Carbon Emission Disclosures and Financial Reporting Quality: Does Ownership Structure and Economic Development Matter?

Abstract

Carbon emission disclosures have lately gained considerable attention from investors, public companies, and regulators due to their adverse impact on global warming. Our study examines the implication of the extent of carbon emission disclosures on financial reporting quality. Using a sample of the Chinese high polluting companies from 2012 to 2018, we found a negative relationship between carbon emission disclosures and discretionary accruals, indicating that companies with more carbon disclosures have better financial reporting quality. In addition, we find that state-owned Chinese companies with more carbon disclosures experienced better financial reporting quality. Furthermore, we find that companies from more developed regions that engage in carbon emission disclosure are also associated with higher financial reporting quality than companies from less developed regions. Our findings are robust using alternative methodologies. Our study has implications for companies' managers since it helps them legitimize their actions to stakeholders by providing carbon emission disclosures and higher financial reporting quality. It will assist the Chinese regulators and policymakers encourage high-polluting companies to disclose more carbon-related matters for different stakeholders voluntarily.

Keywords: Carbon emission disclosures; financial reporting quality; state-owned enterprises; high polluting industries; Climate change.

1. Introduction

One of the dominant issues in the past decade is how to reduce the adverse impact of carbon emissions to save our climate (Clarkson et al., 2010, Cadez et al., 2019, Halkos and Skouloudis, 2016, He et al., 2021, Herman and Shenk, 2021), and this has led to the unanimous decision from all nations to ratify the Paris agreement of 2015. China is keen to play a significant role in this ecological civilization, especially after the United States exited in 2017, and has made unprecedented efforts towards introducing comprehensive measures and specific emission targets, thereby ensuring the improvement of environmental conditions (Wang et al., 2019). Before the Paris agreement, the Chinese government established the National Development and Reform Commission (NDRC) to achieve its climate change objectives through incremental exertion of institutional pressure on firms and various regions. The ongoing academic debate and increased institutional pressure have resulted in multiple firms-initiated carbon reduction schemes intended to signal transparency and responsiveness in greenhouse gas emissions (GHG) reduction (Luo and Wu, 2019b, He et al., 2021).

Although studies recognized the benefits of voluntary disclosure of carbon-related information (Luo and Tang, 2014, Jaggi et al., 2017, Qian and Schaltegger, 2017), firms' motives for disclosing such information is still debated (Jaggi et al., 2017). Previous studies suggested various reasons why firms disclose GHG emission information. These include regulatory compliance (Freedman et al., 2011), firms' effort to protect their reputation, their relationship with stakeholders (Scholtens and Kleinsmann, 2011), and their desire to avoid any form of blame (Galbreath, 2011). This study examines the impact of ownership type and the institutional environment on the carbon emission disclosure and its implication of financial reporting quality (FRQ).

We are motivated to explore this relationship for the following reasons: First, previous studies suggest that firms may commit to reducing GHG emissions due to political pressure (Baboukardos, 2017, Wang et al., 2019, Herold and Lee, 2019). However, the impact of such Chinese government's pressure on individual firms' carbon reduction efforts is yet to be established due to the observed variation of carbon reduction practices among firms in various regions. While some studies report a positive relationship between institutional pressure and carbon emission reduction (Herold and Lee, 2019, Arellano and Bond, 1991), others show significant heterogeneity in firms' response to such pressure (Colwell and Joshi, 2013). Secondly, despite huge body of literature on how ownership structure influence disclosure practice (Makhija and Patton, 2004, Donnelly and Mulcahy, 2008, Md Zaini et al., 2020) there is still a lack of attention on how ownership structure affects firms' carbon disclosure and its implication on FRQ?

In China, a firm's ownership reflects its trait and behaviour (Wang et al., 2019). State-owned enterprises are perceived as an affiliation of the Chinese government are expected to champion the government's initiatives (Rui-qi et al., 2017). However, Chang and Wu (2014) show that non-SOEs are more likely to respond to the government's pressure. Finally, the variation in the level of economic development across different Chinese provinces is likely to impact firms' ability to champion the government's carbon disclosure campaign (Wang et al., 2018a, Kusnadi et al., 2015, Lin et al., 2017, Yamineva and Liu, 2019). However, prior studies have paid less attention to how firms in the different Chinese provinces respond to carbon emission guidelines from the central government and the implication on their FRQ (Tan et al., 2020, Yamineva and Liu, 2019).

Furthermore, in line with disclosure literature, ethical and opportunistic perspectives offer competing evidence on firms' rationale for disclosing non-financial information. The ethical

perspective suggests that the firm's disclosure is motivated by its moral obligation to benefit society, implying that carbon disclosure reflects managers' commitment to save our ecology (Luo and Wu, 2019b). In line with this view, we expect a positive association between voluntary disclosures of carbon emission and earnings quality. In contrast, some studies see carbon disclosure as a deliberate outward-facing behaviour and a type of 'greenwashing' designed to boost the firm's overall image and show compliance with institutional pressure (Bowen and Aragon-Correa, 2014, O'donovan, 2002). This view of disclosure is in line with the opportunistic perspective, which argues that firms disclose information to fulfil their interests at the expense of shareholders. Following this view, managers' cosmetic disclosure of carbon emission will negatively impact carbon emission disclosures and FRQ (Luo and Tang, 2014, Luo and Wu, 2019b, Lemma et al., 2020a, Velte, 2021).

Prior carbon accounting studies found that carbon-related information reduces information asymmetry and improves transparency (Lemma et al., 2020a). The signaling theory suggests that carbon-related disclosure signals a firms' transparency. This theory suggests that unethical practices such as earnings manipulation may result from information asymmetry (Salem et al., 2020, Salem et al., 2021). Therefore, disclosing quality information enhances the FRQ.

Using a sample of the Chinese high polluting companies from 2012 to 2018, we, therefore, examine the relationship between GHG emission disclosure and discretionary accrual. Our findings show that Chinese high polluting companies which disclose carbon emission information provide high-quality financial reporting. We also found that SOEs, central SOEs, and companies located in better developed regions boost their FRQ by disclosing carbon emission information. We found that results are only significant for companies with higher carbon emission disclosures and a higher CSR rating in an additional analysis. In the sensitivity tests, we find substantial effects

for only three dimensions of climate change: greenhouse gas (GHG) emission disclosures, GHG cost and reduction disclosures, and the accountability of carbon emission disclosures. Finally, our results are robust with alternative methodologies and measure of FRQ. Since tackling climate change is increasingly recognized as one of the most important global corporate agenda, our result is likely to encourage higher carbon emission disclosures thereby helping in tackling global warming. Gupta et al. (2019) argues that reducing carbon emission ensures sustainable development. Our results will, therefore, contribute to global efforts towards emission reduction to save our planet.

This study makes significant contributions to FRQ and carbon emission disclosure literature in many ways. First, several studies have examined the impact of carbon disclosures on earnings management (Bui et al., 2021, Lemma et al., 2020b, Luo and Tang, 2014, Luo and Wu, 2019a). Our study contributes to this growing body of research by providing new evidence on the impact of carbon emission disclosures and financial reporting in Chinese high polluting companies. Second, we contribute to previous studies on corporate voluntary disclosure and earnings quality (Rezaee and Tuo, 2019, Ji et al., 2017, Blanco et al., 2014), by reporting that the level of economic development influences firms financial reporting quality. We find that companies from more developed regions that engage in carbon emission disclosure are also associated with higher financial reporting quality than companies from less developed regions. Third, previous studies have ignored the impact of ownership structure on carbon emission disclosure. We contribute to the broader environmental management literature by showing that SOEs and central SOEs disclose more carbon emission information.

The rest of the papers as follows: section 2 provides the review of literature; section 3 contains the research methodology; section 4 presents the results and discussion; and section 5 concludes the study.

2. Review of Literature

2.1 Carbon emission disclosure and financial reporting quality:

Prior studies have examined companies' motives for carbon emission disclosures (Freedman et al., 2011; Qian & Schaltegger, 2017; Lemma et al., 2020). The long-term perspective of signaling theory suggests that companies may mitigate asymmetric information gaps and enhance their financial reporting quality (FRQ) by signaling more transparent and carbon-related information (Lemma et al. (2020a). In this context, signaling theory also assumes that unethical practices such as earnings management have a positive association with information asymmetry and, therefore, disclosing credible and high-quality information reduce asymmetric information and mitigate the earnings management behaviour (Gerged et al., 2020). This, in turn, increases the quality of the financial reports (Salem et al., 2020). In this regard, managers may reveal carbon-related information to convey a signal about the strength of their financial performance. For instance, Gray and Skogsvik (2004) indicated that directors of financially stable and high performing companies are more likely to differentiate themselves from their competitors and those of poorly performing companies by revealing (signaling) more carbon-related information to successfully communicate with stakeholders.

