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Firm governance structures, earnings management, and carbon emission disclosures in Chinese high-polluting firms

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Abstract

This study examines the influence of firm governance structures (board size, independence, CEO duality, director share ownership, and board meeting frequency) in relation to carbon emission disclosures by high-polluting Chinses firms. In addition, the study further examined the moderating role of earnings management on this relationship. In line with stakeholder and agency theories, our study identified that the large and independent boards exercise and demonstrate a higher degree of carbon emission disclosures. However, CEO duality and director share ownership are associated with lower carbon emission disclosures. In addition, the study determined that higher earnings management results in a reduced level of carbon emission disclosures. Lastly, a firm earnings management strategy moderates the relationship between a firm governance structure and its carbon emission disclosures. The findings from the study are consistent with multiple econometric models and variables. The findings from the study contribute to the literature in the areas of firm corporate governance and carbon emission disclosures by documenting the moderating role of earnings management, which is not evident in previous studies; provide an enhanced perspective on the implications for firms, regulators, policymakers, and stakeholders who have an interest in reducing carbon emissions and advancing climate change mitigation goals in line with UN's Sustainable Development Goal (SDG) 7: climate action, and zero emissions goal by 2050.

KEYWORDS
carbon emission disclosures, climate change mitigation, earnings management, firm governance structures, high-polluting firms

1 | INTRODUCTION

Climate change represents the greatest global environmental challenge facing organizations today (Chen, 2021). In particular, carbon emissions from industrial processes are accelerating climate change at such an alarming rate (Jamali et al., 2022; Liao et al., 2015); that continued stakeholders' demands and pressure have led firms to release a more integrated level of emission disclosures reports related to its climate change mitigation efforts (Baranova & Meadows, 2017; Gerged, Beddewela, et al., 2021; Hysa et al., 2020; Lee et al., 2023; Tan et al., 2020). Whether around the corner or globally, institutional investors are concerned about the environmental information regarding a firm's carbon emission mitigation strategies deployed to

evaluate investment risks and opportunities (Döring et al., 2023; Einig, 2022; Jiang et al., 2023).

In fact, policymaker, regulators, and interest groups have also demand information on a firm's efforts to manage climate change risks and to identify opportunities, particularly concerning their carbon emissions, to mitigate its adverse effects on the environment (Baranova & Meadows, 2017; Busch et al., 2023). In response to stakeholder demands and to minimize the impact of carbon emissions on the environment, regulatory bodies at the global level, have introduced global wide initiatives such as the Paris Climate Accords, carbon pricing, and climate action initiatives (Sustainable Development Goal (SDG) 7: SDGs 2030), and zero emissions (SDGs 2050) to tackle environmental challenges, particularly reducing carbon emissions and greenhouse gas emissions that have profound implications for humanity (Cho et al., 2022; Jamali et al., 2022). Thus, this paper aims to explore carbon emission disclosures related to high-polluting firms located in China.

The Chinese context is unique since China is the world's largest carbon emitter, and since firms are required to enforce carbon emissions mitigation in line with national and global carbon neutrality goals. In this context, China has adopted a dual approach to addressing climate change through carbon peaking and neutrality goals (Tan et al., 2022; Wang et al., 2021). President Xi proposed carbon peaking and neutrality goals to achieve carbon peaking by 2030 and neutrality by 2060 (Li et al., 2022; Yang & Liu, 2023; Ye et al., 2022). In addition, China has also implemented a series of national strategies to minimize carbon emissions. For example, in 2018, the Chinese government established the Ministry of Ecology and Environment with a mandate to cut carbon emissions (Shi et al., 2023). In 2021, a national and provincial special task forces of leading experts were formed to initiate climate change action plans to achieve carbon peaking and neutrality targets. Additionally, China has further integrated its economic and social planning with climate change, within its 14th five-year plan to highlight and stress its clean energy alternatives to achieve carbon neutrality by 2060 (Pian-Pian et al., 2023).

Progressing forward, the Chinese government's initiatives for green and low-carbon industries include energy conservation policies (Wen & Liu, 2022), environmental protection laws (Li et al., 2023), clean production (Zeng et al., 2023), and clean energy sources (Wang, 2023). More recently, China has started to ban projects with high energy consumption which create direct carbon emissions (Qi et al., 2022) by implementing an evaluation process which determines the energy and carbon efficiency within 13[i] high-polluting industries and set specific benchmarks within each of these industries. To ensure continued progress forward, in 2019 China introduced a national emission trading system to lower carbon emissions (Fang et al., 2021; Li et al., 2019; Liu et al., 2022). The Chinese government implemented the national trading system to limit carbon emissions which reflected performance data from seven pilot regional emission trading systems (Shen, Tang, et al., 2020; Tan et al., 2020). In support of its goal of carbon emission reduction, China has also supported industrial firms with innovative green technologies (Huang et al., 2023), using a carbon emission accounting system (Hong-Shuo et al., 2023), and carbon emissions reporting guidelines (Schaltegger & Csutora, 2012). Both of these initiatives demonstrate the continuous efforts of the Chinese government to address climate change in line with its 2060 carbon neutrality goal. However, in spite of the goals, and initiatives identified by the Chinese government, carbon emission reduction efforts and disclosures by high-polluting firms in China remain debatable due to lower levels of carbon emission reporting by such firms (Bilal et al., 2022; Nguyen et al., 2021; Yu et al., 2020).

Carbon emission disclosures reporting provide information about firms' operations related to its climate change impact, including strategies to reduce its emissions, the risks and opportunities linked within these disclosures. These disclosures challenge firm managers as they must navigate risks and opportunities simultaneously (Aggarwal & Dow, 2012; Karim et al., 2021). Karl and Orwat (1999) suggested that firm disclosures related its environmental strategy can minimize the information gap among managers and stakeholders, while providing an opportunity to moderate market volatility. Additionally, firms typically use one of two channels to disseminate carbon emission information: voluntary or mandatory disclosures (e.g., as required by firms listed in the United Kingdom). This study investigates the relationship between a firm governance structures and its carbon disclosures. The study further aimed to examine whether earnings management strengthen or weaken the connection between a firm governance structure and its carbon disclosures.

