Nature and Information Engineering Publishing

Journal of Emerging Markets and Management

https://journals.niepublish.com/jemm

ARTICLE

The Impact of Family Control on Corporate Climate Performance: Evidence from Chinese Listed Firms

Chenlu Liao [1] **, *Xiaolin Li*** [2*]

[1] *School of Business, Central University of Finance and Economics, Beijing 100081, China*

[2] *School of Economics and Management, Harbin Institute of Technology, Weihai City 264209, China*

ABSTRACT

This paper explores the relationship between family ownership and corporate climate-related disclosure. These empirical findings show that family control is positively associated with higher levels of climate performance, using panel data of 9762 firm-year observations from 2010 to 2022, where climate performance is measured by the Bloomberg Environmental Disclosure Score. A quantitative research design is employed, combining fixed-effects regression models with robustness checks including lagged dependent variables and propensity score matching. This suggests that family firms, due to their long-term orientation and concern for reputation and legacy, may be more inclined to engage in environmentally responsible practices. However, the study also finds that when there is a greater separation between ownership and control—such as through complex ownership structures—the positive effect of family control on climate performance diminishes. In these cases, the misalignment between cash flow rights and control rights may lead family owners to prioritize personal benefits over climate-related commitments. To understand the underlying mechanisms, this study constructs a managerial short-termism index using machine learning-based text analysis. These results indicate that family-controlled firms typically exhibit lower levels of managerial short-termism, which helps explain their stronger climate performance. In contrast, higher separation between ownership and control correlates with increased short-termism, negatively affecting environmental outcomes. This study contributes to the literature by offering new theoretical insights and empirical evidence on how family governance influences climate performance. It also provides practical implications for improving climate-related disclosure in firms with family involvement, especially by addressing the risks posed by

*CORRESPONDING AUTHOR:

Xiaolin Li, School of Economics and Management, Harbin Institute of Technology, Weihai City 264209, China; Email: lixiaolin@hit.edu.cn

ARTICLE INFO

Received: 20 September 2025 | Revised: 15 November 2025 | Accepted: 22 November 2025 | Published Online: 30 November 2025
DOI: https://doi.org/10.63385/jemm.v2i1.51

CITATION

Liao, C., Li, X., 2026. The Impact of Family Control on Corporate Climate Performance: Evidence from Chinese Listed Firms. Journal of Emerging Markets and Management. 2(1): 1–14. DOI: https://doi.org/10.63385/jemm.v2i1.51

control-ownership divergence.

Keywords: Family Control; Climate Performance; Ownership-Control Separation

1. Introduction

Climate-related information has become an essential component of corporate strategy in recent years, as firms face increasing regulatory pressures and stakeholder expectations to manage environmental risks. Such information enables companies to identify, assess, and respond to potential climate risks that may affect their operations, financial performance, and long-term sustainability. Furthermore, climate disclosures serve as a critical channel through which external investors evaluate a firm's environmental accountability and climate risk management capabilities[1]. Research has shown that institutional investors who prioritize environmental, social, and governance (ESG) considerations believe that climate risks can significantly influence both the financial and regulatory landscapes of companies[2]. Consequently, strong climate performance signals a firm's forward-looking approach to managing potential regulatory costs and environmental risks. In this study, the Bloomberg Environmental Disclosure Score is employed as the primary proxy for corporate climate disclosure, capturing firms' policies, actions, and reporting practices. While this measure is broader than climate-specific outcomes, it is complemented with robustness checks using climate-specific indicators.

In this study, climate performance is conceptualized as a broad construct that captures firms' environmental disclosure and governance practices related to climate and sustainability issues. Following prior ESG literature, the Bloomberg Environmental Disclosure Score is employed as the primary proxy for climate performance. This score reflects not only the extent of firms' environmental disclosures but also the underlying policies and actions taken to address climate-related risks and opportunities. Although it is not a direct measure of physical climate outcomes, it provides a standardized, comparable, and widely used indicator of corporate commitment to climate governance. Consistent with this definition, the term climate performance is used throughout the paper to denote this disclosure-based proxy, while acknowledging that future research may further validate the findings using more climate-specific indicators such as carbon intensity or CDP scores when such data becomes more available.

As a key innovation in evaluating corporate performance, climate risk disclosure has far-reaching implications for firms' investment strategies, risk controls, and governance structures. It reshapes how firms integrate sustainability into their business models and adapt to the evolving regulatory environment[3]. Prior research suggests that ESG disclosures can play an important role in reducing the risk of stock price crashes, thereby enhancing market confidence and firm resilience[4]. Moreover, effective climate performance contributes not only to improved corporate valuation but also to enhanced operational efficiency, reduced financial risk, and expanded access to financing[5]. In this context, the role of management becomes particularly critical, as managers make key decisions regarding the content, timing, and quality of ESG-related disclosures[6].

Despite the growing attention to climate-related issues, the existing literature has largely concentrated on family businesses from the perspectives of innovation, earnings management, and value creation[7]. However, limited research has explored how family firms approach climate disclosure and performance[8]. This oversight is particularly important given that family-owned firms often exhibit distinct governance structures, control rights, and strategic objectives compared to non-family firms[9]. From an investor's perspective, robust climate performance in family firms could play a vital role in mitigating both operational and informational risks[10]. Nevertheless, the unique ownership characteristics of family firms—such as concentrated control, intergenerational succession[11], and socioemotional priorities—may lead to different disclosure behaviors and environmental strategies[12].

This study aims to fill this void in the literature by investigating how family control influences the level of corporate climate performance. Specifically, it examines whether and how family involvement shapes firms' climate-related practices. The empirical analysis incorporates multiple robustness tests and mechanism analyses to validate the findings and ensure the reliability of the results. While the empirical design incorporates multiple strategies such as lagged dependent variables, propensity score matching, and firm-

level clustered standard errors with fixed effects, potential endogeneity concerns cannot be completely ruled out. Future research may strengthen causal inference by exploiting exogenous shocks—such as regulatory changes in disclosure requirements—or by applying instrumental variable approaches to family control.

