of government and society. It is a necessity in the transformation process of the manufacturing industry, which should, therefore, engage in green innovation behaviors. The active media attention gives them a positive field of action and better promotes their green innovation behavior. Generally speaking, the larger the enterprise, the more innovation resources and stakeholder resources are available to support the enterprise to carry out sustainable green innovation. In addition, larger firms face more significant reputational risks and public legitimacy pressures and are, therefore, more likely to receive media attention to promote their green innovation behaviors.

**Table 8.** Results of heterogeneity analysis.

	(1) State -owned	(2) Nonstate- owned	(3) East	(4) Mid	(5) West	(6) Big	(7) Small
Media_negative	6.73 *** (5.14)	0.05 (0.12)	2.48 *** (4.36)	0.65 (0.84)	0.87 (0.56)	3.52 *** (3.94)	0.06 (0.31)
Media_negative <sup>2</sup>	−0.92 *** (−5.70)	−0.01 (−0.18)	−0.34 *** (−4.84)	−0.11 (−1.08)	−0.09 (−0.46)	−0.44 *** (−4.07)	−0.02 (−0.67)
Industry							
Firm	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year							
N	2710	7617	07245	1776	1280	5165	5790
R <sup>2</sup>	0.04	0.07	0.04	0.10	0.08	0.05	0.07
F	4.35 ***	14.49 ***	6.85 ***	8.36 ***	4.12 ***	8.15 ***	10.42 ***

Note: \*\*\*  $p < 0.001$ , t statistics in parentheses.

## 5. Conclusions and Policy Implications

Based on stakeholder theory and organizational legitimacy theory, this paper discusses the behavioral mechanism of green innovation in Chinese-listed manufacturing enterprises. By empirically analyzing the relationship between media attention and green innovation of 1919 A-share listed manufacturing enterprises from 2011 to 2019, the main findings are as follows: media attention and green innovation of manufacturing enterprises show an inverted U-shaped trend, i.e., media attention significantly promotes green innovation of manufacturing enterprises, but there are differences in the direction and scale of the different stages of the role. Whether it is positive media attention, neutral media attention, or negative media attention, it can significantly promote green innovation in manufacturing enterprises. However, in the late stage of excessive news fermentation or media attention, media attention can no longer cause the green innovation behavior to be active. On the contrary, it will inhibit green innovation behavior. In addition, the inverted U-shaped trend may not be maintained given the differences in regions, nature, and size of firms. However, media attention still generates a positive impact on green innovation.

As a result, the paper may develop the following management insights:

Given the heterogeneity, regions should do their best to create an atmosphere that values and encourages green development so that media attention can play a more active role. Areas should strengthen information disclosure to provide conditions for collaborative governance: media reports reduce information asymmetry by providing information to the public, and public access to information further helps the media ferment public opinion pressure, thereby increasing pressure on enterprise legitimacy and achieving governance. In addition, the relationship and resources between traditional media, emerging media,

mass media, and government media should be actively promoted and coordinated to create a positive news space for enterprises and to promote the goodness of manufacturing enterprises. Due to the dismay of the manufacturing industry and the need for reform, more media platforms and spotlights should be given to promote the green transformation of manufacturing enterprises to serve the national economic development better.

At a deeper level, one of the critical mechanisms of central environmental regulation is to focus on the public, actively receive monitoring feedback from the public and the media, enhance the public's and the media's capacity for dialogue, enhance their right to speak out, broaden the channels for public participation, and amplify the monitoring power of the public and the media, which the central government will consciously utilize to help it improve the effectiveness of its monitoring. This pressure for sustainable development, which coexists in both the norm and the short term, will lead enterprises to eliminate polluting production capacity independently and create a compelling incentive for green innovation.

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