On the other side, managers may disclose carbon emission information as a cover-up for their opportunistic behaviour. Hence, the carbon emission disclosure can be used as a tool to divert shareholders' attention so they cannot detect any manipulation of earnings. Previous studies

suggested that companies can use carbon-related information disclosure as a strategy to deal with political pressure and build a positive image among their stakeholders (Prior et al., 2008, Sun et al., 2010, Scholtens and Kang, 2013, Cahan et al., 1997). Studies found that voluntary disclosure of carbon information is positively associated with FRQ (Lemma et al., 2020a). Similarly, we expect that carbon emission disclosures improve the quality of financial reporting among Chinese listed firms and propose the following hypothesis:

H1: Carbon emission disclosures are positively associated with financial reporting quality.

2.2 Carbon emission disclosure and ownership structure

China's economy is one of the world's largest and fastest-growing; the country's success is due to its transition from a command-and-control to a market-based economy. According to Ding et al. (2007), two key occurrences throughout the Chinese economy's transition were a growth in non-SOEs and a decrease in the number of state-owned enterprises (SOEs). Companies' ownership structures have an impact on their governance changes and are likely to have an effect on their financial reporting quality (Wang and Yung, 2011, Rahman et al., 2019, Tam and Thanh, 2019, Dong et al., 2020, Ramalingegowda et al., 2020). Based on the standpoint of ownership structure, the state-owned enterprises (SOEs) frequently have insufficient monitoring systems and severe agency difficulties as a result of government meddling (Wang et al., 2019). This will very certainly have an influence on managers' capacity to involve in unethical practices such as earnings manipulations (Dong et al., 2020). Privately held firms (non-SOEs), on the other hand, have superior governance and less political impact, limiting managers' ability to manipulate earnings (Huang et al., 2011).

Furthermore, prior research suggest that in China, the frequency of political interference may have an impact on the efficacy of corporate transparency and management engagement in earnings management. Additionally, SOEs frequently have insufficient monitoring procedures and significant agency issues, which may increase managers motivation to engage in unethical practice (Huang et al., 2011, Fan and Wang, 2019). In contrast, Chen et al. (2011) and Gompers et al. (2003) found that managers of SOEs are more unlikely to manipulate earnings than those of non-SOEs. This might be due to the fact that the CEO remuneration contracts in SOEs are mainly unrelated to the businesses' financial performance, lowering the possibility of opportunistic conduct among SOE executives. Unlike, non-SOEs, Estrin et al. (2009) and Gaio and Pinto (2018) suggested that they are more transparent and have robust governance procedures compared to SOEs.

Inferring from the above literature, we might expect that the SOEs' disclosure of carbon emission information is unlikely to be 'greenwashing' (Bowen and Aragon-Correa, 2014, Tan et al., 2020). Similarly, prior research found that non-SOEs respond positively to institutional pressure regarding emission reduction compared to SOEs (Herold and Lee, 2019, Wang et al., 2019). Due to pronounced regulatory discrimination against Non-SOEs (Yen and Abosag, 2016), they are likely to be unwilling to disclose carbon emission information, which may harm their FRQ. Liu and Sun (2010) found that disclosure quality is better among SOEs compared to non-SOEs. Likewise, Tan et al. (2020) claimed that Chinese SOEs exhibit higher quality carbon emission disclosures.

These SOEs are classified into the central and local SOEs. Both the central and local governments are highly committed to effectively implementing the carbon emission reduction policies and require their firms to disclose more transparent carbon emission disclosures to the stakeholders (Wang et al., 2019). However, the quality of carbon emission disclosures is more

robust in central SOEs than in local SOEs (Tan et al., 2020). Therefore, it is inferred from the prior literature that SOEs provide transparent carbon emission disclosures, which, in line with signaling disclosing transparent carbon emission disclosures, may lead to reducing the gap of asymmetric information as well as mitigating the manager's opportunistic behaviour, which in turn, increases the quality of the financial reports. Thus, we hypothesize that disclosing carbon emission disclosure is positively associated with FRQ. Hence, we propose the following hypothesis:

H2: The association between carbon emission disclosures and the financial reporting quality is significantly different in Chinese SOEs and Non-SOEs.

2.3 Carbon emission disclosure and regional differences in economic development

Previous studies have documented evidence of widening regional inequalities in China (Huang et al., 2003, Mi et al., 2020). The uneven development across various provinces has led China to consider the provincial level of development in its action to protect the environment (Mi et al., 2020). For instance, the wealthier eastern provinces (Tianjin, Beijin and Shanghai) have energy intensity target of 17% while lower developed provinces in the west are only required to reduce their energy intensity by 10%.

China's business and economic environment are not evenly developed across the country's regions (Lin et al., 2017, Zhou et al., 2014). Fan et al. (2011) constructed National Economic Research Institute (NERI) indices based on the marketization process of Chinese provinces. Their study found a large discrepancy in economic development across various regions. Prior literature pointed out that the crime rate is high, and social trust is lower in economically less developed regions (Li and Ma, 2015, Wu et al., 2014, Yamineva and Liu, 2019). Companies operating in less developed regions are likely to accept unethical behaviour. Furthermore, the

government have fewer incentives to monitor their corporate reporting; such companies are dependent on social and political networks, and the economic and social costs of not obeying the laws are low (Shafer et al., 2007, Marquis and Qian, 2014, Hung et al., 2015). It is expected that the FRQ of companies operating in economically developed regions is better compared to those in less developed environment (Chen et al., 2018, Wang et al., 2019). Hence, no study to date has examined whether carbon emission disclosure is linked with the level of economic development across difference region. Therefore, we proposed the following hypothesis:

H3: The association between carbon emission disclosures and the financial reporting quality is significantly different for Chinese companies located in a more developed and less developed region.

3. Research Methodology

Our study sample consists of Chinese carbon-intensive companies from 2012 to 2018. The data for financial reporting quality (FRQ), ownership structure, and control variables are taken from the China Stock Market and Accounting Research (CSMAR) database. The carbon emission disclosures data are manually collected from the annual reports stand-alone Environmental Social and Governance (ESG) or Corporate Social Responsibility (CSR) reports. Data for institutional environment is taken from the NERI Index of Marketization of China's Provinces contains a score for each province and major municipality. Our study's final sample is 3,073 firm-year observations after merging all variables. Table 1 shows the sample classification based on industries and the accounting year.

[Insert Table 1 here]

$$DA_{it} = \beta_{0i} + \beta_1 FRQ_{it-1} + \beta_2 CDI_{it} + \beta_3 SOE_{it} + \beta_4 ED_{it} + \beta_5 CSR\_ass_{it} + \beta_6 ROA_{it} + \beta_7 CF\_vol_{it} + \beta_8 Rev\_vol_{it} + \beta_9 SIZE_{it} + \beta_{10} LEV_{it} + \beta_{11} BS_{it} + \beta_{12} CEO\_dual_{it} + \beta_{13} BI_{it} + \beta_{14} TMT\_fe_{it} + \beta_{15} AQ_{it} + \beta_{16s} AF_{it} + u_{it} \quad (1)$$

Equation 1 reports the GMM estimates, and we have employed this methodology following the prior literature (Eugster, 2019, Rezaee and Tuo, 2019, Ezeani et al., 2021, Ezeani et al., 2022), which claimed that dynamic panel system GMM uses instruments to address endogeneity arising from unobserved heterogeneity and simultaneity directly. We employed the partial adjustment model in estimating the performance-adjusted earnings management model of Kothari et al. (2005), which is explained below in equation 3. Following Öztekin (2015), we addressed the unobserved heterogeneity problem by using a lag of the independent variables as instruments.

Equation 2 presents the fixed-effects model as an alternative methodology for robust findings.

$$DA_{it} = \beta_{0i} + \beta_1 CDI_{it} + \beta_2 SOE_{it} + \beta_3 ED_{it} + \beta_4 CSR\_ass_{it} + \beta_5 ROA_{it} + \beta_6 CF\_vol_{it} + \beta_7 Rev\_vol_{it} + \beta_8 SIZE_{it} + \beta_9 LEV_{it} + \beta_{10} BS_{it} + \beta_{11} CEO\_dual_{it} + \beta_{12} BI_{it} + \beta_{13} TMT\_fe_{it} + \beta_{14} AQ_{it} + \beta_{15} AF_{it} + + u_{it} \quad (2)$$

The dependent variable, discretional accruals (DA), is measured through the standard deviation of the residuals (discretionary accruals) of the performance-adjusted model during the five years before the year *t* following Kothari et al. (2005), which is an inverse measure of FRQ, and calculated as presented in Equation 6. This proxy of FRQ is a common measure that several prior studies have implied (Rezaee and Tuo, 2019, Lemma et al., 2020a).

$$\frac{TA_{it}}{A_{it-1}} = \alpha_1 \frac{1}{A_{it-1}} + \alpha_2 \frac{(\Delta REV_{it} - \Delta REC_{it})}{A_{it-1}} + \alpha_3 \frac{PPE_{it}}{A_{it-1}} + \alpha_3 \frac{ROA_{it}}{A_{it-1}} + \varepsilon_{it} \quad (3)$$

where:

TA_{it} = total accruals in year t divided by total assets in year $t-1$,
ΔREV_{it} = the change in revenues of a company i between years t and $t-1$,
ΔREC_{it} = the change in revenues of the company i between years t and $t-1$,
PPE_{it} = gross value of property plant and equipment in year t,
ROA_{it} = return on assets of the company i in year t.
A_{it-1} = total assets in year $t-1$,
ε_{it} = discretionally accruals/ residuals in year t.

