

*Original Research*

# Do Industry Peers across and within Regions Affect Corporate Environmental Responsibility? Evidence from Chinese Listed Companies

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## Abstract

In the context of China's development of modern environmental governance systems, it is crucial to recognise the vital role played by businesses. The internal impetus for environmental governance will be generated by accelerating the emergence of a universal industry trend of enterprises proactively fulfilling their environmental responsibilities. Therefore, this study utilises listed A-share companies in Shanghai and Shenzhen stock exchanges from 2010 to 2020 as samples to investigate the peer impacts of corporate environmental responsibility (CER). It was discovered that industry peers across and within regions might influence CER. When companies meet their environmental duties, the peer effects of CER may be seen as convergent responsiveness to external pressure. In a cross-regional context, the combination of industry competitive pressure and severe environmental uncertainty may greatly amplify the peer implications of CER, and small businesses are more susceptible to convergence. In an intra-regional scenario, environmental regulatory pressure has dramatically diminished the peer effects of CER, and the high-level marketisation process ensures that environmental regulatory pressure will favour the independent fulfilment of CER. Moreover, this phenomenon is magnified in state-owned enterprises.

**Keywords:** corporate environmental responsibility, environmental regulation, industry competition, industry peers, peer effects

## Introduction

Corporate social responsibility, as an important means for enterprises to achieve their own sustainable development, is also an important thrust to coordinate economic development, ecological protection and social

harmony. This not only requires enterprises to reflect the triple bottom line of economy, environment and society in all aspects of their activities, but also requires them to clearly set responsibility goals related to them [1]. With the concept of green, low-carbon and sustainable development gradually becoming the general consensus of the international community [2-3], corporate social responsibility and the realization of its environmental performance have received attention [4-6], and

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environmental behaviors such as pollution reduction and emission reduction [7], green innovation [4] and environmental information disclosure [8] have become important ways for enterprises to fulfill their social responsibility. In this context, corporate environmental responsibility (CER), as an important component of corporate social responsibility, has gradually formed an independent branch [9-10], which is of common concern to stakeholders such as government, shareholders and the public [11]. In the existing studies, CER involves a series of responsibilities for companies to actively protect the environment, minimize environmental pollution, and bear the adverse consequences of environmental damage when conducting business activities [12-13].

The acceptance of environmental responsibility by companies and the implementation of their environmental strategies not only play a decisive role in promoting environmental sustainability [14], but can also create significant economic value for companies [15]. For example, compliant corporate environmental behavior can lead to good financial performance [16], and the ensuing environmental performance can also attract the interest and attention of investors [17], positively influencing stock performance [18]. In studies contrary to this line of thought, financial performance [19-20], environmental performance [21] and other types of corporate performance have also been found to be effective in promoting CER activities. The relevance of the intrinsic factor of corporate motivation to perform environmental responsibility and corporate economic goals has been relatively well demonstrated in the above studies. Among other studies on the external influences on CER, influence from environmental regulatory policies [22-23] and product market competition [24-25] have been identified as common external pressures driving firms to actively pursue environmental responsibility.

Notably, studies have found that the role of power or pressure within and between groups of firms is critical to understanding the evolution of environmental policies [26] and that CER is associated with the pursuit of strategic similarity, where firms can secure their legitimacy, resources, and strategic position in the market by adopting CER strategies similar to those of their peer competitors [27]. In both of these studies, extrinsic influence from environmental policies and market competition seem to be associated with CER either through group behavior of firms or similarity between groups of firms. Considering that internal factors such as firms' economic objectives are unique to individual firms, whereas the effects of government policies and market competition in firms' external environment can cover a large number of firms, i.e., they can affect a specific group of firms in a given region or industry. Therefore, it is necessary to take the role of groups of firms into account when exploring the external factors affecting CER.

With the development of the market economy, the relationship between the decision-making behaviours of various economic entities has become closer, and research on peer effects has been gradually applied to study the mutual influence and convergence attributes of corporate behaviours in specific groups. Peer effects have been identified in corporate governance practices [28], business investment and financing [29-30], mergers and acquisitions [31], employee welfare policies [32], innovation [33], disclosure decisions [34] and even financial fraud [35]. The above peer effects mostly occur at the level of the industry. In the realms of corporate social responsibility [36-40], environmental information disclosure [41-42], environmental strategies [43] and green innovation [44], which are analogous to CER, corporate behaviour may also be impacted by enterprises in the same industry. In addition, it was discovered that peer comparisons between organisations yield quick pollution reductions [45]. However, few studies directly correlate CER with peer effects.

Combined with the actual situation, in recent years, the Chinese government has advanced the building of a modern environmental governance framework, declaring that companies are accountable for legally sharing environmental information. According to the Evaluation Report on Environmental Responsibility Information Disclosure of Listed Companies in China, the environmental responsibility information disclosure index of Chinese listed companies reached its highest level since 2012 in 2020, with 1,135 of 4,418 Chinese listed companies publishing social responsibility reports, environmental reports, sustainability reports, and environmental, social, and governance (ESG) reports. China's publicly traded corporations have evolved into a group of firms with a reasonably advanced level of environmental responsibility, and CER is increasingly becoming a collective trend. Therefore, it is crucial to China's contemporary environmental governance to allow corporations to become the primary agents of environmental responsibility and maximise CER's peer impact.

The considerations mentioned above prompt us to answer specific questions. Will there be peer effects when businesses fulfil their environmental obligations? If peer effects exist and CER is seen as a reflection of a firm's environmental management process in response to pressure factors, would various pressures induce firms to develop distinct environmental responsiveness modes in response to peer effects?

This study makes several contributions to the present body of literature. First, it classifies cross-regional and intra-regional peer effects in the industry based on the pressure factors of industry competition and local government environmental regulation emanating from the industry and regional levels. Second, it demonstrates that when businesses fulfil their environmental responsibilities, the peer effects of CER may be seen as a convergent reaction to external pressure. Third, the findings indicate that cross-regional industry

competitive pressure and intra-regional environmental regulatory pressure have differing moderating effects on the peer effects of CER, hence triggering the convergent and independent responsiveness of firms, respectively. The objective is to investigate the inherent nature and occurrence mechanism of CER peer effects using empirical evidence from Chinese listed companies to provide management solutions for enhancing corporate environmental responsiveness and policy references for the government to address the role of corporate performers in modern environmental governance.