The current study makes three significant contributions to carbon accounting and firm governance literature. First, the study addresses the ongoing call for additional research related to the relationship between firm governance structures and its carbon disclosures (Velte et al., 2020). As noted in the research literature, firm governance structures such as board size (Godos-Díez et al., 2018), board independence (Ullah et al., 2019), CEO duality, directors' share ownership (Masud et al., 2018), and board meeting frequency (Godos-Díez et al., 2018), all play a key role in improving the level of carbon disclosures. However, the prior research is inconclusive. From one perspective, few studies which considered legitimacy and stakeholders' theories suggested that effective firm governance structures play a crucial role in promoting environmental-related disclosures, particularly carbon disclosures (Garas & ElMassah, 2018; Gerged, Albitar, et al., 2021; Khan et al., 2013; Peters & Romi, 2014; Velte et al., 2020). In contrast, several studies argued that firm governance mechanisms are not essential for monitoring and reporting carbon emission information (Chithambo & Tauringana, 2017; Prado-Lorenzo & Garcia-Sanchez, 2010). Rodrigue et al. (2013) by noting the evidence to support the latter viewpoint, which suggests that firm governance structures play a symbolic as opposed to a strategic role in disclosing environmental concerns. More recently, various studies have produced mixed results regarding the relationship between a firm governance structures and its carbon disclosures (Bui et al., 2020; De Masi et al., 2022; Gerged, 2021; Karim et al., 2021; Orazalin, 2019; Palea & Drogo, 2020; Velte et al., 2020). Therefore, the current paper contributes to the literature by exploring the relationship of firm governance structures and carbon disclosures in

high-polluting firms. Carbon peaking 2030 particularly with respect to China, where high-polluting firms are significant contributors to global carbon emissions and are criticized for failing to provide a full picture or transparency within their carbon disclosures reports. In response to a lack of fully transparent carbon disclosures by firms, the Chinese government has set both a carbon peaking 2030 and 2060 carbon neutrality goals. Therefore, examining the relationship of a firm governance structures and carbon disclosures is essential to identifying the potential barriers and enablers of carbon disclosure practices, while contributing to development of regulatory policies within China's in relation to its dual carbon peaking 2030 and 2060 carbon neutrality goal.

As well, the study further explores the moderating role of earnings management on the relationship between a firm governance structures and carbon emission disclosures. We expect that a firm that manipulates earnings can weaken the oversight role of its board of directors and use environmental and carbon emission disclosures as a disguising tool (Gerged, Albitar, et al., 2021; Sun et al., 2010). In contrast, firms that do not engage in earnings manipulations are associated with strong monitoring of governance structures, and provide more detailed and transparent information with respect to their carbon emissions to stakeholders, which aligns to stakeholder and legitimacy theories (Bilal et al., 2022; Choi et al., 2013; Lemma et al., 2020). Therefore, the current study aims to contribute to this ongoing debate by exploring the moderating influence of earnings management on the relationship between firm governance structures and its carbon emission disclosures.

The current research notes that among the firm governance structures, board size and independence are directly linked with carbon emission disclosures, whereas other attributes, such as CEO duality and directors' share ownership, are indirectly linked with carbon emission disclosures in the case of Chinese firms; and that a negative relationship exists between earnings management and carbon emission disclosures. Finally, the literature identified that earnings management moderates the relationship between a firm governance structures and carbon emission disclosures. Finally, the paper presents practical and managerial implications for both firms as well as for regulators and environmental watchdogs, since carbon emission disclosures are considered a major concern by multiple various stakeholders.

The remainder of the paper is divided into four sections. Section 2 presents previous literature and formulates the study's hypotheses. Section 3 explains the research methodology. The fourth section presents and analyzes the findings and discusses it implications. The final section offers recommendations for future studies.

2 | LITERATURE REVIEW

Prior researchers have extensively studied the relationships between firm governance structures and environmental, social, and governance disclosures based on stakeholders, legitimacy, and agency theories (García-Sánchez et al., 2022; Jain & Jamali, 2016; Jamali et al., 2008; Ntim & Soobaroyen, 2013; Tran et al., 2021; Zaman et al., 2022). First, the stakeholder theory researchers suggested that firms should initiate socially responsible actions and fulfill the demands of various stakeholders by not sacrificing the firms' objectives of increasing shareholder wealth (Apostu et al., 2023; Carroll, 1999; Donaldson & Preston, 1995; Einig, 2022; Panait et al., 2023; Valentinov & Chia, 2022). Specifically, based on stakeholder theory, several researchers determined that firms disclose provides more sustainability information to stakeholders when they have strong firm governance structures which include larger board size (Godos-Díez et al., 2018; Masud et al., 2018; Pucheta-Martínez & Gallego-Álvarez, 2019), independent directors (Masud et al., 2018), regular and ongoing board meetings (Godos-Díez et al., 2018), and directors who have foreign experience (Cuadrado Ballesteros et al., 2015), and an inclusion of female directors (Liao et al., 2015). Thus, inferring from the sustainability literature, we expect that firms having strong governance structures are more likely to disclose greater carbon disclosures, which reasonably fulfill the demands of multiple stakeholder groups.

Second, the legitimacy theory proposed that firms provide sustainability disclosures to legitimize their actions to relevant stakeholders in relation to demands from society in relation to environmental interest (Benameur et al., 2023; Deegan, 2002, 2019; Wilmshurst & Frost, 2000). Prior researchers determined that firms reduce the legitimacy gap by unveiling environmental information to multiple stakeholders with governance structures based on board size (Godos-Díez et al., 2018; Masud et al., 2018), board independence (Fahad & Rahman, 2020; Garas & ElMassah, 2018; Masud et al., 2018; Ullah et al., 2019), CEO duality (Lassoued & Khanchel, 2022), directors' share ownership (Masud et al., 2018), and frequency of board meetings (Godos-Díez et al., 2018). However, Velte et al. (2020) claimed that carbon disclosures have heterogeneous findings when firm governance structures are considered. For this reason, the current study adds to this ongoing debate and assumes that firms with strong governance structures legitimize their actions with higher carbon disclosures.

Third, agency theory predicts that when a firm's managers hold more information and they will opportunistically use this information for their personal benefit as opposed to maximizing shareholders' wealth (Ng & Koh, 1994). Large and independent boards should urge greater information transparency and ask management challenging questions for information disclosure (Kaymak & Bektas, 2017). Prior research on the relationship of firm governance structures and sustainability disclosures yields inconclusive evidence. For example, more sustainability disclosures were associated with a large board size (Endrikat et al., 2021; Formigoni et al., 2020; Masud et al., 2018), CEO duality (Fahad & Rahman, 2020; Pucheta-Martínez & Gallego-Álvarez, 2019), independent directors (Endrikat et al., 2021; Kaymak & Bektas, 2017; Masud et al., 2018), higher directors ownership (Masud et al., 2018), and more frequent/regular board meetings (Alnabsha et al., 2018; Godos-Díez et al., 2018). While Alnabsha et al. (2018) argued that large boards are related to less communication, free-riding issues, and poor coordination, which may lead to

lower sustainability disclosures. Likewise, several researchers identified an inverse impact of board independence (Pucheta-Martínez & Gallego-Álvarez, 2019), CEO duality (Allegrini & Greco, 2013), and frequency of meetings (Hussain et al., 2018) with respect to sustainability disclosures. Therefore, the prior literature has mixed findings regarding the relationships between firm governance structures and sustainability disclosures.