This study makes two main contributions to the literature. First, it applies the Social-Emotional Wealth (SEW) theory to explore the behavioral motivations behind family firms' climate strategies, offering a theoretical explanation for their disclosure choices. Second, it introduces a machine learning-based managerial short-termism index to empirically examine the mediating mechanisms between family control and climate performance. In doing so, this study complements recent work highlighting how digital capability and knowledge ecosystems shape sustainability strategies within governance contexts [13]. Moreover, by focusing on Chinese listed firms, the findings contribute to the broader debate on disclosure practices in emerging markets, where institutional and developmental challenges complicate the pursuit of transparency [14]. These contributions enhance the understanding of how family firms balance long-term sustainability goals with short-term financial incentives, while situating evidence within the global discussion on governance and sustainability in emerging economies.

Building on the identified literature gap, this study seeks to answer the following research question: How does family control influence corporate climate performance, and through which mechanisms does this relationship operate? By addressing this question, the paper aims to advance the understanding of how family governance shapes firms' environmental strategies, particularly in the context of emerging markets.

The remainder of this paper is organized as follows: Section 2 develops the research hypotheses; Section 3 outlines the data sources and empirical methodology; Section 4 presents the main results and robustness checks; and Section 5 concludes with theoretical and practical implications.

2. Materials and Methods

2.1. Theoretical Foundations

2.1.1. Sustainable Development Theory

Sustainable development theory encompasses not only economic, ecological, and social factors but also emphasizes their integrated and interactive impacts. This theory advocates for green and harmonious growth, requiring enterprises to adhere to corresponding principles. Traditionally, corporate operations have centered on maximizing profit, often neglecting issues such as environmental pollution, resource depletion, and other negative impacts on the planet. However, with the increasing severity of global environmental challenges, the international community has paid growing attention to environmental protection. In response, China has gradually prioritized sustainable development as a national agenda, prompting enterprises to consider environmental protection and social responsibility alongside economic growth.

A particularly important aspect of sustainable development is the integration of environmental protection with corporate growth. In recent years, climate- and environment-related information disclosure has emerged as a key metric for evaluating corporate sustainability practices. This indicator encourages firms to balance economic interests with environmental and social considerations, mitigate negative environmental impacts, and promote environmental stewardship. Notably, the theory does not advocate for a trade-off between economic growth and environmental protection but rather emphasizes a balanced approach. For enterprises, this means taking into account both business performance and the broader environmental and social consequences of their operations.

2.1.2. Socioemotional Wealth (SEW) Theory

Family firms attach great importance to socioemotional wealth in their decision-making, reflecting the unique emotional attachment of family members to the business. To preserve this socioemotional wealth, family firms may make decisions that prioritize non-economic goals, such as maintaining family control, embedding family values into corporate culture, and blurring the boundaries between the family and the business [15]. This emotional connection leads family businesses to place greater emphasis on reputation and long-term control, even if it requires sacrificing short-term financial gains.

In other words, family firms often view the business as an asset for long-term family legacy and generational continuity. This long-term orientation reinforces shared values and visions among family members and heightens their concern for corporate image and sustainable development. As a result, family firms are more inclined to disclose climate-related information. Such disclosure not only helps reduce

information asymmetry but also facilitates stronger, more stable relationships with stakeholders and investors, ultimately fostering mutual benefits[16].

2.1.3. Stakeholder Theory

Stakeholder theory, proposed by Freeman in 1984, emphasizes that the core goal of corporate management is to maximize the interests of all stakeholders, rather than focusing solely on shareholders or the management team. According to this theory, a firm is viewed as a nexus of contracts among various stakeholders, including shareholders, employees, suppliers, and government entities. The expectations and actions of these groups can directly influence the firm's success and its legitimacy in society[17]. As such, environmental pressures, government policy preferences, and consumer attitudes are all important factors that businesses must consider.

Stakeholder theory posits that all stakeholders—shareholders and others alike—ultimately seek returns and are willing to bear corresponding risks to support the firm's development. Therefore, corporate decision-makers must consider and balance the diverse demands and interests of these stakeholders[18]. This is especially relevant for family firms, where the support of stakeholders is critical to sustaining operations. Among these stakeholders, investors have shown growing interest in corporate climate disclosures. To maintain strong stakeholder relationships and mitigate potential agency problems, family firms are more likely to actively disclose climate-related information in response to these expectations.

Although sustainable development theory, SEW theory, and stakeholder theory originate from different research traditions, they are complementary in explaining family firms' climate-related behavior. Sustainable development theory provides a macro-level rationale, emphasizing that firms must balance economic growth with environmental stewardship as part of long-term societal development. SEW theory highlights the internal, non-economic motivations of family firms, particularly their desire to preserve reputation, legacy, and intergenerational continuity. Stakeholder theory, in turn, focuses on the external environment, stressing how stakeholder expectations and legitimacy pressures shape corporate disclosure practices. Taken together, these perspectives form an integrated framework: sustainable development theory defines the overall context of corporate environmental responsibility, SEW theory explains why family firms are especially motivated to engage in climate-related practices, and stakeholder theory illustrates how external demands reinforce these behaviors. This integrated framework provides the foundation for empirical hypotheses, which are primarily derived from SEW theory but enriched and supported by the other two theories.

2.2. The Impact of Family Firm on Climate Performance

The literature on information disclosure in family firms is varied. Some studies suggest that family businesses prioritize long-term development goals and the accumulation of social-emotional wealth, thereby fostering a stronger motivation to enhance the extent of their information disclosure[8]. However, concentrated family control may also lead family members to perceive the firm as their personal asset, potentially resulting in manipulation of the capital structure to the detriment of minority shareholders[18].

According to Social-Emotional Wealth (SEW) theory, family businesses incorporate non-financial factors, such as social-emotional wealth, into strategic decision-making, which reduces the likelihood of short-term, profit-driven actions. Consistent with Information Asymmetry theory, family firms can improve transparency through climate-related disclosures and performance[16], thereby reducing information asymmetry and fostering more stable relationships with creditors and investors[15].

Further, Impression Management theory posits that family executives—who often enjoy longer tenures and higher visibility—are motivated to protect and enhance the family image. As such, they may proactively disclose climate performance to build a favorable external perception of the firm[19]. These theoretical perspectives collectively suggest that family firms, despite potential agency concerns, may be incentivized to engage in more active and transparent climate-related disclosure practices.

Based on these arguments, the following hypothesis is proposed:

H1. *Family firms are more proactive in climate-related performance compared to non-family firms*.