## Hypotheses Development

### Types of CER Peer Effects

#### *Industry Peers across Regions*

Given that information asymmetry and uncertainty pose risks to the operation and decision-making of organisations in several ways [46], market analysis has become an efficient method for firms to mitigate the risk of information asymmetry [47]. Companies may reduce uncertainty when making choices by emulating and referencing the actions of other firms with comparable characteristics. For companies, peers usually imply facing similar market environment, business risks and other attribute characteristics, and the collection of these attributes often appears simultaneously across regions and by industry. Since the aim of CER is to tackle environmental issues, various sectors have varying degrees of environmental impact, and the decision-making of enterprises to meet their environmental duties is more sensitive to the influence of firms in the same industry. Therefore, the peer effects of CER are likely to occur at the industry level and are not restricted to geographic agglomeration.

Hypothesis 1: There are peer effects of CER across regions.

#### *Industry Peers within Regions*

As mentioned earlier, the peer effects of corporate decisions mostly exists at the industry level, but it cannot be ignored that there are other more segmented sets within the peer group. From the perspective of regional economics, with the rapid formation of regional economic layouts, industrial agglomeration in urban agglomerations has become very common [48], which encourages tighter interaction of factor resources among economic entities in the regional industries. Since network-based social interactions may initially decay with increasing distance [49], the possibility of corporate environmental strategies being influenced by small-scale regional networks is relatively high. Coupled with the fact that the industrial policies of local governments may have a greater influence on the linkages of economic activity groups in the network

[50], there is a possibility that firms may further select their local industry counterparts as imitation objects in addition to industry peers as reference when fulfilling their environmental responsibilities.

Hypothesis 2: There are intra-regional peer effects of CER.

### Moderating Mechanisms of CER Peer Effects

#### *Competitive Pressure in the Industry across Regions*

When exploring the mechanisms of cross-regional peer effects from an external perspective, the factors that can act on CER at the industry level deserve focused attention. From the perspective of dynamic capabilities, inter-firm interaction is an important component of competition [51], and performing imitation is one way to strengthen a firm's market position [52]. Although firms can choose unrelated firms from other industries as learning targets, since inter-firm competition from the same industry is the main source of competitive advantage [53], the motivation for firms to maintain their competitive position and protect their market share by imitating their industry peers is stronger [47]. Learning from them can not only ensure the robustness of CER decisions, but also enhance firms' green competitiveness and make CER a strategic decision to gain competitive advantage [25].

Hypothesis 1a: The cross-regional peer effects of CER are considerably promoted by the pressure of competitiveness within an industry.

With the escalation of market rivalry, companies will face a more unpredictable business environment, and management uncertainty will also grow [54]. Information transfer theory suggests that environmental uncertainty exacerbates the degree of information asymmetry in firms [55], making it more difficult for managers to assess the business conditions of their firms. To cope with possible contingencies from environmental uncertainty, firms will adopt a more conservative strategy [56], using learning and imitating industry peers to make robust CER decisions. Moreover, in the face of an unstable industry environment, a firm's dynamic capabilities are more critical to the acquisition of competitive advantage [56]. Using industry peers' CER information as a reference is beneficial for firms to react quickly to the changing environmental changes and participate in the market competition flexibly.

Hypothesis 1b: When environmental uncertainty is substantial, the impact of industry competition pressure on the cross-regional peer effects of CER is amplified.

In addition, because deciding whether to fulfil environmental duty is a corporate choice, the source of rational decisions is still whether the company has enough decision-making resources. A lack of resources may impede small and medium-sized businesses' adoption of proactive environmental management practices [57]. Faced with the overlaying

of sector competitive pressure and environmental unpredictability, small companies may be more inclined to establish a decision-making foundation via external acquisition. Small businesses pay greater attention to maintaining external knowledge [58]. This offers an adequate behavioural incentive for small businesses to comply with their industry peers' environmental obligations. Therefore, the following hypotheses are formulated:

Hypothesis 1c: When environmental uncertainty is substantial, the CER of small firms is more subject to the CER of their industry peers under the pressure of industry competitiveness.

#### *Environmental Regulatory Pressure within Regions*

When conducting research on industry peers within regions, institutional factors at the regional level are potential external mechanisms of CER peer effects that deserve attention. According to institutional theory, firms tend to develop their growth strategies based on perceived institutional pressures in order to better survive and thrive [59]. Although, environmental regulations are considered to be detrimental to entrepreneurship [60], institutional pressures represented by environmental regulations still make CER activities attractive to firms given that compliant corporate environmental behavior can reduce environmental costs or lead to economic profits [61]. The strict environmental regulation policies of local governments not only make firms pay more attention to the basic requirements of environmental behavior, but also effectively reduce the problems caused by information asymmetry through institutional guarantees, so that firms can fully rely on the judgment of their own conditions and the integration of internal resources to develop environmental strategies, rather than just following the industry peers for convergent responsiveness.

Hypothesis 2a: Environmental regulatory pressure significantly weakens the intra-regional peer effects of CER.

Neither the practice of business decisions nor the implementation of government policies can be separated from the market environment in which they operate. A high-level marketisation process may encourage firms to become the core of market activities [62]. This offers a foundation for businesses to make CER choices using their resources independently. It is worth noting that, since the higher the degree of regional marketization, the lower the degree of government intervention in the market, the government's environmental regulation policy can be an effective external reference for firms to make independent CER decisions. This provides the conditions for firms, which are important activity players in the market, to achieve compliance with CER activities through good internal control rather than imitating their peers.

Hypothesis 2b: When regional marketisation is substantial, the pressure of environmental regulation significantly reduces the intra-regional peer effect of CER.

Furthermore, because the enterprises to be studied in the next step are located in regions with a high marketisation process, the ownership structure factors of enterprises that thrive in the regional institutional environment are more likely to affect CER's intra-regional peer effects than the features of enterprise scale in the cross-regional situation mentioned above. Compared to non-state-owned firms, state-owned enterprises are more eager to comply with government policies, which may increase the effectiveness of environmental regulation on their environmental behaviour [63]. Under the pressure of environmental regulation, the responsiveness of state-owned firms may become more autonomous, and they may perform their environmental responsibilities with more consciousness.

Hypothesis 2c: When regional marketisation is substantial, the CER of state-owned firms is less subject to the influence of industry peers under pressure from environmental regulation.

The research framework based on the above hypotheses is shown in Fig. 1.