The independent variable, carbon disclosures index (CDI), is measured through content analysis of 18 carbon emission disclosure items. Carbon disclosures are manually extracted from annual reports or stand-alone ESG or CSR reports of carbon-intensive companies following prior studies (Choi et al., 2013b, Tan et al., 2020). The 18 carbon disclosures are classified into five sub-themes of climate-change issues such as 1) climate-change risks and opportunities disclosures; 2) disclosures about GHG emissions; 3) energy consumption disclosures; 4) disclosures of GHG cost and reduction; and 5) disclosures about the accountability of carbon emission. We measured the ownership structure through a dummy variable taken as 1 for state-owned companies and 0 for privately-owned companies. The developmental score is taken from the NERI Index of Marketization of China's Provinces. The index is constructed by Fan et al. (2011) on a scale of 0 to 10 to explore the province's level of development and helps to compare areas. The index consists of five dimensions, namely the sum of total market intermediaries and degrees of professionalism (e.g., the number and percentage of lawyers and certified public accountants) in a province; (2) the economic development level and government's involvement and monitoring in business; (3) the maturity of the debt and commodity markets; (4) the efficiency and effectiveness of legal enforcement; and (5) the adequacy of intellectual property and consumer rights protection. This is

a highly cited and reliable index used in a Chinese setting (Lin et al., 2017, Hu et al., 2017, Jiang and Hong, 2020). Following Lin et al. (2017), we measure the economic development by taking an average of scores of five dimensions for each province and rank provinces based on high/low median scores as more or less developed region. A dummy variable permits us to explore whether the relationship between the variables of interest varies for firms headquartered in regions with high versus low level of development.

The control variables, including CSR assurance, audit quality, analyst following, firm characteristics such as profitability, cash flow volatility, sales growth volatility, firm size, and leverage, as well as governance indicators such as board size, board independence, CEO duality, and percentage of females in the top management team, were included for the robust analysis based on prior literature (Rezaee and Tuo, 2019, Wang et al., 2018b, Tan et al., 2020, Lemma et al., 2020a, Choi et al., 2013b, Komal et al., 2021, Gerged et al., 2021).

In the additional analysis, we have split the sample into high and low carbon emission disclosures based on median values. Likewise, we run further examination based on the high and low corporate social responsibility scores of companies, based on the median values of their CSR ranking. In addition, we have also run the sensitivity results with five sub-themes of climate-change issues. Finally, we have re-estimated Equation 1 with an alternative proxy of FRQ, such as real earnings management, which is measured as the sum of the abnormal levels of cash flow from operations, abnormal discretionary expenses and production costs (Roychowdhury, 2006). For the robust analysis, we have used the two-stage least square (2SLS) in which industry average of CDI is used as an instrument by following the prior literature (Shahab et al., 2020, Zalata et al., 2019). We have also used the lagged model for robust analysis.

4. Results and discussion

Table 2 provides the summary statistics of the study. There are, in total, 3073 firm-year observations. The average value of the financial reporting quality (DA) is 0.290, which is in line with prior work in a Chinese setting and indicates that, on average, Chinese companies do not engage in earnings management (Rezaee et al., 2019). The average value of carbon disclosures is 0.14, indicating that the carbon emission disclosures is around 14% out of 100% (18) maximum points, which is higher than 11% found in a recent study on Chinese data (Tan et al., 2020). The independent variable, i.e., ownership structure, has an average value of 0.46, indicating that there are around 46% state-owned companies in the study period. The economic development variable has an average value of 0.52, representing around 52% of companies from highly developed region. Table 2 also provides a univariate analysis of ownership structure (SOEs vs. Non-SOEs) and level of development using t-tests. We found a significant difference among SOEs and Non-SOEs, SOEs report slightly more carbon emission disclosures compared to private (Non-SOEs) companies. Finally, we also found a significant difference among companies located in different regions. The companies from highly developed regions report more carbon disclosures than companies operating in less developed region.

[Insert Table 2 here]

Table 3 reports Pearson correlation matrix for the independent and control variables. The correlation outcomes, as expected, suggest that the correlation between independent and control variables does not exceed the cut point of 0.70, indicating no chances of multicollinearity in the regression models.

[Insert Table 3 here]

Table 4 provides evidence concerning our main hypotheses, which are to investigate the relationship between the extent of carbon emission disclosure and financial reporting quality (FRQ) by employing both dynamic panel system GMM estimator (panel A) and fixed effect (FE) regression (panel B). Based on the full sample, our findings show that both regression models, GMM and FE, confirm the negative and significant association between carbon emission disclosures and the earnings management (discretionary accruals) as an inverse measure of FRQ (Coefficient = -0.887, P-value <0.05; Coefficient = -0.698, P-value <0.001) respectively. Our finding implies that companies tend to be more conservative in accounting decisions by providing more transparent and accurate financial information, along with better reported environmental information, to be perceived as ethically responsible as a method to legitimize their activities and decrease the possibility of any formal or informal actions that could be imposed upon their companies. This finding statistically supports hypothesis $\mathbf{H_1}$ and is in line with those previous studies which suggested that firms with a high level of carbon disclosure are more likely to mitigate earnings manipulation and, in return, reduce any asymmetric information gap among stakeholders (Salem et al., 2020, Lemma et al., 2020a, Muttakin et al., 2015).

With regards to state-owned enterprises (SOEs), Table 4 illustrates that carbon emission disclosure has a negative and significant relationship with earnings management in both regression models (Coefficient = -0.803, P-value <0.001; Coefficient = -0.602, P-value <0.05), suggesting that SOEs are unlikely to involve themselves in activities such as earnings management. This is because they are extensively supported by the government and have no incentives to mislead information (Wang and Yung (2011). This outcome could be justified, as engaging in any unethical practice may lead to being penalized by the Chinese government. Therefore, managers in SOEs are highly likely to provide more carbon emission information to be recognized as ethically

accountable and avoid any potential fines (Salem et al., 2020, Tan et al., 2020). Furthermore, this result is in line with the signaling theory perspective, suggesting that companies' carbon emission disclosures lessen the gap of asymmetric information through signaling more carbon information to their stakeholders. Thus, the current study accepts **H_2** and concludes that carbon emission disclosure is positively associated with the FRQ of Chinese SOEs. In addition to this, only central SOEs have a significant positive relationship with FRQ among the SOEs.

In contrast, Table 4 shows that both regression models confirm the insignificant association between carbon emission disclosures and earnings management in non-SOEs (Coefficient = -0.162, P-value <0.201; Coefficient = -0.353, P-value <0.258), suggesting that carbon emission disclosure has no impact on enhancing the FRQ. This could be attributed to the low level of government engagement and control over non-SOEs. This result is similar to the findings of Huafang and Jianguo (2007), who indicated that information disclosed voluntarily has an insignificant influence on the structure of ownership of Chinese firms.

Furthermore, Table 4 presents the results of examining the association between carbon emissions disclosure and FRQ in companies operating in both highly developed and less developed regions. Based on both regression models, we found evidence indicating that carbon emission disclosure plays a major role in reducing earnings management (high FRQ) in companies operating in a regions with higher development (Coefficient = -0.993, P-value <0.001; Coefficient = -0.696, P-value <0.001), whereas, there is no significant impact of carbon emission disclosure on earnings management in companies operating in less developed regions (Coefficient = -0.513, P-value <0.233; Coefficient = -0.287, P-value <0.168). This implies that companies operating in a less economically developed provinces with no government monitoring mechanisms are very likely to be involved in unethical practices such as earnings management. These outcomes are in line with

prior studies that found that companies operating in a weaker institutional environment are likely to engage in earnings manipulation, reflecting negatively on the quality of their financial reporting (Li and Ma, 2015, Wu et al., 2014). Therefore, these results indicate a positive relationship between the extent of carbon disclosures and FRQ in companies located in a more developed regions as compared to less developed regions, which supports **H**$_3$.

[Insert Table 4 here]

Going a step further, we divided the dataset into High-CDI and Low-CDI and repeated the same regression models to verify the reliability of the primary findings. Table 5 Panels A and B report the outcomes of high and low CDI, respectively. The empirical results presented in Table 4 Panel A indicate that there is a negative and significant association between carbon emissions disclosure and earnings management as a proxy for FRQ. At the same time, Panel B shows an insignificant relationship between carbon emissions disclosure and earnings management. These findings suggest that Chinese companies with high-CDI are less likely to be involved in an ethical practice compared with low-CDI companies, which in turn enhance their FRQ. This could be attributed to the fact that high-CDI companies are mostly SOEs and face stronger monitoring mechanisms employed by the Chinese government to prevent their engagement in any potential unethical practice. This outcome is in line with the main findings presented in Table 4.

