



Research article

Study on the influence of Chinese traditional culture on corporate environmental responsibility

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Abstract: In accordance with the theory of informal institutions, culture exerts a crucial influence on the enactment of corporate social responsibility. Based on the two core variables of Chinese traditional culture and corporate environmental responsibility, we designed a panel data model to investigate the impact of Chinese traditional culture on corporate environmental responsibility and its heterogeneity. The findings indicate the following: 1) Chinese traditional culture can promote the performance of corporate environmental responsibility. 2) Chinese traditional culture has a heterogeneous influence on the environmental responsibility of enterprises that depends on the ownership difference of enterprises; that is, the influence of traditional culture on the environmental responsibility of state-owned enterprises is stronger than that of non-state-owned enterprises. 3) Chinese traditional culture has a heterogeneous influence on the environmental responsibility of enterprises according to the difference in industrial pollution levels; that is, traditional culture has a positive correlation with the environmental responsibility of enterprises in heavily polluting industries and a negative correlation with non-heavily polluting industries. 4) Chinese traditional culture has a heterogeneous influence on corporate environmental responsibility according to geographical differences; that is to say, traditional culture promotes the development of corporate environmental responsibility in the central and western regions, and vice versa in the eastern regions.

Keywords: Chinese traditional culture; corporate environmental responsibility; theory of informal institutions; impact analysis; heterogeneity

1. Introduction

Cultural diversity engenders a multifaceted foundation for enterprise decision-making. Chinese traditional culture serves as the spiritual mainstay influencing the modernization trajectory of China and Southeast Asia, permeating all dimensions of individuals' social, political, economic and other activities. Despite distinct schools within Chinese traditional culture, the core ideology primarily revolves around Confucianism, resulting in corporate culture being predominantly steeped in Confucian values. Consequently, Confucian culture should exhibit a robust correlation with the performance of corporate environmental responsibility. Corporate environmental responsibility was initially posited by McGee (1998), who contended that systems, the economy and morality constituted the three principal reasons for enterprises to undertake environmental responsibility [1]. Existing literature regarding the influence of corporate environmental responsibility factors can be classified into two categories: external factors and internal factors.

External factors originate beyond the firm, with the primary focus of extant literature centering on government environmental regulation. Many scholars asserted that, in contrast to a unified emission standard prescribed by regulatory agencies, market-oriented environmental regulation mechanisms offer superior incentives to encourage polluters to proactively develop emission technologies or adopt advanced pollution abatement techniques [2–4]. Through market mechanisms, firms can secure greater compensation for pollution control while simultaneously cultivating a positive social image. Through pertinent research, due to the stochastic nature of enterprises' environmental pollution emissions, the enforcement of environmental regulations has been found to be deterministic [5]. Owing to the absence of adaptive environmental regulation methods, the execution of government environmental regulation fails to attain the anticipated outcome.

In the case of China, a lot of empirical results revealed that environmental protection departments' reinforcement of environmental inspections and the collection of pollution discharge fees aid enterprises in complying with environmental regulations, thereby promoting the fulfillment of environmental responsibilities, even though many enterprises passively adhere to government regulations [6,7]. However, some scholars believe that environmental regulations will weaken the competitiveness of companies, thus reducing the level of corporate environmental responsibility. When companies face stricter environmental regulations, they spend more on environmental governance, which can affect their operational efficiency and competitiveness, and also deter potential investors. Therefore, when companies face strict environmental regulations, they are easily caught in a dilemma of economic benefits and environmental responsibility; at this point, some companies may refuse to assume environmental responsibility [8]. Some researchers posited that environmental regulation can be classified into two types: explicit environmental regulation and implicit environmental regulation. Explicit regulation refers to government agencies issuing laws and regulations to supervise enterprises' environmental pollution behaviors, safeguard the ecological environment and actualize economic transformation. Implicit regulation pertains to the modification of behavior by enhancing enterprise decision-makers environmental awareness and social responsibility consciousness, reducing environmental pollution, and actualizing a green economy [9,10]. Informal environmental regulations can also affect corporate environmental responsibility. With the enhancement of environmental awareness, the public's demand for corporate environmental responsibility is also increasing. Under public pressure, companies' attitudes toward environmental responsibility are also changing. In order to prevent the spread of negative information, companies with substantial media attention are more

likely to disclose more information and improve environmental performance [11–14].

In the evaluation of external factors, a limited number of scholars also take into account religious and cultural factors. A lot of scholars found that social norms, especially religion, have a strong effect on corporate governance practices and corporate environmental responsibility practices [15,16]. Many researchers determined that national culture affects enterprises' environmental governance measures, and that enterprises with high power distance and a strong masculinity culture have comparatively effective environmental management systems overall [17–20]. In the investigation of enterprise information disclosure, some scholars examined the heavy pollution industry in China as the research object and discovered that adherence to cultural guidance and education could enhance the sense of responsibility of enterprise management and influence their attitude toward risk, consequently augmenting the environmental information disclosure activities of enterprises in heavily polluted industries and substantially boosting the performance of corporate environmental responsibility [21–23]. Approaching from the perspective of enterprise and business ethics, some Chinese scholars uncovered the ideas of cultivating one's morality in Confucianism and that the nature-human harmony endorsed by Taoists can restrain managers and employees from pursuing short-term profit maximization and egoism, directing their thinking mode and behavior to align with the requirements of enterprises and business ethics. They conducted empirical analyses on the interrelation between informal institutions, government competition and China's low-carbon economic development. The research results indicate that the traditional culture in informal institutions can complement and fortify the structure and function of formal institutions, execute external supervision on regional enterprises, instruct regional enterprises to transition into low-carbon environmental protection and sustainable development modes, and advance the development of a green economy [24,25].

The internal factors influencing corporate environmental responsibility encompass the level of corporate financialization, corporate size, the moral level of corporate managers and employees, and corporate ownership. Some scholars ascertained that the impact of corporate financialization on corporate environmental responsibility was considerably negative, and that the impact of corporate financialization on corporate environmental responsibility was heterogeneous [26–28]. When small and medium-sized enterprises (SMEs) are taken as the research objects, found that large SMEs are more disposed to assume environmental responsibilities; for SMEs in the 15 EU countries, as the age of enterprises escalates, these enterprises may assume diminished environmental responsibilities. Top managers are the internal catalysts of corporate environmental responsibility practices [29,30]. Top managers or Green Boards (directors with work or academic experience in environmentally-related fields) who endorse corporate strategies related to environmental responsibility are more likely to promote sustainability and amplify corporate environmental responsibility [31,32]. The corporate governance structure, especially board independence, board size, board gender diversity and ownership structure, will influence the environmental responsibility of enterprises [33,34]. According to the Blue Book of Corporate Social Responsibility: China's CSR Report (2013), state-owned enterprises (SOEs) shoulder more social responsibilities due to their distinctive nature, so they also need to assume more environmental responsibilities and generate better environmental performance. A plethora of studies have revealed that corporate ownership in China can affect the attainment of corporate environmental sustainability. The most salient example is that state-owned ownership prompts state-owned enterprises to assume more social responsibilities, thus impacting their behavior in terms of corporate environmental responsibility. Scholars contend that SOEs should fulfill their social responsibilities by addressing their environmental responsibilities, community

responsibilities, and government responsibilities. SOEs should take the lead in safeguarding the environment, upholding community interests and responding to government calls, especially environmental protection [35–37]. In addition, multinational corporations (MNCs) face pressure from global markets on environmental issues, and they tend to emphasize environmental responsibility more significantly [38–40].