## **Research Design and Methodology**

### Data Collection and Sample Selection

Since China has formally adopted environmental information disclosure since 2008, and to further reduce the influence of the 2008 financial crisis on relevant factors, the research samples are comprised of Shanghai and Shenzhen A-share listed companies from 2010 to 2020. The CER data are obtained from Hexun.com. The corporate data are from the China Stock Market & Accounting Research Database (CSMAR). At the same time, the regional statistics come from the EPS database, CNKI's big data research platform on China's economy and society, and The Marketization Index of China's Provinces: NERI Report (2018). The interpolation approach, the average growth rate method, or the weighted moving average method are used to fill in specific missing data regarding pertinent literature specifications.

To gain a deeper understanding of the peer effects of CER, this study divides peer effects in the industry into two categories: cross-regional peer effects and intra-regional peer effects. The industry is categorised according to the secondary industry categorisation code of the China Securities Regulatory Commission (2012 version). In the research of cross-regional peer effects, industries with fewer than two companies in a given year are eliminated. When analysing intra-regional peer effects, industries with fewer than two enterprises within the same region in the same year are excluded.

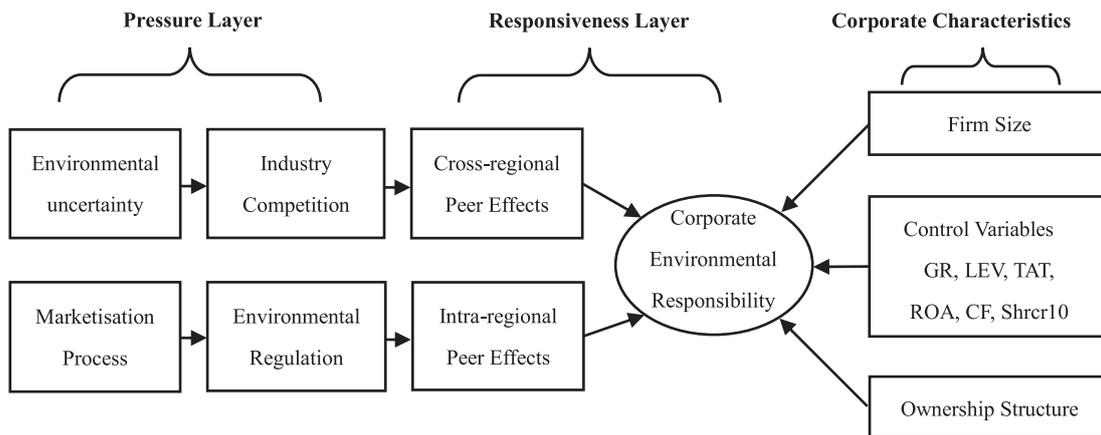


Fig. 1. Conceptual framework.

When filtering the data, this research first excludes businesses with unavailable financial data. Second, it removes financial and insurance firms and ST and \*ST companies. Third, considering the endogeneity, all continuous variables other than the independent variable are lagged by one period [64]. Fourth, all continuous variables were winsorised at 1% and 99% quantiles to control for extreme values. Finally, the estimation model for cross-regional peer effects uses 9,050 observed values, whereas 8,200 experimental values are used to estimate intra-regional peer effects.

Measurement of Variables

*Dependent Variable*

This article measures the dependent variable using the environmental responsibility rating system of Hexun.com [65]. Hexun’s environmental responsibility score is better for gauging CER performance [66]. It contains five indicators: environmental protection awareness, certification of an environmental management system, investment in environmental protection, number of types of pollutants discharged, and number of kinds of energy savings. Regarding the industrial weight ratio for the environmental responsibility score, the manufacturing sector is 30%, the service sector is 10%, and other sectors are 20% by default. Therefore, a higher degree of environmental responsibility performance suggests a greater desire on the part of companies to engage in environmental responsibility.

*Independent Variable*

In the cross-regional scenario, concerning the measurement methodologies of peer variables in previous research [67], this study identifies companies in the same year and the same industry as cross-regional industry peers and measures the strength of peer effects of CER (IPCER\_Cross) by averaging the environmental responsibility scores of other firms in the same industry in the same year.

In the intra-regional scenario, firms in the same region and industry in the same year are classified as intra-regional industry peers, and the strength of the peer effects of CER (IPCER\_Intra) is quantified by the average environmental responsibility score of other firms in the same region and industry of the same year.

*Moderator Variables*

In the cross-regional scenario, the classic Herfindahl-Hirschman index [68] (HHI) is used as the moderator variable to quantify the competitive pressure in the industry. This variable is a negative indicator. In other words, the stronger the industry competitive pressure a company endures, the lower its HHI value.

The intra-regional scenario used environmental regulation (ER) as the moderator variable. This research determines the pressure of ER by calculating the ratio of the current year’s completed investment in industrial pollution control projects to the regional GDP. All ratios are multiplied by 10,000 to ensure the data magnitude’s uniformity.

*Other Variables*

To further clarify the peer effects research of CER, this study incorporates two variables for group regression in each scenario. These variables are identified as follows:

**Environmental uncertainty (EU):** Ghosh and Olsen’s research [69] is referenced. First, the operating income at the end of the year serves as the explained variable, while the annual dummy variable serves as the explanatory variable for regression. Second, the regression disturbance term utilised as abnormal operational income in the preceding five years is divided by the average operating income in the preceding five years to calculate environmental uncertainty without industry adjustment. Third, the environmental uncertainty of the industry is determined by using the median environmental uncertainty of all enterprises in the same industry in the same year

without industry adjustment. Finally, the industry-adjusted environmental uncertainty is obtained by dividing uncertainty without industry adjustment by industry environmental uncertainty.

Regional marketisation process (RMP): Based on The Marketization Index of China's Provinces: NERI Report (2018), this research uses the marketisation scores of 31 provinces in China to assess regional marketisation. As this indicator was last updated in 2016, this study populates the years 2017 to 2020 with data based on the average growth rate of marketisation scores.

Firm size (Size): This variable is determined by the natural logarithm of the firm's year-end total assets.

Ownership Structure (SOE): This item uses a dummy variable to assess the ownership of a company, with a value of 1 for state-owned firms and 0 for non-state-owned enterprises.

In addition, this paper selects the following control variables: sustainable growth rate (GR), leverage ratio (LEV), total asset turnover (TAT), return on assets (ROA), net profit to cash flow ratio (CF), and the sum of shareholding ratios of the firm's top 10 major shareholders (Shrcr10). They are all computed using the CSMAR database.