2.1 | Firm governance structures and carbon emission disclosures

First governance structure, the board size relationship with carbon disclosures is inconclusive, as (Bui et al., 2020) observed larger board size leads to an enhanced level of carbon disclosures. In contrast, Akbaş and Canikli (2018) argued larger boards' having an inverse impact on voluntary carbon disclosures. However, some studies failed to find any link between board size and carbon disclosures (Al-Qahtani & Elgharbawy, 2020; Kılıç & Kuzey, 2018). The second governance indicator, board independence, also has an unclear impact on carbon disclosures. A few studies found a direct influence of board independence on carbon disclosures (Elsayih et al., 2018; Jaggi et al., 2018; Liao et al., 2015). In contrast, several researchers argued that independent boards are associated with lower carbon disclosures as opposed to its governance structures. For example, Chau and Gray (2010) found CEO duality directly linked with firms' disclosures. However, Goud (2022) found an inverse relationship between CEO duality and carbon performance. In contrast, Ho and Wong (2001) and Barako et al. (2006) found no link between CEO duality and voluntary disclosure levels. Fourth firm governance mechanism, director ownership also has a positive (Giannarakis et al., 2018; Hermawan et al., 2018), negative (Chu et al., 2013; Goud, 2022), and no impact (Peng et al., 2015) on carbon disclosures. Finally, board meetings' impact on carbon disclosures also has mixed evidence in the literature (Elsayih et al., 2021). Therefore, prior research on the relationships between firm governance structures and carbon disclosures remain inconclusive. The current study aims to contributes to this contemporary research by examining the relationships between firm governance structures and carbon emission disclosures.

According to the agency theory, the choice of disclosure of carbon emissions is an agency clash between shareholders and managers (Harjoto, 2017; Harjoto & Jo, 2011; Jo & Harjoto, 2012). Management's objective is to make the operations of business profitable, and if they are not observed properly through the firm governance mechanism, there are chances that they will safeguard their interest over the interest of stakeholders. Effective firm governance mechanisms including board size, CEO duality, board independence, directors' shareholding, and frequency of meetings can reduce the managers' opportunity to fulfill their interests (Velte et al., 2020).

Both the legitimacy theory and stakeholder theory seek to maximize shareholders' value by recommending several external and internal approaches, firm governance mechanisms, and carbon emission information disclosure to stakeholders (Tibiletti et al., 2021). As a result, the firms can utilize the effective practices of governance mechanisms and disseminate information on carbon emissions to settle the terms with diverse stakeholders (Bui et al., 2020; Elsayih et al., 2018; Giannarakis et al., 2018; Hermawan et al., 2018; Jaggi et al., 2018; Liao et al., 2015). In considering both stakeholder and legitimacy theories literature, we expect that firms having strong governance structures are more likely to disclose greater carbon disclosures and reasonably fulfill the demands of multiple stakeholders. Hence, the following hypothesis is presented:

> **Hypothesis 1.** There is a significant relationship between firm governance structures and carbon emission disclosures.

2.2 | Firm governance structures, earnings management, and carbon emission disclosures

The earnings management acts a moderator in the relationship between firm governance structures and carbon emission disclosures from two contradictory perspectives. The first perception, agency problem perspective suggested that firms that manipulate earnings can weaken the oversight role of their board of directors, and use environmental and carbon emission disclosures as a disguising tool (Gerged, Albitar, et al., 2021; Sun et al., 2010).

In contrast, using a wealth maximization approach, researcher using this perspective followed stakeholder and legitimacy theories, which claimed that firms which are not engaged in earnings manipulations are associated with strong monitoring of governance structures y (Bilal et al., 2018; Ezeani et al., 2021; Komal, Bilal, Chengang, et al., 2022; Usman, Ezeani, et al., 2022; Usman, Salem, et al., 2022), and provided more transparent information about carbon disclosures (Bilal et al., 2022; Choi et al., 2013; Lemma et al., 2020). The prior literature considered corporate governance as a moderating factor, while inferring from the stakeholder and legitimacy theories, the current study aims to contribute to the literature by examining the moderating impact of earnings management on the relationship between firm governance structures and carbon emission discourses. Based on the above arguments, the following hypothesis is proposed:

> **Hypothesis 2.** Earnings management moderates the relationship between firm governance structures and carbon emission disclosures.

3 | RESEARCH METHODOLOGY

The current study selected a sample of Chinese high-polluting firms between 2012 and 2018. The data for carbon emission disclosures is hand collected from stand-alone firm sustainability reports which

included Environmental Social and Governance (ESG) or Firm Social Responsibility (CSR). If a firm did not have a stand-alone sustainability report, carbon emission disclosure data were extracted from its annual reports' CSR/ESG section. Alternatively, data for earnings management, firm governance structures, and annual report were collected from the China Stock Market and Accounting Research (CSMAR) database. The sample duration was restricted to 2018 due to the difficulty of manually collecting the carbon emission disclosures. The initial sample of 3077 firm-year observations was obtained from manual data entry. However, after merging all the variables with carbon emission disclosures, a final sample of 2840 firm-year observations was obtained.

To test the study's hypotheses, the study used the fixed-effects model, as shown in Equation (1).

$$\begin{aligned} CD_{it} = {} & \beta_{0i} + \beta_1 CG_{it} + \beta_2 EM_{it} + \beta_3 CG_{it}{}^{*} EM_{it} + \beta_4 SOE_{it} + \beta_5 ROA_{it} \\ & + \beta_6 CF\_vol_{it} + \beta_7 Rev\_vol_{it} + \beta_8 SIZE_{it} + \beta_9 LEV_{it} \\ & + \beta_{10} CSR\_ass_{it} + \beta_{11} CSR\_score_{it} + u_{it} \end{aligned} \quad (1)$$

Carbon disclosures (CD) were identified as a dependent variable constructed via content analysis of carbon disclosure items reported in stand-alone environmental, social, and governance (ESG) or annual reports. These carbon disclosure items are 18 further splits into five sub-themes: risks and opportunities of climate change; reporting of greenhouse gas (GHG) emissions; reporting of energy consumption; policies regarding GHG reduction; carbon disclosures accountability.

The independent variables were firm governance structures, which consist of board size, CEO duality, directors' share ownership, board independence, and frequency of board meetings (Gerged, 2021; Jo & Harjoto, 2012; Shao, 2019).

Earnings management (EM) which is a moderating variable proxied by the estimation of discretional accruals (EM1) from the Modified Jones Model by Dechow et al. (1995), the following Equations (2–4) used:

$$\frac{TACC_{it}}{Asset_{it-1}} = \beta_0 \frac{1}{Asset_{it-1}} + \beta_1 \frac{\Delta\, Sales_{it}}{Asset_{it-1}} + \beta_2 \left(\frac{PPE_{it}}{Asset_{it-1}} \right) + \varepsilon_{it} \quad (2)$$

Here

$TACC_{it}$, Total Accruals = Operating income − Net cashflow from activities related to operations;

$Asset_{it-1}$, Taking the lag values of total assets (t-1) to eliminate the scale effect;

$\Delta\, Sales_t$, Annual changes in the firm's net revenues;

PPE_t, Value of property, plant, and equipment in the current year.

$$NDA_{it} = \hat{\beta}_0 \frac{1}{Asset_{it-1}} + \hat{\beta}_1 \frac{\Delta Sales_{it} - \Delta REC_{it}}{Asset_{it-1}} + \hat{\beta}_2 \left(\frac{PPE_{it}}{Asset_{it-1}} \right) \quad (3)$$

$\Delta\, REC_t$, Annual change in the amount of accounts receivables; NDA, Non-discretionary accruals, the fitted values of Equation (3).

$$DA_t = \frac{TACC_{it}}{Aseet_{it-1}} - NDA_{it} \quad (4)$$

DA, Discretionary accruals values after putting the NDA values.