In addition, the industry classification in which the enterprise is situated is also pivotal to the performance of corporate environmental responsibility. Some researchers postulate that the closer an enterprise is to natural resources in the industrial chain (production-oriented enterprises), the more likely it is to adopt proactive environmental plans, while the enterprises providing services in the industrial chain (such as sales enterprises) are markedly less likely to embrace corporate environmental responsibility strategies [41,42]. Some researchers contemplated that the varying intensity of external environmental regulation constraints on high-carbon and low-carbon emission industries was the primary reason why industry heterogeneity influenced the level of carbon information disclosure of enterprises. They ascertained that enterprises in high-carbon emission industries are more proactive in disclosing information about corporate carbon activities under high-intensity environmental regulations, suggesting that such enterprises can accomplish low-carbon emission reduction tasks in compliance with institutional requirements and implement the concept of sustainable development. Investors will also interpret this as a positive signal, perceiving that such enterprises are superior to other enterprises in terms of operating legitimacy and social responsibility, designating them as priority investment objects [43].

Although the existing literature provides a rich research basis, it also yields ample research space for this study. On the one hand, how traditional culture affects corporate environmental responsibility necessitates further discussion. Culture is a concept with a rich scope, and religion is only one aspect. For China, traditional culture is more shaped by Confucianism than Buddhism, and Confucianism encompasses more abundant ecological thoughts. Therefore, it is not comprehensive to examine the influence of religion only, and it is meaningful to expand it to the influence of traditional culture, particularly Confucian culture, on corporate environmental responsibility. Confucian culture has a long history. Compared with today's development, Confucian culture is the heritage of development and plays a role in standardizing, guiding and promoting social behavior. It embodies the common maintenance of social development and people's life. In the process of undertaking social responsibility, enterprises are not only affected by external forces, but also by internal forces, which are the driving force for the development of enterprises. Cultural deposits are conducive to enhancing the awareness of corporate social responsibility. Therefore, according to the internal characteristics of corporate responsibility, traditional culture has an important impact on corporate environmental responsibility.

On the other hand, the impact of traditional culture on corporate environmental responsibility is heterogeneous. First of all, corporate environmental responsibility is affected by many factors, including legal awareness, social evaluation, environmental protection products, low-carbon technology and green management. There are differences in the development direction and process of different aspects, and the development of traditional culture may have a heterogeneous impact on corporate environmental responsibility depending on the different types of corporate ownership. Second, the focus of enterprise development is biased. For example, heavy industry enterprises cause pollution due to the necessary production process to a certain extent. Light industry enterprises and environmental protection enterprises can avoid pollution in the production process as much as possible.

The influence of traditional culture on these two types of enterprises is also heterogeneous. Finally, due to the difference in the origin of traditional culture and the existence of cultural and historical factors, there are differences in the influence of culture on corporate responsibility in different regions, such as eastern, central, and western regions. Therefore, with the development of traditional culture, the different ownership of enterprises, industries, and regions will lead to different influences among enterprises.

This paper mainly studies the impact of traditional culture on corporate environmental responsibility, focusing on the degree and heterogeneity of the impact of traditional culture on corporate environmental responsibility. Its main marginal contributions are as follows. First, the role of Chinese traditional culture on corporate environmental responsibility is studied. Second, based on the perspective of corporate ownership differences, this paper studies the impact of traditional culture on corporate environmental responsibility. Third, based on the perspective of industrial pollution level differences, this paper studies the impact of traditional culture on the industrial heterogeneity of corporate environmental responsibility. Fourth, based on the perspective of geographical differences, this paper studies the influence of traditional culture on the regional heterogeneity of corporate environmental responsibility.

The subsequent part of this paper is structured as follows. The second section outlines the research design of this paper; the third section undertakes empirical research on the impact of Chinese traditional culture on corporate environmental responsibility in accordance with the research design; the fourth section explores the impact heterogeneity, and the fifth section formulates the conclusion.

2. Materials and methods

2.1. Model settings

2.1.1. The estimation strategy for the impact of Chinese traditional culture on corporate environmental responsibility

This paper investigates the impact of Chinese traditional culture on corporate environmental responsibility. The benchmark regression model is set as follows:

$$cer_{it} = \alpha + \gamma \ln cul_{it} + \beta' X_{it} + \phi_o + \eta_i + \delta_r + \lambda_t + u_{it} \quad (1)$$

In Eq (1), subscripts i and t represent the individual enterprise and the year, respectively; cer_{it} is the environmental responsibility index of enterprise i in year t ; cul represents traditional Chinese culture, which is measured by the number of Confucian temples within 100 kilometers of listed companies and processed by logarithm¹. In the selection of control variable X that affects corporate environmental responsibility, this paper not only considers the return on assets (roa), asset-liability ratio (lev) and enterprise age (age), but it also presents the environmental regulation intensity (er) and per capita GDP ($pgdp$) of the province where the enterprise is located as control variables at the macro level². ϕ_o , η_i , δ_r and λ_t respectively represent the equity type of the enterprise, the industry

¹ Considering that the number of Confucian temples within 100 kilometers of some listed companies is 0, we have added 1 to this index and then performed logarithmic processing.

² In the model setting, they are logarithmically processed.

category of the enterprise, the region where the enterprise is located, and the time dummy variables to capture the impact of enterprise ownership type, industry characteristics, location and macroeconomic fluctuations on the performance of corporate environmental responsibility. M_{it} is a random disturbance term and obeys $i.i.d (0, \sigma^2_\mu)$.

In terms of estimation strategy, we mainly apply the ordinary least squares (OLS) to estimate the parameters of Eq (1). At the same time, in order to deal with the errors caused by the potential endogenous issue that may occur in the model parameter estimation results, we conducted robustness tests by using the methods of two-stage least square (2SLS) and limited information maximum likelihood (LIML) based on the selection of appropriate tool variables.