### Model Specification

The following empirical model is developed to test CER's inter- and intra-regional peer effects.

$$CER_{i,t} = \alpha_0 + \alpha_1 \cdot IPCER\_Cross_{-i,t-1} + \beta_j \cdot \sum Controls_{ji,t-1} + \varepsilon_{i,t} \tag{1}$$

$$CER_{i,t} = \alpha_0 + \alpha_1 \cdot IPCER\_Cross_{-i,t-1} + \alpha_2 \cdot IPCER\_Cross_{-i,t-1} \times HHI_{i,t-1} + \alpha_3 \cdot HHI_{i,t-1} + \beta_j \cdot \sum Controls_{ji,t-1} + \varepsilon_{i,t} \tag{2}$$

$$CER_{i,t} = \alpha_0 + \alpha_1 \cdot IPCER\_Intra_{-i,t-1} + \beta_j \cdot \sum Controls_{ji,t-1} + \varepsilon_{i,t} \tag{3}$$

$$CER_{i,t} = \alpha_0 + \alpha_1 \cdot IPCER\_Intra_{-i,t-1} + \alpha_2 \cdot IPCER\_Intra_{-i,t-1} \times ER_{i,t-1} + \alpha_3 \cdot ER_{i,t-1} + \beta_j \cdot \sum Controls_{ji,t-1} + \varepsilon_{i,t} \tag{4}$$

Of which, *i* represents the firm and *t* represents the year.

Model (1) is used to verify Hypothesis 1.  $CER_{i,t}$  signifies the CER of firm *i* in year *t*, and  $IPCER\_Cross_{-i,t-1}$  represents the CER average value of other firms in the same industry with the firm *i* in year *t-1*.  $\sum Control_{ji,t-1}$  is the set of control variables, and *j* is the control variable symbol. The  $\varepsilon_{i,t}$  is a stochastic disturbance.

Model (2) is used to verify Hypothesis 1a. Based on

the model (1), firm *i*'s industrial competition pressure  $HHI_{i,t-1}$  in year *t-1* and the interaction term for  $HHI_{i,t-1}$  and  $IPCER\_Cross_{-i,t-1}$ , are added.

Model (3) is used to verify Hypothesis 2.  $IPCER\_Intra_{-i,t-1}$  represents the average value of the CER of other firms in the same region and industry with the firm *i* in year *t-1*, and the settings of the explained and control variables are consistent with those of model (1).

Model (4) is used to verify Hypothesis 2a. Based on the model (3), firm *i*'s regional environmental regulation pressure  $ER_{i,t-1}$  in year *t-1* and the interaction term between  $ER_{i,t-1}$  and  $IPCER\_Intra_{-i,t-1}$  are added.

Considering the structure of the variables and the fixed effects of the model need to be controlled, because  $IPCER\_Cross_{-i,t-1}$  contains information about the industry, to avoid the occurrence of collinearity, referring to the research of Adhikari and Agrawal [70], this study only controls the fixed effect of year and region in Models (1) and (2). Since  $IPCER\_Intra_{-i,t-1}$  contains both industry and regional information, regional fixed effects in Models (3) and (4) are not controlled.

## Empirical Results

### Descriptive Statistics

The descriptive statistics of the two samples are shown in Table 1. In the cross-regional and intra-regional peer groups, the average CER performance values are 2.197 and 2.080, respectively, with a minimum value of 0 and a maximum value of 23, indicating a considerable variation in environmental responsibility performance among firms, and even some companies take absolutely no action to fulfil environmental responsibilities.

### The Cross-Regional Peer Effects

First, under the cross-regional scenario, this research empirically examines Hypotheses 1 and 1a.

In Table 2, column (1) reveals that the coefficient of  $IPCER\_Cross$  is positive and statistically significant at the 1% level. This demonstrates that as the CER level of industry peers improves, enterprises react more aggressively to environmental responsibility because they imitate industry peers across geographies. In other words, there are substantial cross-regional peer effects of CER, hence confirming Hypothesis 1. Moreover, the control factors demonstrate that greater ownership concentration, profitability, and capital acquisition capability can motivate businesses to make strategic choices about their environmental responsibilities and execute CER proactively.

Based on the above, the interaction term for  $IPCER\_Cross$  and  $HHI$  is added to column (2) of Table 2. The coefficient of this interaction term is negative and statistically significant at the 1% level. Since

Table 1. Descriptive statistics.

Cross-regional industry peers						Intra-regional industry peers					
Variable	Obs	Mean	Std dev	Min	Max	Variable	Obs	Mean	Std dev	Min	Max
CER	9050	2.197	5.508	0	23	CER	8200	2.080	5.404	0	23
IPCER_Cross	9050	2.479	2.576	0	10.820	IPCER_Intra	8200	2.429	4.383	0	20
HHI	9050	0.126	0.121	0.016	0.697	ER	8200	8.171	5.810	0.639	30.310
EU	9050	1.422	1.347	0.137	8.008	RMP	8200	8.269	1.694	3.830	11.140
Size	9050	4.153	1.317	1.260	7.717	SOE	8200	0.521	0.500	0	1
GR	9050	0.054	0.107	-0.437	0.393	GR	8200	0.058	0.097	-0.354	0.382
Shrcr10	9050	54.220	15.140	22.000	89.640	Shrcr10	8200	55.090	15.070	22.310	89.480
LEV	9050	0.506	0.198	0.077	0.920	LEV	8200	0.480	0.204	0.061	0.897
TAT	9050	0.678	0.508	0.058	2.928	TAT	8200	0.677	0.492	0.073	2.829
ROA	9050	0.034	0.053	-0.183	0.195	ROA	8200	0.038	0.052	-0.170	0.193
CF	9050	1.604	6.457	-24.130	35.450	CF	8200	1.379	5.487	-21.020	29.100

HHI is a negative indicator, this finding indicates that the cross-regional peer effects of CER become more apparent as industry competitive pressure increases, thereby confirming Hypothesis 1a. Intense rivalry

increases the frequency of behavioural interactions within an industry and accelerates the flow of production factors. Although this will alter the sector's competitive landscape and increase the companies' survival risks, it will give the incentive and opportunity for firms to engage in competitive or imitative learning. To consolidate current competitive positions and sustain competitiveness, firms will investigate and analyse new business decisions made by industry peers, including the execution of environmental duties, more often. The CER decision-making based on the current environmental behaviour of industry rivals will exhibit apparent convergence features, resulting in a CER peer effect inside the industry. Therefore, this study concludes that competitive pressure within the sector is the cause and the basis of the CER peer effect.