The working capital accruals (EM2) as an alternative model are calculated from cash flow from operating activities of the previous, current, and subsequent periods using accrued working capital from the DD Model (Dechow & Dichev, 2002). Real earnings management (REM), following Roychowdhury (2006) were used as an alternative model for earnings management.

Finally, our study included several firm-level variables and characteristics as control variables like firm profitability, volatility of firm's cashflows, annul sales growth, firm size, financial leverage, CSR assurance, and performance. As documented by prior literature, these variables significantly influence carbon disclosures (Bilal et al., 2022; Velte et al., 2020). The proxies of all variables of the study are explained in Appendix 1.

To ensure a robust level of evidence, our study conducted a sub-group analysis for ownership structure (e.g., state-owned vs privately owned firms); level of carbon disclosures (e.g., higher carbon disclosures if CD > median value vs lower carbon disclosures); CSR performance (higher CSR scores vs lower CSR firms).

The current study tested the endogeneity concerns for the robustness of the findings using a dynamic panel system two-step generalized method of moments (GMM) following Arellano and Bond (1991), as shown in Equation (5). The system GMM takes instruments from the model to address endogeneity (Eugster, 2020).

$$\begin{aligned} CD_{it} = {} & \beta_{0i} + \beta_1 CD_{it-1} + \beta_2 CG_i + \beta_3 EM_{it\,t} + \beta_4 CG_{it}{}^{*} EM_{it} + \beta_5 SOE_{it} \\ & + \beta_6 ROA_{it} + \beta_7 CF\_vol_{it} + \beta_8 Rev\_vol_{it} + \beta_9 SIZE_{it} + \beta_{10} LEV_{it} \\ & + \beta_{11} CSR\_ass_{it} + \beta_{12} CSR\_score_{it} + u_{it} \end{aligned} \quad (5)$$

Finally, to address the endogeneity issue, we used Heckman (1979) two-stage model Heckman to address the sample selection bias, since few firms never disclose carbon emission disclosures. Following prior accounting literature, other researchers such as Zalata et al. (2019) used Heckman's two-stage model analyses. We computed the inverse mills' ratio (IMR) from the probit model in the first stage. In the probit model, the carbon disclosures as a dummy variable, taken a value of 1 if the CD score is higher than zero (e.g., showing any form of carbon disclosures) and a value of 0 if the firm did not disclose carbon disclosures at all treated as a dependent variable. On the other hand, for independent variables of the probit model, following Zalata et al. (2019), we used the industry CD average as an instrumental variable which included the same independent and control variables as the main models. In the second stage of the Heckman model, we included the IMR as an additional control variable to address the sample selection bias and, to address any possible endogeneity issues.

4 | RESULTS AND DISCUSSION

Table 1 depicts a summary of the descriptive statistics of the study. The dependent variable carbon emission disclosures' average value

TABLE 1 Descriptive statistics.

Variable	Obs	Mean	*SD*	Min	Max
CD	2840	0.14	0.14	0.00	0.67
EM1	2840	0.03	0.08	−0.01	0.06
EM2	2840	0.02	0.07	−0.01	0.06
REM	2840	0.09	0.12	−0.03	0.11
BS	2840	8.89	1.65	5.00	15.00
BI	2840	3.26	0.60	2.00	6.00
CEO dual	2840	1.77	0.42	1.00	2.00
DSO	2840	14.83	3.89	5.58	20.59
BM	2840	9.53	3.64	3.00	37.00
SOE	2840	0.57	0.48	0.00	1.00
ROA	2840	0.04	0.04	−0.15	0.20
CF_vol	2840	0.02	0.09	−0.51	0.48
REV_vol	2840	0.73	0.60	0.04	7.61
SIZE	2840	22.41	1.31	20.05	26.23
LEV	2840	0.44	0.21	0.05	0.91
CSR_ass	2840	0.28	0.45	0.00	1.00
CSR_score	2840	3.02	0.78	−2.66	4.41

Note: Variables definitions are given in Appendix 1.

TABLE 2 Correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
(1) BS	1.000												
(2) BI	.64*	1.000											
(3) CEO_dual	.11*	.08*	1.000										
(4) DSO	−.28*	−.28*	−.22*	1.000									
(5) BM	.020	.050	−.010	−.030	1.000								
(6) SOE	.33*	.31*	.25*	−.60*	.030	1.000							
(7) ROA	−.10*	−.11*	−.020	.30*	−.07*	−.26*	1.000						
(8) CF_vol	−.12*	−.11*	−.07*	.34*	−.010	−.31*	.61*	1.000					
(9) REV_vol	−.030	−.040	.000	.040	−.09*	.000	.040	−.010	1.000				
(10) SIZE	.40*	.40*	.20*	−.39*	.21*	.50*	−.22*	−.26*	−.08*	1.000			
(11) LEV	.32*	.32*	.08*	−.43*	.21*	.42*	−.46*	−.39*	−.030	.63*	1.000		
(12) CSR_ass	.22*	.21*	.17*	−.24*	.11*	.31*	−.09*	−.16*	.07*	.40*	.23*	1.000	
(13) CSR_score	.08*	.06*	.07*	.040	−.030	.050	.43*	.26*	.040	.12*	−.10*	.42*	1.000

Note: Variables definitions are given in Appendix 1.
*$p < .05$.

is approximately 14 per cent, which represents a lower level of carbon emission disclosures by Chinese high-polluting firms in line with prior research (Bilal et al., 2022; Tan et al., 2020). The variable of interest, firm governance structures, related to the average value of board size (BS), is 8.89, with a standard deviation of 1.65. The average board independence (BI) value is 3.26, with a standard deviation of 0.60. The average CEO duality (CEO_dual) value is 1.77, and the standard deviation is 0.42. The average value of directors' share ownership (DSO) is 14.83, with a standard deviation of 3.89. The average value related to the frequency of board meetings (BM) is 9.53, with a standard deviation of 3.64. The mean value of the moderating variable-earnings management (EM1), (EM2), and (REM) are 0.03, 0.02, and 0.09, respectively, consistent with related studies in the same context (Bilal et al., 2022; Rezaee et al., 2019; Shahab & Ye, 2018). Similarly, Table 1 details the mean and standard deviation of the control variables.

Table 2 describes the Pearson correlation between independent, moderator, and control variables. For determining the probable chances of multicollinearity, the analysis illustrates the association between independent, moderators, and control variables is less than 0.70 cut point; thus, there is no probability of multicollinearity in the model.