In addition, this paper measures the corporate environmental responsibility with 12 indicators of five dimensions. Therefore, in the regression analysis with five sub-indexes of corporate environmental responsibility as dependent variables, we also use the OLS method to estimate parameters based on Eq (1). Considering that the values of the 12 specific indicators of corporate environmental responsibility are 0-1 binary discrete variables, in order to obtain more effective estimation results, we set the logit regression model as shown in Eq (2).

$$\ln[p/(1-p)] = \alpha + \gamma \ln cul_{it} + \beta' X_{it} + \phi_o + \eta_i + \delta_r + \lambda_t \quad (2)$$

where p is the probability that 12 specific indicators are taken as 1. Since Eq (2) is for parameter estimation of the nonlinear model, this paper will use the Maximum Likelihood Estimation (MLE) method.

2.1.2. The estimation strategy for the impact heterogeneity

The impact of Chinese traditional culture on the enterprise environment may be heterogeneous. This paper will investigate the heterogeneous impact from three aspects, namely, enterprise ownership type, industry pollution level and regional differences.

In the regression analysis for enterprises of different ownership types, since the ownership types of enterprises in the sub-samples are the same, the dummy variable of enterprise ownership type is no longer controlled in Eq (1), and the empirical model is set as shown in Eq (3).

$$cer_{it} = \alpha + \gamma \ln cul_{it} + \beta' X_{it} + \eta_i + \delta_r + \lambda_t + u_{it} \quad (3)$$

In the regression analysis for enterprises in different industries, since there is no difference in the industries of the enterprises in the sub-samples, the industry dummy variables are no longer controlled in Eq (1), and the empirical model is set as shown in Eq (4).

$$cer_{it} = \alpha + \gamma \ln cul_{it} + \beta' X_{it} + \phi_o + \delta_r + \lambda_t + u_{it} \quad (4)$$

Similarly, in the regression analysis of enterprises of different regions, the dummy variables of the region where the enterprise is located are no longer controlled in Eq (1), and the regression model is set as shown in Eq (5).

$$cer_{it} = \alpha + \gamma \ln cul_{it} + \beta' X_{it} + \phi_o + \eta_i + \delta_r + \lambda_t + u_{it} \quad (5)$$

This paper also adopts the OLS method to estimate the parameters of Eqs (3)–(5).

2.2. Variable measurement

2.2.1. Measurement of corporate environmental responsibility

Considering the multifaceted nature of corporate environmental responsibility, we referred to [43] and selected 12 specific indicators from the five dimensions of legal awareness, social rating, eco-friendly products, low-carbon technology and green management (shown in Table 1) to comprehensively measure corporate environmental responsibility. The specific dimension descriptions are as follows.

First, the dimension of legal awareness primarily characterizes the enterprises' compliance with laws and regulations related to environmental protection, which is measured by three indicators. One indicator is whether an enterprise has referred to the GRI (Global Reporting Initiative) Sustainability Reporting Guidelines, which provide crucial guidance for enterprises to comply with the relevant codes of conduct for sustainable development. The second is whether an enterprise reveals information on the environment and sustainable development. This indicator can directly mirror whether enterprises genuinely uphold their environmental responsibility to a large extent. The third is whether an enterprise has received environmental penalties, which can exemplify whether they have met the basic environmental behavior requirements prescribed by law.

Second, the social evaluation dimension mainly examines whether the environmental behavior of enterprises has a good reputation in society. Specifically, this dimension will be measured by two indicators: whether an enterprise has received environmental recognition or other positive evaluations and whether an enterprise possesses environmental advantages.

Third, the dimension of eco-friendly products mainly assesses whether enterprises' production and operation activities are environmentally friendly, which will be reflected by the following three indicators: whether an enterprise has utilized renewable energy or implemented policies and measures of a circular economy; whether an enterprise has developed or applied innovative products, equipment or technologies that benefit the environment; whether an enterprise has discharged pollutants.

Fourth, the low-carbon technology dimension is measured by whether an enterprise has policies, measures or technologies to conserve energy, and whether an enterprise has policies, measures, or technologies to reduce emissions of waste gas, wastewater, waste residue, and greenhouse gases.

Fifth, the dimension of green management evaluates whether enterprises prioritize environmental protection in their daily operations, which is measured by two indicators. Considering that the use of third-party certification can not only effectively guarantee the objectivity of corporate environmental disclosure, but it can also better regulate their daily behavior, we chose whether to be assessed by third-party institutions as an indicator. In addition, whether an enterprise has green office policies or measures can also portray the green management caliber of the enterprise.

Table 1. Index system for measuring corporate environmental responsibility.

Dimension (weight)	Indicator
1. Legal awareness (10%)	1.1 whether an enterprise has referred to the GRI's Sustainability Reporting Guidelines 1.2 whether an enterprise discloses the environment and sustainable development 1.3 whether an enterprise has received environmental punishment
2. Social evaluation (15%)	2.1 whether an enterprise has received environmental recognition or other positive evaluations 2.2 whether an enterprise has environmental advantages
3. Environment-friendly products (25%)	3.1 whether an enterprise has used renewable energy or adopted policies and measures of circular economy 3.2 whether an enterprise has developed or applied innovative products, equipment, or technologies that are beneficial to the environment 3.3 whether an enterprise has discharged pollutants (*)
4. Low-carbon technology (25%)	4.1 whether an enterprise has policies, measures, or technologies to save energy 4.2 whether an enterprise has policies, measures, or technologies to reduce emissions of waste gas, wastewater, waste residue, and greenhouse gases
5. Green management (25%)	5.1 whether an enterprise has been examined by a third-party organization 5.2 whether an enterprise has green office policies or measures

Note: Indicators 1.3 and 3.3 are inverse indicators.

Based on the formulation of the evaluation index system of corporate environmental responsibility shown in Table 1, we chose to further integrate the indicators into a comprehensive index of corporate environmental responsibility, encompassing the following two steps. First of all, in terms of indicator values, as described above, the 12 specific indicators in Table 1 are binary discrete variables with values of 0 and 1. At the same time, it is worth noting that the indicators "whether an enterprise has received environmental punishment" and "whether an enterprise has discharged pollutants" are both inverse indicators. In order to maintain the consistency of the directionality of all indicators, we assigned 0 to the two indicators with the answer "Yes" and 1 to the two indicators with the answer "No". For the other 10 indicators, if the answer is "Yes", the value is 1; otherwise, the value is 0. Second, in terms of the allocation of indicator weights, according to the practice of [10], we assigned 10%, 15%, 25%, 25% and 25% weights, respectively, to the five dimensions of legal awareness, social evaluation, eco-friendly products, low-carbon technology, and green management. The weight of specific indicators under each dimension is set with equal weight.

2.2.2. Measurement of Chinese traditional culture

The core explanatory variable of this paper is Chinese traditional culture. In view of the preeminent role of Confucianism in Chinese traditional culture and its far-reaching impact on Chinese people's outlook on life and values, we measure Chinese traditional culture by assessing the Confucian culture. At the same time, considering that the establishment of the Confucius Temple and the development of Confucianism are closely related, the Confucius Temple is not only a place to venerate Confucius, but it has also been accompanied by the education and dissemination of Confucian ideas for thousands of years [44]. Therefore, most literature asserts that the denser the number of Confucian temples in a region, the stronger the influence of the Confucian culture [45,46]. In this regard, we

referred to the practice of [45] and selected the number of Confucian temples within 100 kilometers of the location of listed companies as an indicator to measure the Confucian culture. The specific calculation steps are as follows.

