

Article

Does the CEO–Chairperson Dialect Connection Affect Corporate Carbon Emissions?

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Abstract

This paper examines the influence of the CEO–chairperson dialect connection on corporate carbon emissions. The results suggest that such a connection significantly increases corporate carbon emissions, and this effect is more pronounced among firms operating in highly competitive industries, non-state-owned enterprises and firms in non-heavily polluting industries. Further results show that this effect is stronger for firms with lower media coverage and for dialects that are more difficult for outsiders to understand. These findings indicate that the dialect connection increases corporate carbon emissions by weakening the monitoring effectiveness of chairpersons and by reinforcing cognitive preferences between CEOs and chairpersons. This study contributes to understanding how cultural factors shape corporate carbon emissions and suggests that informal linguistic ties can undermine corporate environmental accountability, revealing the dark side of informal connections among corporate leaders in capital markets.

Keywords: carbon emissions; dialect connection; informal institutions

1. Introduction

Global climate change has become one of the urgent challenges in the contemporary era, with corporate carbon emissions constituting a major source of greenhouse gas concentrations. Against this background, investors have increasingly intensified pressure on firms to strengthen carbon emissions management and reduce carbon footprints, driving them to adopt more sustainable business practices [1]. This trend has stimulated a growing body of empirical research examining the determinants of corporate carbon emission performance. However, the existing studies primarily emphasize the role of formal institutions, such as corporate governance [2], government inspection [3], and environmental regulation [4]. Although recent research has begun to consider the role of informal institutions, it mainly focuses on corporate external informal institutions that arise from outside the firm and exert pressure through the social environment, such as religion [5], public environmental preferences [6], and market freedom [7]. The role of corporate internal informal institutions in shaping corporate carbon emissions remains largely under-explored. Rather than exerting pressure from outside the firm, internal informal institutions arise from informal interpersonal relationships, shared identities, and cultural ties within organizations [8]. Building on this perspective, the CEO–chairperson dialect connection constitutes an internal informal institution, and this study addresses an important research gap in the literature



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by investigating whether this overlooked internal informal institution influences corporate carbon emissions.

Upper echelons theory posits that corporate leaders' behavior and cognitive preferences shape firm strategies and outcomes [9]. Because culture affects individuals' behavior and cognition, the cultural proximity between CEOs and chairpersons (the leaders of management and the board of directors) may significantly influence corporate carbon emissions outcomes. As a novel proxy for culture, mother tongue dialects reflect membership in specific social groups and foster a shared ethnic identity [10]. Individuals who speak different dialects often show distinct cultural traits and cognitive patterns, while those who share the same dialect tend to form stronger social cohesion and norms [11]. Thus, dialect is culturally distinctive and helps establish interpersonal informal ties. In this study, we use the CEO–chairperson dialect connection, that is, whether they share the same mother tongue dialect, as a proxy for their cultural proximity and examine its influence on corporate carbon emissions.

CEOs' decisions about corporate carbon emission intensity depend on the level of oversight exercised by chairpersons, who lead the board of directors and have the power to approve, restrict, or block managerial decisions. Because carbon emission reduction activities entail substantial costs and do not generate immediate economic returns, CEOs may overlook these activities when pursuing short-term economic interests [12]. If CEOs and chairpersons speak different dialects, this cultural heterogeneity may prompt chairpersons to provide diverse thinking and exercise stronger monitoring focused on long-term corporate interests and less on personal emotions [11]. Studies show that this heterogeneity improves corporate environmental performance and may lower corporate carbon emissions [13].

Conversely, when CEOs and chairpersons speak the same dialect, they likely share similar behavioral and cognitive preferences. This increases leadership homogeneity, which may limit corporate leaders' diverse thinking, encourage conformity, and strengthen resistance to external carbon reduction pressures [14]. Studies suggest that a homogeneous board is often linked to poorer corporate social responsibility and increased carbon emissions [15,16]. Chairpersons may also value close ties with CEOs and offer extra support in the workplace, which weakens their ability to monitor CEOs [17]. Without stronger monitoring, CEOs tend to engage in opportunistic managerial behavior that leads to higher carbon emissions rather than undertake long-term initiatives aimed at reducing carbon emissions [18]. Hence, the first task of this study is to investigate whether the CEO–chairperson dialect connection increases corporate carbon emissions.

Moreover, the potential influence of the dialect connection on corporate carbon emissions is shaped by the unique relationships between CEOs and chairpersons, and consequently, the effect of such a connection may vary with industry competition and ownership structure. Firms in highly competitive industries face greater external pressure to focus on short-term profits, potentially deprioritizing corporate long-term carbon reduction efforts [19]. Conversely, firms in less competitive industries face lower external pressure and enjoy greater resource slack, which may facilitate more effective coordination between CEOs and chairpersons, thereby enhancing the firm's long-term development. Hence, we examine whether the CEO–chairperson dialect connection affects corporate carbon emissions differently across industries with varying levels of competition. State-owned enterprises (SOEs) are subject to direct government oversight; their leaders are appointed by party-state authorities and face multifaceted evaluations by central and local governments. Such interventions may weaken the influence of the CEO–chairperson dialect connection. Hence, we also investigate whether the impact of the dialect connection on carbon emissions differs between SOEs and non-SOEs.

The Chinese stock market data offer an ideal setting in which to investigate our research questions. First, the abundant dialects in China eliminate the influence of cross-country differences. According to Ref. [20], there are 17 dialect regions and 98 dialect pieces in China, and some dialect pieces can be further divided into different dialect small pieces. Over the past two thousand years, Chinese dialect regions have evolved to a level where many of them have become mutually unintelligible [10]. Because of this phenomenon, the Chinese government has led a series of movements to promote standard Chinese (called Putonghua in Chinese). However, dialect identity is deeply embedded in Chinese social networks, and Chinese people prefer to speak dialects in private to strengthen their group identification [21]. Second, as the world's largest carbon emitter, China has committed to achieving peak carbon emissions before 2030 and carbon neutrality before 2060. The Chinese government has taken various measures to encourage Chinese firms to take environmental responsibility, prompting many Chinese firms to increase their engagement in carbon emission reduction activities [3]. As a result, we expect the factors influencing carbon emissions to be more obvious in the Chinese stock market than in the more mature stock markets. Based on the above considerations, we employ Chinese stock market data in our study.

The following analyses are conducted to examine our research questions. First, we collect birthplace data for CEOs and chairpersons of listed firms in China from 2010 to 2022. These data are used to determine their dialects and assess the CEO–chairperson dialect connection. We employ two proxies for corporate carbon emissions, and the results consistently indicate that such a dialect connection increases corporate carbon emissions. Furthermore, by accounting for industry-level differences in carbon emission profiles, we show that this association is more pronounced among firms operating in non-heavily polluting industries. Second, we perform sub-sample analyses to test whether industry competition and ownership structure moderate this association. The results show that the increasing effect of the CEO–chairperson dialect connection on carbon emissions remains stronger among firms within highly competitive industries and in non-SOEs, but is statistically weaker among firms within less competitive industries and SOEs.

Third, we use instrumental variables (IV) analysis, a difference-in-differences (DID) approach, propensity score matching (PSM) analysis, and the Heckman selection model to test the robustness of our conclusions. All robustness results support the main findings. Last, additional tests from the perspectives of media coverage, board monitoring intensity, and dialects that are mutually unintelligible are performed to explore the mechanisms behind the increasing effect of the CEO–chairperson dialect connection on corporate carbon emissions. The results reveal that this increasing effect is driven by diminishing chairpersons' vigilance in monitoring and by intensifying cognitive preferences between CEOs and chairpersons.

This study makes three contributions to the literature. First, it enriches the cultural finance literature by examining the impacts of the CEO–chairperson dialect connection on corporate carbon emissions. A few recent papers have investigated how the CEO–chairperson dialect connection affects corporate behavior and performance. Specifically, Ref. [22] finds that the CEO–chairperson dialect connection improves share price informativeness, while Ref. [23] shows that it facilitates optimal corporate cash holdings. Ref. [10] further finds that the CEO–chairperson dialect connection reduces major shareholders' tunneling behavior. These findings suggest that the dialect connection enhances communication efficiency, trust, and coordination between CEOs and chairpersons, and thus positively influences corporate performance. Emerging evidence also points to potential adverse consequences of the dialect connection. For example, Ref. [11] finds that the CEO–chairperson dialect connection constrains corporate innovation activities, and

Ref. [24] shows that CEOs receive higher compensation when they share a common dialect with chairpersons. However, whether the CEO–chairperson dialect connection affects corporate carbon emissions remains unexplored. Corporate carbon emissions differ fundamentally from the outcomes examined in prior studies because they involve long-term environmental responsibility and sustainability considerations that may conflict with firms' short-term economic objectives. As carbon emission reduction activities have become critical issues in both industry and academia over the past few decades, this paper extends the CEO–chairperson dialect connection literature from traditional financial and governance outcomes to environmental outcomes and sheds light on the potential dark side of this internal informal connection within firms with respect to corporate sustainability practices.