In addition to the above analysis, we also divided the sample based on High CSR and Low CSR ranking companies and re-ran the models to achieve the confidence of our analysis, and the findings do signify the impact of carbon emissions disclosure on FRQ. Therefore, we investigated whether the effect of carbon emissions disclosure will remain the same in the High CSR and Low CSR companies. Table 6, Panels A and B present the outcomes of High CSR and Low CSR, respectively. Although the findings remain consistent with the primary outcomes reported in Table

4 in most of the regression models, the SOE models (see Table 6, Panel A) show an insignificant association between carbon emissions disclosure and earnings manipulation. These findings support the stakeholder value maximization view and are in line with the prior studies in the sustainability disclosures and earnings management literature (Rezaee and Tuo, 2019, Scholtens and Kang, 2013, Deng et al., 2013, Choi et al., 2013a). The findings suggest that financial managers of Chinese carbon-intensive companies act socially responsible by providing more reliable and transparent carbon disclosure to the stakeholders, resulting in a higher FRQ.

[Insert Table 5 and 6 here]

To check the robustness of our findings, we also examined the influence of each of the CDI dimensions on FRQ. Table 7 Panels A, B, C, D, and E reveal that the three dimensions of "climate-change risks, Greenhouse gas, Energy consumption and GHG cost" have a negative and significant association with earnings management using GMM regression. On the other hand, the dimension of accountability of carbon emissions disclosure has a negative and significant relationship with earnings management throughout most models. This outcome could be attributed to the fact that accountability of carbon emissions disclosure is directly linked with the quality of reported information (Tan et al., 2020, Luo and Wu, 2019b, Choi et al., 2013b)

[Insert Table 7 here]

Drawing on prior research (Lemma et al., 2020a)**,** we check the robustness of the main outcomes by adopting Real Earnings Management (REM) as an alternative proxy for FRQ to examine whether carbon emissions disclosure has the same impact in reducing unethical practice using the new proxy. The findings of the robustness analysis are reported in Table 8. We found that the carbon emissions disclosure has a negative and significant influence on the alternative

proxy used, signifying that carbon emissions disclosure plays an important role in enhancing the quality of disclosed information by the Chinese firms and is in line with the main findings reported in Table 4. Table 9 panel A shows the results of the 2SLS with industry proportion of carbon emission disclosure as an external instrument by following prior literature (Zalata et al., 2019, Shahab et al., 2020). We have found similar results as reported in Table 4, however main coefficients have higher values as compared to main results. Likewise, Table 9 panel B also reports the consistent results with lagged independent variables.

[Insert Table 8 and 9 here]

5. Conclusions

The current study investigates the relationship between the extent of carbon disclosures and FRQ in the context of Chinese carbon-intensive companies from 2012-2018. Using dynamic panel (System GMM) estimator, we find that the extent of carbon disclosures is negatively associated with absolute values of discretionary accrual (earnings management), indicating that companies that disclose more carbon disclosures have better FRQ. In addition, we find those state-owned Chinese companies that disclose more carbon disclosures experienced better FRQ. Furthermore, we find that companies from highly developed regions that disclose more carbon disclosures have higher FRQ than companies from less developed. Results are robust with an alternative measure of FRQ. Our findings provide implications for the standard setters and other stakeholders in terms of improving the carbon disclosures of companies. The mandatory carbon disclosures required by Chinese regulators seem to be associated with better FRQ. Stakeholders could employ carbon disclosures to infer the prospects of carbon-intensive companies and investigate their voluntary FRQ with more supportive information. Although our study has important findings, it is subject to the inherent limitation of noisy financial reporting measures that

may or may not reflect the managers' opportunistic behaviour. Therefore, future studies may conduct in-depth interviews with directors, auditors, academics, executives (e.g., CEOs or CFOs) and regulators to discuss such issues.

References

ARELLANO, M. & BOND, S. 1991. Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *The review of economic studies,* 58**,** 277-297.

BABOUKARDOS, D. 2017. Market valuation of greenhouse gas emissions under a mandatory reporting regime: Evidence from the UK. *Accounting Forum,* 41**,** 221 - 233.

BLANCO, B., LARA, J. M. G. & TRIBÓ, J. 2014. The relation between segment disclosure and earnings quality. *Journal of Accounting and Public Policy,* 33**,** 449-469.

BOWEN, F. & ARAGON-CORREA, J. A. 2014. Greenwashing in corporate environmentalism research and practice: The importance of what we say and do. Sage Publications Sage CA: Los Angeles, CA.

BUI, B., HOUQE, M. N. & ZAMAN, M. 2021. Climate change mitigation: Carbon assurance and reporting integrity. *Business Strategy and the Environment,* 30**,** 3839-3853.

CADEZ, S., CZERNY, A. & LETMATHE, P. 2019. Stakeholder pressures and corporate climate change mitigation strategies. *Business Strategy and the Environment,* 28**,** 1-14.

CAHAN, S. F., CHAVIS, B. M. & ELMENDORF, R. G. 1997. Earnings management of chemical firms in response to political costs from environmental legislation. *Journal of Accounting, Auditing & Finance,* 12**,** 37-65.

CHANG, S. J. & WU, B. 2014. Institutional Barriers and Industry Dynamics. *Southern Medical Journal,* 35**,** 1103-1123.

CHEN, H., CHEN, J. Z., LOBO, G. J. & WANG, Y. 2011. Effects of audit quality on earnings management and cost of equity capital: Evidence from China. *Contemporary Accounting Research,* 28**,** 892-925.

CHEN, J., KE, B., WU, D. & YANG, Z. 2018. The consequences of shifting the IPO offer pricing power from securities regulators to market participants in weak institutional environments: Evidence from China. *Journal of Corporate Finance,* 50**,** 349-370.

CHOI, B. B., LEE, D. & PARK, Y. 2013a. Corporate social responsibility, corporate governance and earnings quality: Evidence from Korea. *Corporate Governance: An International Review,* 21**,** 447-467.

CHOI, B. B., LEE, D. & PSAROS, J. 2013b. An analysis of Australian company carbon emission disclosures. *Pacific Accounting Review,* 25**,** 58-79.

CLARKSON, P., LI, Y., RICHARDSON, G. & VASVARI, F. 2010. Does it Really Pay to be Green? Determinants and Consequences of Proactive Environmental Strategies. *Environmental Economics eJournal*.

COLWELL, S. R. & JOSHI, A. 2013. Corporate Ecological Responsiveness: Antecedent Effects of Institutional Pressure and Top Management Commitment and Their Impact on Organizational Performance. *Business Strategy and The Environment,* 22**,** 73-91.

DENG, X., KANG, J.-K. & LOW, B. S. 2013. Corporate social responsibility and stakeholder value maximization: Evidence from mergers. *Journal of Financial Economics,* 110**,** 87-109.

DING, Y., ZHANG, H. & ZHANG, J. 2007. Private vs state ownership and earnings management: evidence from Chinese listed companies. *Corporate Governance: An International Review,* 15**,** 223-238.

DONG, N., WANG, F., ZHANG, J. & ZHOU, J. 2020. Ownership structure and real earnings management: Evidence from China. *Journal of Accounting and Public Policy,* 39**,** 106733.

DONNELLY, R. & MULCAHY, M. 2008. Board structure, ownership, and voluntary disclosure in Ireland. *Corporate Governance: An International Review,* 16**,** 416-429.

ESTRIN, S., HANOUSEK, J., KOCENDA, E. & SVEJNAR, J. 2009. The effects of privatization and ownership in transition economies. *Journal of Economic Literature,* 47**,** 699-728.

EUGSTER, F. 2019. Endogeneity and the dynamics of voluntary disclosure quality: Is there really an effect on the cost of equity capital? *Contemporary Accounting Research***,** In press.

EZEANI, E., KWABI, F., SALEM, R., USMAN, M., ALQATAMIN, R. & KOSTOV, P. 2022. Corporate board and dynamics of capital structure: Evidence from UK, France and Germany. *International Journal of Finance & Economics*.

EZEANI, E., SALEM, R., KWABI, F., BOUTAINE, K. & KOMAL, B. 2021. Board monitoring and capital structure dynamics: evidence from bank-based economies. *Review of Quantitative Finance and Accounting***,** 1-26.

FAN, G., WANG, X. & ZHU, H. 2011. NERI index of marketization of China's provinces: 2009 report. Beijing: Economic Science Press (in Chinese).

FAN, S. & WANG, C. 2019. Firm age, ultimate ownership, and R&D investments. *International Review of Economics & Finance*.

FREEDMAN, M., JAGGI, B. J. J. O. I. F. M. & ACCOUNTING 2011. Global warming disclosures: impact of Kyoto protocol across countries. 22**,** 46-90.