First, according to the sorted address information of listed companies and Confucius temples, we obtained accurate longitude and latitude coordinates through the Amap open platform.

Second, the distance between each listed company and its surrounding Confucius temples is calculated one by one by using the Haversine formula. The Haversine formula is a calculation method to determine the distance between two points on the earth according to their latitude and longitude. It plays an important role in spherical trigonometry and is a special case of the “Haversine theorem” formula. For two points on any sphere, the Haversine value of the central angle can be calculated by the following formula:

$$\text{hav}\left(\frac{d}{r}\right) = \text{hav}(\varphi_2 - \varphi_1) + \cos(\varphi_1) \cos(\varphi_2) \text{hav}(\lambda_2 - \lambda_1) \quad (9)$$

where *hav* is the abbreviation of the Haversine formula; *d* is the distance between two points; *r* is the radius of the sphere; $\frac{d}{r}$ is the center angle measured in the radian system, φ_1, φ_2 are the latitudes of two points of the radian system; λ_1, λ_2 are the longitudes of two points measured in radian system, satisfying

$$\text{hav}(\theta) = \sin^2\left(\frac{\theta}{2}\right) = \frac{1 - \cos(\theta)}{2} \quad (10)$$

Given the latitude and longitude of the two points, the distance *d* can be obtained by using the inverse Haversine function or the Arcsine function:

$$d = r \text{archav}(h) = 2r \arcsin(\sqrt{h}) \quad (11)$$

Substituting $h = \text{hav}\left(\frac{d}{r}\right)$ into Eq (11), we can get

$$\begin{aligned} d &= 2r \arcsin(\sqrt{\text{hav}(\varphi_2 - \varphi_1) + \cos(\varphi_1) \cos(\varphi_2) \text{hav}(\lambda_2 - \lambda_1)}) \\ &= 2r \arcsin\left(\sqrt{\sin^2 \frac{(\varphi_2 - \varphi_1)}{2} + \cos(\varphi_1) \cos(\varphi_2) \sin^2 \frac{(\lambda_2 - \lambda_1)}{2}}\right) \end{aligned} \quad (12)$$

Since the earth is not a perfect sphere, but an ellipsoid, the radius of the earth varies from region to region. In the process of calculating the distance in this paper, the value of the earth's radius is the commonly used average radius of 6371 km.

Finally, according to the calculated distance between each listed company and its surrounding Confucian temples, the number of Confucian temples within 100 kilometers of the company can be ascertained.

2.2.3. Control variables

The selection and measurement of control variables are described as follows.

1) Return on assets. The return on assets, which measures the profitability of an enterprise, is calculated by dividing the net profit of an enterprise by the shareholders' equity at the end of a period. Theoretically, for enterprises with poor profitability, there may be problems in maintaining their own operations, not to mention in actively taking environmental responsibility. For enterprises with good profitability, they tend to take more environmental responsibilities for the long-term development and the establishment of a good corporate image. Therefore, we have introduced the return on assets into the measurement model as a control variable, expecting it to have a positive impact on corporate environmental responsibility.

2) Enterprise asset-liability ratio. It is also an important control variable affecting corporate environmental responsibility. On the one hand, enterprises with a higher asset-liability ratio have higher financing difficulties. In order to establish a good credit cooperation relationship with financial institutions, these enterprises often disclose more environmental information to obtain funds. On the other hand, due to the high debt ratio of enterprises, their debt repayment pressure is relatively increased. Under the pressure of high debt, it is unknown whether enterprises can bear more environmental responsibilities. Therefore, the impact of the asset-liability ratio on corporate environmental responsibility needs further empirical testing.

3) Enterprise age. At different stages of an enterprise's life cycle, the threats and pressures it faces are different. Besides, at various stages, enterprise senior managers pay different levels of attention to environmental issues. Therefore, like most studies, this work also includes enterprise age as a control variable.

4) Regional environmental regulation intensity. The performance of corporate environmental responsibility will be affected by the intensity of environmental regulation in the region where an enterprise is located. Generally speaking, strengthening environmental regulation means that local governments will intervene more in environmental issues, which will require enterprises to reduce or even eliminate environmental pollution, thus becoming a mandatory driving factor to promote enterprises to fulfill their environmental responsibilities. Since the completed investment in industrial pollution control can largely reflect the government's emphasis on environmental issues and regulatory intensity, we selected the ratio of the completed investment in industrial pollution control and industrial added value of the province where an enterprise is located to measure the level of regional environmental regulation.

5) Regional economic development level. The economic development level of the region where an enterprise is located is also an important factor affecting the performance of corporate environmental responsibility. Generally speaking, the higher the level of economic development in a region, the stronger the will of the whole society, including the public and enterprises, to protect the environment. At the same time, enterprises in areas with high-level economic development often have strong profitability, which creates good conditions for enterprises to increase investment in aspects like environmental protection. Therefore, we expect that the level of economic development has a positive impact on corporate environmental responsibility. Like most studies, this paper reflects the level of economic development through the per capita GDP of the province where an enterprise is located.

6) Enterprise ownership type. In order to investigate the impact of enterprise ownership type on environmental responsibility, this paper applied a dummy variable. Specifically, we assigned a value of 1 to state-owned enterprises and 0 to non-state-owned enterprises.

7) Enterprise affiliated industry type. Considering that the characteristics of the industry to which an enterprise belongs may have a certain impact on the performance of environmental responsibility,

we chose to add a dummy variable of the industry type to the empirical model. Specifically, this paper classifies the sample listed companies by industry according to the Guidelines on Industry Classification of Listed Companies revised by China Securities Regulatory Commission in 2012. In the setting of dummy variables, this work takes agriculture as the benchmark group and applies 69 industry dummy variables.

8) Enterprise affiliated region. There are big differences in the economic and social development levels among different regions in China, especially between the eastern coastal areas and the central and western inland areas. The differences in the macro environment of the regions where enterprises are located may also have an impact on their corporate environmental responsibility. In this regard, we assigned the value of 1 to the enterprises whose registered location is in the eastern region. Accordingly, the value of 0 has been assigned to enterprises whose registered location is in the central and western regions.

9) Time dummy variable. In order to control the impact of macroeconomic fluctuations on corporate environmental responsibility, we further considered setting time dummy variables. Specifically, this work takes 2010 as the benchmark and introduces seven dummy variables.

The names and meanings of explained variables, explanatory variables and control variables are summarized in Table 2.

Table 2. Names and meanings of the variables.