2.3. The Impact of Family Control on Climate Performance

As the degree of family control increases, the likelihood of illegal or non-compliant information disclosure

tends to decline, thereby contributing to an overall improvement in the quality and credibility of corporate disclosures[17]. Family businesses are typically guided not only by financial objectives but also by the desire to preserve and enhance their social-emotional wealth. According to existing research, family firms are more inclined to embed non-financial factors—such as family reputation, legacy, and stakeholder trust—into their strategic planning and governance decisions[20].

Although climate-related information disclosure and efforts to improve environmental performance often require significant financial and managerial resources, family-controlled firms may be more willing to incur these costs. This willingness stems from their focus on long-term sustainability and the protection of their social-emotional capital, which includes maintaining a positive public image and strengthening intergenerational continuity.

From an ownership structure perspective, family firms tend to exhibit a higher degree of ownership concentration, which enhances their ability to implement consistent, long-term strategies. Because family members often view the firm as a key family asset and legacy, they are more likely to pursue initiatives—such as voluntary climate disclosure—that support the firm's sustainable development goals. This proactive approach can also reduce potential agency problems, especially concerns over the expropriation of minority shareholders, by signaling alignment between controlling families and other stakeholders[21].

Taken together, these dynamics suggest that stronger family control may lead to more transparent and responsible climate-related disclosure[22], as a means to protect both financial performance and social-emotional interests over the long term.

Based on these arguments, the following hypothesis is proposed:

H2. *Family control positively influences the level of climate-related performance in family firms*.

2.4. Methods

2.4.1. Data

This study employs a panel dataset of A-share listed family firms in China spanning the period from 2010 to 2022. In line with the broad definition commonly adopted in the literature, a firm is identified as a family firm if the variable Fam equals 1, indicating that the founding family maintains significant ownership, control, or involvement in the firm's operations. If this criterion is not met, the firm is coded as 0. Data on family firm identification and firm-level characteristics are primarily sourced from the China Stock Market & Accounting Research (CSMAR) database, which provides comprehensive and reliable financial and governance data for Chinese listed firms.

To ensure data quality and consistency, the sample excludes firms under Special Treatment (ST) status, as these firms typically face financial distress or regulatory sanctions that may distort disclosure behavior. In addition, financial institutions are excluded due to their distinct regulatory environment and reporting standards. Firms without a clearly identified controlling shareholder are also removed to maintain the accuracy of family ownership classification. After applying these screening criteria, the final unbalanced panel consists of 9762 firm-year observations.

The identification of family firms in this study is based on the China Stock Market & Accounting Research (CSMAR) database. CSMAR provides a standardized family business classification that draws on multiple information sources, including disclosed ultimate ownership and control rights, family-related tags, annual reports, and executive background disclosures. Following the CSMAR definition, the dummy variable Fam is coded as 1 if a firm is classified as family-controlled and 0 otherwise. This approach has been widely adopted in prior studies on Chinese family firms, ensuring consistency and comparability of results. It is important to note that this study does not rely on survey data or individual respondents. All information is derived from secondary sources, namely the CSMAR database and the Bloomberg ESG database, which provide standardized and reliable firm-level data on ownership structure, governance, and climate-related disclosure. Accordingly, no demographic information of respondents is applicable, as the unit of analysis is the firm.

To further strengthen construct validity, an alternative indicator, FamOne, is constructed, which equals 1 if a family member simultaneously holds both the chairman and CEO positions, and 0 otherwise. This measure captures cases of particularly strong family involvement in strategic decision-making and serves as a robustness check for the

main findings.

2.4.2. Model

The regression model is specified to examine the impact of family ownership and family control on the level of corporate climate information disclosure:

$$Env_{i,t} = \alpha_0 + \alpha_1 FC_{i,t} + \alpha_i Controls_{i,t} + \sum Year + \sum Industry + \varepsilon_{i,t} \quad (1)$$

In the model, the independent variables representing family control $FC_{i,t}$ are Family Firm, Family Ownership Ratio, and Family Control Ratio, while the dependent variable $Env_{i,t}$ represents the level of climate-related disclosure for the firm *i* in year *t*. $Control_{i,t}$ encompasses all the control variables included in the model. Additionally, the model incorporates *Year* and *Industry* as dummy variables.

To address potential concerns about heteroskedasticity and serial correlation, this study computes heteroskedasticity-robust standard errors that are clustered at the firm level in all regressions. This approach accounts for within-firm dependence over time. In addition, all models include year and industry fixed effects to control for unobservable macroeconomic shocks and sector-specific factors that may influence disclosure practices.These specifications ensure that the estimates reflect within-firm variation in family control while mitigating potential bias from omitted variables and common shocks.

2.4.3. Variables

The dependent variable in this study is the level of corporate climate-related disclosure. Climate performance plays a crucial role in allowing external stakeholders—such as investors, regulators, and creditors—to evaluate a firm's ability to identify, assess, and manage climate-related risks. It also serves as a key indicator of a firm's broader commitment to environmental sustainability and its alignment with long-term climate governance goals. In this study, the level of climate-related disclosure is measured using the environmental score from the ESG rating system provided by the Bloomberg database. This score captures a firm's environmental policies, actions, and reported outcomes, offering a standardized and comparable metric across firms and time.

The managerial short-termism index is constructed using textual analysis of the "Management Discussion and Analysis" (MD&A) sections of annual reports obtained from the CSMAR database. The corpus is preprocessed by segmenting the Chinese text into words, removing stopwords, and standardizing expressions. The feature set is built using [e.g., term frequency–inverse document frequency (TF-IDF)] weights of short-term-oriented keywords, initially seeded from established dictionaries[23]. A supervised machine learning classifier is then trained to distinguish short-term versus long-term orientation, and the resulting probabilities are averaged to form the short-termism index. To validate the measure, it is compared with alternative proxies of managerial myopia, including investment horizons, compensation horizons, and board tenure, with consistent correlations found. Robustness checks are also conducted, including placebo tests, permutation tests, and sensitivity analyses using alternative keyword lists, confirming that the results are not driven by specific word choices.