GAIO, C. & PINTO, I. 2018. The role of state ownership on earnings quality: evidence across public and private European firms. *Journal of Applied Accounting Research*.

GALBREATH, J. 2011. To what extent is business responding to climate change? Evidence from a global wine producer. *Journal of Business Ethics,* 104**,** 421-432.

GERGED, A. M., ALBITAR, K. & AL-HADDAD, L. 2021. Corporate environmental disclosure and earnings management—The moderating role of corporate governance structures. *International Journal of Finance & Economics,* n/a.

GERGED, A. M., BEDDEWELA, E. & COWTON, C. J. 2020. Is corporate environmental disclosure associated with firm value? A multicountry study of Gulf Cooperation Council firms. *Business Strategy and the Environment*.

GOMPERS, P., ISHII, J. & METRICK, A. 2003. Corporate governance and equity prices. *The quarterly journal of economics,* 118**,** 107-156.

GRAY, S. J. & SKOGSVIK, K. 2004. Voluntary disclosures of quoted pharmaceutical companies in Sweden and the UK: The development over the period 1984–98. *European Accounting Review,* 13**,** 787-805.

GUPTA, D., GHERSI, F., VISHWANATHAN, S. S. & GARG, A. 2019. Achieving sustainable development in India along low carbon pathways: Macroeconomic assessment. *World Development,* 123**,** 104623.

HALKOS, G. & SKOULOUDIS, A. 2016. Exploring the current status and key determinants of corporate disclosure on climate change: Evidence from the Greek business sector. *Environmental Science & Policy,* 56**,** 22-31.

HE, R., LUO, L., SHAMSUDDIN, A. & TANG, Q. 2021. Corporate carbon accounting: a literature review of carbon accounting research from the Kyoto Protocol to the Paris Agreement. *Accounting & Finance,* n/a.

HERMAN, K. S. & SHENK, J. 2021. Pattern Discovery for climate and environmental policy indicators. *Environmental Science & Policy,* 120**,** 89-98.

HEROLD, D. & LEE, K.-H. 2019. The influence of internal and external pressures on carbon management practices and disclosure strategies. *Australasian Journal of Environmental Management,* 26**,** 63 - 81.

HU, F., STEWART, J. & TAN, W. 2017. CEO's political connections, institutions and audit opinions. *Pacific Accounting Review*.

HUAFANG, X. & JIANGUO, Y. 2007. Ownership structure, board composition and corporate voluntary disclosure. *Managerial Auditing Journal*.

HUANG, J.-T., KUO, C.-C. & KAO, A.-P. 2003. The inequality of regional economic development in China between 1991 and 2001. *Journal of Chinese Economic and Business Studies,* 1**,** 273-285.

HUANG, W., JIANG, F., LIU, Z. & ZHANG, M. 2011. Agency cost, top executives' overconfidence, and investment-cash flow sensitivity—Evidence from listed companies in China. *Pacific-Basin Finance Journal,* 19**,** 261-277.

HUNG, M., WONG, T. & ZHANG, F. 2015. The value of political ties versus market credibility: Evidence from corporate scandals in China. *Contemporary Accounting Research,* 32**,** 1641-1675.

JAGGI, B., ALLINI, A., MACCHIONI, R. & ZAGARIA, C. 2017. The Factors Motivating Voluntary Disclosure of Carbon Information: Evidence Based on Italian Listed Companies. *Organization & Environment,* 31**,** 178-202.

JI, X.-D., LU, W. & QU, W. 2017. Voluntary disclosure of internal control weakness and earnings quality: Evidence from China. *The International Journal of Accounting,* 52**,** 27-44.

JIANG, Y. & HONG, Y. 2020. State Media, Institutional Environment, and Analyst Forecast Quality: Evidence from China. *Emerging Markets Finance and Trade*, 1-15.

KOMAL, B., BILAL, EZEANI, E., SHAHZAD, A., USMAN, M. & SUN, J. 2021. Age diversity of audit committee financial experts, ownership structure and earnings management: Evidence from China. *International Journal of Finance & Economics*.

KOTHARI, S. P., LEONE, A. J. & WASLEY, C. 2005. Performance matched discretionary accrual measures. *Journal of Accounting and Economics,* 39**,** 163-197.

KUSNADI, Y., YANG, Z. & ZHOU, Y. 2015. Institutional development, state ownership, and corporate cash holdings: Evidence from ChinaF *Journal of Business Research,* 68**,** 351-359.

LEE, K.-H. 2017. Does Size Matter? Evaluating Corporate Environmental Disclosure in the Australian Mining and Metal Industry: A Combined Approach of Quantity and Quality Measurement. *Business Strategy and the Environment,* 26**,** 209-223.

LEMMA, T. T., SHABESTARI, M. A., FREEDMAN, M. & MLILO, M. 2020a. Corporate carbon risk exposure, voluntary disclosure, and financial reporting quality. *Business Strategy and the Environment*.

LEMMA, T. T., SHABESTARI, M. A., FREEDMAN, M. & MLILO, M. 2020b. Corporate carbon risk exposure, voluntary disclosure, and financial reporting quality. *Business Strategy and the Environment,* 29**,** 2130-2143.

LI, L. & MA, G. 2015. Government Size and Tax Evasion: Evidence from C hina. *Pacific Economic Review,* 20**,** 346-364.

LIN, K. Z., CHENG, S. & ZHANG, F. 2017. Corporate social responsibility, institutional environments, and tax avoidance: evidence from a subnational comparison in China. *The International Journal of Accounting,* 52**,** 303-318.

LIU, G. & SUN, J. 2010. Ultimate ownership structure and corporate disclosure quality: evidence from China. *Managerial Finance*.

LUO, L. & TANG, Q. 2014. Does voluntary carbon disclosure reflect underlying carbon performance? *Journal of Contemporary Accounting & Economics,* 10**,** 191-205.

LUO, L. & WU, H. 2019a. Voluntary carbon transparency: A substitute for or complement to financial transparency? *Journal of International Accounting Research,* 18**,** 65-88.

LUO, L. & WU, H. 2019b. Voluntary Carbon Transparency: A Substitute for or Complement to Financial Transparency? *Journal of International Accounting Research,* 18**,** 65-88.

MAKHIJA, A. K. & PATTON, J. M. 2004. The impact of firm ownership structure on voluntary disclosure: Empirical evidence from Czech annual reports. *The Journal of Business,* 77**,** 457-491.

MARQUIS, C. & QIAN, C. 2014. Corporate social responsibility reporting in China: Symbol or substance? *Organization science,* 25**,** 127-148.

MD ZAINI, S., SHARMA, U., SAMKIN, G. & DAVEY, H. Impact of ownership structure on the level of voluntary disclosure: A study of listed family-controlled companies in Malaysia. Accounting Forum, 2020. Taylor & Francis, 1-34.

MI, Z., ZHENG, J., MENG, J., OU, J., HUBACEK, K., LIU, Z., COFFMAN, D. M., STERN, N., LIANG, S. & WEI, Y.-M. 2020. Economic development and converging household carbon footprints in China. *Nature Sustainability,* 3**,** 529-537.

MUTTAKIN, M. B., KHAN, A. & AZIM, M. I. 2015. Corporate social responsibility disclosures and earnings quality. *Managerial Auditing Journal*.

O'DONOVAN, G. 2002. Environmental disclosures in the annual report. *Accounting, Auditing & Accountability Journal*.

ÖZTEKIN, Ö. 2015. Capital structure decisions around the world: which factors are reliably important? *Journal of Financial and Quantitative Analysis,* 50**,** 301-323.

PRIOR, D., SURROCA, J. & TRIBÓ, J. A. 2008. Are socially responsible managers really ethical? Exploring the relationship between earnings management and corporate social responsibility. *corporate governance: An international review,* 16**,** 160-177.

QIAN, W. & SCHALTEGGER, S. 2017. Revisiting carbon disclosure and performance: Legitimacy and management views. *The British Accounting Review,* 49**,** 365-379.

RAHMAN, R. A., RAHMAN, A., GHANI, E. K. & OMAR, N. H. 2019. Government-Linked Investment Companies and Real Earnings Management: Malaysian Evidence. *International Journal of Financial Research,* 10.

RAMALINGEGOWDA, S., UTKE, S. & YU, Y. 2020. Common Institutional Ownership and Earnings Management. *Contemporary Accounting Research,* n/a.

REZAEE, Z., DOU, H. & ZHANG, H. 2019. Corporate social responsibility and earnings quality: Evidence from China. *Global Finance Journal***,** 100473.

REZAEE, Z. & TUO, L. 2019. Are the quantity and quality of sustainability disclosures associated with the innate and discretionary earnings quality? *Journal of Business Ethics,* 155**,** 763-786.

ROYCHOWDHURY, S. 2006. Earnings management through real activities manipulation$. *Journal of Accounting and Economics,* 42**,** 335-370.