Second, this study enriches the literature on the factors that drive corporate carbon emissions. Prior studies suggest that various formal institutions, such as corporate governance [2], government inspection [3], and environmental regulation [4], influence corporate carbon emissions. This study provides empirical evidence that a new informal institution, i.e., the CEO–chairperson dialect connection, also shapes corporate carbon emissions. Filling this research gap is particularly important in emerging economies, where informal institutions frequently substitute for weak formal institutions in corporate governance. Third, this study explores the potential mechanisms, thereby providing a more comprehensive understanding of how the CEO–chairperson dialect connection influences corporate carbon emissions. We find that a decrease in chairpersons' monitoring diligence and similar cognitive preferences between CEOs and chairpersons are potential channels that contribute to the increasing effect of the CEO–chairperson dialect connection on carbon emissions.

The rest of this study is organized as follows. Section 2 reviews the related theory and literature and proposes the hypotheses. Section 3 presents the research methods. Section 4 analyzes and discusses the empirical results. Section 5 conducts robustness checks. Section 6 explores the potential mechanisms. Section 7 concludes this paper with potential implications.

2. Theory, Literature Review, and Hypotheses

2.1. Theory

While no unified theoretical framework fully explains how the CEO–chairperson dialect connection influences corporate carbon emissions activities, the integration of upper echelons theory, social identity theory, and agency theory can provide a useful lens for elucidating this association. Upper echelons theory posits that the behavior and cognitive preferences of corporate top leaders strongly affect business decisions and financial outcomes [9]. Social identity theory suggests that shared group membership fosters trust, lowers the propensity to challenge one another, and leads to greater preferential treatment [25]. Building on these two perspectives, we propose that the CEO–chairperson dialect connection constitutes a deep-level attribute that shapes corporate carbon emission initiatives at the apex of the organization.

In addition, agency theory emphasizes that the board of directors represents shareholders and monitors managerial actions to align these actions with shareholders' interests [26]. As board leaders, chairpersons play an important role in influencing corporate monitoring vigilance. When CEOs and chairpersons share the same dialect, their unique relationship may reduce the chairpersons' oversight. Corporate carbon emission reduction activities are often long-term and costly. Without strong chairpersons' oversight, CEOs may under-invest in these activities to preserve short-term profitability [27]. Additionally, the psychological in-group bias induced by the dialect connection may lead chairpersons to interpret CEOs' actions more favorably and be less likely to question environmentally harmful decisions, which may further increase corporate carbon emissions. Taken together, the

CEO–chairperson dialect connection may strengthen interpersonal ties and in-group bias between CEOs and chairpersons, which can weaken the monitoring role of chairpersons and reinforce the cognitive preferences between them, thereby ultimately leading to higher corporate carbon emissions.

2.2. Literature Review and Hypothesis Development

Despite numerous studies showing that corporate diversity affects corporate social responsibility and ESG performance, research examining how it influences corporate carbon emissions is still emerging [13]. Existing studies mainly focus on the role of board diversity in restraining corporate carbon emissions. For example, Ref. [28] finds that various dimensions of board diversity—including demographic diversity (e.g., gender, tenure, and background), structural diversity (e.g., board compensation, size, meeting frequency, and independence), and capital diversity (e.g., skills and directors' affiliations)—are significantly associated with reduced corporate carbon emissions. However, we find no studies that explore how the cultural diversity between CEOs and chairpersons influences corporate carbon emissions activities. As dialects are significant symbols of regional culture, it is possible that corporate diversity may be diminished if CEOs and chairpersons share a common dialect. This paper uses the CEO–chairperson dialect connection as a proxy for their cultural proximity and seeks to fill this research gap by exploring whether such informal cultural ties help explain why firms with similar characteristics have substantially different carbon emissions.

CEOs tend to prioritize short-term goals over long-term corporate development [29]. Given that carbon emission reduction activities entail high costs and lack immediate economic gains for firms, CEOs often under-emphasize such environmental activities [12]. If CEOs and chairpersons speak different dialects, their cultural heterogeneity can lead to diverse thinking among corporate top leaders. This cultural diversity alleviates homogeneous cognitive preferences and reduces the likelihood of preferential treatment in decision making [11]. As a result, chairpersons are more likely to provide advice from different perspectives on carbon reduction initiatives and exert stronger monitoring vigilance over corporate long-term interests without personal emotions. Prior studies have found that the cultural diversity of board members significantly reduces corporate carbon emissions [30]. In contrast, when CEOs and chairpersons speak the same dialect, they likely share similar cultural backgrounds and cognitive preferences. This situation increases corporate leaders' homogeneity and fosters a close informal bond between them, which often produces a high level of unity to resist outside pressures for carbon emission reduction [14]. Ref. [16] finds that stronger ties between CEOs and board members are associated with higher carbon emissions.

Moreover, agency theory suggests that the roles of CEOs and chairpersons should be separated because chairpersons are expected to monitor managerial opportunism on behalf of shareholders [31]. Effective monitoring relies not only on formal governance structures but also on the independence of interactions between corporate leaders. Various corporate governance research suggests that close interpersonal relationships among top decision makers may compromise such independence. For example, Ref. [32] suggests that although close relationships between CEOs and board members facilitate trust and information sharing, they may simultaneously impair the board's monitoring function. Consistent with this view, Ref. [33] finds that social connections between CEOs and directors significantly reduce the effectiveness of board monitoring. Consequently, given the CEO–chairperson dialect connection, chairpersons are likely to highly value their close ties with CEOs and may therefore reduce their ability to monitor CEOs effectively [17]. Without stronger chairpersons' monitoring power, CEOs tend to engage in opportunistic managerial

behavior that leads to higher carbon emissions rather than to undertaking long-term initiatives aimed at reducing carbon emissions [18]. Furthermore, Ref. [27] finds that CEO duality increases carbon emission intensity, suggesting that close CEO–chairperson relationships may overlook climate risks and lead to higher carbon emissions. Hence, the shared cognitive preferences and the weakened monitoring vigilance of chairpersons arising from the dialect connection may increase corporate carbon emissions.

Some prior studies suggest that the CEO–chairperson dialect connection generates positive organizational consequences [10,22]. Specifically, according to social identity theory and upper echelons theory, a shared dialect background can facilitate communication and promote cooperation between CEOs and chairpersons. Such linguistic and cultural similarity may reduce communication barriers and improve strategic consensus, enabling corporate top leaders to coordinate more efficiently in investment decision making [23]. However, this outcome may not occur in the context of environmental investments because corporate carbon emission reduction activities typically involve substantial costs, uncertain short-term returns, and long investment horizons [12]. While the dialect connection may improve communication efficiency, the resulting social identification and interpersonal closeness are more likely to weaken monitoring independence and increase cognitive alignment between CEOs and chairpersons. From the perspective of agency theory, this unique interpersonal close relationship may reduce the chairperson’s willingness to challenge opportunistic managerial decisions and weaken the effectiveness of internal oversight. As a result, the negative consequences of reduced monitoring independence and excessive managerial alignment may outweigh the communication benefits associated with the CEO–chairperson dialect connection, leading firms to place less emphasis on costly carbon reduction initiatives. Therefore, although the CEO–chairperson dialect connection may facilitate coordination, we expect its adverse consequences to dominate in the context of carbon emission reduction activities and propose the first hypothesis:

Hypothesis 1. *CEO–chairperson dialect connection increases corporate carbon emissions.*

The level of competition within an industry can significantly influence corporate carbon emissions [19]. Intense industry competition increases corporate short-term performance pressure and heightens CEOs’ career concerns [34]. As a result, the CEO–chairperson dialect connection is more likely to function as a tool to facilitate mutual support between the two leaders and make chairpersons more likely to endorse CEOs’ short-term-oriented decisions while potentially deprioritizing corporate long-term carbon emission reduction activities. However, in less competitive industries, the absence of intense external pressure diminishes the CEOs’ career concerns and increases firms’ resource slack. Ref. [35] finds that CEOs are more willing to undertake environmental activities when they have fewer career concerns. As carbon emissions reduction activities can enhance reputation and respond to stakeholder expectations [36], CEOs and chairpersons who share a common dialect are more likely to coordinate closely in reducing carbon emissions and pursue firms’ long-term development when industry competition is less intense. Based on the above analysis, we propose the second hypothesis:

Hypothesis 2. *The increasing effect of the CEO–chairperson dialect connection becomes weaker for firms operating in less competitive industries.*

Ownership structure, particularly the distinction between SOEs and non-SOEs, represents a fundamental institutional feature of China’s corporate landscape. In SOEs, formal governance mechanisms and political control may substitute for informal ties [37]. SOEs face direct government oversight, with leaders of SOEs appointed by the government and

evaluated on multiple dimensions, such as policy compliance, social responsibility, and environmental protection [38]. In other words, SOEs face stronger political monitoring and government supervision, and they are required to support and implement the government's environmental policies. As a result, these environmental policies force CEOs and chairpersons to reduce carbon emissions, potentially weakening the influence of the CEO–chairperson dialect connection. Moreover, SOEs have access to government resources and subsidies for environmental investments, which help alleviate SOEs' financial constraints and enable them to undertake carbon emission reduction initiatives without significant financial concerns [39].