The main independent variable of interest is family control, which is measured through two distinct indicators: the Family Ownership Ratio (OwnFam) and the Family Control Ratio (ConFam). The Family Ownership Ratio reflects the proportion of shares held by the ultimate controlling family, highlighting their economic interest in the firm. In contrast, the Family Control Ratio captures the extent of voting or decision-making power the family exerts, often through mechanisms such as pyramidal structures or dual-class shares. Building on agency theory and the tunneling literature, it is suggested that the separation of ownership and control may influence family firms' incentives toward climate performance. When control rights exceed ownership rights, controlling families may prioritize private benefits over long-term sustainability, reducing their willingness to engage in costly climate-related disclosure. Therefore, ownership–control separation is expected to weaken the positive relationship between family control and climate performance.

In addition to these core variables, the analysis includes several control variables to account for firm-level characteristics that may influence disclosure practices. Detailed definitions and descriptive statistics for all control variables are provided in **Table 1**.

Table 1. Control Variables and Definitions.

Variable Name	Symbol	Definition
Climate-related Performance	Env	The environmental score from the Bloomberg ESG rating system.
Family Firm	Fam	A dummy variable that equals 1 if the firm is classified as a family firm according to the definition, and 0 otherwise.
Ownership Ratio	OwnFam	The proportion of ownership held by the controlling family in the firm.
Control Ratio	ConFam	The proportion of control held by the controlling family in the firm.
Firm Size	Size	The natural logarithm of the firm's total assets.
Leverage	Lev	The ratio of total debt to total assets indicats the firm's leverage.
Growth	Growth	The annual growth rate of the firm's revenue.
Profitability	Roe	The average return on equity, calculated as net income divided by shareholders' equity.
Board Size	Board	The total number of members on the firm's board of directors.
Proportion of Independent Directors	Indirector	The proportion of independent directors on the board relative to the total number of board members.
Industry Pollution Level	Pollution	A dummy variable that equals 1 if the firm operates in an industry listed as a polluting industry in the *Environmental Management Directory of Listed Companies*, and 0 otherwise.
Duality	Duality	A dummy variable that equals 1 if the firm's CEO also holds the position of chairman, and 0 otherwise.

Source: author's own work,2025.

3. Results

3.1. Baseline Results

Descriptive statistics for the main variables used in the analysis are reported in **Table 2**. These statistics provide an overview of the distribution, central tendencies, and variability of the key variables, helping to establish the baseline characteristics of the sample. **Table 3** presents the core regression results that examine the relationship between family firms and the level of corporate climate-related performance. In Column (1), the regression estimates the impact of family ownership on environmental disclosure. The results show that family ownership is significantly and positively associated with the level of climate-related disclosure at the 1% confidence level. This finding provides strong support for H1, indicating that family ownership enhances firms' environmental performance and disclosure practices.

Column (2) further investigates this relationship by focusing specifically on the family ownership ratio. The results confirm a significant positive relationship between the proportion of shares held by the family and the level of climate performance, also significant at the 1% level. This reinforces the conclusion that greater family ownership is associated with stronger environmental disclosure. Column (3) turns to the role of family control. The analysis demonstrates that an increase in family control is significantly linked to improved climate-related performance, again with significance at the 1% level, thus confirming H2.

To examine the moderating effect of ownership-control separation, the study introduces an interaction term between family control and the separation ratio, defined as the ratio of control rights to cash flow rights. This approach is grounded in existing literature that highlights the potential for a tunneling effect [24], where controlling families may prioritize private benefits over environmental responsibility when their control rights exceed their ownership rights [25]. As shown in Columns (4) and (5) of **Table 3**, the interaction term is statistically significant, indicating that as the degree of ownership-control separation increases, the positive impact of family control on climate performance weakens. These results suggest that excessive separation can dilute the incentives for responsible disclosure, potentially undermining sustainability outcomes. As shown in **Table 3**, the interaction terms between family control and ownership control separation are negative and statistically significant. This result is consistent with expectations: while family control generally promotes higher climate

performance, this effect diminishes as the degree of separation increases. In other words, the alignment of cash flow rights and control rights is a critical condition for family firms to maintain their sustainability advantage.

Table 2. Descriptive Statistics.

Variables	Sample Size	Mean	Standard Deviation	Minimum	Maximum
Ownership Ratio	9,762	30.64	19.16	0	89.81
Control Ratio	9,762	36.60	19.02	0	92.73
Family Firm Indicator	9,762	0.398	0.490	0	1
Climate-related Disclosure Level	9,762	12.31	13.82	0.332	76.71
Firm Size	9,762	23.35	1.373	18.32	28.64
Leverage	9,762	0.485	0.198	0.00797	2.471
Profitability	9,762	0.0696	1.218	-0.09	0.29
Growth	9,762	1.001	66.50	-0.998	656.00
Duality	9,762	0.195	0.396	0	1
Board Size	9,762	9.069	1.899	4	18
Proportion of Independent Directors	9,762	0.377	0.0600	0.182	0.800
Industry Pollution Level	9,762	0.235	0.424	0	1

Source: author's own work,2025.

Table 3. Regression Results and the Interaction between Ownership-Control Separation and Family Firms.

Variable Name	(1)	(2)	(3)	(4)	(5)
	Level of Climate-Related Disclosure	Level of Climate-Related Disclosure	Level of Climate-Related Disclosure	Level of Climate-Related Disclosure	Level of Climate-Related Disclosure
Family Firm	1.284*** (−0.272)				
Ownership Ratio		0.034*** (−0.007)		0.039*** (−0.007)	
Ownership Ratio * Ownership-Control Separation				−0.037*** (−0.01)	
Control Ratio			0.033*** (−0.007)		0.038*** (−0.007)
Control Ratio * Ownership-Control Separation					−0.025*** (−0.009)
Firm Size	3.426*** (−0.112)	3.474*** (−0.115)	3.471*** (−0.115)	3.531*** (−0.115)	3.516*** (−0.116)
Leverage	−7.310*** (−0.660)	−7.695*** (-0.656)	−7.635*** (−0.655)	−7.545*** (−0.660)	−7.523*** (−0.659)
Profitability	0.046 (−0.118)	0.048 (−0.116)	0.05 (−0.115)	0.045 (−0.119)	0.048 (−0.117)
Growth	0.006*** (0.000)	0.006*** (0.000)	0.005*** (0.000)	0.006*** (0.000)	0.006*** (0.000)
Board Size	−0.070 (−0.073)	−0.128* (−0.071)	−0.136* (−0.071)	−0.088 (−0.072)	−0.103 (−0.072)
Proportion of Independent Directors	0.957 (−2.147)	1.167 (−2.152)	0.685 (−2.142)	1.531 −2.153	1.055 −2.143
Industry Pollution Level	−0.034*** (−0.007)	−0.033*** (−0.007)	−0.034*** (−0.007)	1.020*** (−0.320)	1.097*** (−0.32)
Duality				1.985*** (−0.292)	2.015*** (−0.293)
Cons	−71.391*** (−2.533)	−70.500*** (−2.501)	−70.020*** (−2.481)	−72.331*** (−2.535)	−71.496*** (−2.522)

