



# Co-opted board and carbon emissions in Thailand

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Received: 31 March 2024 / Accepted: 28 January 2025  
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## Abstract

The main objective of this study is to examine the impact of a co-opted board of directors on the carbon emissions of listed companies from the Stock Exchange of Thailand (SET). The data are collected using the top 100 Thai listed firms' corporate annual reports from 2020 to 2022. The co-opted board measures whether there is a change in the board of directors, while a proxy of carbon emissions is used to measure and disclose by ton-kilogram. The collected data were analyzed using descriptive analysis, correlation matrix, and multiple regression. As the results, the average of gas emissions is 6,366,017.764 ton-kilograms. The pattern of gas emissions is increasing from 2020 to 2022. Moreover, a co-opted board has a significantly negative impact on carbon emissions. To consider the impact of corporate governance represented by board composition on carbon emissions, this study finds the negative impact of the female board on carbon emissions. At the same time, there is a positive relationship between board size, board meetings, and carbon emissions. The findings of this study demonstrate that agency, stakeholder, signaling, and legitimacy theories can be used to explain why the board of directors' change can reduce environmental and social impact, including carbon emissions.

**Keywords** Co-opted board · Carbon emissions · Top100 firms · Thailand

## Introduction

The urgency of global climate change initiatives has underscored corporate governance's importance in driving sustainable practices, particularly in emerging economies like Thailand. According to the Global Carbon Budget (2023), in 2022, Thailand ranks fourth in ASEAN for carbon dioxide emissions, releasing approximately 3.8 tons per person. This places it behind Brunei, Singapore, and Malaysia, which emit 24.0, 8.9, and 8.6 tons per person, respectively. Relating

entities pay attention to this increase, so starting in 2022, the Securities and Exchange Commission (SEC) has instituted a requirement for listed firms to disclose their greenhouse gas emissions in the form of one report. This mandatory regulation serves several purposes, particularly transparency and accountability. Mandating greenhouse gas emissions disclosure in one report by the SEC reflects a growing recognition of the importance of environmental considerations in financial decision-making. It contributes to the broader goals of promoting sustainability and combating climate change. Investors and stakeholders can make more informed decisions about the environmental impact of the companies they invest in or engage with. The global economic and environmental interconnectedness necessitates that corporate actions in such regions significantly contribute to worldwide sustainability efforts. Within this context, the significant role of co-opted boards in influencing corporate environmental strategies is highlighted by existing literature that suggests a potential negative correlation between co-opted boards and carbon emissions (Gull et al. 2023). It should acknowledge the complex and varied findings in the field, noting that while some studies find co-opted boards beneficial for reducing emissions, others suggest limitations, particularly when short-term gains are prioritized over long-term sustainability

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(Hossain et al. 2023a, b). With its significant industrial growth, Thailand faces considerable environmental challenges, notably in air pollution and greenhouse gas emissions. The country's economic development, heavily reliant on fossil fuels, has intensified these challenges, making the role of corporate governance in environmental sustainability increasingly critical. This setting offers an opportunity to examine how co-opted boards within Thai corporations can influence environmental policies and practices, contributing to national and global sustainability goals. Acknowledging the environmental impact, Thailand has embarked on ambitious sustainability goals that align with international agreements like the Paris Agreement. The Thai government has implemented policies to foster corporate environmental responsibility, highlighting the essential link between corporate governance and environmental sustainability. These efforts position the corporate sector as pivotal in reducing the nation's environmental footprint.

Co-opted boards play a key role in promoting innovative environmental strategies. These directors bring specialized knowledge and networks that may be lacking in the existing board, which is essential for navigating the complexities of environmental sustainability. Their expertise helps drive the adoption of green technologies, compliance with regulations, and alignment with sustainable development goals. While James & Wang (2021) discuss the influence of independent directors on corporate regulations, their impact on environmental factors remains underexplored. Despite the apparent advantages of incorporating co-opted boards into corporate governance, the literature on their effectiveness in promoting environmental sustainability presents a complex picture. Studies have varied in their conclusions, with some evidence suggesting that co-opted boards' diverse and specialized expertise positively correlates with enhanced environmental outcomes, while other research points to limitations and challenges. These mixed findings highlight a significant research gap and suggest that the impact of co-opted boards may depend on several factors, including the specific environmental context, the industry in question, and the company's existing governance structure. Consequently, this divergence in research findings underscores the need for further empirical investigation to clarify the conditions under which co-opted boards most effectively contribute to environmental sustainability.