However, in non-SOEs, the CEO–chairperson dialect connection may play a more important role in influencing corporate strategies due to fewer political interventions. Corporate leaders of non-SOEs have greater discretion in strategic decision making, and CEOs in such firms are more likely to pursue short-term profit maximization for their own interests, thereby deprioritizing corporate long-term carbon emission reduction activities [40]. In addition, non-SOEs generally lack financial support from the government and are therefore more likely to be constrained by profitability considerations when making carbon emission reduction decisions. Hence, the increasing effect of the dialect connection on carbon emissions should remain pronounced for non-SOEs. Based on the above analysis, we propose the third hypothesis:

Hypothesis 3. *The increasing effect of the CEO–chairperson dialect connection is weaker for SOEs.*

Figure 1 presents the research framework.

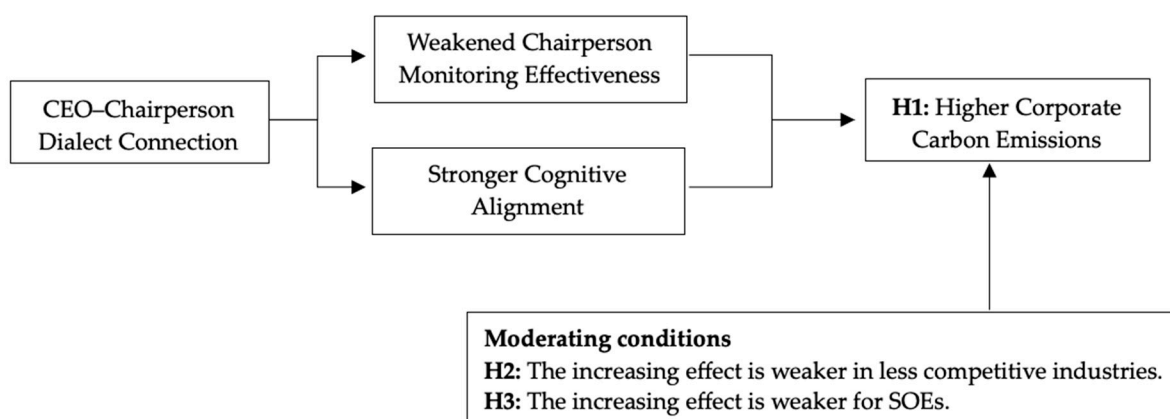


Figure 1. Research framework.

3. Research Methods

3.1. Data

Following Ref. [10], we trace information about CEOs' and chairpersons' dialects based on their birthplace data. We first collect birthplace data from the China Stock Market and Accounting Research (CSMAR) database and public networks. Birthplace information is recorded using a six-digit administrative code, in which the first two digits indicate the province, the next two digits indicate the city, and the final two digits indicate the district. Ref. [20] classifies Chinese dialects into various regions, pieces, and small pieces based on China's administrative codes. Thus, it is plausible to utilize the administrative code of CEOs' and chairpersons' birthplace data for tracking their dialect categories.

Although using birthplace data to identify individuals' dialect backgrounds may have some limitations, this approach has been widely adopted in the existing literature to capture dialect similarity and cultural proximity [22–24]. We acknowledge that some corporate

leaders may relocate during childhood, receive education in different linguistic environments, or use Mandarin more frequently than their native dialect. Consequently, birthplace may not perfectly reflect individuals' actual dialect usage or proficiency. However, such measurement error is unlikely to create systematic bias in our results, because our study does not assume that CEOs and chairpersons communicate in dialect during their daily business interactions. Rather, the dialect connection reflects a shared cultural background that may foster social identification, mutual trust, and interpersonal affinity between CEOs and chairpersons. In other words, CEOs and chairpersons originating from the same dialect area are more likely to share similar cultural norms and social identities, which may foster stronger emotional ties and shape their perceptions even when communication is conducted primarily in Mandarin. In addition, to mitigate potential measurement error, following Ref. [20], we classify dialects into three increasingly stringent levels, i.e., dialect region, dialect piece, and dialect small piece. Our results remain robust across these alternative measures. Therefore, our estimates are likely to provide a conservative assessment of the influence of the CEO–chairperson dialect connection on corporate carbon emissions.

The corporate carbon emission dataset is also obtained from the CSMAR database, which collects carbon emission information disclosed by listed firms in annual reports, sustainability reports, and other public filings. The carbon emission dataset is then merged with CEO–chairperson dialect connection data and firm-level financial information from the CSMAR database. To ensure data quality, observations with missing carbon emission information, missing information on the birthplaces of CEOs or chairpersons, or missing values for key control variables are excluded from the analysis. We further apply the following criteria to filter our sample: (1) exclude financial firms and banks due to different accounting standards; (2) exclude firms with CEO–chairperson duality; (3) exclude special treatment and terminated companies. Eventually, we gather 4987 observations from 989 unique companies from 2010 to 2022. The sample covers 18 of the 19 industry categories defined by the China Association for Public Companies, with the financial industry being the only excluded category.

3.2. Regression Model

Following previous research [11,23], we test Hypothesis 1 using the following model:

$$\text{Car}_{i,t} = \beta_0 + \beta_1 \text{CCDC}_{i,t} + \beta_2 \text{Controls}_{i,t} + \text{Industry FE} + \text{Year FE} + \varepsilon_{i,t} \quad (1)$$

where i represents a unique company, and t represents a calendar year. The dependent variable is corporate carbon emissions intensity (Car), defined as the total tons of carbon dioxide (CO_2) emitted per 10,000 Chinese yuan of sales revenue. Following Ref. [13], we use carbon emissions intensity as a proxy for corporate carbon emissions, as this measure enables comparison across firms of different scales and captures their environmental efficiency. We also follow Ref. [41] by using the natural logarithm of total carbon emissions as an alternative measure of corporate carbon emissions in further analysis.

The key independent variable (CCDC) captures the CEO–chairperson dialect connection. Following the hierarchical classification in Ref. [20], we construct CCDC measures in three ways: (1) dialect region (Region) is a dummy variable equal to 1 if CEOs and chairpersons speak dialects belonging to the same dialect region, and 0 otherwise. (2) dialect piece (Piece) is a dummy variable equal to 1 if CEOs and chairpersons speak dialects belonging to the same dialect piece (a finer classification within dialect regions), and 0 otherwise. (3) dialect small piece (Small piece) is a dummy variable equal to 1 if CEOs and chairpersons speak dialects belonging to the same dialect small piece (the finest classification), and 0 otherwise. This hierarchical measure captures varying degrees of dialect connection, with Small piece representing the closest dialect connection and Region representing the broader

dialect connection. Figure A1 in the Appendix A presents the hierarchical structure of the Chinese dialect classification system and provides representative examples of the dialect categories used in this study.

Following prior literature [27,42–44], we include comprehensive control variables that may affect corporate carbon emissions, including firm size (Size), leverage (Leverage), intangibility ratio (Intangibility), Tobin's Q ratio (Tobin's Q), book-to-market ratio (Book-to-market), return on assets (ROA), and firm age (Firm age). We also control for corporate board and CEO characteristics, including the number of directors (Board size), the separation ratio between the corporate controlling rights and ownership (Separation), CEO gender (CEO gender), and CEO age (CEO age). The descriptions of the main variables are reported in Nomenclature. The industry and year fixed effects are included to control for time-invariant industry characteristics and common time trends. The continuous variables are winsorized at the 1st and 99th percentiles to mitigate the influence of outliers. $\varepsilon_{i,t}$ is the residual value.

For Hypotheses 2 and 3, we conduct sub-sample analyses. Specifically, for Hypothesis 2, we separate the full sample into two sub-samples based on the median year–industry Herfindahl–Hirschman Index (HHI). Firms in industries with an HHI above the median are classified as facing low industry competition (High HHI), while those below the median are classified as facing high industry competition (Low HHI). Similarly, for Hypothesis 3, we separate the full sample into SOEs and non-SOEs based on corporate ownership structure.