Table 3. *Cont.*

Variable Name	(1) Level of Climate-Related Disclosure	(2) Level of Climate-Related Disclosure	(3) Level of Climate-Related Disclosure	(4) Level of Climate-Related Disclosure	(5) Level of Climate-Related Disclosure
Sample Size	9741	9741	9741	9741	9741
R^2	0.307	0.308	0.308	0.309	0.308
adj. R^2	0.306	0.306	0.306	0.307	0.307
Year	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.
Source: author's own work, 2025.

3.2. Robustness Test

To ensure the reliability and robustness of the empirical findings, this study conducts a series of robustness checks using alternative measures, lagged variables, and matching methods.

First, an alternative proxy for family control is introduced by identifying cases in which a family member simultaneously holds both the positions of chairman and CEO. This variable, denoted as FamOne, is assigned a value of 1 when the same individual occupies both roles, and 0 otherwise. This approach captures a high degree of family influence over strategic decision-making. The regression results, reported in Columns (1) and (2) of **Table 4**, show a significantly positive relationship between FamOne and corporate climate performance at the 1% significance level, thereby reinforcing the robustness of the main results.

Second, to address concerns regarding potential bidirectional causality between family control and climate-related disclosure, and to mitigate possible endogeneity, the study incorporates a one-period lag of the dependent variable. That is, the climate performance variable is lagged by one year prior to regression estimation. The corresponding results, shown in Columns (3), (4), and (5) of **Table 4**, continue to indicate a significantly positive relationship at the 1% level, lending further credibility to the causal inference.

Finally, the study adopts the Propensity Score Matching (PSM) method to control for sample selection bias, and a 1:1 matching procedure is used to pair each family firm with a comparable non-family firm based on observable characteristics. The results, presented in Columns (6), (7), and (8), remain significantly positive at the 1% level, consistently supporting the study's primary conclusions across different model specifications and identification strategies.

Table 4. Robustness Test Results.

	(1) Level of Climate-Related Disclosure	(2) Level of Climate-Related Disclosure	(3) Lagged Level of Climate-Related Disclosure	(4) Lagged Level of Climate-Related Disclosure	(5) Lagged Level of Climate-Related Disclosure	(6) Level of Climate-Related Disclosure	(7) Level of Climate-Related Disclosure	(8) Level of Climate-Related Disclosure
Family Firm	1.284*** (−0.272)		1.115*** (−0.280)			1.363*** (−0.261)		
Duality		1.582*** (−0.402)						
Ownership Ratio				0.028*** (−0.007)			−0.035*** (−0.008)	
Control Ratio					0.031*** (−0.007)			−0.034*** (−0.008)
Firm Size	3.426*** (−0.112)	3.382*** (−0.11)	3.206*** (−0.116)	3.247*** (−0.119)	3.257*** (−0.119)	3.045*** (−0.134)	3.094*** (−0.137)	3.120*** (−0.138)
Leverage	−7.310*** (−0.660)	−7.405*** (−0.661)	−6.440*** (−0.678)	−6.781*** (−0.675)	−6.748*** (−0.673)	−5.910*** (−0.703)	−5.907*** (−0.706)	−5.808*** (−0.706)
Profitability	0.046 (−0.118)	0.04 (−0.119)	0.025 (−0.118)	0.025 (−0.116)	0.027 (−0.115)	0.081 (−0.177)	0.092 (−0.175)	0.1 (−0.175)
Growth	0.006*** (0.000)	0.006*** (0.000)	0.113** (−0.056)	0.117** (−0.055)	0.115** (−0.055)	0.081** (−0.034)	0.082** (−0.033)	0.080** (−0.033)
Board Size	−0.07 (−0.073)	−0.119* (−0.071)	−0.041 (−0.073)	−0.09 (−0.072)	−0.097 (−0.072)	0.261** (−0.117)	0.251** (−0.116)	0.250** (−0.116)
Proportion of Independent Directors	0.957 (−2.147)	−0.02 (−.141)	1.934 (−2.176)	2.058 (−2.189)	1.773 (−2.176)	2.438 (−2.897)	3.893 (−2.889)	3.444 (−2.875)

Table 4. *Cont.*

	(1) Level of Climate-Related Disclosure	(2) Level of Climate-Related Disclosure	(3) Lagged Level of Climate-Related Disclosure	(4) Lagged Level of Climate-Related Disclosure	(5) Lagged Level of Climate-Related Disclosure	(6) Level of Climate-Related Disclosure	(7) Level of Climate-Related Disclosure	(8) Level of Climate-Related Disclosure
Duality	1.136*** (−0.320)	0.724** (−0.350)	1.015*** (−0.331)	1.184*** (−0.329)	1.173*** (−0.328)	1.026*** (−0.308)	0.938*** −0.307)	0.939*** (−0.306)
Pollution Industry Indicator	1.911*** (−0.292)	1.866*** (−0.291)	1.933*** (−0.304)	1.926*** (−0.304)	1.968*** (−0.305)	1.526*** (−0.330)	1.555*** (−0.331)	1.589*** (−0.331)
Cons	−71.391*** (−2.533)	−69.247*** (−2.440)	−67.799*** (−2.637)	−67.004*** (−2.611)	−66.793*** (−2.592)	−65.854*** (−3.256)	−66.051*** (−3.255)	−66.277*** (−3.261)
Sample Size	9741	9741	8299	8299	8299	9716	9716	9716
R^2	0.307	0.307	0.263	0.263	0.264	0.282	0.282	0.282
adj. R^2	0.306	0.305	0.261	0.261	0.262	0.281	0.28	0.28
Year	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.
Source: author's own work, 2025.