The nuanced debate on the impact of co-opted boards on environmental performance is deeply rooted in several theoretical frameworks, each offering distinct perspectives on corporate governance (Gull et al. 2023; Damert et al. 2017; Tanthanongsakkun et al. 2023). Incorporating theoretical frameworks such as agency theory, signaling theory, and legitimacy theory highlights the role of corporate actions in promoting environmental sustainability and

forms the theoretical foundation of this research. These theories help explain the potential mechanisms through which co-opted boards may influence carbon emissions, either positively by aligning with environmental goals to enhance the firm's reputation or negatively by engaging in greenwashing practices that mislead stakeholders about the firm's environmental performance (Marquis et al. 2016). These frameworks collectively highlight the potential for co-opted boards to influence environmental strategies. Nevertheless, applying these theories in the context of emerging economies, with their unique corporate and environmental landscapes, still needs to be explored.

The call for further empirical research in emerging economies like Thailand arises from recognizing that these contexts present distinct challenges and opportunities for corporate governance and environmental sustainability. The complexity of environmental issues, coupled with the dynamic nature of emerging markets, suggests that the effectiveness of co-opted boards in enhancing environmental performance may vary significantly from developed markets. Factors such as regulatory frameworks, cultural norms, economic conditions, and environmental awareness and activism can all influence the role and impact of co-opted boards. The existing literature often focuses on more developed economies, but it may need to fully capture these nuances, leading to conflicting findings and methodological limitations when applied to emerging economies. Therefore, there is a pressing need for empirical studies specifically designed to explore the relationship between co-opted boards and environmental performance in these contexts. Such research would not only fill a significant gap in the literature but also offer valuable insights for policymakers, corporate leaders, and stakeholders aiming to leverage corporate governance for environmental sustainability in emerging markets.

Given Thailand's unique challenges and corporate governance structures, this study aims to fill a critical gap in the literature by investigating the impact of co-opted boards on gas emissions among Thai listed companies. It seeks to unravel how co-opted boards influence environmental outcomes, contributing to the broader discourse on corporate governance and environmental sustainability. This research offers practical insights into policy and corporate practices by analyzing the influence of co-opted boards on environmental outcomes within Thailand's distinctive governance landscape.

This next section provides relevant literature and theories for hypothesis development, followed by a description of the research methodology. The subsequent sections present empirical findings, discussion, and conclusion. The study also provides implications, contributions, limitations, and suggestions for future research.



## Literature review and hypothesis development

### Carbon emissions

Carbon emissions encompass the release of carbon dioxide and other greenhouse gases into the atmosphere, primarily due to human activities and industrial processes (Luo et al. 2023). Some green banking rules are settled for commercial banks to increase their investments aimed at environmental protection (Akhter et al. 2023). In line with the Sustainable Development Goals (SDGs), many firms place specific emphasis on climate action, recognizing the imperative of combating climate change to improve corporate performance (Khaled et al. 2021), and promote sustainable development (Raihan 2024). Reducing carbon emissions stands as a foundation for addressing climate change and attaining these goals (Busco et al. 2017). Ganda and Milondzo (2018) found the negative relationship between carbon emissions and corporate financial performance. When firms reduce the amount of carbon released, they can increase the return on investment (ROI), return on sales (ROS), and return on equity (ROE). To be sustainable, firms tend to put more effort into establishing emissions reduction targets, transitioning to renewable energy sources, and integrating climate risk management into their operations and strategies (Chen et al. 2023). Companies with longer-term targets and aim for absolute reductions in emissions tend to achieve substantial decreases in their overall emissions (Dahlmann et al. 2019), which affects their corporate performance. Numerous studies have highlighted the positive correlation between investing in innovative technologies, research, and development (R&D) to reduce carbon emissions and firm performance (Alam et al. 2019; Ganda 2019). This offers a pathway toward long-term corporate sustainable performance (Benkraiem et al. 2023).