Variable type	Variable name	Symbol	Variable meaning
Explained variable	Corporate environmental responsibility	<i>cer</i>	The Corporate Environmental Responsibility Index
Core explanatory variables	Traditional Chinese culture	<i>cul</i>	The number of Confucius temples within 100 kilometers of the enterprise location
Control variable	Return on assets	<i>roa</i>	Return on total assets = net profit/ending shareholders' equity
	Asset-liability ratio	<i>lev</i>	Total liabilities/total assets
	Enterprise age	<i>age</i>	Years of enterprise establishment
	Regional environmental regulation intensity	<i>er</i>	Completed investment in industrial pollution control / industrial added value of a province
	Regional economic development level	<i>pgdp</i>	Per capita GDP of the enterprise affiliated province
	Type of enterprise ownership	φ_o	Dummy variable: state-owned enterprises take 1; non-state-owned enterprises take 0.
	Enterprise affiliated industry type	η_i	Dummy variable: set agriculture as the benchmark group
	Enterprise affiliated region	δ_r	Dummy variable: eastern region enterprise takes 1 and central and western region enterprise takes 0
	Time dummy variable	λ_t	Dummy variable: set 2010 as the benchmark

3. The empirical analysis

3.1. Data source and description

This work employs Chinese A-share listed firms as investigative samples, attributable to the annual reports publicly disseminated by listed firms comprising a substantial amount of high-quality data pertaining to corporate finance, production and operation. Concerning the time interval, in order to circumvent the atypical influence of the 2008 international financial crisis and the COVID-19 pandemic on the performance of corporate environmental responsibilities, we chose to adopt 2010–2018 as the research interval. Upon thoroughly contemplating the availability of corporate social responsibility information and acknowledging the significant disparities between financial enterprises and real enterprises in production, operation and environmental protection, this study excludes financial enterprises from the sample. Furthermore, ST/ST* companies are omitted in compliance with standard practice, and the ultimate number of investigative samples is 506.

The data in this study originate from the China Research Data Service Platform, Guotai'an Database, the Economy Prediction System data platform and China Statistical Yearbooks.

3.2. Preliminary regression results and analysis

Table 3. Results of benchmark regression analysis

	(1)	(2)	(3)
<i>Inc</i> <i>ul</i>	1.438*** (3.78)	1.447*** (3.65)	0.892** (2.21)
<i>roa</i>			25.45*** (5.07)
<i>lev</i>			15.02*** (8.43)
<i>age</i>			0.128* (1.91)
<i>er</i>			-200.4 (-1.47)
<i>lnpgdp</i>			4.301*** (5.98)
ownership dummy	NO	YES	YES
industry dummy	NO	YES	YES
region dummy	NO	YES	YES
year dummy	NO	YES	YES
cons	42.19*** (57.58)	32.52*** (11.36)	-17.84** (-2.17)
<i>N</i>	3465	3395	3395
<i>R</i> ²	0.004	0.135	0.166

*Note: t statistics calculated based on robust standard errors are in parentheses; ***, ** and * indicate being statistically significant at 1%, 5% and 10% significance levels, respectively.

In this subdivision, we utilized the panel data of 506 Chinese listed firms from 2010 to 2018 to perform an empirical analysis of the comprehensive impact of Chinese traditional culture on corporate environmental responsibility by employing the OLS method. The model estimation results are displayed in Table 3.

It can be seen from the estimation results of Column (1) in Table 3 that, without considering any control variables, the estimation coefficient of *lncul* is 1.438, and it is statistically significant at the 10% significance level. This implies that the impact of traditional culture on an enterprise is positively correlated with its environmental responsibility. After incorporating enterprise ownership type, industry, region and annual dummy variables into the model, the estimated results depicted in Column (2) have not altered significantly in comparison with those in Column (1). Simultaneously, after accounting for the five control variables, the estimation coefficient of *lncul* in Column (3) is 0.892. Although this coefficient has diminished to a certain extent relative to that in Column (1), it remains significantly positive at the 10% significance level.

In summary, Chinese traditional culture has a resilient and significant positive impact on corporate environmental responsibility, irrespective of whether control variables are included or not, which further validates the research conclusions of Liu et al. and Li et al. [21,22]. Consequently, the more profoundly an enterprise is influenced by traditional Chinese culture, the better it will execute its corporate environmental responsibility. On the one hand, the Chinese traditional culture accentuates the “nature and humanity harmony” and the “justice over profit” doctrine, which facilitates the sustainable development of enterprise production and management, prompting enterprises to focus on resource conservation and environmental protection while attaining economic benefits. Therefore, traditional Chinese culture has a positive impact on enterprise environmental responsibility. On the other hand, the spread of traditional culture itself has been protected and refined by generations, so the values of traditional culture also reflect the importance of environmental protection from the side, and traditional moral and ethical concepts will also play a certain role in urging and guiding corporate behavior. Furthermore, social pressure and corporate reputation will also play a driving role in the development of corporate environmental responsibility. Therefore, Chinese traditional culture has a positive impact on the environmental responsibility of enterprises.

Regarding the control variables, the estimation coefficient of *roa* is in excess of 0 and statistically significant at the level of 10% significance. This exemplifies that the higher the enterprises' profitability, the stronger their inclination to fulfill environmental responsibilities, which is congruent with the theoretical expectation. In addition, the asset-liability ratio *lev* also has a significant positive impact on corporate environmental responsibility. This may be attributable to enterprises with higher asset-liability ratios often facing greater operating pressure; in order to alleviate financing pressure, they typically excel at performing their environmental responsibilities and disclosing more environmental information to secure more financial support from financial institutions and investors. There is also a significant positive correlation between enterprise age and environmental responsibility, which indicates that enterprises with more business years acknowledge the importance of environmental responsibility performance in the sustainable development of enterprises. Concerning the macro environment of the region where the enterprise is located, the regional per capita GDP has a significant positive impact on the performance of corporate environmental responsibility. This is primarily because, in regions with a higher level of economic development, public awareness of environmental protection is heightened, the degree of participation in environmental protection is more profound and enterprises are more disposed to fulfill environmental responsibilities. It is noteworthy

that the effect of regional environmental regulation on corporate environmental responsibility is not significant. The reason may be that although the government's intensification of environmental regulation can stimulate enterprises to protect the environment, it may also escalate enterprise production costs, constraining their investment in the use of environmentally friendly products and low-carbon technology research and development. Underneath the complex influence mechanism of environmental regulation on corporate environmental responsibility, there is a scarcely significant relationship between the two.

3.3. Robustness check

Table 4. Robustness test results.