RUI-QI, W., WANG, F., XU, L.-Y. & YUAN, C. 2017. R&D expenditures, ultimate ownership and future performance: Evidence from China. *Journal of Business Research,* 71**,** 47-54.

SALEM, R., USMAN, M. & EZEANI, E. 2021. Loan loss provisions and audit quality: Evidence from MENA Islamic and conventional banks. *The Quarterly Review of Economics and Finance,* 79**,** 345-359.

SALEM, R. I. A., EZEANI, E., GERGED, A. M., USMAN, M. & ALQATAMIN, R. M. 2020. Does the quality of voluntary disclosure constrain earnings management in emerging economies? Evidence from Middle Eastern and North African banks. *International Journal of Accounting & Information Management*.

SCHOLTENS, B. & KANG, F. C. 2013. Corporate social responsibility and earnings management: Evidence from Asian economies. *Corporate Social Responsibility and Environmental Management,* 20**,** 95-112.

SCHOLTENS, B. & KLEINSMANN, R. J. E. P. 2011. Incentives for subcontractors to adopt CO2 emission reporting and reduction techniques. 39**,** 1877-1883.

SHAFER, W. E., FUKUKAWA, K. & LEE, G. M. 2007. Values and the Perceived Importance of Ethics and Social Responsibility: The U.S. versus China. *Journal of Business Ethics,* 70**,** 265-284.

SHAHAB, Y., NTIM, C. G., CHEN, Y., ULLAH, F., LI, H. X. & YE, Z. 2020. Chief executive officer attributes, sustainable performance, environmental performance, and environmental reporting: New insights from upper echelons perspective. *Business Strategy and the Environment,* 29**,** 1-16.

SUN, N., SALAMA, A., HUSSAINEY, K. & HABBASH, M. 2010. Corporate environmental disclosure, corporate governance and earnings management. *Managerial Auditing Journal*.

TAM, T. M. & THANH, N. P. Earnings Quality: Does State Ownership Matter? Evidence from Vietnam. International Econometric Conference of Vietnam, 2019. Springer, 477-496.

TAN, D., BILAL, GAO, S. & KOMAL, B. 2020. Impact of Carbon Emission Trading System Participation and Level of Internal Control on Quality of Carbon Emission Disclosures: Insights from Chinese State-Owned Electricity Companies. *Sustainability,* 12**,** 1788.

VELTE, P. 2021. Environmental performance, carbon performance and earnings management: Empirical evidence for the European capital market. *Corporate Social Responsibility and Environmental Management,* 28**,** 42-53.

WANG, F., SUN, J. & LIU, Y. 2019. Institutional pressure, ultimate ownership, and corporate carbon reduction engagement: Evidence from China. *Journal of Business Research,* 104**,** 14-26.

WANG, L. & YUNG, K. 2011. Do state enterprises manage earnings more than privately owned firms? The case of China. *Journal of Business Finance & Accounting,* 38**,** 794-812.

WANG, R., WIJEN, F. & HEUGENS, P. 2018a. Government's green grip: Multifaceted state influence on corporate environmental actions in China. *Southern Medical Journal,* 39**,** 403-428.

WANG, X., CAO, F. & YE, K. 2018b. Mandatory corporate social responsibility (CSR) reporting and financial reporting quality: Evidence from a quasi-natural experiment. *Journal of Business Ethics,* 152**,** 253-274.

WU, W., FIRTH, M. & RUI, O. M. 2014. Trust and the provision of trade credit. *Journal of Banking & Finance,* 39**,** 146-159.

YAMINEVA, Y. & LIU, Z. 2019. Cleaning the air, protecting the climate: Policy, legal and institutional nexus to reduce black carbon emissions in China. *Environmental Science & Policy,* 95**,** 1-10.

YEN, D. A.-W. & ABOSAG, I. 2016. Localization in China: How guanxi moderates Sino–US business relationships. *Journal of Business Research,* 69**,** 5724-5734.

ZALATA, A. M., NTIM, C. G., CHOUDHRY, T., HASSANEIN, A. & ELZAHAR, H. 2019. Female directors and managerial opportunism: Monitoring versus advisory female directors. *The Leadership Quarterly,* 30**,** 101309.

ZHOU, K. Z., LI, J. J., SHENG, S. & SHAO, A. T. 2014. The evolving role of managerial ties and firm capabilities in an emerging economy: evidence from China. *Journal of the Academy of Marketing Science,* 42**,** 581-595.

Table 1: Sample classification

Year	Industry					
	Electricity	**Chemical**	**Non-ferrous**	**Steel and Iron**	**Metal**	**Total**
2012	69	158	65	42	50	384
2013	72	162	74	41	54	403
2014	71	169	78	32	55	405
2015	73	181	78	44	55	431
2016	74	216	79	43	56	468
2017	70	203	85	43	59	460
2018	75	259	85	43	60	522
Total	**504**	**1348**	**544**	**288**	**389**	**3073**

Table 2: Descriptive statistics (n = 3073).

Variable	Overall sample				Mean of Ownership structure			Mean of Economic Development		
	Mean	Std. Dev.	Min	Max	SOEs (n = 1397)	Non-SOEs (n = 1640)	p_value	High (n = 1598)	Low (n = 1475)	p_value
DA	0.290	0.900	0.014	0.430	0.252	0.2640	0.002	0.265	0.291	0.042
REM	0.083	0.135	0.017	0.121	0.069	0.076	0.000	0.072	0.084	0.003
CDI	0.140	0.150	0.000	0.670	0.166	0.115	0.000	0.130	0.127	0.644
CCI	0.285	0.359	0.000	1.000	0.309	0.260	0.000	0.301	0.255	0.025
GHGI	0.058	0.157	0.000	0.857	0.066	0.052	0.020	0.051	0.044	0.000
ECI	0.169	0.314	0.000	1.000	0.209	0.136	0.000	0.196	0.170	0.000
RCI	0.162	0.192	0.000	1.000	0.205	0.128	0.000	0.183	0.168	0.000
ACCI	0.176	0.28	0.000	1.000	0.233	0.131	0.000	0.178	0.169	0.001
SOE	0.460	0.500	0.000	1.000				0.647	0.343	0.000
ED	0.520	0.500	0.000	1.000	0.368	0.672	0.000			
CDI_rank	0.530	0.500	0.000	1.000	0.469	0.601	0.000	0.518	0.488	0.183
CSR_rank	0.600	0.490	0.000	1.000	0.600	0.580	0.267	0.479	0.553	0.001
CSR_ass	0.130	0.420	0.000	1.000	0.120	0.367	0.000	0.342	0.298	0.039
ROA	0.040	0.050	-0.150	0.200	0.047	0.022	0.000	0.022	0.038	0.000
CF_vol	0.080	0.070	0.010	0.390	0.079	0.072	0.018	0.079	0.078	0.886
REV_vol	0.150	0.140	0.010	0.820	0.143	0.147	0.429	0.144	0.155	0.103
Size	22.40	1.380	20.05	26.23	21.82	23.03	0.000	22.503	22.203	0.000
LEV	0.450	0.220	0.050	0.910	0.372	0.537	0.000	0.511	0.419	0.000
BS	8.900	1.810	5.000	15.000	8.415	9.444	0.000	9.178	8.817	0.000
CEO_dual	0.200	0.400	0.000	1.000	0.298	0.089	0.000	0.145	0.251	0.000
BI	3.260	0.640	2.000	6.000	3.081	3.454	0.000	3.342	3.239	0.001
TMT_fe	0.180	0.100	0.040	0.710	0.198	0.149	0.000	0.158	0.188	0.000
AQ	13.80	0.750	12.210	19.400	13.563	14.067	0.000	13.768	13.736	0.348
AF	1.400	1.110	0.000	4.170	1.394	1.417	0.566	1.543	1.398	0.002

Note: Variables definition is given in Appendix 1.

Table 3: Correlation analysis

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	(14)	(15)
(1) CDI	1.000														
(2) SOE	0.174*	1.000													
(3) ED	0.010	0.304*	1.000												
(4) CSR_ass	0.187*	0.291*	0.046	1.000											
(5) ROA	-0.009	-0.236*	-0.162*	-0.092*	1.000										
(6) CF_vol	-0.097*	-0.045	0.003	-0.082*	-0.101*	1.000									
(7) REV_vol	-0.067*	0.015	-0.037	0.030	0.007	0.338*	1.000								
(8) Size	0.306*	0.440*	0.110*	0.323*	-0.136*	-0.194*	0.002	1.000							
(9) LEV	0.140*	0.382*	0.205*	0.176*	-0.449*	-0.025	0.024	0.556*	1.000						
(10) BS	0.110*	0.284*	0.099*	0.188*	-0.060*	-0.116*	-0.042	0.371*	0.268*	1.000					
(11)CEO-dual	-0.111*	-0.260*	-0.133*	-0.119*	0.080*	0.009	-0.019	-0.197*	-0.113*	-0.129*	1.000				
(12) BI	0.108*	0.292*	0.079*	0.197*	-0.074*	-0.117*	-0.043	0.397*	0.273*	0.407*	-0.114*	1.000			
(13) TMT_fe	-0.093*	-0.250*	-0.158*	-0.112*	0.101*	-0.019	-0.031	-0.224*	-0.163*	-0.273*	0.043	-0.234*	1.000		
(14) AQ	0.253*	0.334*	-0.021	0.269*	-0.094*	-0.112*	0.068*	0.394*	0.366*	0.263*	-0.141*	0.285*	-0.198*	1.000	
(15) AF	0.087*	0.010	-0.069*	0.155*	0.298*	-0.171*	-0.010	0.370*	-0.014	0.123*	0.018	0.138*	0.007	0.273*	1.000

Note: Variables definition is given in Appendix 1. * shows significance at the .01 level.