Despite this, carbon emissions reduction remains a strategic imperative. Notably, carbon emissions are associated with many factors. It is found that the carbon emissions rate is negatively associated with environment, social and governance (ESG) committee (Oyewo 2023), board gender diversity, and CEO duality (Oyewo 2023; Goud 2022). Some studies state that carbon emissions are positively associated with board independence and ESG-based compensation. Some studies state gender diversity is positively associated with firms' emissions performance. Companies with gender diversity on corporate boards tend to reduce environmental emissions (Kyaw et al. 2022). In contrast, previous studies show that staggered boards significantly worsen emissions performance. The result shows staggered boards insulate self-interested managers from

market discipline and thus exacerbate agency problems, resulting in more unfavorable outcomes (Cremers et al. 2017).

Regarding governance mechanisms, it is debatable which factors are positively and negatively associated with carbon emissions. It is found that co-opted boards negatively affect the carbon emissions of firms. An increase in the proportion of co-opted directors reduces greenhouse gas emissions (Gull et al. 2023). This could be because of stakeholder pressure on emissions reduction activities (Damert et al. 2017). Tanthanongsakkun et al. (2023) show in the takeover market, board members could get under pressure from outsiders and then set the target to reduce carbon emissions. This is to satisfy the stakeholders and improve corporate performance in the long term. In the opposite, having co-opted board members could negatively impact on carbon emissions. As reducing carbon level could take a long time, co-opted directors who are risk-averse tend to make decisions that prioritize short-term gains over long-term environmental sustainability, leading to increased greenhouse gas emissions (Hossain et al. 2023b). Board co-option could lead to higher climate change risk of the firms associating carbon emissions, unexpected climate anomalies, and regulatory uncertainties (Ghafoor et al. 2023).

### Co-opted board

A "co-opted board" for listed firms refers to a situation where the board of directors includes individuals who are appointed or brought onto the board after CEO assumes office (Coles et al. 2014). The co-opted board could be appointed because of their specific expertise, experience, or perspective (Adams & Kastrinaki 2023; Fedaseyeu et al. 2018) rather than being elected by shareholders traditionally. This could especially occur if the CEO establishes the company's specific targets. Companies having an environmental committee tend to demonstrate improved performance in managing carbon emissions (Elsayih et al. 2021). They could bring valuable industry insights, connections, or strategic guidance to the board (Fedaseyeu et al. 2018). Adams and Kastrinaki (2023) provide an example found in insurance firms. The study demonstrates insurance experienced outside directors improve profitability by providing valuable operational and strategic advice. Companies with boards that include co-opted members have a notable and beneficial impact on the firm's financial leverage (Lartey et al. 2021).

While co-opting directors can bring fresh perspectives and expertise to the boardroom, it can raise concerns about transparency, accountability, and conflicts of interest (Jensen & Meckling 2019; Zaman et al. 2021), particularly if the process of appointing co-opted directors lacks proper oversight or if their interests diverge from those of shareholders. Co-opted board could allow CEOs to exert influence over



the terms of their own compensation agreements (Bachmann et al. 2020). Co-opted directors could influence analysts' recommendations. Papangkorn et al. (2020) found companies with fewer co-opted directors influenced by outside interests often receive better recommendations, indicating analysts prefer firms with good corporate governance to ensure the interests of shareholders are still protected. The more the co-opted directors are on the board, the less capable the board is believed to be in reducing conflicts of interest (Jiraporn & Lee 2018).

The composition of the co-opted board is influenced by various factors. Previous studies show that the co-opted boards are commonly found in family firms, where family members are invited to join the board. Cordeiro et al. (2020) found that many family-owned firms opt to appoint female directors to promote environmental social responsibility (CSR). Female directors are often seen as a promoting greater attention to CSR, and their presence on the board, particularly in combination with CEO duality, has been shown to improve CSR scores (El Saleh & Jurdi 2023). Gender diversity in corporate boards, including the inclusion of female directors, has been linked to improved environmental performance. For example, female directors are often more likely to advocate for environmentally sustainable practices and long-term strategies that reduce carbon emissions (Kyaw et al. 2021). Studies have found that companies with greater gender diversity on their boards tend to reduce environmental emissions, which in turn can increase in firm value, productivity, and profitability (Pichler et al. 2018). Moreover, Hossain et al. (2023a, b) support the idea that gender-diverse boards contribute long-term sustainability by promoting environmentally responsible decision-making. Although governance structure influences corporate environmental performance, its impact is notably stronger for carbon-intensive companies compared to those with lower carbon intensity (Konadu et al. 2022).