In addition, it is noteworthy that the HHI coefficient is positive and statistically significant at the 1% level. In other words, excessive industry competitive pressure inhibits companies' efforts to fulfil their environmental obligations. When coupled with the idea of dynamic capability, it is clear that organisations' acquisition of new competitiveness is contingent on their unique circumstances and the coordination and integration of their resources. Since environmentally responsible investment for technological innovation etc. may increase the cost of enterprises in the short term [71], in the face of intense industry competition, enterprises may be more inclined to invest limited resources in areas such as innovation and R&D that can rapidly improve business performance, as opposed to focusing on enhancing environmental responsibility performance. Therefore, to effectively exert the positive effect of the market competition mechanism on the CER peer effect, it is necessary to assist businesses in developing a technological cost advantage and to provide assistance for the enterprises' short-term

Table 2. Regression results of cross-regional peer effects.

	(1) CER	(2) CER
IPCER_Cross	0.325*** (9.99)	0.429*** (9.90)
IPCER_Cross*HHI		-0.517*** (-3.72)
HHI		2.105*** (3.66)
GR	-0.768 (-0.87)	-0.733 (-0.83)
Shrcr10	0.023*** (6.34)	0.022*** (6.17)
LEV	0.975*** (3.14)	0.992*** (3.20)
TAT	-0.063 (-0.60)	-0.071 (-0.68)
ROA	8.155*** (4.22)	8.380*** (4.34)
CF	0.021*** (2.65)	0.021*** (2.58)
Constant	-0.572** (-2.22)	-0.907*** (-3.35)
Year FE	YES	YES
Region FE	YES	YES
Observations	9050	9050
R-squared	0.202	0.204

Numbers in parentheses are t values; \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

rational allocation of internal resources to fulfil environmental responsibilities.

This research uses a median grouping approach to identify enterprises' routes in response to industry competitive pressure. The sample of industry peers across regions is separated into two subsamples, high-EU and low-EU, based on the median level of environmental uncertainty (EU).

In the presence of significant cross-regional peer effects of CER, columns (1) and (2) of Table 3 reveal that the estimated coefficients of the interaction term for IPCER\_Cross and HHI differ significantly; in the high-EU group, the coefficients of the interaction term are negative and significant at the 1% level, whereas in the low-EU group, the interaction fails the significance test. This validates Hypothesis 1b, which states that when environmental uncertainty is high, the level of CER varies in the same direction as industry peers, and industry competitive pressure plays a more significant role in amplifying the peer effects of CER. The greater the degree of environmental uncertainty, the more complex and dynamic information the organisation must confront and evaluate throughout the decision-

making process, and the more challenging it is for the enterprise to make meaningful CER judgments based purely on internal data. The high unpredictability of the industry environment will exacerbate the decision-making risk caused by industry rivalry. The departure of environmental responsibility from the industry trend will add to the management's burden. Then, enterprise CER decisions will tend to take references from industry peers or leaders, and the convergence of corporate responses to environmental responsibility will increase. However, does this strategic divergence pressure exist across all company types? Are small firms with weaker resources more susceptible to being influenced by peers in their industry?

To test Hypothesis 1c, this study keeps just the subsamples with high-EU. It conducts a grouping regression based on the median of firm size (Size) to examine the effect of companies' fundamental resource capacities in reacting to industry competition pressures.

According to Table 3, columns (3) and (4), the cross-regional peer effects of CER are still significant in both secondary subsample groups, and the coefficient

Table 3. Group regression results of cross-regional peer effects.

	(1)	(2)	(3)	(4)
	High-EU	Low-EU	High-EU	
			Large-size	Small-size
IPCER_Cross	0.523*** (8.25)	0.342*** (5.71)	0.755*** (6.83)	0.327*** (4.67)
IPCER_Cross*HHI	-0.958*** (-4.72)	-0.015 (-0.08)	-0.430 (-1.03)	-0.833*** (-4.04)
HHI	1.476* (1.75)	2.465*** (3.09)	0.212 (0.13)	2.160** (2.41)
GR	-0.973 (-0.84)	-0.097 (-0.07)	-2.747 (-1.23)	-0.677 (-0.55)
Shrcr10	0.018*** (3.52)	0.027*** (5.13)	-0.005 (-0.65)	0.020*** (3.22)
LEV	0.673 (1.59)	1.395*** (2.97)	-1.264 (-1.38)	0.111 (0.24)
TAT	0.137 (0.86)	-0.287** (-1.99)	0.513** (2.10)	-0.096 (-0.49)
ROA	7.905*** (3.13)	8.977*** (2.94)	13.017** (2.35)	3.260 (1.27)
CF	0.021* (1.87)	0.021* (1.78)	0.001 (0.07)	0.025* (1.92)
Constant	-0.656* (-1.76)	-1.217*** (-3.03)	1.697** (2.24)	-0.567 (-1.36)
Year FE	YES	YES	YES	YES
Region FE	YES	YES	YES	YES
Observations	4400	4650	2020	2380
R-squared	0.202	0.224	0.310	0.157

Numbers in parentheses are t values; \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

of the interaction term of IPCER\_Cross and HHI in the small-size group is negative and statistically significant at the 1% level. However, the interaction term is not significant in the large-size group. Compared with big firms, when small enterprises with relatively poor resource-based capacities endure high environmental uncertainty, industry rivalry pressure plays a more significant role in boosting the peer effects of environmental responsibility performance. Typically, businesses of all sizes use diverse environmental strategies. Large companies are more likely to engage in experimental and creative environmental practices to gain industry leadership. Due to a lack of employees, funding, and necessary environmental protection technology, small businesses are more cautious and adaptable in their environmental strategies. They can only get crucial data after other companies have accomplished certain environmental obligations. Therefore, small businesses are more likely to use their industry peers as benchmarks and gradually complete their environmental duties to achieve consistent growth. This is also evident from the significance of each control variable; that is, a firm's enthusiastic reaction to

environmental responsibility is significantly influenced by its sound business performance.

### The Intra-Regional Peer Effects

The above examination of the peer effects of CER is based on cross-regional industry peers. Nonetheless, if concentrating on a particular sector in a specific region, as opposed to the cross-regional situation, the number of players in the industry will drastically decrease, and the competitive landscape of enterprises will become relatively constant. Therefore, the peer effects of CER under industry competitive pressure may be less apparent. Within a region, does the peer effect exist? If so, is there still industry competitive pressure sensitivity? In light of these problems, this study proceeds to test Hypotheses 2 and 2a empirically. Table 4 presents the findings of the regression analysis.