We conduct four additional robustness tests on the baseline findings. First, although dialect background is predetermined and exogenous to corporate carbon emission behavior, concerns regarding reverse causality between CEO–chairperson dialect connection and carbon emissions may still bias our baseline estimates. For instance, a chairperson who lacks environmental awareness might appoint a CEO who speaks the same dialect. To address this concern, we implement the IV analysis for robustness. Ref. [45] identifies land surface relief (LSR) as a key determinant of linguistic variation. Greater topographical variation tends to fragment populations into smaller, more isolated communities, thereby facilitating the emergence of distinct local dialects [46]. Accordingly, differences in LSR provide a powerful predictor of dialect differences between individuals.

After controlling for firm characteristics, CEO characteristics, and industry and year fixed effects, LSR is unlikely to affect corporate carbon emissions through channels other than dialect connection. Specifically, we measure LSR based on the birth regions of CEOs and chairpersons rather than the geographic characteristics of the locations where firms operate. Since executives are often employed in firms located outside their birth regions [47], the topographical conditions of their birthplaces are unlikely to directly influence the carbon emissions of the firms they currently manage. Instead, birthplace topography primarily shapes the linguistic environment in which individuals are raised and therefore affects the likelihood that a CEO and a chairperson share a similar dialect background. Hence, LSR satisfies the exclusion restriction. Following Refs. [10,48], we use the absolute difference in the LSR between CEOs' and chairpersons' birth regions (ADLSR) as an IV to perform a two-stage least squares regression in our IV analysis.

Second, we employ a DID approach based on within-firm changes in dialect connection status to examine the causal effect of CEO–chairperson dialect connection on corporate carbon emissions. The treatment group comprises firms that experience a transition from a CEO–chairperson dialect connection to no CEO–chairperson dialect connection during the sample period, whereas the control group consists of firms whose dialect connection status remains unchanged throughout the observation period. Treat is an indicator variable equal to 1 for firms undergoing such a transition and 0 otherwise. Post takes the value of 1 for the years following the transition from a dialect connection to no dialect connection and 0 for

the pre-transition years. The interaction term, $Treat \times Post$, measures the differential change in corporate carbon emissions following the loss of the dialect connection relative to firms without changes in dialect connection status. If dialect connection functions as an informal governance mechanism that contributes to higher carbon emissions, the coefficient on $Treat \times Post$ is expected to be negative, suggesting that firms reduce their carbon emissions after the CEO–chairperson dialect connection relationship is terminated.

Third, we employ PSM analysis to reduce bias from observable differences. In this approach, each treated firm ($CCDC = 1$) is matched to a control firm ($CCDC = 0$) through nearest-neighbor matching. Following Ref. [11], the matching procedure relies on the control variables in the baseline model (1). We then re-estimate the regression using the matched sample to assess the robustness of our baseline results. Finally, we apply the Heckman selection model to address potential sample selection bias in our results. Specifically, in the first step, we perform a probit regression analysis, where $CCDC$ is regressed on all control variables from the baseline model (1). In the probit regression, we add $ADLSR$ as an exclusion restriction variable [10]. Using the probit results, we estimate the inverse Mills ratio (IMR) for each observation. In the second step, we add IMR as an extra control variable in the baseline model (1). If the coefficient of IMR is insignificant, it implies that the sample exhibits no selection bias.

4. Empirical Results

4.1. Descriptive Statistics

Table 1 presents descriptive statistics and pairwise correlation values of the main variables. In Panel A, the mean of Car is 0.4973, suggesting that, on average, Chinese listed firms emit approximately 0.4973 tons of CO_2 per 10,000 Chinese yuan of sales revenue. The minimum (0.0433) and maximum (2.3867) values indicate a substantial variation in carbon emissions across Chinese listed firms. The median value (0.1726) is much lower than the mean (0.4973), indicating a right-skewed distribution, i.e., most Chinese firms have relatively low carbon intensity, but a small number of high-emission firms emit disproportionately more carbon, pulling the average upward. Regarding $CCDC$, about 52.10% of observations share the same dialect region (Region), while 46.66% and 45.08% share the same dialect piece (Piece) and dialect small piece (Small piece), respectively. These declining percentages are reasonable since finer dialect classifications would naturally reduce the pool of speakers, making it less likely to find CEOs and chairpersons who share the same dialect piece or dialect small piece.

For the control variables, Leverage suggests that, on average, Chinese listed firms finance approximately 40.45% of their assets through debt. Tobin's Q has an average of 2.1972, with a wide range from 0.8800 to 8.8693, reflecting substantial differences in market valuation across Chinese firms. The Book-to-market ratio has a median of 0.6159, suggesting that Chinese firms' market values generally exceed their book equity values. In terms of profitability, ROA has an average of 4.77%, but its minimum value of -16.61% indicates that some firms experience financial distress. Firm age has an average log value of 2.1961, which corresponds to approximately nine years, indicating that the firms in our sample are relatively well-established. With respect to the characteristics of the board, Separation has a mean of 0.0475, suggesting that, on average, the separation between ownership and control is not excessively large for Chinese listed firms. Finally, CEO age has an average log value of 3.8781, translating to approximately 49 years of age. Panel B reports correlation coefficients between the main variables. Most variables are significantly correlated with one another. For brevity, we report only the correlation results between Region and the main variables. We obtain similar correlation results when Region is replaced with Piece or Small piece. The last column in Panel B reports the variance inflation factors (VIFs), with

the largest VIF being 3.78, which is below the commonly accepted threshold of 5, indicating that multicollinearity is unlikely to be a major concern in our analysis [49].

Table 1. Descriptive statistics and correlation.

Panel A. Summary statistics														
Variables	N	Mean	STD	Min	Median	Max								
(a) Dependent variables														
Car	4987	0.4973	0.5962	0.0433	0.1726	2.3867								
(b) Independent variables														
Region	4987	0.5210	0.4996	0	1	1								
Piece	4987	0.4666	0.4989	0	0	1								
Small piece	4987	0.4508	0.4976	0	0	1								
(c) Control variables														
Size	4987	20.6943	1.6424	14.7167	20.4489	27.3198								
Leverage	4987	0.4045	0.1905	0.0569	0.4032	0.8644								
Intangibility	4987	0.0477	0.0376	0	0.0391	0.2368								
Tobin's Q	4987	2.1972	1.3386	0.8800	1.7730	8.8693								
Book-to-market	4987	0.6159	0.2422	0.1252	0.6147	1.1869								
ROA	4987	0.0477	0.0533	−0.1661	0.0426	0.2026								
Firm age	4987	2.1961	0.6321	1.0986	2.1972	3.4340								
Board Size	4987	2.3812	0.2213	1.6094	2.3026	3.2958								
Separation	4987	0.0475	0.0786	−0.4145	0	0.3988								
CEO gender	4987	0.9146	0.2795	0	1	1								
CEO age	4987	3.8781	0.1474	3.2581	3.8918	4.3944								
Panel B. Correlation matrix														
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)	VIF
(1) Car	1.0000													
(2) Region	−0.0147	1.0000												1.04
(3) Size	0.3535	−0.1058	1.0000											2.05
	***	***												
(4) Leverage	0.2508	−0.1078	0.5301	1.0000										1.78
	***	***	***											
(5) Intangi-	0.1022	−0.0099	0.0920	0.0568	1.0000									1.04
bility	***	***	***	***										
(6) Tobin's	−0.2061	0.0256	−0.3090	−0.2862	0.0571	1.0000								3.27
Q	***	*	***	***	***									
(7) Book-to-	0.2913	−0.0695	0.4652	0.3650	0.0373	−0.8208	1.0000							3.78
market	***	***	***	***	***	***								
(8) ROA	−0.1363	0.0782	−0.0800	−0.3986	−0.0641	0.3120	−0.3418	1.0000						1.38
	***	***	***	***	***	***	***							
(9) Firm age	0.1714	−0.1088	0.4648	0.4128	0.0287	−0.0474	0.1606	−0.1468	1.0000					1.42
	***	***	***	***	**	***	***	***						
(10) Board	0.1120	−0.0333	0.3135	0.2145	0.0392	−0.0878	0.1378	−0.0447	0.2239	1.0000				1.14
Size	***	**	***	***	***	***	***	***	***					
(11) Separation	0.0366	−0.0248	0.1304	0.1323	0.0175	−0.0496	0.0675	0.0059	0.1379	0.0654	1.0000			1.03
	***	*	***	***	***	***	***	***	***	***	***			
(12) CEO	0.0701	−0.0317	0.1086	0.1168	−0.0539	−0.0412	0.0387	−0.0200	0.0863	0.1408	0.0627	1.0000		1.04
gender	***	**	***	***	***	***	***	***	***	***	***	***		
(13) CEO	0.0738	−0.1433	0.1848	0.1038	0.0187	0.0099	0.0476	0.0038	0.1814	0.0931	0.0233	−0.0145	1.0000	1.07
age	***	***	***	***	***	***	***	***	***	***	*	***	***	