### **Theoretical concept: the relationship between carbon emissions and co-opted board**

This study adopts agency theory to explain the association between a co-opted board and carbon emissions. Agency theory traditionally posits that the alignment of interest between shareholders (principals) and management (agents) can be facilitated by effective governance mechanisms (Chang et al., 2014; Jensen & Meckling 2019). However, the role of co-opted boards within this framework is complex. In well-governed systems, co-opted directors may contribute positively by using their inside knowledge to mediate between management and shareholders, potentially mitigating conflicts of interest. In the opposite, in systems with low governance, where the CEO holds substantial influence over the board, co-opted directors tend to align more closely

with the CEO's interests. This alignment can diminish their role, leading to agency issues as their primary responsibility shifts from protecting shareholders to supporting the CEO's agenda (Afzali et al. 2023). As such, the effect of co-opted boards on agency conflicts is highly context dependent (Fedaseyeu et al. 2018). Over time, experienced directors tend to get closer to managers and may overlook their oversight duties. This is especially true in firms with powerful CEOs who control nominations, have long tenures, and significant voting power. Essentially, long board tenure can indicate directors aligning more with management than acting independently (Vafeas 2003).

Although external board could generate a greater degree of post-succession strategic change (Karaevli & Zajac 2013), agency theory suggests that co-opted directors may prioritize their personal interests, such as maximizing short-term profits or maintaining power over the long-term interests of shareholders and broader society concerns (Hossain et al. 2023b). While Balsam and Kwack (2022) state that executive's external network connections with the CEO enhance firm value, internal board networks are associated with lower firm value and an ineffective monitoring environment. This is reflected in higher expense ratios, increased director compensation, and more frequent cases of financial misrepresentation (Souther 2018). Additionally, co-opted directors have been found to propose fewer agenda items, attend fewer board meetings, and receive higher compensation, exacerbating conflicts between stakeholders and the board (Zaman et al. 2021). The effects are particularly pronounced in firms with weak external oversight, strong social ties between CEOs and boards, high career concerns, and low CEO power.

In the context of a co-opted board and carbon emissions, while these directors may bring expertise in environmental issues (Elsayih et al. 2021; Gull et al. 2023), they may also prioritize career advancement or job preservation. Co-opted directors could be more risk-averse, particularly if they believe that aggressive actions to reduce carbon emissions may harm the company's short-term profitability or competitive position in the short term (Hossain et al. 2023a, b). Directors with shorter tenures are generally less risk-averse when considering requests to disclose environmental information (Lewis et al. 2014). In contrast, longer board service tends to reflect stronger commitment to the firm, which could include implementing policies that address environmental impacts (Vafeas 2003). This risk aversion may result in hesitation to invest in costly environmental initiatives or technologies aimed at reducing carbon emissions.

Moreover, independent directors who are not co-opted have been shown to contribute positively to CSR engagement (Afzali et al. 2023). In some cases, co-opted boards may engage in 'greenwashing,' presenting a misleadingly positive image of the company's environmental practices or



commitments while continuing to engage in environmentally harmful activities, such as high levels of carbon emissions (Lyon & Maxwell, 2011; Bowen & Aragon-Correa 2014). Marquis et al. (2016) found that providing higher incentives to board members increases the likelihood of greenwashing, which can eventually reduce firm value. Without effective oversight or incentives for environmental performance, managers may prioritize other objectives over reducing carbon emissions. Firms with a higher proportion of co-opted directors tend to disclose less ESG information (Hoang et al. 2023) and exhibit poorer ESG performance (Maneenop et al. 2024).

In contrast with agency theory, the study proposes signaling theory and legitimacy theory to explain the relationship between a co-opted board and carbon emissions. Signaling theory suggests that actions taken by an organization, such as the composition of its board, can serve as signals to external stakeholders about its underlying qualities, intentions, or future behavior (Pollock & Gulati 2007; Hawn & Ioannou 2016; Bae et al. 2018). In the context of a co-opted board and carbon emissions, when a company appoints members to its board who have expertise or experience in sustainability, environmental issues, or carbon reduction strategies, it could send a signal to stakeholders that the company is committed to addressing environmental concerns (Begley 1996; Jaggi et al. 2011). Environmental practices carry significance both in tangible outcomes and symbolic representations (Bowen 2014). Stakeholders may interpret the presence of environmental experts on the board (Peters & Romi 2014) and carbon emissions disclosure (Hardiyansah et al. 2021; Datt et al. 2019) as signs that the company takes its environmental responsibilities seriously (Hardiyansah et al. 2021). This perception can influence stakeholders' attitudes and behaviors toward the company, affecting its reputation and investment attractiveness as a signal of long-term sustainability (Arco-Castro et al. 2020). A co-opted board with members knowledgeable about environmental issues may advocate for and implement policies and strategies aimed at reducing carbon emissions within the company. Their expertise can lead to better decision-making processes regarding environmental initiatives, potentially resulting in lower carbon emissions over time (Gull et al. 2023).