The main findings of the fixed effects model of the study are presented in Table 3. The firm governance structures which include board size (BS) and board independence (BI) have a positive and significant relationship with carbon emission disclosures (CD) as denoted in column 1. Consistent with prior research related to stakeholders, and legitimacy theories, the findings indicate that larger and independent boards are legitimizing their climate change mitigation efforts to stakeholders through more transparent carbon disclosures (Bui et al., 2020; Elsayih et al., 2018; Jaggi et al., 2018; Liao et al., 2015). However, among other governance structures, CEO duality (CEO_dual) and directors' ownership (DSO) there is an inverse impact on carbon disclosures. These findings are in line with the prior research, which argued that CEO duality and directors' shareholding do not contribute further toward the disclosure of carbon emissions to stakeholders (Chu et al., 2013; Goud, 2022). Based on agency theory, we recommend that CEOs with board chairmanship and directors who have an ownership concentration to reduce the information asymmetry among the stakeholders by providing more transparent disclosures regarding their carbon emissions. Finally, the variable frequency of board meetings (BM) has no impact on carbon disclosures. This finding may be attributed to various alternative factors, including board composition and expertise (Karim et al., 2021), organizational culture and commitment (Perkins et al., 2022), as well as stakeholder demands (Baranova & Meadows, 2017; Shen et al., 2020a). Future research should further explore these factors to gain a deeper understanding of their influence on carbon disclosures. Therefore, our findings support Hypothesis 1 which is in line with the stakeholders, legitimacy, and

TABLE 3 Main results.

Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
BS	0.054***	0.061***	0.061***	0.060***	0.060***	0.059***
	(0.013)	(0.014)	(0.014)	(0.013)	(0.013)	(0.013)
EM1		−0.353**	−0.395**	−0.349**	−0.309**	−0.371**
		(0.162)	(0.194)	(0.164)	(0.151)	(0.178)
BS * EM1		0.048**				
		(0.020)				
BI	0.027***	0.027***	0.028***	0.027***	0.026***	0.026***
	(0.011)	(0.008)	(0.009)	(0.009)	(0.008)	(0.009)
BI * EM1			0.143**			
			(0.056)			
CEO_dual	−0.031***	−0.030***	−0.030***	−0.029***	−0.029***	−0.030***
	(0.007)	(0.008)	(0.008)	(0.006)	(0.006)	(0.008)
CEO_dual * EM1				−0.071**		
				(0.031)		
DSO	−0.005***	−0.006***	−0.006***	−0.008***	−0.005***	−0.006***
	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.001)
DSO * EM1					−0.016**	
					(0.008)	
BM	−0.003	−0.004	−0.002	−0.002	−0.003	−0.003
	(0.004)	(0.004)	(0.003)	(0.002)	(0.003)	(0.004)
BM * EM1						−0.001
						(0.008)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.350***	−0.322***	−0.331***	−0.331***	−0.324***	−0.334***
	(0.075)	(0.081)	(0.081)	(0.081)	(0.081)	(0.081)
Observations	2840	2840	2840	2840	2840	2840
R-squared	.168	.171	.171	.169	.170	.168
Industry and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Variables definitions are given in Appendix 1. Robust standard errors in parentheses.
***$p < .01$; **$p < .05$; *$p < .1$.

agency theories and conclude that firm governance structures are linked with carbon disclosures.

We identified an inverse relationship between earnings management (EM) and carbon disclosures (CD), as identified in column 2. In line with stakeholders and legitimacy theories, the finding indicates that firms that report a more robust level of carbon disclosures to stakeholders exhibit transparency in their financial reporting (Bilal et al., 2022; Choi et al., 2013; Lemma et al., 2020). Next, the moderating impact of earnings management on the relationships between firm governance structures and carbon disclosures are reported in columns 2–6 of Table 3. The first two variables of interest are the interaction terms board size-earnings management (BS * EM1) and board independence-earnings management (BI*EM1) have significant positive relationships, which show that firms without earnings manipulations and with larger and independent boards are disclosed increased transparency carbon disclosures. Consistent with the agency and stakeholders theories, transparent financial reporting with large and independent boards act in the best interests of diverse stakeholders and enhance the firms commitment to disclosing increased carbon emissions-related information (Gerged, Albitar, et al., 2021; Velte et al., 2020). In contrast, in other firm governance structures interactions with earnings management, CEO duality-earnings management (CEO_dual * EM1) directors' shareholding-earnings management (DSO * EM1) show a negative moderating impact of earnings management, which indicates that firms with earnings manipulations are associated with weaker firms' governance structures in these respective dimensions. In particular, based on agency problem, these findings indicate that CEO duality and directors' shareholding governance structures serve the interest of the CEO or directors instead of diverse stakeholders, which leads to lesser carbon disclosures (Goud, 2022). These findings statistically support Hypothesis 2. This study acceded with the agency theory and with prior research that effective firm governance attributes is associated with better monitoring and significantly constrain earnings manipulation practices and transparent carbon disclosures (Al-Haddad & Whittington, 2019; Bilal et al., 2018; El Diri et al., 2020; Ezeani et al., 2021; Gerged, Albitar, et al., 2021; Goud, 2022; Komal et al., 2021; Komal, Bilal, Chengang, et al., 2022; Usman, Salem, et al., 2022).

Finally, the last indicator, frequency of board meetings (BM * EM1) interaction not proved as a moderator. Table 4 presents the

TABLE 4 Additional results with the alternative proxy of earnings management.

Panel A: Working capital accruals						
Variables	**(1) CD**	**(2) CD**	**(3) CD**	**(4) CD**	**(5) CD**	**(6) CD**
BS	0.054***	0.060***	0.060***	0.059***	0.060***	0.059***
	(0.013)	(0.013)	(0.013)	(0.014)	(0.013)	(0.012)
EM2		−0.263**	−0.290**	−0.247**	−0.324**	−0.288**
		(0.131)	(0.135)	(0.120)	(0.156)	(0.121)
BS * EM2		0.040**				
		(0.018)				
BI	0.027***	0.028***	0.027***	0.027***	0.026***	0.026***
	(0.009)	(0.008)	(0.008)	(0.009)	(0.009)	(0.009)
BI * EM2			0.116**			
			(0.056)			
CEO dual	−0.031***	−0.030***	−0.030***	−0.030***	−0.029***	−0.030***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.008)	(0.008)
CEO dual * EM2				−0.076**		
				(0.037)		
DSO	−0.005***	−0.006***	−0.006***	−0.005***	−0.005***	−0.006***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
DSO * EM2					−0.014**	
					(0.007)	
BM	−0.003	−0.003	−0.001	−0.002	−0.001	−0.001
	(0.003)	(0.003)	(0.002)	(0.002)	(0.001)	(0.001)
BM * EM2						−0.002
						(0.010)

(Continues)

TABLE 4 (Continued)