Panel A reports the descriptive statistics of main variables during the sample period. Panel B reports the pairwise correlation of the variables. Abbreviations: Car, carbon emissions intensity; Region, dialect region; Piece, dialect piece; Small piece, dialect small piece; Size, firm size; Leverage, leverage ratio; Intangibility, intangibility ratio; Tobin's Q, Tobin's Q ratio; Book-to-market, book-to-market ratio; ROA, return on asset ratio; Firm age, firm's age; Board size, number of directors; Separation, the separation ratio of the corporate controlling right and ownership; CEO gender, CEO's gender; CEO age, CEO's age. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

4.2. Dialect Connection on Carbon Emissions

Table 2 presents the baseline regression results. The significantly positive coefficient of Region in column (1) suggests that a CEO–chairperson dialect–region connection increases corporate carbon emissions. Columns (2) and (3) indicate similar increasing effects for the CEO–chairperson connections based on the same dialect piece and dialect small piece. These coefficients are economically meaningful: firms with a one-standard-deviation increase in CEO–chairperson dialect connection are associated with an increase of approximately 0.025 tons of CO₂ emissions per 10,000 Chinese yuan of sales revenue, representing about 5% of the average value of corporate carbon emissions intensity. This finding suggests that firms with a CEO–chairperson dialect connection generate noticeably higher carbon emissions for the same level of economic output. From a practical perspective, such a deterioration in carbon efficiency may hinder firms' ability to meet increasingly

stringent environmental regulations and carbon reduction targets, while increasing future environmental risks and compliance costs. Overall, the results in Table 2 support Hypothesis 1.

Table 2. Effects of dialect connection on corporate carbon emissions.

	(1)	(2)	(3)
Region	0.0528 *** (0.016)		
Piece		0.0423 *** (0.016)	
Small piece			0.0457 *** (0.016)
Size	0.0860 *** (0.007)	0.0858 *** (0.007)	0.0861 *** (0.007)
Leverage	0.0598 (0.055)	0.0626 (0.055)	0.0620 (0.055)
Intangibility	1.0207 *** (0.219)	1.0316 *** (0.220)	1.0271 *** (0.220)
Tobin's Q	0.0122 (0.010)	0.0118 (0.010)	0.0117 (0.010)
Book-to-market	0.4028 *** (0.067)	0.3999 *** (0.067)	0.3978 *** (0.067)
ROA	−0.6717 *** (0.181)	−0.6635 *** (0.181)	−0.6625 *** (0.181)
Firm age	0.0144 (0.015)	0.0147 (0.015)	0.0156 (0.015)
Board Size	−0.0395 (0.039)	−0.0371 (0.039)	−0.0369 (0.039)
Separation	−0.1547 (0.104)	−0.1568 (0.104)	−0.1605 (0.104)
CEO gender	0.0783 *** (0.024)	0.0774 *** (0.024)	0.0770 *** (0.024)
CEO age	0.1034 * (0.054)	0.0978 * (0.054)	0.0991 * (0.054)
Constant	−2.0734 *** (0.250)	−2.0526 *** (0.251)	−2.0631 *** (0.251)
Industry FE	Yes	Yes	Yes
Year FE	Yes	Yes	Yes
Observations	4987	4987	4987
Firms	989	989	989
Adj. R ²	0.1783	0.1776	0.1777

This table displays the regression results for analyzing the effects of CEO–chairperson dialect connection on corporate carbon emissions. Abbreviations: Region, dialect region; Piece, dialect piece; Small piece, dialect small piece; Size, firm size; Leverage, leverage ratio; Intangibility, intangibility ratio; Tobin's Q, Tobin's Q ratio; Book-to-market, book-to-market ratio; ROA, return on asset ratio; Firm age, firm's age; Board size, number of directors; Separation, the separation ratio of the corporate controlling right and ownership; CEO gender, CEO's gender; CEO age, CEO's age. FE represents the fixed effects model. Standard error is shown in brackets. * $p < 0.10$; *** $p < 0.01$.

The coefficients of the control variables are consistent with our expectations and prior studies. For example, Size and Intangibility are positively associated with carbon emissions, suggesting that larger firms with higher intangible intensity tend to produce more carbon emissions due to their greater scale of operations [42,44]. The Book-to-market ratio is also positively associated with carbon emissions, which is consistent with the finding of Ref. [43]. ROA is negatively associated with carbon emissions, indicating that more profitable firms may have greater resources and incentives to invest in environmental protection and emission reduction activities [42].

Table 3 reports the regression results for Hypotheses 2 and 3. For brevity, the coefficients estimated for the control variables are not reported here, but those variables are included in all of regressions. Panel A shows that the coefficients of CCDC for firms in the highly competitive industries (Low HHI) sub-samples are all significantly positive, whereas the coefficients of CCDC for firms in the less competitive industries (High HHI) sub-samples are insignificant. Hence, the increasing effect of the CEO–chairperson dialect connection on corporate carbon emissions becomes less pronounced for firms operating in less competitive industries. This finding supports Hypothesis 2. In addition, we perform a permutation-based coefficient difference test to examine whether the estimated CCDC coefficients differ between highly competitive and less competitive industries. This method

tests the null hypothesis that the estimated CCDC coefficients are equal across the two sub-samples. The statistically significant coefficient differences reported in the last row of Panel A indicate that the increasing effect of CCDC on corporate carbon emissions is weaker for firms operating in less competitive industries, providing further support for Hypothesis 2.

Table 3. Impact of industry competition and ownership structure.

Panel A. Herfindahl–Hirschman Index (HHI)						
	High (1)	Low (2)	High (3)	Low (4)	High (5)	Low (6)
Region	0.0118 (0.022)	0.1043 *** (0.022)				
Piece			0.0067 (0.023)	0.0875 *** (0.022)		
Small piece					0.0187 (0.023)	0.0817 *** (0.022)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2321	2666	2321	2666	2321	2666
Firms	560	607	560	607	560	607
Adj. R ²	0.2803	0.1181	0.2802	0.1157	0.2804	0.1150
Difference	0.0925 ***		0.0808 ***		0.0629 ***	
Panel B. Ownership structure						
	SOEs (1)	Non–SOEs (2)	SOEs (3)	Non–SOEs (4)	SOEs (5)	Non–SOEs (6)
Region	0.0135 (0.031)	0.0811 *** (0.018)				
Piece			0.0115 (0.034)	0.0677 *** (0.018)		
Small piece					0.0246 (0.035)	0.0665 *** (0.018)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1632	3353	1632	3353	1632	3353
Firms	294	710	294	710	294	710
Adj. R ²	0.2499	0.0755	0.2499	0.0739	0.2501	0.0738
p-value	0.0676 ***		0.0562 ***		0.0419 **	

This table displays the regression results for analyzing the effects of CEO–chairperson dialect connection on corporate carbon emissions after considering industry competition and corporate ownership structure. Abbreviations: Region, dialect region; Piece, dialect piece; Small piece, dialect small piece; SOE, state-owned enterprises; Controls, control variables. FE represents the fixed effects model. Standard error is shown in brackets. ** $p < 0.05$; *** $p < 0.01$.

This finding may be attributed to the fact that intense industry competition increases firms' pressure to maintain short-term financial performance and market position. Under such conditions, CEOs face stronger performance evaluation and career concerns because poor short-term performance may increase their risk of dismissal and reduce their future career opportunities. Consequently, CEOs are more likely to prioritize short-term operational outcomes over long-term carbon emission reduction initiatives, whose benefits typically materialize over time [27]. The close relationship established through the dialect connection makes chairpersons more likely to support or refrain from challenging such short-term decisions. As a result, the influence of the dialect connection on increasing carbon emissions remains pronounced for firms in highly competitive industries. By contrast, firms operating in less competitive industries face weaker external performance pressure and possess greater resource slack, reducing CEOs' short-term performance pressure. In this context, the dialect connection is more likely to reinforce coordination in support of long-term corporate development, thereby weakening its increasing effect on carbon emissions. Moreover, these results provide important practical implications. Specifically, corporate boards should strengthen oversight of environmental decisions in highly competitive industries to mitigate the governance risks associated with informal ties among corporate top leaders. Policymakers may also consider providing stronger environmental monitoring and increasing incentives for carbon emission reduction for firms facing intense

competitive pressure, where informal relationships are more likely to undermine long-term environmental objectives.