	(1) Winsorization	(2) 2SLS	(3) LIML
<i>Incul</i>	0.886** (2.23)	1.088** (2.32)	1.088** (2.34)
<i>roa</i>	32.08*** (5.10)	25.50*** (5.08)	25.50*** (5.14)
<i>lev</i>	15.95*** (8.93)	15.01*** (8.42)	15.01*** (8.52)
<i>age</i>	0.124* (1.85)	0.129* (1.93)	0.129* (1.95)
<i>er</i>	-94.02 (-0.54)	-194.5 (-1.42)	-194.5 (-1.44)
<i>lnpgdp</i>	4.402*** (6.06)	4.244*** (5.86)	4.244*** (5.93)
ownership dummy	YES	YES	YES
industry dummy	YES	YES	YES
region dummy	YES	YES	YES
year dummy	YES	YES	YES
cons	-19.85** (-2.38)	-19.38** (-2.15)	-19.38** (-2.18)
<i>N</i>	3395	3395	3395
<i>R</i> ²	0.167	0.166	0.166
Kleibergen-Paap rk LM (p-value)		417.534 (0.000)	418.902 (0.000)
Cragg-Donald Wald F statistic		5908.01	5908.01
Stock-Yogo Weak ID test critical values:		16.38	16.38
10% Maximal IV			

*Note: t statistics calculated based on robust standard errors are in parentheses; ***, ** and * indicate being statistically significant at 1%, 5% and 10% significance levels, respectively.

We conducted the following robustness test to ascertain the robustness of the aforementioned

empirical research results. In order to test the potential impact of the outliers of listed firms on the model estimation results, all continuous variables were winsorized at the 1% and 99% quantile levels, and then the parameter estimation was conducted. The parameter estimation results are exhibited in Table 4.

The estimation results in Column (1) of Table 4 reveal that *lncul* is still significantly positive at the significance level of 10% after winsorization, which further corroborates the stimulative effect of Chinese traditional culture on enterprises to fulfill environmental responsibility. Concurrently, the estimated coefficient value of *lncul* is 0.886, which is not significantly different from the estimated coefficient of 0.892 in the preceding benchmark regression. It can be seen that the data extreme value problem does not compromise the robustness of the empirical results in this study.

Subsequently, although the environmental responsibility of listed enterprises does not form a reverse causal relationship with the traditional culture epitomized by the number of Confucian temples within 100 kilometers of their registered location, relevant independent variables may still be omitted in the configuration of regression models, which may lead to an endogeneity dilemma, yielding errors in the parameter estimation results. In order to address the impact of potential endogenous problems on model estimation results, this investigation further employs two-stage least squares method (2SLS) to estimate the parameters. In view of the practical operability of instrumental variable construction, we referred to [47], taking the cubic of deviation of the number of Confucian temples within 100 kilometers of the enterprise as the instrumental variable to execute 2SLS estimation. It can be seen that the P-value of the Kleibergen-Paap rk LM statistic for insufficient identification test in Table 4 is 0, which rejects the null hypothesis that the instrument variable is not related to the endogenous explanatory variable. Simultaneously, the Cragg-Donald Wald F statistic is 5908.01, which is far greater than the critical value of 16.38 at the 10% significance level. Therefore, the null assumption that the instrument variable is a weak one can be rejected. In addition, because the number of instrument variables selected in this investigation is the same as the number of endogenous explanatory variables, the over identification test was no longer conducted. The above tests demonstrate that the instrument variables selected in this study are reasonable. Likewise, the estimated results in Column (2) of Table 4 also indicate that Chinese traditional culture has a significant positive impact on the environmental responsibility of listed companies, which further validates the robustness of the empirical research results of this paper when considering potential endogenous issues.

Ultimately, the limited information maximum likelihood method (LIML) is deemed to be less sensitive to weak instrumental variables than the two-stage least square method; in other words, even in the case of weak instrumental variables, the estimation results grounded on the LIML method will be less affected. As can be seen from Column (3) of Table 4, the estimation results predicated on the LIML method are remarkably close to those derived from the 2SLS method. Explicitly, the estimated coefficient of *lncul* is statistically significant, and it is also 1.088, signifying that there is no weak instrumental variable problem, and it also exemplifies the important positive role of Chinese traditional culture in the advancement of corporate environmental responsibility.

4. Further discussion

4.1. Discussion on the heterogeneous influence of traditional culture on the sub-indexes of corporate environmental responsibility

In order to delve deeper into the impact of Chinese traditional culture on corporate environmental responsibility, we first conducted regression analysis on five sub-indices of the corporate environmental responsibility index, specifically, legal awareness, social rating, environment-friendly products, low-carbon technology and green management, as dependent variables. The estimated results are displayed in Table 5.

Table 5. Estimated results with the sub-indexes of corporate environmental responsibility as dependent variables.

	(1) Legal awareness	(2) Social rating	(3) Environment-friendly products	(4) Low-carbon technology	(5) Green management
<i>Incult</i>	1.172*** (2.99)	1.153 (1.43)	0.0998 (0.15)	0.190 (0.21)	2.116*** (3.41)
<i>roa</i>	10.62*** (2.67)	46.40*** (4.57)	32.53*** (3.86)	23.10* (1.80)	14.07* (1.79)
<i>lev</i>	11.12*** (7.02)	22.94*** (6.91)	18.67*** (6.88)	20.55*** (4.95)	2.655 (0.98)
<i>age</i>	-0.185*** (-2.66)	0.166 (1.34)	0.158 (1.44)	0.508*** (3.42)	-0.180* (-1.73)
<i>er</i>	104.3 (0.78)	42.77 (0.16)	-333.2 (-1.43)	-337.3 (-1.02)	-198.7 (-1.05)
<i>lnpgdp</i>	1.847** (2.53)	2.659* (1.93)	3.943*** (3.46)	6.903*** (4.28)	4.024*** (3.77)
ownership	YES	YES	YES	YES	YES
dummy					
industry dummy	YES	YES	YES	YES	YES
region dummy	YES	YES	YES	YES	YES
year dummy	YES	YES	YES	YES	YES
cons	38.72*** (4.95)	-38.22*** (-2.61)	-5.921 (-0.46)	-43.99** (-2.29)	-14.01 (-1.13)
<i>N</i>	3395	3395	3395	3395	3395
<i>R</i> ²	0.131	0.127	0.238	0.208	0.192

Note: t statistics calculated based on robust standard error are in brackets; ***, ** and * represent being significant at the significance levels of 1%, 5% and 10%, respectively.

According to the estimated results in Table 5, although previous studies have demonstrated that Chinese traditional culture has a significant positive impact on the comprehensive index of corporate environmental responsibility, its effects on different sub-indices are markedly different. Specifically, although the estimated coefficients of *Incult* displayed in Columns (1)–(5) are greater than zero, they

are statistically significant at the 10% significance level only when legal awareness and green management are selected as dependent variables, while they are not significant when social rating, environment-friendly products and low-carbon technology are selected as dependent variables. We posit that the above empirical analysis results can be explained as follows.

Under the influence of traditional Chinese cultural philosophies such as “harmony between nature and human beings” and “valuing justice over profit”, enterprises tend to have a stronger environmental awareness and are more willing to implement norms, standards, and regulations related to environmental protection and sustainable development, as well as promote green management policies and measures. Therefore, Chinese traditional culture plays a significant role in promoting legal awareness and green management as two sub-indices of corporate environmental responsibility.