Table 4: Main results

Panel A: System GMM

Variables	(1) Baseline	(2) SOEs	(3) CSOEs	(4) LSOEs	(5) Non-SOEs	(6) More develop	(7) Less develop
CDI	-0.887**	-0.803***	-0.547***	-0.213	0.162	-0.993***	0.513
	(0.361)	(0.302)	(0.198)	(0.192)	(0.456)	(0.272)	(0.444)
SOE	-0.946***					-0.117	-0.108
	(0.268)					(0.274)	(0.387)
ED	-0.348***	-0.393***	-0.169***	-0.062	-0.214		
	(0.042)	(0.053)	(0.047)	(0.057)	(0.265)		
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,754	1,078	356	722	1,321	1,279	1,156
Sargan	0.269	0.298	0.209	0.447	0.354	0.154	0.110
AR1	0.139	0.128	0.156	0.133	0.137	0.191	0.092
AR2	0.281	0.217	0.312	0.263	0.286	0.538	0.224
Panel B: Fixed Effects Regression							
CDI	-0.698***	-0.602**	-0.450**	-0.172	-0.353	-0.696***	-0.287
	(0.213)	(0.297)	(0.189)	(0.213)	(0.315)	(0.234)	(0.193)
SOE	-0.808***					-0.297	-0.825***
	(0.150)					(0.193)	(0.254)
ED	-0.342***	-0.216***	-0.465**	-0.433*	-0.182		
	(0.041)	(0.069)	(0.206)	(0.238)	(0.254)		
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	3,073	1,397	461	936	1,640	1,598	1,475
R-squared	0.207	0.230	0.247	0.194	0.162	0.247	0.214

Note: Variables definition is given in Appendix 1. CSOEs and LSOEs represent the central and local state-owned companies sub-sample. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 5: Higher and lower carbon emission disclosures

Variables	(1) Baseline (GMM)	(2) Baseline (FE)	(3) SOEs (GMM)	(4) SOEs (FE)	(5) Non-SOEs (GMM)	(6) Non-SOEs (FE)	(7) More develop (GMM)	(8) More develop (FE)	(9) Less develop (GMM)	(10) Less develop (FE)
Panel A: High carbon emission disclosures										
CDI	-0.987***	-0.837***	-0.925**	-0.836***	-0.232	-0.262	-0.746**	-0.867***	0.770	-0.782
	(0.317)	(0.237)	(0.361)	(0.242)	(0.632)	(0.334)	(0.307)	(0.273)	(0.539)	(0.534)
SOE	0.188	0.004					-0.291	0.174	0.329	
	(0.359)	(0.272)					(0.229)	(0.218)	(0.584)	
ED	-0.458***	-0.404***	-0.145***	-0.129***	-0.026	-0.030				
	(0.048)	(0.056)	(0.042)	(0.038)	(0.020)	(0.027)				
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,301	1,620	741	851	659	769	687	842	623	778
R-squared		0.229		0.280		0.384		0.318		0.223
Sargan	0.710		0.269		0.408		0.584		0.447	
AR1	0.171		0.135		0.182		0.091		0.204	
AR2	0.334		0.380		0.336		0.265		0.505	
Panel B: Low carbon emission disclosures										
CDI	0.827	0.110	-2.015	-1.042	1.032	-0.027	-1.084	0.359	1.063	0.095
	(2.717)	(2.054)	(2.710)	(1.765)	(3.711)	(3.011)	(1.487)	(2.210)	(5.012)	(3.583)
SOE	-1.323***	-1.318***					-2.005***	-0.971**	-0.553	-1.175***
	(0.334)	(0.232)					(0.481)	(0.384)	(0.571)	(0.364)
ED	-0.301***	-0.203***	-0.342***	-0.261***	-0.140	-0.082				
	(0.073)	(0.045)	(0.070)	(0.041)	(0.109)	(0.078)				
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,134	1,453	761	871	472	582	601	756	542	697
R-squared		0.245		0.376		0.131		0.292		0.236
Sargan	0.811		0.563		0.606		0.590		0.304	
AR1	0.213		0.208		0.211		0.143		0.148	
AR2	0.381		0.425		0.360		0.257		0.335	

Note: Variables definition is given in Appendix 1. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 6: High and low CSR ranking

Variables	(1) Baseline (GMM)	(2) Baseline (FE)	(3) SOEs (GMM)	(4) SOEs (FE)	(5) Non-SOEs (GMM)	(6) Non-SOEs (FE)	(7) More develop (GMM)	(8) More develop (FE)	(9) Less develop (GMM)	(10) Less develop (FE)
Panel A: High CSR ranking companies										
CDI	-1.346***	-1.118***	-1.330***	-1.207***	-0.427	-0.775*	-0.348	-0.259	-0.345	-0.508*
	(0.407)	(0.302)	(0.424)	(0.374)	(0.400)	(0.456)	(0.413)	(0.519)	(0.406)	(0.276)
SOE	0.001	0.064					0.379	-0.021	0.022	-0.165
	(0.349)	(0.291)					(0.359)	(0.533)	(0.172)	(0.264)
ED	-0.291***	-0.214***	-0.361***	-0.262***	-0.114	-0.103				
	(0.073)	(0.045)	(0.070)	(0.041)	(0.110)	(0.078)				
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,534	1,829	844	983	707	846	635	951	562	878
R-squared		0.167		0.359		0.181		0.156		0.347
Sargan	0.246		0.256		0.309		0.265		0.453	
AR1	0.128		0.127		0.095		0.197		0.165	
AR2	0.302		0.307		0.248		0.309		0.345	
Panel B: Low CSR ranking companies										
CDI	-0.152	-0.151	-0.380	-0.172	-0.054	-0.944	-0.718	-0.887	-0.305	-0.410
	(0.697)	(0.370)	(0.404)	(0.242)	(1.166)	(0.685)	(0.519)	(0.514)	(1.185)	(0.619)
SOE	-0.718	-0.339					-0.673***	-0.348**	0.435	-0.323
	(0.714)	(0.217)					(0.211)	(0.167)	(1.267)	(0.427)
ED	-0.015	-0.029	-0.015	-0.049	-0.050	-0.034				
	(0.077)	(0.049)	(0.067)	(0.039)	(0.137)	(0.097)				
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	928	1,244	421	587	491	657	537	647	487	597
R-squared		0.185		0.161		0.198		0.505		0.211
Sargan	0.319		0.646		0.212		0.249		0.413	
AR1	0.128		0.160		0.096		0.090		0.124	
AR2	0.243		0.416		0.273		0.172		0.313	

Note: Variables definition is given in Appendix 1. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Sensitivity tests

Variables	(1) Baseline (GMM)	(2) Baseline (FE)	(3) SOEs (GMM)	(4) SOEs (FE)	(5) Non-SOEs (GMM)	(6) Non-SOEs (FE)	(7) More develop (GMM)	(8) More develop (FE)	(9) Less develop (GMM)	(10) Less develop (FE)
Panel A: Climate-change risks and opportunities disclosures										
CCI	-0.827	-0.110	-2.015	-1.042	-1.032	-0.027	-1.084	-0.359	-1.063	-0.095
	(2.717)	(2.054)	(2.710)	(1.765)	(3.711)	(3.011)	(1.487)	(2.210)	(5.012)	(3.583)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,754	3,073	1,078	1,397	1,321	1,640	1,279	1,598	1,156	1,475
R-squared		0.202		0.228		0.155		0.240		0.211
Sargan	0.426		0.540		0.327		0.211		0.357	
AR1	0.064		0.136		0.074		0.119		0.134	
AR2	0.133		0.276		0.184		0.241		0.231	
Panel B: Greenhouse gas (GHG) emissions disclosures										
GHGI	-0.585***	-0.521***	-0.391**	-0.359***	-0.107	-0.101	-0.589***	-0.697***	-0.361	-0.279
	(0.224)	(0.138)	(0.192)	(0.131)	(0.272)	(0.190)	(0.169)	(0.172)	(0.259)	(0.195)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,754	3,073	1,078	1,397	1,321	1,640	1,279	1,598	1,156	1,475
R-squared		0.209		0.236		0.163		0.256		0.212
Sargan	0.447		0.613		0.439		0.494		0.325	
AR1	0.182		0.126		0.138		0.182		0.130	
AR2	0.355		0.231		0.268		0.297		0.218	
Panel C: Energy consumption disclosures										
ECI	-0.268	-0.016	-0.442**	-0.029	-0.064	-0.001	-0.314*	-0.128	-0.061	-0.027
	(0.218)	(0.129)	(0.187)	(0.111)	(0.336)	(0.232)	(0.165)	(0.137)	(0.351)	(0.214)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,754	3,073	1,078	1,397	1,321	1,640	1,279	1,598	1,156	1,475