As shown in Panel B, the coefficients of CCDC for the non-SOEs sub-sample are all positive at the 1% significance level, while the coefficients of CCDC for the SOEs sub-sample are insignificant. The above findings indicate that the CEO–chairperson dialect connection clearly increases corporate carbon emissions for non-SOEs, but has limited effects in SOEs, supporting Hypothesis 3. Moreover, the coefficient difference test in the last row confirms that the two CCDC coefficients differ significantly across ownership structures, indicating that the influence of the CEO–chairperson dialect connection is significantly weaker in SOEs than in non-SOEs. This result provides further support for Hypothesis 3.

One possible explanation for these findings is that SOEs are subject to stronger government oversight and face greater societal expectations to fulfill environmental responsibilities than non-SOEs [38]. Environmental performance in SOEs is closely aligned with government and societal objectives, and corporate leaders generally face more formal monitoring and have less managerial discretion in strategic decision making, limiting their ability to deviate from these objectives [37]. Consequently, although CEO–chairperson dialect connections may still foster stronger mutual trust and shared cultural values, their influence on environmental decisions is constrained by formal governance mechanisms and government supervision. In other words, formal governance reduces the role of informal dialect-based relationships in shaping corporate carbon emissions. By contrast, non-SOEs are subject to fewer government-imposed constraints regarding environmental objectives, leaving corporate leaders with greater discretion over strategic and environmental decisions. Under these circumstances, the weakened monitoring power and shared cultural values associated with dialect connection are more likely to influence corporate leaders' decision making, resulting in higher corporate carbon emissions.

Moreover, these results have important practical implications, suggesting that strong formal governance mechanisms can effectively constrain the influence of informal relationships among corporate top leaders on environmental decision making. Specifically, for SOEs, maintaining rigorous government oversight and environmental accountability remains essential for preventing informal ties from weakening environmental governance. For non-SOEs, where managerial discretion is greater, strengthening board independence and environmental oversight may help mitigate the adverse environmental consequences of such informal ties.

4.3. Further Analysis

We conduct two analyses to further examine the robustness of our baseline results. First, following Ref. [41], we use the natural logarithm of total carbon emissions as an alternative measure of corporate carbon emissions. As reported in Panel A of Table 4, the coefficients of CCDC remain positive and statistically significant, confirming the robustness of our baseline results. Second, to examine whether industry-level differences in carbon emission profiles affect the interpretation of our findings, we classify firms into heavily and non-heavily polluting industries according to the Environmental Verification Industry Classification (2008) issued by the Chinese government. The results, reported in Panel B of Table 4, show that the increasing effect of the CEO–chairperson dialect connection on corporate carbon emissions is significant only for firms operating in non-heavily polluting industries, whereas this effect is statistically insignificant for firms in heavily polluting industries. One possible explanation for these findings is that firms in heavily polluting industries are subject to stricter environmental regulations, greater public scrutiny, and stronger external pressure to reduce carbon emissions, thereby constraining the extent to which informal relationships among corporate top leaders can influence environmental

decision making. By contrast, firms in non-heavily polluting industries generally face relatively weaker environmental constraints, allowing the stronger mutual trust and shared cultural values associated with the CEO–chairperson dialect connection to exert a more pronounced influence on corporate environmental decisions.

Table 4. Alternative measure and industry-based analysis.

Panel A. Alternative proxy						
	(1)		(2)		(3)	
Region	0.0753 ** (0.032)					
Piece			0.0619 * (0.033)			
Small piece					0.0636 * (0.033)	
Controls	Yes		Yes		Yes	
Industry FE	Yes		Yes		Yes	
Year FE	Yes		Yes		Yes	
Observations	4987		4987		4987	
Firms	989		989		989	
Adj. R ²	0.7200		0.7199		0.7182	
Panel B. Heavily polluting vs. Non-heavily polluting industries						
	Heavily (1)	Non-Heavily (2)	Heavily (3)	Non-Heavily (4)	Heavily (5)	Non-Heavily (6)
Region	0.0598 (0.058)	0.0334 *** (0.008)				
Piece			0.0041 (0.028)	0.0355 *** (0.008)		
Small piece					0.0146 (0.028)	0.0342 *** (0.008)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1925	3050	1925	3050	1925	3050
Firms	362	627	362	627	362	627
Pseudo R ²	0.2092	0.2055	0.2071	0.2060	0.2072	0.2057
p-value		−0.0265 **		0.0314 **		0.0196 *

This table displays the regression results for analyzing the effects of CEO–chairperson dialect connection on corporate carbon emissions using an alternative measure of corporate carbon emission and across industries with different carbon emission profiles. Abbreviations: Region, dialect region; Piece, dialect piece; Small piece, dialect small piece; Controls, control variables. FE represents the fixed effects model. Standard error is shown in brackets. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

5. Robustness Checks

Four additional robustness checks are conducted for our baseline findings. The IV analysis results are shown in Panel A of Table 5. In the first-stage regression, the coefficients for our IV are all significantly negative, which is consistent with existing studies [24]. This result suggests that the IV is strongly associated with the endogenous variable and the relevance condition has been satisfied. The first-stage F statistic exceeds the critical value at the 10% level [50], suggesting that our IV is sufficiently strong. In the second-stage regression, the Kleibergen–Paap LM statistics are significant at the 1% level, indicating that our model is properly identified. The estimated coefficients on the instrumented CCDC variables are positive and statistically significant, suggesting that our main findings are robust after accounting for potential endogeneity. In summary, the IV analysis results show consistency with the baseline findings that the CEO–chairperson dialect connection increases corporate carbon emissions. Panel B reports the DID estimation results. The coefficients on $Treat \times Post$ are negative and statistically significant in columns (1) to (3), indicating that firms exhibit lower corporate carbon emissions after the CEO–chairperson dialect connection is lost. These findings reinforce the inference that the CEO–chairperson dialect connection causally increases corporate carbon emissions.

Table 5. Additional robustness tests.

Panel A. Instrumental variable analysis						
	(1)	First-Stage (2)	(3)	(4)	Second-Stage (5)	(6)
IV	−0.2591 *** (0.0121)	−0.2794 *** (0.0106)	−0.2670 *** (0.0104)			
Region				0.1135 ** (0.0482)		
Piece					0.1052 ** (0.0444)	
Small piece						0.1101 ** (0.0464)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	4846	4846	4846	4846	4846	4846
Firms	956	956	956	956	956	956
Adj. R ²	0.1500	0.1923	0.1858	0.1758	0.1750	0.1751
First-stage F statistic	459.959 ***	691.732 ***	657.089 ***			
Kleibergen-Paap rank LM statistic				466.197 ***	626.277 ***	596.425 ***
Panel B. Difference-in-differences approach: dialect connection to no dialect connection						
	(1)	(2)	(3)			
Treat × Post _{Region}	−0.0511 *** (−3.0879)					
Treat × Post _{Piece}		−0.0485 *** (−2.9018)				
Treat × Post _{Small_Piece}			−0.0510 *** (−3.0020)			
Treat	0.0149 (0.4426)	−0.0413 (−1.2574)	−0.0521 (−1.5835)			
Controls	Yes	Yes	Yes			
Industry FE	Yes	Yes	Yes			
Year FE	Yes	Yes	Yes			
Observations	4346	4392	4355			
Firms	897	902	900			
Adj. R ²	0.1490	0.1645	0.1619			

This table displays the instrumental variable (IV) analysis and difference-in-differences approach results. The IV refers to the absolute difference in the land surface relief between CEOs' and chairpersons' birth regions. Abbreviations: Region, dialect region; Piece, dialect piece; Small piece, dialect small piece; Controls, control variables. Treat equals 1 for firms experiencing a transition in CEO–chairperson dialect connection and 0 otherwise. Post equals 1 for the years following the transition from dialect connection to no dialect connection and 0 for the years before the transition. FE represents the fixed effects model. Standard error is shown in brackets. ** $p < 0.05$; *** $p < 0.01$.

Table 6 reports the PSM analysis results. Panel A presents the covariate balance statistics before and after matching. After matching, the pseudo R² decreases substantially from 0.040 to 0.001, and the likelihood ratio χ^2 statistic becomes statistically insignificant, indicating that the matched treatment and control groups no longer differ systematically in their observable characteristics. The mean and median standardized biases are reduced from 18.5% and 17.7% to 1.5% and 1.4%, respectively. The Rubin's B statistic declines from 48.1 to 7.4, while Rubin's R remains close to 1, both satisfying the recommended balance criteria [51]. Overall, the results in Panel A suggest that the matching procedure effectively improves covariate balance and mitigates observable selection bias. Panel B presents the regression results based on the matched sample. As can be seen from columns (1) to (3), all estimated coefficients are clearly significantly positive, which further supports the findings in Table 2.