However, it is worth noting that the influence of Chinese traditional culture on the sub-index of social evaluation is not significant. This is mainly because, although Chinese traditional culture can effectively cultivate enterprises’ legal awareness of environmental protection, in order to obtain environmental recognition and form environmental advantages, enterprises need to further show better environmental performance by increasing investment in environmental governance. Therefore, the amplification effect of traditional culture on corporate social evaluation does not show statistical significance.

Similarly, we contend that the reasons why Chinese traditional culture has an insignificant impact on the two sub-indices of enterprise environment-friendly products and low-carbon technology can be attributed to the following two main aspects. On the one hand, although Chinese traditional culture can enhance the environmental protection awareness of enterprises, the transformation of this environmental awareness into the increase of environmental innovation behaviors such as environment-friendly products and low-carbon technologies depends on the accumulation of enterprises’ past knowledge stock and the continuous increase of R&D investment. On the other hand, Chinese traditional culture emphasizes the collectivist culture that individuals obey and belong to groups. This collectivist culture is conducive to the collective tackling of technical activities and innovative cooperation, but it may also dampen individual creativity and enthusiasm and thus have a certain negative impact on the atmosphere of innovation. In addition, the harmonious equilibrium emphasized in Chinese traditional culture often makes it easier for enterprises to form a conservative business strategy and fear risks, which, to some extent, deviates from the characteristics of high risk and high investment in scientific and technological innovation activities.

4.2. Econometric analysis results for the heterogeneous impact of traditional culture on the component indicators of the corporate environmental responsibility index

On the foundation of the above analysis, this sub-section further takes 12 specific component indicators of the corporate environmental responsibility index as dependent variables to investigate the impact of Chinese traditional culture on each component indicator. Considering that the data of the 12 indicators are all in the form of 0-1 categorical variables, we conducted empirical research through the logit regression analysis, and the resulting parameter estimation results are shown in Table 6.

As evidenced in the results reported in Table 6, there are certain differences in the influence of Chinese traditional culture on the 12 component indicators of corporate environmental responsibility in terms of statistical significance, coefficient sign, and coefficient size.

Table 6. Estimated results with each indicator of the corporate environmental responsibility index as the dependent variable.

	(1)	(2)	(3)	(4)	(5)	(6)
Referred to the GRI's Sustainability Reporting Guidelines	Disclosed the environment and sustainable development	No environmental punishment	Received environmental recognition or other positive evaluations	Having environmental advantages	Using renewable energy or circular economy	measures
<i>ln cul</i>	0.339*** (4.17)	-0.384 (-1.13)	-0.271 (-1.30)	0.104 (1.47)	0.0592 (0.69)	-0.0758 (-1.20)
<i>roa</i>	3.029*** (3.10)	-2.602 (-0.79)	2.852 (1.28)	3.126*** (3.24)	4.497*** (3.80)	2.839*** (3.25)
<i>first</i>	2.510*** (7.19)	0.581 (0.49)	0.975 (0.98)	1.588*** (5.30)	2.118*** (5.62)	1.438*** (5.35)
<i>age</i>	-0.0308** (-2.37)	-0.0192 (-0.59)	-0.105** (-2.41)	0.0104 (0.92)	0.0174 (1.28)	0.0155 (1.51)
<i>er</i>	-0.346 (-0.01)	142.7 (1.57)	105.9 (0.87)	-5.975 (-0.26)	14.72 (0.51)	-26.45 (-1.25)
<i>lnpgdp</i>	0.345** (2.46)	0.887* (1.77)	-0.339 (-0.75)	0.359*** (3.10)	-0.0275 (-0.18)	0.173 (1.64)
ownership dummy	YES	YES	YES	YES	YES	YES
industry dummy	YES	YES	YES	YES	YES	YES
region dummy	YES	YES	YES	YES	YES	YES
year dummy	YES	YES	YES	YES	YES	YES
cons	-7.723*** (-4.63)	-5.201 (-1.03)	9.256* (1.88)	-5.993*** (-4.39)	-5.407*** (-2.81)	-3.569*** (-2.87)
N	3096	2085	1100	3318	3310	3356

Note: t statistics calculated based on robust standard error are in brackets; ***, ** and * represent being significant at the significance levels of 1%, 5% and 10%, respectively.

Table 6 (continued). Estimated results with each indicator of the corporate environmental responsibility index as the dependent variable.

	(7)	(8)	(9)	(10)	(11)	(12)
	Developed or applied innovative products, equipment or technologies that are beneficial to the environment	Pollution-free emissions	Having policies, measures or technologies to save energy	Having policies, measures or technologies to reduce emissions of waste gas, wastewater, waste residue and greenhouse gases	Been examined by a third-party organization	Having green office policies or measures
<i>Incul</i>	-0.0221 (-0.34)	0.777*** (4.81)	0.115* (1.80)	-0.156** (-2.10)	0.216 (1.15)	0.251*** (3.18)
<i>roa</i>	2.066** (2.55)	0.289 (0.15)	1.510* (1.73)	0.799 (0.74)	7.812** (2.38)	1.432 (1.37)
<i>first</i>	1.499*** (5.66)	-0.947 (-1.44)	1.485*** (5.52)	0.768** (2.39)	0.891 (0.91)	0.313 (1.02)
<i>age</i>	0.0139 (1.43)	0.00190 (0.08)	0.0303*** (2.95)	0.0238** (2.21)	-0.0365 (-1.34)	-0.0160 (-1.45)
<i>er</i>	-12.04 (-0.55)	-72.60 (-1.09)	-40.56** (-1.98)	17.18 (0.56)	5.959 (0.06)	-53.74* (-1.76)
<i>lnpgdp</i>	0.341*** (3.17)	0.151 (0.56)	0.380*** (3.51)	0.405*** (3.34)	1.614*** (4.57)	0.342*** (2.65)
ownership dummy	YES	YES	YES	YES	YES	YES
industry dummy	YES	YES	YES	YES	YES	YES
region dummy	YES	YES	YES	YES	YES	YES
year dummy	YES	YES	YES	YES	YES	YES
cons	-6.968*** (-5.45)	0.888 (0.27)	-4.889*** (-3.99)	-5.720*** (-4.15)	-21.03*** (-5.16)	-3.472** (-2.45)
N	3372	1297	3348	3343	1986	3290

Note: t statistics calculated based on robust standard error are in brackets; ***, ** and * represent being significant at the significance levels of 1%, 5% and 10%, respectively.