R-squared		0.200		0.227		0.153		0.237		0.209
Sargan	0.474		0.662		0.478		0.462		0.315	
AR1	0.147		0.250		0.136		0.111		0.130	
AR2	0.273		0.496		0.272		0.254		0.224	
Panel D: GHG cost and reduction disclosures										
RCI	-0.761***	-0.701***	-0.609**	-0.313**	-0.363	-0.216	--0.603***	-0.547***	-0.401	-0.068
	(0.252)	(0.171)	(0.273)	(0.153)	(0.366)	(0.290)	(0.204)	(0.178)	(0.339)	(0.270)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,754	3,073	1,078	1,397	1,321	1,640	1,279	1,598	1,156	1,475
R-squared		0.201		0.232		0.154		0.237		0.209
Sargan	0.463		0.662		0.495		0.492		0.308	
AR1	0.172		0.266		0.142		0.146		0.128	
AR2	0.280		0.462		0.291		0.277		0.230	
Panel E: Accountability of carbon emission disclosures										
ACCI	-0.556***	-0.510***	-0.407***	-0.391***	-0.237	-0.198	-0.297**	-0.288**	-0.352	-0.310
	(0.169)	(0.167)	(0.138)	(0.094)	(0.158)	(0.213)	(0.137)	(0.124)	(0.227)	(0.167)
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,754	3,073	1,078	1,397	1,321	1,640	1,279	1,598	1,156	1,475
R-squared		0.206		0.227		0.168		0.237		0.222
Sargan	0.493		0.634		0.489		0.484		0.284	
AR1	0.139		0.232		0.136		0.134		0.127	
AR2	0.247		0.451		0.281		0.285		0.224	

Note: Variables definition is given in Appendix 1. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 8: REM model

Variables	(1) Baseline (GMM)	(2) Baseline (FE)	(3) SOEs (GMM)	(4) SOEs (FE)	(5) Non-SOEs (GMM)	(6) Non-SOEs (FE)	(7) More develop (GMM)	(8) More develop (FE)	(9) Less develop (GMM)	(10) Less develop (FE)
CDI	-0.158**	-0.100**	-0.215**	-0.127*	-0.102	-0.060	-0.317***	-0.143**	-0.065	-0.058
	(0.068)	(0.047)	(0.097)	(0.070)	(0.091)	(0.063)	(0.115)	(0.066)	(0.088)	(0.066)
SOE	0.008	-0.029					0.213**	-0.009	0.035	-0.026
	(0.051)	(0.033)					(0.105)	(0.055)	(0.087)	(0.051)
ED	-0.271***	-0.210***	-0.322***	-0.258***	-0.103	-0.110				
	(0.073)	(0.045)	(0.070)	(0.041)	(0.110)	(0.077)				
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2,754	3,073	1,078	1,397	1,321	1,640	1,279	1,598	1,156	1,475
R-squared		0.207		0.230		0.162		0.247		0.214
Sargan	0.609		0.642		0.583		0.624		0.595	
AR1	0.138		0.076		0.169		0.123		0.165	
AR2	0.255		0.272		0.323		0.238		0.454	

Note: Variables definition is given in Appendix 1. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 9: Robust analysis

Panel A: 2SLS regression

Variables	(1) Baseline	(2) SOEs	(3) CSOEs	(4) LSOEs	(5) Non-SOEs	(6) More develop	(7) Less develop
CDI	-1.020***	-1.069***	-0.648***	-0.470	0.390	-1.071**	0.698
	(0.352)	(0.331)	(0.210)	(0.785)	(0.289)	(0.480)	(0.434)
SOE	-1.048***					-0.167	-0.135
	(0.361)					(0.288)	(0.111)
ED	-0.517***	-0.681**	-0.234**	-0.108	-0.363		
	(0.156)	(0.321)	(0.107)	(0.089)	(0.839)		
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,313	673	259	413	640	638	675
R-squared	0.260	0.162	0.453	0.063	0.405	0.306	0.291
Sargan score	2.94	3.10	2.83	2.91	3.02	1.75	1.88
Sargan score [χ2(1) P-value]	0.57	0.54	0.64	0.59	0.55	0.78	0.76
Panel B: Fixed Effects Regression (Lagged model)							
CDI_{t-1}	-0.345**	-0.601***	-0.735***	-0.535**	-0.105	-0.528***	-0.048
	(0.167)	(0.175)	(0.212)	(0.244)	(0.198)	(0.154)	(0.043)
SOE_{t-1}	-0.137***					-0.134***	-0.117***
	(0.050)					(0.049)	(0.045)
ED_{t-1}	-0.365***	-0.027**	-0.031***	-0.028**	-0.029**		
	(0.121)	(0.012)	(0.011)	(0.012)	(0.014)		
Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,325	791	306	483	854	1,147	1,121
R-squared	0.181	0.227	0.423	0.145	0.244	0.296	0.260

Note: Variables definition is given in Appendix 1. CSOEs and LSOEs represent the central and local state-owned companies sub-sample. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix 1: Variable Definitions.

Variable type	Variable name	Definition
Dependent variable	Discretionary accruals (DA_{it})	The standard deviation of the residuals (discretionary accruals) of the performance-adjusted model during the five-year window before the year t. It is as an inverse measure of financial reporting quality.
	Real earnings management (REM_{it})	The sum of the abnormal levels of cash flow from operations, abnormal discretionary expenses and production costs (Roychowdhury, 2006).
Main variables	Carbon emission disclosure index (CDI_{it})	Carbon emission disclosure index is calculated via content analysis of 18 carbon emission disclosures items following (Lee, 2017, Choi et al., 2013b). Specifically, it is the ratio of actual carbon emission disclosures of a company

	divided by the total number (18) of carbon emission disclosures.
Climate change risks and opportunities disclosure index (CCI_{it})	Climate change-related disclosure index is calculated as the ratio of actual climate change-related disclosures of a company divided by the total number (2) of climate change-related disclosures.
Greenhouse gas (GHG) emission disclosure index ($GHGI_{it}$)	Greenhouse gas emission disclosure index is calculated as the ratio of actual greenhouse gas emission disclosures of a company divided by the total number (7) of greenhouse gas emission disclosures.
Energy consumption disclosure index ($GHGI_{it}$)	Energy consumption disclosure index is calculated as the ratio of actual energy consumption disclosures of a company divided by the total number (3) of energy consumption disclosures.
GHG cost and reduction disclosure index ($GHGI_{it}$)	GHG cost and reduction disclosure index is calculated as the ratio of actual GHG cost and reduction disclosures of a company divided by the

		total number (4) of GHG cost and reduction disclosures.
Control variables	Accountability of carbon emission disclosure index ($GHGI_{it}$)	Accountability of carbon emission disclosure index is calculated as the ratio of actual accountability of carbon emission disclosures of a company divided by the total number (2) of accountability of carbon disclosures.
	Ownership structure (SOEs)	A dummy variable, taken as 1 for state-owned enterprises, 0 for privately-owned enterprises.
	Economic Development (ED_{it}s	A dummy variable, taken as 1 for the companies located in a more developed economic region, and 0 for the companies located in a less developed economic region.
	CSR assurance (CSR_ass)	Dummy variable, taken as 1 if a third party has inspected the CSR report of the company and 0 otherwise.
	Profitability (ROA_{it})	Return on total assets calculated as net income divided by total assets.

Cash flow volatility (CF_vol_{it})	The standard deviation of cash flows scaled by total assets over the prior five years window.
Sales growth volatility (REV_vol_{it})	The standard deviation of sales scaled by total assets over the prior five years window.
Firm size ($SIZE_{it}$)	Natural log of the total assets.
Leverage (LEV_{it})	Leverage, measured by the ratio of debt to total assets.
Board size (BS_{it})	Total number of directors in a company
CEO duality (CEO_dual_{it})	Dummy variable, taken as 1 if the CEO of a company is also chairman of the board and 0 otherwise.
Board independence (BI_{it})	Total number of independent directors
Gender diversity (TMT_fe_{it})	Gender diversity is measured as a percentage of females in the top management team of the company.

Audit quality (AQ_{it})	Audit quality is measured through audit efforts, which is the natural log of total audit fees.
Analyst forecast (AF_{it})	Analyst forecast is measured through the natural logarithm of the number of analysts following the company plus 1 at the beginning of the year.