Table 6. Propensity score matching analysis.

Panel A. Covariate balance statistics						
	Pseudo R ²	LR χ^2	Mean Bias	Median Bias	Rubin's B	Rubin's R
Unmatched	0.040	278.46 ***	18.5	17.7	48.1	0.95
Matched	0.001	6.41	1.5	1.4	7.4	1.02
Panel B. Regression results						
	(1)	(2)	(3)			
Region	0.0418 * (0.022)					
Piece		0.0518 ** (0.021)				
Small piece				0.0548 ** (0.022)		
Controls	Yes	Yes		Yes		
Industry FE	Yes	Yes		Yes		
Year FE	Yes	Yes		Yes		
Observations	2643	2529		2480		
Firms	861	841		834		
Adj. R ²	0.1713	0.1610		0.1516		

This table displays the regression results using the propensity score matching analysis. Abbreviations: Region, dialect region; Piece, dialect piece; Small piece, dialect small piece; Controls, control variables. FE represents the fixed effects model. Standard error is shown in brackets. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Table 7 presents the results from the Heckman selection model. In Panel A, the coefficients of CCDC remain positive and statistically significant even after including the IMR, indicating that the baseline findings are robust to potential selection bias. Panels B and C further show that the CCDC coefficients continue to be significantly positive in the highly competitive industries and non-SOE sub-samples, indicating that the results reported in Table 3 hold after addressing possible selection concerns. The differences in the coefficients for CCDC are also significant, further supporting Hypotheses 2 and 3.

Table 7. Heckman selection model.

Panel A. Full sample						
	(1)	(2)	(3)			
Region	0.0438 *** (0.017)					
Piece		0.0316 * (0.017)				
Small piece			0.0355 ** (0.017)			
IMR	−0.0274 (0.019)	−0.0307 (0.019)	−0.0298 (0.019)			
Controls	Yes	Yes	Yes			
Industry FE	Yes	Yes	Yes			
Year FE	Yes	Yes	Yes			
Observations	4834	4834	4834			
Firms	953	953	953			
Pseudo R ²	0.1784	0.1778	0.1780			
Panel B. Herfindahl–Hirschman Index (HHI)						
	High (1)	Low (2)	High (3)	Low (4)	High (5)	Low (6)
Region	0.0187 (0.024)	0.0852 *** (0.023)				
Piece			0.0126 (0.025)	0.0648 *** (0.024)		
Small piece					0.0256 (0.025)	0.0590 ** (0.024)
IMR	0.0082 (0.028)	−0.0619 ** (0.028)	0.0059 (0.028)	−0.0645 ** (0.028)	0.0103 (0.028)	−0.0675 ** (0.028)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2254	2580	2254	2580	2254	2580
Firms	543	582	543	582	543	582
Pseudo R ²	0.2845	0.1176	0.2844	0.1155	0.2847	0.1151
p-value		0.0665 ***		0.0521 **		0.0334 *

Table 7. Cont.

Panel C. Ownership structure						
	SOEs (1)	Non-SOEs (2)	SOEs (3)	Non-SOEs (4)	SOEs (5)	Non-SOEs (6)
Region	−0.0034 (0.032)	0.0815 *** (0.020)				
Piece			−0.0157 (0.035)	0.0660 *** (0.020)		
Small piece					0.0004 (0.036)	0.0644 *** (0.020)
IMR	−0.0890 *** (0.034)	0.0127 (0.023)	−0.0928 *** (0.035)	0.0063 (0.023)	−0.0882 ** (0.034)	0.0052 (0.023)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1626	3206	1626	3206	1626	3206
Firms	291	676	291	676	291	676
Pseudo R ²	0.2529	0.0760	0.2530	0.0744	0.2529	0.0743
p-value		0.0849 ***		0.0817 ***		0.0640 ***

This table displays the Heckman selection model results. Abbreviations: Region, dialect region; Piece, dialect piece; Small piece, dialect small piece; IMR, inverse Mills ratio; Controls, control variables. FE represents the fixed effects model. Standard error is shown in brackets. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

6. Influence Mechanisms

To further explore the potential mechanisms underlying the relationship between the CEO–chairperson dialect connection and corporate carbon emissions, we conduct three additional tests focusing on monitoring effectiveness and cognitive alignment arising from the dialect connection. Media coverage increases corporate visibility and represents an important external monitoring mechanism that may affect the influence of the CEO–chairperson dialect connection [52]. In contrast, the absence of strong external media scrutiny makes internal monitoring by chairpersons more salient. Hence, if the increasing effect of dialect connection on corporate carbon emissions arises from a reduction in chairpersons’ monitoring vigilance, this effect is expected to be weaker in firms with greater media coverage, where external media scrutiny offsets the reduction in chairpersons’ monitoring induced by the dialect connection. The coefficients of CCDC in Panel A of Table 8 are consistent with our expectations. Economically, for firms with lower media coverage, a one-standard-deviation increase in the CCDC is associated with an increase in corporate carbon emissions equivalent to approximately 7% to 9% of the mean corporate carbon emissions intensity. These effects are larger than those observed in the full-sample baseline regressions (approximately 5%), indicating that the economic impact of the CEO–chairperson dialect connection is amplified in environments where external monitoring is weaker. The significant coefficient differences reported in the last row further support this finding. Hence, the results in Panel A suggest that the weakening monitoring vigilance of chairpersons is a potential channel that contributes to the increasing effect of the CEO–chairperson dialect connection on corporate carbon emissions.

To complement the external monitoring mechanism, we further employ the proportion of independent directors as a more direct proxy for corporate internal monitoring intensity [27]. Accordingly, we divide the sample into firms with high and low independent director ratios based on the sample median. As reported in Panel B, the increasing effect of the CEO–chairperson dialect connection on corporate carbon emissions is significant only among firms with a low independent director ratio, whereas this effect becomes insignificant for firms with a high independent director ratio. The coefficient differences reported in the last row are also significant at the 1% level. Economically, for firms with a lower proportion of independent directors, a one-standard-deviation increase in the CCDC is associated with an increase in corporate carbon emissions equivalent to approximately 10% of the mean corporate carbon emissions intensity. This magnitude is notably larger than that observed in the full-sample baseline regressions (approximately 5%), suggesting

that the economic impact of the CEO–chairperson dialect connection is more pronounced when internal monitoring is weaker. Since board monitoring is relatively weak in firms with a lower proportion of independent directors, this finding provides more direct evidence consistent with the argument that the dialect connection increases corporate carbon emissions by reducing the effectiveness of chairperson oversight.

Table 8. Mechanisms.

Panel A. Media coverage						
	High (1)	Low (2)	High (3)	Low (4)	High (5)	Low (6)
Region	0.0205 (0.024)	0.0909 *** (0.021)				
Piece			0.0140 (0.024)	0.0695 *** (0.021)		
Small piece					0.0169 (0.024)	0.0692 *** (0.021)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2346	2641	2346	2641	2346	2641
Firms	643	700	643	700	643	700
Adj. R ²	0.2200	0.1552	0.2199	0.1527	0.2199	0.1527
p-value		0.0704 ***		0.0555 **		0.0523 ***
Panel B. Independent director ratio						
	High (1)	Low (2)	High (3)	Low (4)	High (5)	Low (6)
Region	−0.0011 (0.022)	0.1132 *** (0.022)				
Piece			−0.0126 (0.022)	0.1044 *** (0.023)		
Small piece					−0.0078 (0.022)	0.1035 *** (0.023)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2340	2647	2340	2647	2340	2647
Firms	642	648	642	648	642	648
Pseudo R ²	0.2123	0.1690	0.2124	0.1676	0.2123	0.1674
p-value		0.1144 ***		0.1170 ***		0.1112 ***
Panel C. Communication challenges						
	North (1)	South (2)	North (3)	South (4)	North (5)	South (6)
Region	0.0120 (0.033)	0.0632 *** (0.018)				
Piece			0.0223 (0.033)	0.0459 ** (0.018)		
Small piece					0.0330 (0.033)	0.0446 ** (0.018)
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1508	3479	1508	3479	1508	3479
Firms	317	738	317	738	317	738
Adj. R ²	0.2235	0.1625	0.2237	0.1610	0.2240	0.1609
p-value		0.0512 **		0.0236 *		0.0116 **

This table displays the regression results for analyzing the potential mechanisms of CEO–chairperson dialect connection on corporate carbon emissions. Abbreviations: Region, dialect region; Piece, dialect piece; Small piece, dialect small piece; Controls, control variables. FE represents the fixed effects model. Standard error is shown in brackets. * $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$.