According to Table 4, column (1), the coefficient of IPCER\_Intra is positive and statistically significant at the 1% level. This demonstrates that industry peers impact the CER even within a region. The continued existence of a sizeable intra-regional peer impact

Table 4. Regression results of intra-regional peer effects.

	(1) CER	(2) CER	(3) CER
IPCER_Intra	0.075*** (5.41)	0.059*** (2.72)	0.183*** (8.07)
IPCER_Intra*HHI		0.127 (0.90)	
HHI		1.135 (1.49)	
IPCER_Intra*ER			-0.011*** (-6.00)
ER			0.042*** (3.64)
GR	1.223 (1.18)	1.211 (1.16)	1.208 (1.16)
Shrcr10	0.019*** (5.13)	0.018*** (4.90)	0.019*** (5.00)
LEV	2.008*** (6.11)	1.974*** (6.00)	2.017*** (6.14)
TAT	0.147 (1.29)	0.149 (1.31)	0.176 (1.55)
ROA	7.235*** (3.41)	7.385*** (3.48)	7.249*** (3.42)
CF	0.025** (2.44)	0.025** (2.46)	0.024** (2.39)
Constant	-0.601** (-2.27)	-0.656** (-2.42)	-0.960*** (-3.39)
Year FE	YES	YES	YES
Observations	8200	8200	8200
R-squared	0.159	0.160	0.163

Numbers in parentheses are t values; \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

of CER supports Hypothesis 2. The coefficients and significance levels of the control variables do not differ substantially from those shown in Table 2.

However, as shown in column (2) of Table 4, neither the interaction term between IPCER\_Intra and HHI nor the HHI regression coefficient alone is statistically significant. Due to the low number of enterprises, competitive pressure at the industry level cannot effectively play a moderating function within a region. To perform further empirical tests on the intra-regional peer effects of the CER, this study uses environmental regulation (ER) as the moderator variable at the regional level.

Based on column (1) of Table 4, column (3) adds the interaction term of IPCER\_Intra and ER, and the coefficient of the interaction term is negative and significant at the 1% level. This demonstrates that environmental regulation exerts a considerable dilution on the peer effects of CER within a region. Therefore, Hypothesis 2a is confirmed. In other words, when confronted with the pressure of environmental regulation, firms' responses will become more independent, and firms will resort to the explicit requirements of environmental regulation to fulfil their environmental duties rather than mindlessly emulating

industry peers. As a macro-level measure of local governments, environmental regulation often includes clear energy saving and emission reduction standards, which may serve as a standardised and explicit frame of reference for local businesses developing environmental strategies. Under the supervision of environmental regulation, companies can more precisely grasp the unique environmental responsibility needs of stakeholders such as the government and the public.

Given that the peer effects of CER are the outcome of learning and imitation, the convergence features of business decision-making are readily apparent. It cannot be ruled out that some businesses may mindlessly follow the trend and that the method or degree to which they fulfil their environmental duties may not be commensurate with their fundamental resource capabilities, making it not beneficial to the future growth of the business. The establishment of environmental regulations may somewhat compensate for the inefficiency of this spontaneous behaviour and successfully direct companies to perform their environmental responsibilities in line with fundamental criteria. This is evident from the strong promotion effect that environmental regulation has on the fulfilment of corporate environmental responsibility. At the 1% level,

Table 5. Group regression results of intra-regional peer effects.

	(1)	(2)	(3)	(4)
	High-RMP	Low-RMP	High-RMP	
			SOE = 1	SOE = 0
IPCER_Intra	0.306*** (8.61)	0.041 (1.22)	0.308*** (6.35)	0.102* (1.84)
IPCER_Intra*ER	-0.024*** (-5.29)	-0.003 (-1.22)	-0.023*** (-3.24)	-0.007 (-1.11)
ER	0.051* (1.87)	0.039*** (2.92)	-0.010 (-0.24)	0.090** (2.55)
GR	3.225* (1.91)	0.289 (0.22)	7.545*** (2.87)	-2.809 (-1.33)
Shrcr10	0.027*** (4.70)	0.009* (1.88)	0.060*** (7.06)	-0.011 (-1.45)
LEV	1.204** (2.33)	2.462*** (5.80)	-0.622 (-0.77)	1.660** (2.53)
TAT	-0.007 (-0.04)	0.375** (2.40)	-0.250 (-1.09)	0.442* (1.93)
ROA	1.285 (0.38)	10.801*** (3.97)	-4.367 (-0.76)	10.802*** (2.72)
CF	0.020 (1.19)	0.024* (1.90)	0.027 (1.09)	0.004 (0.18)
Constant	-0.926** (-2.06)	-0.738** (-2.00)	-1.001 (-1.45)	0.079 (0.14)
Year FE	YES	YES	YES	YES
Observations	3447	4753	1630	1817
R-squared	0.203	0.145	0.306	0.123

Numbers in parentheses are t values; \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

the coefficient of the moderating variable ER is positive and statistically significant. Therefore, this study concludes that even though environmental regulation has decreased the CER peer effect, it may still be an essential tool for encouraging businesses to take the lead, react autonomously, and aggressively fulfil their environmental duties.

This research revisits the median-based grouping regression to investigate the nature of responsiveness to environmental regulation, continuing the prior analytic ideas. Since both the spontaneous adjustment of the market and the macro-control of the government need the backing of a healthy market economic system, this study utilises the regional marketisation process (RMP) as the critical variable in group regression. The sample of industry peers within regions is separated into two subsample groups, high-RMP and low-RMP, based on the median of RMP.

According to column (1) of Table 5, the coefficient of IPCER\_Intra is positive and statistically significant at the 1% level in the high-RMP group. In contrast, the interaction term coefficient between IPCER\_Intra and ER is negative and significant at the same level. This demonstrates that while the regional marketisation process is robust and intra-regional peer effects of CER are substantial, environmental regulatory pressure continues to considerably reduce the propensity of enterprises to learn CER decisions from industry peers, thereby confirming Hypothesis 2b. Since businesses are the primary market participants, regardless of what kind of environmental responsibility activities they engage in, they cannot be isolated from the regional marketisation environment as a whole. A process of marketisation at a high level may give firms a more mature market for production factors and more meaningful business information, allowing them to make environmentally responsible choices more independently. Moreover, the advancement of the marketisation process can provide a more just and transparent environment for the formulation and effective implementation of government environmental regulations, thereby vastly improving the fundamental conditions for enterprises to participate independently in environmental governance. Furthermore, environmental regulation ceases to be an obligatory external restraint on businesses and instead becomes an external guide and reference for companies' design of environmental strategy. This partially explains why the positive impact of environmental regulation on CER is no longer significant at present.