The estimated results of Column (1) show that Chinese traditional culture can significantly improve the probability of listed companies performing their environmental responsibilities by referring to GRI's Guidelines for Sustainable Development Reports, further demonstrating that promoting Chinese traditional culture is an important way to enhance corporate environmental awareness. However, the results in Columns (2) and (3) show that traditional culture has no significant impact on whether listed companies disclose environmental and sustainable development information or whether they are subject to environmental penalties. Although the estimated coefficients of *Incul* in

Columns (4) and (5) are greater than 0 in the logit regression analysis with “whether the enterprise has received environmental recognition or other positive evaluations” and “whether the enterprise has other environmental advantages” as dependent variables, they are not statistically significant at the 10% significance level. This further reflects that Chinese traditional culture does not play an apparent role in promoting corporate social ratings. As far as the sub-index of environment-friendly products is concerned, although the effect of Chinese traditional culture on this sub-index is not significant, there are marked differences in the statistical significance of its impact on its three indicators. Among them, the results in Column (6) show that traditional culture has a significant positive impact on “pollution-free emissions”, which indicates that enterprises that are more affected by traditional culture are less likely to pollute the environment. In Columns (7) and (8), the estimated coefficients of *lncul* are not statistically significant at the significance level of 10%, but their signs are negative. It indicates that Chinese traditional culture has a certain negative impact on listed enterprises’ environment-friendly product and process innovation.

For the low-carbon technology sub-index, the impacts of Chinese traditional culture on its two component indicators are statistically significant, but the impact direction is completely opposed, which is also the main reason why the overall effect of Chinese traditional culture on the low-carbon technology sub-index is not significant. Specifically, the estimated results in Columns (9) and (10) show that Chinese traditional culture can significantly increase the willingness of listed companies to adopt energy-saving policies, measures, or technologies, but it also significantly reduces the probability of companies to adopt policies, measures, or technologies to reduce waste and greenhouse gas emissions. This may be because, compared with energy-saving technologies, technological innovation activities in the fields related to the reduction of waste and greenhouse gas emissions face greater R&D risks, and the inhibitory effect of Chinese traditional culture on such innovation activities is more obvious. Finally, for the dimension of green management, the estimation coefficients of *lncul* in Columns (11) and (12) are both positive but only show statistical significance in Column (12). This indicates that Chinese traditional culture has no noticeable effect on improving the probability of enterprises passing the third-party inspection, but it can significantly encourage enterprises to adopt green office policies or measures. This is also why traditional Chinese culture has a significant positive effect on the green management of listed companies.

5. Conclusions and implications

Utilizing the panel data of Chinese listed companies from 2010 to 2018, this study explores the impact of Chinese traditional culture on corporate environmental responsibility and its heterogeneity, and gleans the following conclusions and implications.

Firstly, Chinese traditional culture has a significant positive impact on corporate environmental responsibility based on an empirical analysis of the overall impact of Chinese traditional culture on corporate environmental responsibility with the help of the least squares estimation method. A robustness test was conducted and ensures the robustness of the finding; that is, Chinese traditional culture has a significant positive impact on corporate environmental responsibility, and this promotion effect is still robust considering the impact of extreme data and potential endogenous problems. Therefore, the government and enterprise managers should deliberately guide the traditional culture to play an important role in the enterprise operation process and formulate corresponding incentive implementation regulations so that the traditional culture can be internalized into the enterprise culture,

thus promoting the performance of enterprise environmental responsibility, and ultimately achieving green and sustainable development.

Secondly, in terms of the impact mechanism of Chinese traditional culture on corporate environmental responsibility, the influencing factors and their impact process are generally as follows. First, the higher the profitability of enterprises, the stronger the willingness of enterprises to fulfill their environmental responsibility. Although enterprises with high balance sheets often face greater operating pressure, in order to ease the financing pressure, enterprises usually better perform their environmental responsibilities and disclose more environmental information so as to obtain more financial support from financial institutions and investors. Second, the age of enterprises also shows a significant positive correlation with environmental responsibilities, reflecting that enterprises that have been operating for a relatively longer time pay more attention to the important role of environmental responsibility performance in the sustainable development of enterprises. Third, from the perspective of the location of the enterprise, because regions with higher economic development levels have stronger public awareness of environmental protection, deeper participation in environmental protection, and higher consciousness of enterprises to fulfill environmental responsibility, regional per capita GDP has a significant positive impact on the enterprises' fulfillment of environmental responsibility in those regions. Although the government's strengthening of environmental regulation can encourage enterprises to strengthen their awareness of environmental protection, it may also increase the production costs of enterprises, which may squeeze their investment in the use of environment-friendly products and research and development of low-carbon technologies. Therefore, local governments should guide enterprises to fulfill their environmental responsibilities according to their own characteristics and local conditions.

Thirdly, heterogeneity exists in the impact of Chinese traditional culture on corporate environmental responsibility. In terms of legal awareness, Chinese traditional culture can significantly improve the probability of listed enterprises to fulfill their environmental responsibilities according to the GRI Sustainability Reporting Guidelines. However, traditional culture has no significant influence on whether listed companies disclose environmental and sustainable development information or whether they are subjected to environmental penalties. In terms of social rating, the improvement effect of Chinese traditional culture on the corporate social rating is not pronounced. In the aspect of environment-friendly products, Chinese traditional culture has a certain negative impact on listed enterprises' environment-friendly product innovation and process innovation. For the low-carbon technology aspect, Chinese traditional culture can significantly increase the willingness of listed companies to adopt energy-saving policies, measures or technologies. Still, it also significantly reduces the probability of companies to adopt policies, measures or technologies to reduce waste and greenhouse gas emissions. Finally, for the dimension of green management, Chinese traditional culture does not play an evident role in improving the probability of enterprises passing the audit of third-party institutions, but it can significantly encourage enterprises to adopt green office policies or measures, which indicates that Chinese traditional culture has a significant positive effect on the green management of listed companies. Therefore, promoting Chinese traditional culture is an important way to enhance enterprises' environmental awareness. Besides, governments and enterprise managers can leverage Chinese traditional culture to promote the adoption of energy-saving policies, measures or technologies.

In conclusion, this study highlights the importance of understanding the various impacts of Chinese traditional culture on corporate environmental responsibility. By taking into account the heterogeneity of these effects, policymakers and enterprise managers can develop targeted strategies

to harness the positive aspects of traditional culture while mitigating any potential negative consequences. By doing so, they can help to create an environment in which enterprises are not only more environmentally responsible but are also more sustainable and competitive in the long run. The topic research of Chinese traditional culture on corporate environmental responsibility is of practical significance and worthy of further in-depth study. Based on theoretical analysis of its influence mechanism, this paper mainly focuses on the theoretical and empirical exploration of the heterogeneous influence of traditional culture on corporate environmental responsibility. Therefore, empirical analysis of the mechanism effect of traditional culture on corporate environmental responsibility is one of the focuses of subsequent research.

Use of AI tools declaration

The authors declare they have not used Artificial Intelligence (AI) tools in the creation of this article.

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Conflict of interest

The authors declare that there is no conflict of interest.

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