3.3. Further Analysis

Managers adopting a long-term perspective can significantly enhance corporate climate performance. In contrast, prioritizing investment projects with substantial short-term returns may reduce resources allocated to climate performance [26], thereby negatively impacting disclosure levels [27]. To further explore the mechanism underlying this relationship, this study utilizes machine learning-based text analysis to quantify the frequency of terms associated with short-term perspectives [23], thereby constructing an indicator of managerial short-term behavior (Shorterm). A higher Shorterm value reflects a stronger managerial inclination toward short-term behavior. The specific model construction is as follows:

$$Shorterm_{i,t} = \alpha_0 + \alpha_1 FC_{i,t} + \alpha_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (2)$$

Short-termism is treated as the dependent variable to examine the relationship between family control and managerial short-term behavior driven by a focus on immediate gains.

$$Env_{i,t} = \alpha_0 + \alpha_1 Shorterm_{i,t} + \alpha_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (3)$$

The climate information score serves as the dependent variable to investigate the relationship between managerial short-term behavior, family control, and the firm's climate performance score.

$$Env_{i,t} = \alpha_0 + \alpha_1 Shorterm_{i,t} + \alpha_2 FC_{i,t} + \alpha_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (4)$$

The empirical results of the mediation analysis are presented in **Table 5**. Columns (1) and (4) show that family control has a significant positive effect on corporate climate information disclosure, meeting the first condition for establishing a mediation effect. This indicates that higher levels of family involvement are associated with improved environmental disclosure practices.

Columns (2) and (5) reveal a significant negative relationship between family control and managerial short-term behavior, both at the 1% significance level. This suggests that family-controlled firms are more likely to adopt long-term strategic perspectives and are effective in curbing short-term managerial tendencies, likely due to the alignment of family interests with long-term firm sustainability.

Table 5. Mechanism test.

	(1) Level of Climate-Related Disclosure	(2) Short-Term Behavior	(3) Level of Climate-Related Disclosure	(4) Level of Climate-Related Disclosure	(5) Short-Term Behavior	(6) Level of Climate-Related Disclosure
Ownership Ratio	0.034*** (0.007)	−0.196*** (4.226)	0.020*** (0.007)			
Short-term behavior			−7.187*** (1.396)			−7.245*** (1.392)

Table 5. *Cont.*

	(1) Level of Climate-Related Disclosure	(2) Short-Term Behavior	(3) Level of Climate-Related Disclosure	(4) Level of Climate-Related Disclosure	(5) Short-Term Behavior	(6) Level of Climate-Related Disclosure
Control Ratio				0.033***	−0.194**	0.025***
				(0.007)	(4.237)	(0.007)
Firm Size	3.474***	0.001	2.911***	3.471***	0.001	2.929***
	(0.115)	(0.001)	(0.123)	(0.115)	(0.001)	(0.124)
Leverage	−7.695***	0.021***	−5.975***	−7.635***	0.020***	−5.938***
	(0.656)	(0.005)	(0.667)	(0.655)	(0.005)	(0.666)
Profitability	0.048	−0.001**	−0.068	0.050	−0.001**	-0.066
	(0.116)	(0.000)	(0.099)	(0.115)	(0.000)	(0.098)
Growth	0.006***	−0.001***	0.049	0.005***	−0.001***	0.047
	(0.000)	(0.000)	(0.048)	(0.000)	(0.000)	(0.048)
Board Size	−0.128*	0.001	−0.109	−0.136*	0.001	−0.116
	(0.071)	(0.001)	(0.071)	(0.071)	(0.001)	(0.071)
Proportion of independent directors	1.167	−0.004	−0.609	0.685	0.001	−0.772
	(2.152)	(0.017)	(2.142)	(2.142)	(0.017)	(2.134)
Duality	1.324***	−0.011***	1.089***	1.330***	−0.012***	1.072***
	(0.318)	(0.002)	(0.324)	(0.317)	(0.002)	(0.323)
Pollution Industry Indicator	−0.033***	0.012***	1.849***	−0.034***	0.013***	1.890***
	(0.007)	(0.002)	(0.299)	(0.007)	(0.002)	(0.300)
Cons	−70.500***	0.088***	−57.305***	−70.020***	0.080***	−57.290***
	(2.501)	(0.019)	(2.659)	(2.481)	(0.019)	(2.650)
Sample Size	9741	9741	9741	9741	9741	9741
R^2	0.308	0.072	0.219	0.308	0.071	0.219
adj. R^2	0.306	0.070	0.217	0.306	0.068	0.217
Year	Yes	Yes	Yes	Yes	Yes	Yes
Industry	Yes	Yes	Yes	Yes	Yes	Yes
SobelZ		4.434***			3.129***	

Note: Robust standard errors clustered at the firm level are reported in parentheses. ***, **, and * represent significance at the 1%, 5%, and 10% levels, respectively.
Source: author's own work, 2025

Columns (3) and (6) confirm that managerial short-term behavior significantly affects climate disclosure in the expected direction and continues to play a mediating role under both measures of family control—ownership and control ratios—again at the 1% level. This finding supports the view that family control indirectly enhances climate disclosure by reducing managerial short-termism.

Finally, the Sobel test results (Z = 4.434 and 3.129) provide strong statistical support for the mediation effect. These results collectively validate the hypothesized mechanism: family control enhances climate-related disclosure through its influence on reducing managerial short-term behavior.

4. Discussion

The findings of this study contribute to the understanding of how family control influences corporate climate performance. Consistent with Hypothesis 1, the results indicate that family firms are more proactive in disclosing climate-related information compared to non-family firms. This supports the view in prior literature that family businesses are driven by long-term orientation and the preservation of socioemotional wealth, motivating them to engage more deeply in sustainability practices. The integration of non-financial goals into corporate decision-making appears to enhance transparency and responsiveness in environmental matters.

Hypothesis 2 is also supported by the evidence, as a higher degree of family control is significantly associated with stronger climate performance. However, this study also reveals that this positive effect is moderated by the degree of separation between ownership and control. When controlling rights exceed ownership rights, the incentive to disclose environmental information weakens, echoing concerns raised in agency theory and tunneling literature.