Panel A: Working capital accruals						
Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.350***	−0.329***	−0.335***	−0.332***	−0.327***	−0.335***
	(0.075)	(0.080)	(0.080)	(0.081)	(0.081)	(0.081)
Observations	2840	2840	2840	2840	2840	2840
R-squared	.168	.170	.171	.169	.170	.169
Industry and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Real earnings management						
Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
BS	0.054***	0.061***	0.060***	0.062***	0.061***	0.062***
	(0.013)	(0.014)	(0.013)	(0.014)	(0.014)	(0.014)
REM		−0.192**	−0.239**	−0.108**	−0.132**	−0.129**
		(0.093)	(0.099)	(0.048)	(0.061)	(0.059)
BS * REM		0.015**				
		(0.007)				
BI	0.027***	0.024***	0.024**	0.023***	0.025***	0.024***
	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)	(0.009)
BI * REM			0.063***			
			(0.022)			
CEO dual	−0.031***	−0.030***	−0.032***	−0.033***	−0.032***	−0.032***
	(0.007)	(0.007)	(0.008)	(0.008)	(0.006)	(0.008)
CEO dual * REM				−0.036***		
				(0.014)		
DSO	−0.005***	−0.006***	−0.005***	−0.006***	−0.005***	−0.005***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
DSO * REM					−0.007**	
					(0.003)	
BM	−0.002	−0.002	−0.001	−0.001	−0.002	−0.001
	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)
BM * REM						−0.002
						(0.006)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.350***	−0.307***	−0.309***	−0.315***	−0.313***	−0.313***
	(0.075)	(0.083)	(0.083)	(0.083)	(0.082)	(0.082)
Observations	2840	2762	2762	2762	2762	2762
R-squared	.168	.161	.162	.161	.161	.160
Industry and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Variables definitions are given in Appendix 1. Robust standard errors in parentheses.
***$p < .01$; **$p < .05$; *$p < .1$.

results using alternative proxies of earnings management: EM2 and real earnings management (REM) in panels A and B, respectively. We identified similar findings as found in Table 3.

Additional evidence to the findings are reported for firms with higher and lower carbon disclosures. Table 5 Panel A reports the results of firms with higher than median values of carbon disclosures

TABLE 5 Higher and lower carbon emission disclosures.

Panel A: Higher carbon emission disclosures						
Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
BS	0.055***	0.063***	0.064***	0.061***	0.062***	0.060***
	(0.016)	(0.017)	(0.018)	(0.017)	(0.017)	(0.018)
EM1		−0.396***	−0.482***	−0.380***	0.489***	0.342***
		(0.149)	(0.169)	(0.133)	(0.131)	(0.127)
BS * EM1		−0.046***				
		(0.014)				
BI	0.024***	0.026***	0.030***	0.026***	0.025***	0.026***
	(0.008)	(0.008)	(0.007)	(0.007)	(0.008)	(0.008)
BI * EM1			0.179***			
			(0.057)			
CEO dual	−0.055***	−0.054***	−0.054***	−0.055***	−0.054***	−0.055***
	(0.011)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
CEO dual * EM1				−0.106***		
				(0.034)		
DSO	−0.006***	−0.007***	−0.007***	−0.007***	−0.008***	−0.007***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)	(0.001)
DSO * EM1					−0.025***	
					(0.007)	
BM	−0.003***	−0.004**	−0.003***	−0.004**	−0.003***	−0.004***
	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.001)
BM * EM1						−0.013***
						(0.003)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.422***	−0.338**	−0.348***	−0.348***	−0.356***	−0.359***
	(0.121)	(0.133)	(0.133)	(0.134)	(0.132)	(0.133)
Observations	1638	1619	1619	1619	1619	1619
R-squared	.270	.261	.263	.260	.262	.259
Industry and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: Lower carbon emission disclosures						
Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
BS	0.024	0.026	0.026	0.027	0.028	0.027
	(0.018)	(0.018)	(0.019)	(0.018)	(0.018)	(0.019)
EM1		−0.288	−0.278	−0.219	−0.234	−0.209
		(0.205)	(0.225)	(0.201)	(0.197)	(0.197)
BS * EM1		0.060				
		(0.046)				
BI	0.018	0.017	0.015	0.016	0.016	0.016
	(0.012)	(0.013)	(0.012)	(0.013)	(0.013)	(0.012)
BI * EM1			0.097			
			(0.088)			

(Continues)

TABLE 5 (Continued)

Panel B: Lower carbon emission disclosures						
Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
CEO dual	−0.014	−0.010	−0.009	−0.007	−0.010	−0.010
	(0.010)	(0.012)	(0.011)	(0.012)	(0.010)	(0.010)
CEO dual * EM1				−0.068		
				(0.049)		
DSO	−0.005	−0.005	−0.006	−0.005	−0.006	−0.005
	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)	(0.005)
DSO * EM1					−0.009	
					(0.013)	
BM	−0.001	−0.002	−0.001	−0.004	−0.001	−0.003
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.004)
BM * EM1						−0.010
						(0.015)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.023	−0.040	−0.044	−0.039	−0.040	−0.043
	(0.119)	(0.123)	(0.124)	(0.124)	(0.125)	(0.124)
Observations	1202	1221	1221	1221	1221	1221
R-squared	.112	.121	.118	.117	.117	.118
Industry and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Variables definitions are given in Appendix 1. Robust standard errors in parentheses.
***$p < .01$; **$p < .05$; *$p < .1$.

in our sample period. In contrast, panel B presents the results for firms with less than the median values of carbon disclosures. Surprisingly, our findings hold only for the group of firms with higher carbon disclosures.

The findings are further reported for firms with higher and lower CSR performance. Table 6 Panel A reports the findings of firms with higher than median values of CSR scores in our sample period. In comparison, panel B presents the results for firms with less than the median values of CSR scores. However, our findings hold only for firms with higher CSR performance.

Table 7 presents the robust findings by employing the system GMM as an alternative methodology. The system GMM takes instruments from the model to address endogeneity (Eugster, 2020). Our main results as noted in Table 3 still hold with respect to system GMM. Therefore, we conclude that carbon disclosures are directly associated with firm governance structures related to board independence and size. While CEO duality and directors' share ownership are negatively linked with carbon disclosure. Our study also determined a significant negative relationship between earnings management and carbon disclosures. Finally, the earnings management moderates the relationship between firm governance structures and carbon disclosures.

Table 8 presents the outcomes of Heckman's two-stage model as an alternative methodology. The first stage (untabulated) uses the probit model for calculating the inverse mills' ratio by taking the carbon disclosures as a dependent variable. This variable measures via a dummy variable, taking a value of 1 if the carbon disclosure score is higher than zero (e.g., showing any form of carbon disclosures) and 0 if the firm did not disclose carbon emission disclosures. On the other hand, for independent variables of the probit model, we followed Zalata et al. (2019) approach, which used the industry carbon disclosures average as an instrumental variable including the same independent and control variables of our main models (Table 3).

In the second stage of the Hackman model, we have included IMR as an additional control variable to address the sample selection bias and, ultimately, possible endogeneity issues. Our findings align with our main findings (Table 3), indicating that the sample selection does not influence our results; thus, we conclude that board size and independence are directly related to carbon disclosures. On the other hand, CEO duality and directors' share ownership have an inverse impact on carbon disclosures. The earnings management moderates the relationship between firm governance structures and carbon disclosures and are consistent with our main results. The frequency of board meetings has a negative and insignificant relationship with carbon disclosures.