To test Hypothesis 2c, this study keeps just the high-RMP subsample. It does a group regression based on the ownership structure of companies (SOE) to determine if changes in ownership alter the impact of environmental regulatory pressure on intra-regional peer effects.

Table 5's columns (3) and (4) indicate that the intra-regional peer effects of CER are significant for state-owned firms and that environmental regulatory

pressure significantly decreases these intra-regional peer effects. For non-state-owned businesses, however, the coefficient of IPCER\_Intra is only positive and statistically significant at the 10% level, and the interaction term fails the significance test. These results suggest that compared with non-state-owned enterprises, when state-owned enterprises are in a sound regional marketisation, environmental regulatory pressure has a more substantial weakening impact on the peer effects of CER. Therefore, Hypothesis 2c is confirmed. Unlike the internal logic of operational choices made by non-state-owned firms, state-owned enterprises more closely resemble the transmission mechanism of the state's macro-control. Typically, they can make business decisions that are helpful to the sustainable growth of the whole society while following the government's environmental regulating rules successfully. Simultaneously, a robust market economy system may further promote the vitality of state-owned firms, allowing them to develop and execute more strategic environmental responsibility measures spontaneously. Notably, the peer effect in the non-state-owned business group is substantially less than in the state-owned firm group. This suggests that in areas with a robust marketisation process, the CER peer effects are likely based on the follow-up of state-owned firms by non-state-owned firms. Therefore, the autonomous responsiveness mode of state-owned firms under the pressure of environmental legislation may be utilised as a model in the local industry to encourage an increase in the industry's overall CER level.

### Endogeneity Problems

To solve the endogeneity issue, this study selects the revised Environmental Protection Law of the People's Republic of China (officially implemented on January 1, 2015) as the dividing line and selected A-share listed companies on Shanghai and Shenzhen stock exchanges from 2010 to 2014 as the samples to rule out the possibility that the implementation of the new Environmental Protection Law would then abruptly alter the mean value of CER of industry peers across China. If the introduction of samples from before 2015 does not change the current empirical findings, this indicates that there is no endogeneity issue between peer effects and CER that is substantial. Table 6 presents the results of the regression analysis.

From columns (1) to (4), the significance and direction of coefficients for IPCER\_Cross and IPCER\_Intra, as well as the interaction terms IPCER\_Cross\*HHI and IPCER\_Intra\*ER, are remarkably comparable to the prior findings. Due to space constraints, this study only reports the outcomes of models (1) to (4), excluding control variable coefficients and group regression outcomes. The cross-regional peer effects, intra-regional peer effects, and CER do not provide a sizeable endogenous problem.

Table 6. Regression results of endogeneity test of cross-regional and intra-regional peer effects.

	(1)	(2)	(3)	(4)
	Cross-regional		Intra-regional	
IPCER_Cross	0.389*** (7.84)	0.605*** (8.36)		
IPCER_Cross*HHI		-1.172*** (-4.17)		
HHI		6.224*** (4.03)		
IPCER_Intra			0.094*** (4.36)	0.231*** (6.55)
IPCER_Intra*ER				-0.015*** (-4.91)
ER				0.086*** (3.36)
Constant	-1.202** (-2.21)	-2.224*** (-3.75)	-1.613*** (-2.89)	-2.391*** (-3.94)
Control variables	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Region FE	YES	YES	NO	NO
Observations	3620	3620	3280	3280
R-squared	0.162	0.166	0.101	0.108

Numbers in parentheses are t values; \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

### Robustness Test

Notably, Hexun.com's rating methodology for environmental responsibility reveals that the service industry's weight ratio is just 10%. Nevertheless, many companies in the service sector are non-polluting and may achieve sustainable growth without participating in extensive environmental responsibility initiatives. In accordance with the Guidelines for Industry Classification of Listed Companies (revised in 2012) issued by the China Securities Regulatory Commission, this study deleted firms belonging to the modern service industry with first-level industry codes of I, K, L, M, N, P, Q, R, and S from the samples to verify the robustness of the above conclusion.

As indicated in Table 7, the re-validation of the empirical model yields regression findings similar to those mentioned before. This demonstrates that the empirical results of this investigation are generally robust.

### Discussion

The above empirical tests show that the peer effects of CER exist in two different scenarios, cross-regional and intra-regional, and can trigger convergent and independent environmental responsibility responsiveness of firms under the moderating effects

of industry competition and local government environmental regulation, respectively. This result reveals the mechanism by which the behavior of industry peers affects CER decisions from the perspective of exogenous factors, and the following two issues deserve further discussion.

First, the CER behavior of industry peers is a key external factor driving firms to fulfill their environmental responsibility. In other studies exploring the motivations of firms' environmental behavior from an external perspective, macro-environmental factors such as government policies and market competition have often received focused attention. As mentioned in the introduction, the effect of this type of factor does not target only a single firm, but affects all firms covered by the policy scope or in the market, and its actual effect may be related to the group behavior of firms. As micro-entities in the market economy, enterprises do not exist independently in the industry environment, but have frequent communication and interaction with other enterprises. This interactive feature among groups of enterprises makes it possible to transmit CER signals among industry peers. When a company makes a new environmental responsibility decision in the previous year and actually implements it, the launch of documents such as annual reports and CER reports at the end of the year quickly signals the CER decision within the industry, causing other companies in the same industry to respond by taking

Table 7. Regression results of robustness test of cross-regional and intra-regional peer effects.

	(1)	(2)	(3)	(4)
	Cross-regional		Intra-regional	
IPCER_Cross	0.194*** (4.84)	0.279*** (5.28)		
IPCER_Cross*HHI		-0.426*** (-2.62)		
HHI		2.162*** (2.86)		
IPCER_Intra			0.052*** (3.41)	0.153*** (6.17)
IPCER_Intra*ER				-0.011*** (-5.16)
ER				0.036*** (2.76)
Constant	-0.233 (-0.77)	-0.521 (-1.63)	-0.580* (-1.88)	-0.899*** (-2.71)
Control variables	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Region FE	YES	YES	NO	NO
Observations	7590	7590	6800	6800
R-squared	0.210	0.211	0.168	0.171

Numbers in parentheses are t values; \*\*\*p<0.01, \*\*p<0.05, \*p<0.1

appropriate actions in the following year. Moreover, in terms of the type of industry peers, the empirical results demonstrate that strong CER signals can be transmitted both over long distances in industries that span multiple regions and on a small scale within local industries. This signaling mechanism can effectively promote the CER level of industry peers as a whole, i.e., forming a benign industry trend of fulfilling environmental responsibility and triggering convergent responsiveness from other firms in the following year, which becomes an effective driver of CER. Therefore, we can consider the peer effects of CER as a convergent responsiveness to the group behavior of industry peers and their external pressure.