The findings are broadly consistent with prior research suggesting that family firms, due to their long-term orientation and emphasis on reputation, tend to engage more actively in environmental and sustainability practices [12]. Consistent with previous studies, family ownership and control are positively associated with climate-related disclosure. However, the results extend the existing literature in two important ways. First, while previous studies have largely treated family firms as a homogeneous group, the degree of ownership-control separation is shown to critically moderate their climate performance. This highlights an important source of heterogeneity that has not been sufficiently addressed in prior work. Second, by introducing managerial short-termism as a mediating mechanism, this study provides a novel explanation for why family-controlled firms are more likely to prioritize long-term environmental strategies.

These contributions not only refine the theoretical understanding of family governance and sustainability but also offer practical insights for policymakers and regulators. Specifically, the findings suggest that disclosure regulations should account for governance structures, as family firms with concentrated ownership and aligned control are more likely to respond positively to climate-related requirements. This insight brings additional value to current society by informing targeted regulatory interventions and enhancing the effectiveness of climate governance in emerging markets.

Furthermore, the mechanism analysis shows that family control helps reduce managerial short-termism, which in turn positively impacts climate disclosure. This finding is consistent with socioemotional wealth theory and highlights the importance of long-term managerial thinking in shaping environmental strategy.

These results have broad implications for both theory and practice. They suggest that policymakers and investors should consider ownership structures and control dynamics when assessing firms' sustainability commitments. Future research may explore cross-country comparisons or delve into how generational transitions in family firms affect climate strategies. Additionally, the role of board characteristics and external pressures, such as regulation or public scrutiny, may offer further insights into the drivers of climate-related disclosure in family-controlled firms. Although multiple robustness checks were performed, the study is subject to certain limitations. Although lagged dependent variables, propensity score matching, and firm-level clustered standard errors with fixed effects are employed, potential endogeneity concerns cannot be fully eliminated. Future research could strengthen causal inference by exploiting natural experiments, such as regulatory shocks in environmental disclosure requirements, or by developing suitable instrumental variables for family control. In addition, more climate-specific indicators, such as carbon intensity or CDP scores, may provide complementary evidence when comprehensive data become available. Exploring these avenues would further enhance the understanding of how family governance affects firms' sustainability strategies. Future research may also explore heterogeneity across industries, regions, or generational stages of family firms, which could provide further insights into how contextual factors shape the relationship between family control and climate performance.

Beyond these methodological considerations, the findings also open avenues for broader discussion. They are consistent with recent evidence linking environmental outcomes to logistics and mobility choices, representing another dimension of firms' exposure to climate-related risks [28]. Furthermore, they align with research demonstrating that corporate actions play a central role in shaping environmental sustainability performance [29]. By integrating these perspectives, this study underscores that family governance is not only a determinant of disclosure practices but also a driver of capability building and sustainability outcomes more generally.

5. Conclusions

This study investigates the relationship between family control and corporate climate performance, with a focus on how varying degrees of control influence environmental outcomes. The regression results show that family control has a significant positive impact on the level of climate-related performance. Family firms, which typically prioritize long-term development and intergenerational sustainability, are more inclined to engage in proactive environmental practices and climate-related disclosures.

However, the analysis also reveals that the positive effect of family control is not uniform. As the separation between ownership and control increases—such as when controlling families hold disproportionate control rights relative

to their ownership stakes—the positive relationship between family control and climate performance weakens. This suggests that the divergence between control and ownership may give rise to agency problems, ultimately reducing the effectiveness of climate-related initiatives in family firms.

The core contribution of this study lies in its examination of the role of social-emotional wealth in shaping family firms' environmental strategies. By highlighting how the accumulation and preservation of non-financial family assets influence climate performance, this research provides a new perspective within the broader discourse on corporate sustainability. It advances understanding of the unique governance characteristics of family firms and their impact on climate-related behavior. Overall, the findings enrich the literature on climate performance and family firm governance, offering a theoretical and empirical foundation for future research on sustainable development across different ownership structures.

Author Contributions

Conceptualization, C.L.; methodology, C.L.; software, C.L.; validation, C.L. and X.L.; data curation, X.L.; writing—original draft preparation, C.L.; writing—review and editing, X.L.; visualization, X.L.; supervision, X.L. Both authors have read and agreed to the published version of the manuscript.

Funding

This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Institutional Review Board Statement

Not applicable.

Informed Consent Statement

Not applicable.

Data Availability Statement

Data is from CSMAR.

Conflicts of Interest

The authors declare no conflict of interest.

References

[1] Tomar, S., 2023. Greenhouse Gas Disclosure and Emissions Benchmarking. Journal of Accounting Research. 61(2), 451–492. DOI: https://doi.org/10.1111/1475-679X.12473

[2] Krueger, P., Sautner, Z., Starks, T.L., 2020. The Importance of Climate Risks for Institutional Investors. The Review of Financial Studies. 33(3), 1067–1111. DOI: https://doi.org/10.1093/rfs/hhz137

[3] Hartzmark, S.M., Sussman, A.B., 2019. Do Investors Value Sustainability? A Natural Experiment Examining Ranking and Fund Flows. The Journal of Finance. 74(6), 2789–2837. DOI: https://doi.org/10.1111/jofi.12841

[4] Lin, B., Wu, N., 2023. Climate risk disclosure and stock price crash risk: The case of China. International Review of Economics & Finance. 83, 21–34. DOI: https://doi.org/10.1016/j.iref.2022.08.007

[5] Wang, L.L., Lian, Y.H., Dong, J., 2022. Research on the impact mechanism of ESG performance on corporate value. Securities Market Herald. (5), 23–34. Available from: http://qikan.cqvip.com/Qikan/Article/Detail?id=7107158072 (in Chinese)

[6] Wang, L.L., 2023. Transmission Effects of ESG Disclosure Regulations Through Bank Lending Networks. Journal of Accounting Research. 61(3), 935–978. DOI: https://doi.org/10.1111/1475-679X.12478

[7] He, K., Lu, D., Zhang, L.G., 2023. Founding control of family business and investment in corporate innovation. Nankai Business Review. (8), 1–18. Available from: https://nbr.nankai.edu.cn/nkglpl/article/pdf/211107212 (in Chinese)

[8] Wang, H., Wei, Z.X., Wang, J.J., et al., 2018. Does intergenerational succession of family firms affect the quality of information disclosure?—— empirical evidence from Chinese listed companies. Friends of Accounting. (14), 45–50. Available from: https://d.wanfangdata.com.cn/periodical/CiBQZXJpb2RpY2FsQ0hJU29scjkyMDI1MTExNzE2MDExNxINa2p6eTIwMTgxNDAxMBoIeWc3N2JwaXY%253D (in Chinese)