Our findings contribute the contemporary literature by highlighting the influential role of Chinese firms' earnings

TABLE 6 High and low CSR ranking.

Panel A: High CSR ranking firms						
Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
BS	0.058***	0.057***	0.059***	0.055***	0.057***	0.056***
	(0.018)	(0.018)	(0.019)	(0.017)	(0.018)	(0.019)
EM1		−0.311***	−0.396***	−0.305***	−0.390***	−0.317***
		(0.123)	(0.148)	(0.105)	(0.151)	(0.112)
BS * EM1		0.037***				
		(0.011)				
BI	0.039***	0.037***	0.035***	0.036***	0.036***	0.036***
	(0.012)	(0.011)	(0.012)	(0.011)	(0.010)	(0.012)
BI * EM1			0.156***			
			(0.055)			
CEO dual	−0.054***	−0.052***	−0.052***	−0.052***	−0.051***	−0.050***
	(0.011)	(0.010)	(0.012)	(0.012)	(0.012)	(0.011)
CEO dual * EM1				−0.126***		
				(0.030)		
DSO	−0.006***	−0.007***	−0.007***	−0.007***	−0.008***	−0.007***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
DSO * EM1					−0.023***	
					(0.005)	
BM	−0.004***	−0.003***	−0.005***	−0.003***	−0.004***	−0.006***
	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.002)
BM * EM1						−0.015***
						(0.004)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.436***	−0.359***	−0.367***	−0.361***	−0.374***	−0.373***
	(0.123)	(0.134)	(0.134)	(0.136)	(0.133)	(0.135)
Observations	1650	1625	1625	1625	1625	1625
R-squared	.274	.265	.266	.264	.266	.263
Industry and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Panel B: Low CSR ranking firms						
Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
BS	0.029	0.027	0.027	0.029	0.028	0.029
	(0.021)	(0.022)	(0.021)	(0.020)	(0.021)	(0.023)
EM1		−0.411	−0.359	−0.404	−0.393	−0.342
		(0.315)	(0.308)	(0.359)	(0.297)	(0.276)
BS * EM1		0.063				
		(0.043)				
BI	0.023	0.025	0.029	0.026	0.025	0.026
	(0.019)	(0.019)	(0.021)	(0.020)	(0.020)	(0.020)
BI * EM1			0.122			
			(0.093)			

(Continues)

TABLE 6 (Continued)

Panel B: Low CSR ranking firms						
Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
CEO dual	−0.015	−0.011	−0.010	−0.007	−0.010	−0.011
	(0.010)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
CEO dual * EM1				−0.055		
				(0.040)		
DSO	−0.004	−0.005	−0.005	−0.005	−0.006	−0.005
	(0.004)	(0.004)	(0.004)	(0.003)	(0.005)	(0.004)
DSO * EM1					−0.004	
					(0.010)	
BM	−0.003	−0.001	−0.002	−0.001	−0.003	−0.001
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
BM * EM1						−0.007
						(0.014)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	0.014	−0.046	−0.051	−0.045	−0.041	−0.048
	(0.121)	(0.125)	(0.126)	(0.126)	(0.127)	(0.126)
Observations	1190	1215	1215	1215	1215	1215
R-squared	0.112	0.120	0.118	0.116	0.116	0.116
Industry and year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes

Note: Variables definitions are given in Appendix 1. Robust standard errors in parentheses.
***$p < .01$; **$p < .05$; *$p < .1$.

manipulations on the relationship between firm governance structures and carbon disclosures. Our research findings have the potential to assist Chinese regulatory authorities, such as the Ministry of Ecology and Environment, the China Securities Regulatory Commission (CSRC), and Chinese stock exchanges, in urging firms to enhance their carbon disclosures (Shen, Zheng, et al., 2020; Shi et al., 2023). Specifically, our research highlights the importance of developing large and truly independent boards and implementing a more robust level of transparent financial reporting as means to improve carbon disclosures. The Chinese government's initiatives, including the dual 2030 carbon peaking and 2060 carbon neutrality goals, demonstrate their continuous efforts to address climate change (Pian-Pian et al., 2023). However, the existing research on the Chinese high-polluting firms criticized for their lower levels of carbon emission reporting (Bilal et al., 2022; Nguyen et al., 2021; Yu et al., 2020). Therefore, further consideration required for ensuring the consistent as well as comprehensive carbon emission disclosures.

Our study contributes to the literature by documentation the positive role of large and independent directors in promoting carbon disclosures. These findings indicate that regulators who removed obstacles such as political interference of management and weaken for independent directors effectively enable a firm to fulfill the needs of its stakeholders by enabling monitoring financial reporting quality (Komal, Bilal, Chengang, et al., 2022; Komal et al., 2021). On the other hand, CEO duality and directors' shareholding are inversely related to carbon disclosures. These findings indicate that CEOs with board chairmanship and directors with ownership concentration cannot reduce the information asymmetry among the stakeholders and are associated with lower disclosures about carbon emissions and less transparent financial reporting quality (Barako et al., 2006; Ho & Wong, 2001). Weak firm governance and compliance with environmental regulations due to the prevalence of more state-owned firms is likely a contributing factor for the lower level of carbon disclosures and earnings management in China (Bilal et al., 2022; Komal et al., 2021; Komal, Bilal, Chengang, et al., 2022; Qian & Chen, 2021; Shi et al., 2021).

5 | CONCLUSIONS

This study focused on carbon emission disclosures of Chinese high-polluting firms, where it is voluntary for the firms to disclose carbon-related information. The study documents that large and independent boards are associated with more consistent and

TABLE 7 System GMM.

Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
L.CDI	0.916***	0.929***	0.931***	0.927***	0.931***	0.926***
	(0.041)	(0.038)	(0.039)	(0.038)	(0.038)	(0.038)
BS	0.058***	0.066***	0.066***	0.065***	0.064***	0.060***
	(0.015)	(0.015)	(0.014)	(0.015)	(0.015)	(0.013)
EM1		−0.468***	−0.495***	−0.410***	−0.435***	−0.391***
		(0.159)	(0.168)	(0.109)	(0.129)	(0.093)
BS * EM1		0.053***				
		(0.020)				
BI	0.031***	0.033***	0.031***	0.033***	0.033***	0.032***
	(0.010)	(0.009)	(0.010)	(0.011)	(0.011)	(0.011)
BI * EM1			0.158***			
			(0.062)			
CEO dual	−0.038***	−0.037***	−0.037***	−0.032***	−0.031***	−0.037***
	(0.008)	(0.008)	(0.008)	(0.007)	(0.007)	(0.009)
CEO dual * EM1				−0.093***		
				(0.037)		
DSO	−0.007***	−0.008***	−0.008***	−0.009***	−0.006***	−0.007***
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.002)
DSO * EM1					−0.017**	
					(0.009)	
BM	−0.005	−0.005	−0.006	−0.004	−0.007	−0.005
	(0.004)	(0.005)	(0.004)	(0.003)	(0.005)	(0.004)
BM * EM1						−0.004
						(0.008)
Control	Yes	Yes	Yes	Yes	Yes	Yes
Constant	−0.646***	−0.638***	−0.640***	−0.647***	−0.636***	−0.645***
	(0.163)	(0.170)	(0.170)	(0.167)	(0.166)	(0.166)
Observations	2505	2480	2480	2480	2480	2480
Sargan	0.206	0.287	0.222	0.270	0.332	0.459
AR1	0.117	0.141	0.140	0.199	0.117	0.166
AR2	0.253	0.343	0.245	0.315	0.249	0.350