Second, the superposition of external pressures from industry competition and environmental regulation with the peer effects can trigger different patterns of CER responsiveness. After verifying that the behavioral decisions of industry peers can indeed affect firms' CER levels, we still need to consider whether other factors in the external environment can act on the peer effects of CER. It is worth discussing that while industry competition can positively reinforce the cross-regional CER peer effects, environmental regulation moderates the intra-regional one inversely. However, this does not mean that the industry signaling mechanism mentioned in the above analysis fails. In a cross-regional industry peers, the competitive pressures of the industry may signal to the firms that raising CER

levels is one of the means to cope with fierce market competition and to further strengthen their competitive advantage beyond their main business. This behavioral motivation is more fully reflected in the group of small firms with high uncertainty in their environment. For intra-regional industry peers, the number of intra-regional peers and the degree of industry competition have decreased significantly, making it difficult for the market role to create external drivers of CER, while the formal institution's influence on firm behavior through institutional isomorphic pressures can effectively fill the gap. Compared to the CER trend in the local industry, environmental regulation policies formulated by local governments send clearer signals of environmental responsibility to firms through interactions among groups of firms. In this scenario, policy compliance will be seen by firms as a basic requirement to meet the industry entry threshold, and firms will prioritize the content and intensity of local environmental regulations as a reference for appropriate CER decisions, rather than just intuitively referring to the behavior of industry peers. Further evidence for this is provided by the results of the subgroup tests based on the moderating effects of regional marketization process and firm ownership structure. Higher marketization process implies lower risk of information asymmetry within the region, which effectively ensures efficient transmission of environmental responsibility signals from government environmental regulation among groups of firms,

especially among SOEs. Thus, we argue that industry competitive pressures can effectively reinforce firms' convergent responsiveness under the peer effects, while the superposition of environmental regulation pressures and CER peer effects can trigger firms' independent responsiveness.

## Conclusions and Implications

### Conclusions

This study suggests that the peer effects of CER are a convergent response of firms to external pressure in carrying out their environmental responsibilities. This research reaches the following findings based on an empirical examination of A-share listed businesses on the Shanghai and Shenzhen stock exchanges from 2010 to 2020.

First, industry peers within and across regions can affect CER. Companies must have a high equity concentration, profitability, and cash acquisition capability to fulfil their environmental duties.

Second, in an inter-regional setting, the pressure of industrial competitiveness can dramatically augment CER's peer effects. In addition, environmental uncertainty can exacerbate the external pressure produced by industry rivalry, compelling businesses to attain convergent responsiveness in carrying out their environmental obligations. Under the strain of industry competitiveness and environmental unpredictability, small enterprises are more susceptible to industry peers' influence than large firms.

Third, in an intra-regional situation, environmental regulatory pressure can dramatically diminish the peer effects of CER. In addition, the assurance of a high-quality marketisation process may strengthen the guiding function of environmental regulation, encouraging businesses to carry out their environmental obligations autonomously. Based on the high-level marketisation process, compared to non-state-owned firms, state-owned enterprises are less likely to be affected by industry peers. They may make independent judgments under the guidance of environmental regulation.

### Implications for Firm Managers

This research has several ramifications for business management. Due to practical issues such as information asymmetries and fundamental resource capacity restrictions, businesses are sometimes compelled to fulfil their environmental duties by emulating the decisions made by the same industry or local competitors. Therefore, companies should increase their relationships and exchanges with industry peers. It is suggested that managers of firms rely on the flow of information and other industry elements to strengthen the mutual learning of decision-making

information inside and outside the firm, unblock the decision-making channels of the CER, and assist in maintaining the stability and strategic flexibility of their adaptability in CER. In addition, managers are advised to focus on the relationships between industry peers to mitigate the business risks posed by the increasing convergence of CER due to external pressure.

### Implications for Policymakers

This investigation has significant implications for policymakers as well. Given that the dual effects of industry competition and environmental uncertainty typically exacerbate market decision-making and operational risks, it is essential to provide firms with an external guarantee that they can independently carry out their environmental responsibilities in a healthy institutional setting. Therefore, it is recommended that the government utilises environmental regulation policy as an essential macro-control method to provide a more transparent environment and normative guidance for firms to fulfil their environmental responsibilities and to encourage state-owned enterprises to serve as environmental stewardship role models for their industry peers. In addition, the government should maintain a level playing field in the market to advise businesses in identifying their industry positions and provide financial support for creating short-term cost advantages and long-term competitive advantages of environmental responsibility.

### Limitations and Future Research

Although this study gives fresh insights into the disparities in CER peer effects across and within regions and, to a certain degree, demonstrates the relationship between pressure and responsiveness in peer effects, the following limitations suggest hints for further research. First, the research idea of this paper is to take the external factors affecting CER as the entry point, explore the behavioral interaction of industry peers, and analyze the mechanism by which the peer effects work together with industry competitive pressure and environmental regulatory pressure on CER to reveal the external drivers of corporate fulfillment of environmental responsibility. However, this study does not address any interpretation of the factors intrinsically influencing CER. Although a large number of studies have considered the pursuit of corporate value or corporate performance as an intrinsic driver of CER, the role of corporate governance factors, such as leadership and management incentives, still deserves to be explored. Second, although this paper provides a relatively detailed analysis of the cross-regional and intra-regional CER peer effects and their occurrence mechanisms, it does not empirically examine the intrinsic composition of different industry peers and their signaling mechanisms. Based on the arguments

mentioned above, further study will investigate whether peer effects result from the behavior of corporate managers and assess the differential impact of management interaction on CER and its peer effects. In addition, detecting the centrality of leading businesses among industry peers, determining whether there is a multi-point centre in the network of industry peers, and identifying the number of firms linked to it are all issues that need in-depth investigation.

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### Conflict of Interest

The authors declare no conflict of interest.

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