[9] Zhu, Z.D., Li, X.C., Zhao, Y., 2021. Father-Son Co-governance and Innovative Decision-making: The Effect of Fatherhood and Foresight in the Intergenerational Inheritance of Chinese Family Firms. Management World. 37(9), 191–206+232+207. Available from: https://qikan.cqvip.com/Qikan/Article/Detail?id=7105635816 (in Chinese)

[10] Xiao, F., Lan, F.Y., Shi, W., et al., 2021. Will the ESG rating of a listed company affect the audit fee? A quasi-

natural experiment based on ESG rating events. Auditing Research. (3), 41–50. Available from: http://qikan.cqvip.com/Qikan/Article/Detail?id=7104978871 (in Chinese)

[11] Anita, V.G., Jolien, H., Tommaso, M., et al., 2019. Unraveling the impact of family antecedents on family firm image: A serial multiple-mediation mode. Journal of Family Business Strategy. 10(1), 17–27. DOI: https://doi.org/10.1016/j.jfbs.2019.02.001

[12] Maggi, B., Gjergji, R., Vena, L., et al., 2023. Family firm status and environmental disclosure: The moderating effect of board gender diversity. Business Ethics, the Environment & Responsibility. 32(4), 1334–1351. DOI: https://doi.org/10.1111/beer.12578

[13] Cai, M., Xie, J., 2025. Investment Flows, Talent Inflows: Unraveling the Spatial Spillover Effects of FDI on College Students' City Choice. Journal of Knowledge Economy. 16, 9847–9872. DOI: https://doi.org/10.1007/s13132-024-02288-y

[14] Cai, M., 2025. Transforming Trade and Environment: Digital Trade's Impact on Carbon Emissions in the European Union. International Development. 37(2), 570–583. DOI: https://doi.org/10.1002/jid.3977

[15] Bessler, W., Drobetz, W., Gruninger, M.C., 2011. Information Asymmetry and Financing Decisions. International Review of Finance. 11(1), 123–154. DOI: https://doi.org/10.1111/j.1468-2443.2010.01122.x

[16] Miller, D., Le Breton-Miller, I., 2014. Deconstructing Socioemotional Wealth. Entrepreneurship Theory and Practice, 38(4), 713–720. Available from: https://sage.cnpereading.com/paragraph/article/?doi=10.1111/etap.12111

[17] Li, W., Li, X., 2017. Family involvement, external audits, and information disclosure violations. Systems Engineering. 35(9), 60–69. Available from: https://cstj.cqvip.com/Qikan/Article/Detail?id=674705950 (in Chinese)

[18] Zhong, K., Liu, J.Z., Wang, H.C., 2018. Does family control exacerbate the mismatch of corporate capital term structure?—— empirical evidence from China's non-state-owned listed companies. Accounting and Economics Research. 32(2), 3–20. Available from: https://www.zhangqiaokeyan.com/academic-journal-cn_detail_thesis/02012106410191.html (in Chinese)

[19] Bolino, M.C., Kacmar, K.M., Turnley, W.H., et al., 2008. A multi-level review of impression management motives and behaviors. Journal of Management. 34(6), 1080–1109. Available from: https://sage.cnpereading.com/paragraph/article/?doi=10.1177/0149206308324325

[20] Chen, L., Chen, H.L., 2014. Family Involvement, Social Emotional Wealth and Corporate Charitable Giving: An Empirical Study Based on the National Survey of Private Enterprises. Management World. (8), 90–101+188. Available from: http://qikan.cqvip.com/Qikan/Article/Detail?id=661871342 (in Chinese)

[21] Dey, A., 2008. Corporate Governance and Agency Conflicts. Journal of Accounting Research. 46(5), 1143–1181. DOI: https://doi.org/10.1111/j.1475-679X.2008.00301.x

[22] Krueger, P., Sautner, Z., Tang, D.Y., et al., 2024. The Effects of Mandatory ESG Disclosure Around the World. Journal of Accounting Research. 62(5), 1795–1847. DOI: https://doi.org/10.1111/1475-679X.12548

[23] Hu, N., Xue, F.Q., Wang, H.N., 2021. Does Shortsightedness of Managers Affect Long-Term Investment? - Based on text analytics and machine learning. Management World. 37(5), 139–156+11+19–21. Available from: https://d.wanfangdata.com.cn/periodical/Ch9QZXJpb2RpY2FsQ0hJTmV3UzIwMjUwMTE2MTYzNjE0Eg1nbHNqMjAyMTA1MDEyGghrNXA4cWtsZg%3D%3D (in Chinese)

[24] Lin, Y., Shen, R., Wang, J., et al., 2024. Global Evolution of Environmental and Social Disclosure in Annual Reports. Journal of Accounting Research. 62(5), 1941–1988. DOI: https://papers.ssrn.com/sol3/papers.cfm?abstract_id=4500957

[25] Wang, D.F., Zhang, C., 2022. Separation of powers, R&D innovation and corporate value. Commercial Accounting. (11), 79–83. Available from: https://d.wanfangdata.com.cn/periodical/syhj202211019 (in Chinese)

[26] Zhang, X., Yang, L., Gao, Y., Liu, X., 2019. What influences the rhetorical language use in information disclosure? – Empirical evidence from the listed enterprises' CSR reports. Accounting Research. 380(6), 20–26. Available from: https://lib.cqvip.com/Qikan/Article/Detail?id=7002612260&from=Qikan_Article_Detail (in Chinese)

[27] Zhou, B., Zhang, C., Zeng, Q., 2019. Annual report's tone and stock crash risk–Evidence from China A−Share companies. Accounting Research. (11), 41–48.

[28] Cai, M., Cui, L., Zhang, Y., 2025. Beyond metros: pollution mitigation and environmental benefits in diverse transit systems. Transportation. DOI: https://doi.org/10.1007/s11116-025-10598-6

[29] Cai, M., Hu, J., Hu, M., 2025. Energy consumption and trade liberalization: new micro-evidence from China. Environment, Development and Sustainability. DOI: https://doi.org/10.1007/s10668-025-06624-3