Note: Variables definitions are given in Appendix 1. Robust standard errors in parentheses.
***$p < .01$; **$p < .05$;; *$p < .1$.

transparent carbon emission disclosures. In contrast, CEO duality and directors' share ownership are negatively linked with carbon emission disclosures. The study also determined a significant negative relationship exists between earnings management and carbon emission disclosures. Finally, earnings management moderates the relationship between firm governance structures and carbon emission disclosures. Therefore, our findings contribute the contemporary carbon accounting and corporate governance literature by highlighting the influential role of Chinese firms' earnings manipulations on the firm governance structures and carbon emission disclosures nexus.

Our findings are practical for the Chinese government's initiatives related to the 2030 carbon peaking initiatives in 2030 and 2060 neutrality goals. However, for successful implementation of these initiatives by the Chinese companies, we recommend that Chinese regulators should remove obstacles related to firm governance structures, such as political involvement of the government in corporate decision-making, and institutional barriers (e.g., complex bureaucratic procedures, weak enforcement, and unclear guidelines), which effectively fulfill the needs of a firm's stakeholders by monitoring financial reporting quality and promoting carbon disclosures.

TABLE 8 Robust analyses through Heckman two-stage model.

Variables	(1) CD	(2) CD	(3) CD	(4) CD	(5) CD	(6) CD
BS	0.058***	0.065***	0.065***	0.064***	0.061***	0.063***
	(0.016)	(0.015)	(0.015)	(0.013)	(0.015)	(0.015)
EM1		−0.364**	−0.402**	−0.361**	−0.316**	−0.377**
		(0.167)	(0.201)	(0.167)	(0.158)	(0.183)
BS * EM1		0.053**				
		(0.023)				
BI	0.035***	0.036***	0.037***	0.036***	0.036***	0.036***
	(0.010)	(0.011)	(0.011)	(0.012)	(0.011)	(0.011)
BI * EM1			0.148**			
			(0.061)			
CEO_dual	−0.039***	−0.040***	−0.039***	−0.039***	−0.038***	−0.040***
	(0.0010)	(0.010)	(0.011)	(0.011)	(0.010)	(0.010)
CEO_dual * EM1				−0.075**		
				(0.037)		
DSO	−0.009***	−0.010***	−0.010***	−0.010***	−0.010***	−0.010***
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)
DSO * EM1					−0.021**	
					(0.010)	
BM	−0.006	−0.007	−0.006	−0.005	−0.006	−0.006
	(0.005)	(0.005)	(0.006)	(0.006)	(0.006)	(0.007)
BM * EM1						−0.003
						(0.009)
Lambda	0.137***	0.156***	0.156***	0.156***	0.164***	0.159***
	(0.044)	(0.048)	(0.048)	(0.048)	(0.048)	(0.048)
Constant	−0.820***	−0.839***	−0.847***	−0.850***	−0.866***	−0.860***
	(0.166)	(0.171)	(0.170)	(0.172)	(0.171)	(0.171)
Control, Industry, year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2840	2840	2840	2840	2840	2840
R-squared	.172	.176	.176	.173	.175	.173

Note: Variables definitions are given in Appendix 1. Robust standard errors in parentheses.
***$p < .01$; **$p < .05$; *$p < .1$.

However, the study findings are related to specifically within a Chinese context and may not reflect the practical decision-making of firm managers due to the noisy construct of earnings management. Thus, our study findings are interpreted cautiously. For addressing this issue, future research may contribute to the literature through practical case studies and managers' insights via interviews by applying qualitative analysis. We also urge future research which may contribute to the literature in a cross-country setting. As well, future research may also extend this literature by including other moderating factors, such as national culture, politics, laws, and market forces, that affect carbon emission disclosures and earnings management in developed and developing countries.

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All the authors have reviewed and approved this manuscript. The authors declare no conflict of interest. Finally, this paper is not under consideration in any other journal.

PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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ENDNOTE

[i] The high-polluting industries includes: "power generation; iron and steel; nonferrous metals; chemical industry; building materials; petroleum processing and coking; paper-making; textile industry; pharmaceuticals; food; electronics; automobiles; and equipment manufacturing" (Dou & Han, 2019).

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APPENDIX 1:
VARIABLE DEFINITIONS

Variable type	Variable name	Definitions
Dependent variable	*Carbon disclosures*	
	Carbon disclosures (CD_{it})	Following Bilal et al. (2022), Carbon disclosures (CD) act as a dependent variable constructed via content analysis of carbon disclosure items reported in stand-alone environmental, social, and governance (ESG) or annual reports
Independent variables	*Corporate Governance (CG_{it})*	
	Board size (BS_{it})	The total number of directors in a firm
	Board Independence (BI_{it})	The total number of independent directors
	CEO duality (CEO_dual_{it})	Measured through the Dummy variable, 1 if CEO is also the chairman of the board and 0 otherwise
	Directors' share ownership (DSO_{it})	Measured through the percentage of shares owned by directors of the firm
	Frequency of board meetings (BM_{it})	Number of board meetings in a financial year
Moderating variable	*Earnings Management (EM)*	
	Discretionary accruals ($EM1_{it}$)	Measured through the absolute value of discretionary accruals calculated from modified Jones models (Dechow et al., 1995)
	Working capital accruals ($EM2_{it}$)	Measured through the absolute value of working capital accruals calculated from the DD Model (Dechow & Dichev, 2002)
	Real earnings management (REM_{it})	The aggregate of three components: abnormal cash flow of operations, abnormal production costs, and discretionary expenses (Roychowdhury, 2006)
Control variables	State ownership (SOE_{it})	It is measured via a dummy; state-owned enterprises are scored 1, and a 0 value is assigned to privately owned enterprises
	Profitability (ROA_{it})	Measured through return on assets ratio
	Cashflow volatility (CF_vol_{it})	The standard deviation of cash flows scaled by total assets over the prior 5 years window
	Sales growth volatility (REV_vol_{it})	It is the sales to total assets ratio's standard deviation in the last 5 years window
	Firm size ($SIZE_{it}$)	The natural logarithm of the value of total assets of the firm
	Leverage (LEV_{it})	Leverage is the debt-to-assets ratio of the firm
	CSR assurance (CSR_ass_{it})	It is a dummy which taken 1 in case of assurance of CSR report and 0 otherwise
	CSR_score (CSR_score_{it})	CSR ratings collected from HEXUN site