Chinese dialects can be broadly classified into two super-categories: northern Mandarin and southern dialect groups [20]. The North China Plain presents fewer migratory barriers, resulting in a relatively homogeneous linguistic environment [45]. Similar dialects lead to a similar culture and perceptions among speakers of northern Mandarin dialects [10]. However, dialects within the southern group vary significantly, often making mutual comprehension difficult [46]. Hence, if the increasing effect of dialect connection on corporate carbon emissions is indeed driven by similar perceptions, we expect this increasing effect to be weaker among northern Mandarin dialects, where cultural homogeneity reduces the distinctiveness of dialect connection. In contrast, the greater dialectal and

cultural differences in southern regions may strengthen the impact of dialect connection by facilitating more effective communication and fostering deeper mutual understanding between CEOs and chairpersons. The coefficients of CCDC in Panel C of Table 8 are consistent with this expectation. In terms of economic significance, within the southern dialect sub-sample, a one-standard-deviation increase in the CCDC is associated with an increase in corporate carbon emissions equivalent to approximately 5% of the mean corporate carbon emissions intensity. This magnitude is comparable to that observed in the full-sample baseline regressions (approximately 5%). These results suggest that similar perceptions between CEOs and chairpersons are a potential channel that contributes to the increasing effect of the CEO–chairperson dialect connection on corporate carbon emissions. The differences in coefficients reported in the last row further support this finding.

7. Conclusions and Implications

This study investigates whether and how the CEO–chairperson dialect connection influences corporate carbon emissions. Using unique data on CEOs’ and chairpersons’ dialect information and firm-level carbon emissions, we find robust evidence that the CEO–chairperson dialect connection increases corporate carbon emissions. This effect is weaker among firms operating in less competitive industries, SOE firms and firms in heavily polluting industries. We further explore the potential mechanisms behind this relationship and find that this effect remains stronger for firms with lower media coverage and independent director ratio and for dialects that are more difficult for outsiders to understand. These results suggest that dialect connection increases corporate carbon emissions by weakening the independent monitoring effectiveness of chairpersons and reinforcing cognitive alignment between CEOs and chairpersons. Our results remain robust across a range of robustness tests.

This study provides three main theoretical implications. First, it extends the theory of upper echelons by demonstrating that informal connections between CEOs and chairpersons play a significant role in shaping corporate carbon emissions, whereas previous research has primarily emphasized the influence of CEO characteristics on corporate carbon emissions [53]. Second, it contributes to the literature regarding the determinants of corporate carbon emissions and broader sustainability outcomes by documenting the role of a novel corporate internal informal institution, i.e., the CEO–chairperson dialect connection, in influencing corporate carbon emissions. This informal connection can influence corporate behavior in contexts where formal institutions are underdeveloped, potentially increasing corporate carbon emissions. Third, it advances our understanding of how cultural factors influence corporate carbon emissions. While prior research shows that the CEO–chairperson dialect connection affects corporate innovation [11] and shareholders’ tunneling [10], this study demonstrates that such a connection also has important implications for firms’ environmental behavior, thereby extending the relevance of cultural proximity to the climate governance domains.

Beyond theoretical contributions, our findings have important implications for sustainable corporate governance and ESG practice. For boards of directors and ESG committees, our results highlight that informal ties between CEOs and chairpersons increase corporate carbon emissions. Accordingly, when evaluating firms’ environmental strategy and ESG performance, the board may benefit from considering not only formal governance structures but also the informal relational dynamics between key corporate leaders. For investors, a CEO–chairperson dialect connection may serve as a supplementary signal when assessing firms’ ESG risk exposure and environmental accountability. Although such informal ties are often not directly observable, investors may infer corporate leaders’ shared backgrounds from publicly available information and incorporate this information

into a broader assessment of firms’ governance effectiveness and environmental risk. For policymakers, the evidence is consistent with the view that strengthening external information environments and board independence may help mitigate potential environmental risks associated with excessive corporate top leaders’ cohesion. As our analysis identifies associations rather than definitive causal relationships, any policy implications drawn from these findings should be interpreted with appropriate caution.

This study is based on Chinese listed firms, where dialect diversity, informal social networks, and state-influenced governance structures provide a distinct institutional setting. While these features may raise concerns regarding external validity, the baseline findings are not unique to China. It is likely to operate in other economies with pronounced cultural heterogeneity. However, the magnitude of the effect is expected to vary across institutional contexts, implying that the results should be interpreted as context-dependent rather than universally generalizable. Although the IV analysis, DID approach, PSM analysis, and Heckman selection model help mitigate potential endogeneity concerns, identification ultimately relies on the assumption that unobserved firm-specific characteristics do not jointly determine corporate leaders’ matching and corporate environmental outcomes. This is a limitation of this study. Future research could strengthen causal identification by exploiting exogenous shocks such as unexpected executive turnover.

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Nomenclature

Variables	Descriptions
Dependent variable	
Car	Carbon emissions represent the firm’s total tons of carbon dioxide (CO ₂) are emitted per 10,000 Chinese yuan of sales revenue.
Key Independent variables	
Region	A dummy variable equals 1 if both CEO and chairperson speak the same dialect region and 0 otherwise.
Piece	A dummy variable equals 1 if both CEO and chairperson speak the same dialect piece and 0 otherwise.
Small piece	A dummy variable equals 1 if both CEO and chairperson speak the same dialect small piece and 0 otherwise.
Control variables	
Size	The natural logarithm of a firm’s total fixed assets.
Leverage	Total liabilities are divided by total assets.

Intangibility	Total tangible assets divided by total assets.
Tobin's Q	Market value divided by total assets.
Book-to-market	The book value of equity is divided by the market value of equity.
ROA	Net income divided by total assets.
Firm age	The natural logarithm of a firm's age.
Board size	The natural logarithm of board size.
Separation	The difference between the ratios of the actual controller's controlling right and ownership.
CEO gender	A dummy variable equals 1 for male CEO and 0 otherwise.
CEO age	The natural logarithm of the CEO's age.
Other variables	
HHI	Herfindahl–Hirschman index. The firms with a high HHI index suggest that they face less market competitiveness.
SOEs	State-owned enterprises (SOEs) and non-SOEs otherwise.
Media coverage	The high media coverage group includes the firms with media coverage above the median figure each year and low media coverage group otherwise.
Northern Mandarin group	See Figure A1 in the Appendix A.

Appendix A

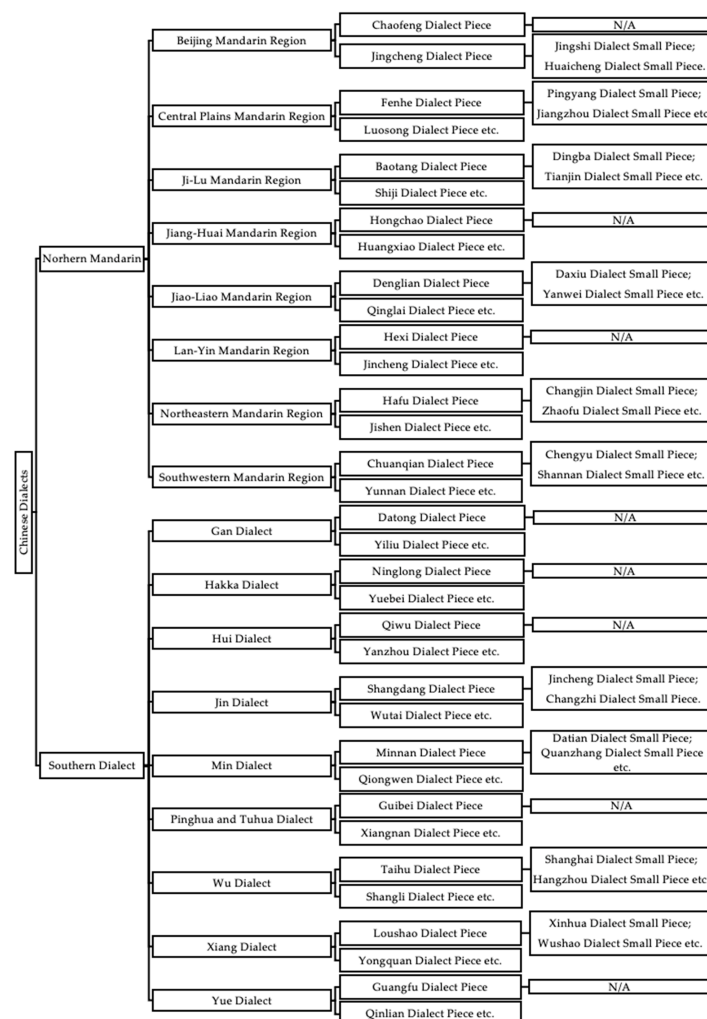


Figure A1. Structure of Chinese dialect classification system. N/A denotes not applicable, indicating that the dialect piece cannot be further classified into different dialect small pieces.

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