Legitimacy theory suggests that organizations strive to maintain alignment between their activities and societal expectations to secure legitimacy and support from stakeholders (Cowen and Marcel 2011; Fich and Shivdasani 2007). This theory is critical in understanding the relationship between co-opted boards and carbon emissions because it explains why companies might appoint board members with environmental expertise. In doing so, companies are signaling their awareness of and commitment to environmental issues, which aligns with broader societal expectations for corporate responsibility (Rohani & Jabbour 2023).

By co-opting directors with environmental expertise, companies actively seek to enhance their legitimacy, particularly in an era where stakeholders such as investors, customers, and regulators are placing increasing emphasis on sustainability and carbon emissions reduction (Damert et al. 2017). This practice allows the company to demonstrate responsiveness to these pressures and adherence to the norms and values of its stakeholder community. According to legitimacy theory, failure to meet these expectations could result in a loss of social acceptance, stakeholder trust, and financial support (Arco-Castro et al. 2020). For instance, companies in industries with high environmental impacts, such as manufacturing or energy, face significant scrutiny from stakeholders regarding their carbon emissions. Appointing co-opted directors with environmental expertise not only signals a commitment to address these concerns, but also ensures the company can better navigate emerging regulations and stakeholder expectations (Epstein 2018). This action helps the firm maintain or even enhance its legitimacy by ensuring that its board is equipped with the knowledge to guide the company in implementing sustainable practices (Gull et al. 2023).

Based on literatures, co-opted directors, particularly those with environmental expertise, can use their knowledge and connections to help the company implement more effective sustainability strategies. Additionally, under stakeholder pressure and in alignment with long-term sustainability goals, co-opted boards may contribute to the reduction in greenhouse gas emissions by influencing environmental policy decisions and ensuring compliance with regulatory frameworks. Therefore, this study developed the hypothesis as:

**H1:** *The presence of a co-opted board is negatively associated with carbon emissions.*

## Methods

The top 100 listed companies on the Stock Exchange of Thailand (SET) were used as population and sample in this study. The reasons to pick up top 100 firms out of all listed firms in Thailand are (1) the market capitalization of top 100 firms used in this study was more than seventy percent of the total market capitalization in Thailand and (2) the larger firms tended to adopt new reporting practices and regulations faster than the other firms. The corporate annual reports from 2020 to 2022 were used to collect the data of this study. Although the mandatory environmental performance reporting of one annual report, including carbon emissions, has been launched since 2021, the SET asked all listed companies to have early adoption of one report in 2020. However, some of the top 100 listed firms from the SET did not have all annual reports from 2020 to



2021 because they had just registered into the SET after 2020 or 2021, and some had merger each other from 2020 to 2022. Therefore, there were three years period of study from 2020 to 2022. Therefore, the final samples consisted of 291 firm-years of observations.

Hand-collect is used on co-opted board and carbon emissions from annual reports of the top 100 firms from the Stock Exchange of Thailand (SET) during 2020 to 2022. The database of the SET Security Market Analysis and Reporting Tool (SETSMART) is also used to collect data on control variables. There are four main groups of variables used in this study which include co-opted board, carbon emissions, board composition, and corporate characteristics. Co-opted board was measured whether there is change of board of director, while carbon emissions are proxied by level of carbon emissions. This study uses carbon because many global agreements as key targets for national policies. This makes the total emissions level very relevant to policymakers and other stakeholders who need to meet specific goals. Moreover, carbon emissions build up over time, so the total amount emitted has a big impact on climate change. By looking at the total emissions, this provides a clearer picture of how much carbon is being added to the atmosphere. Finally, measuring total emissions makes it easier to compare different regions or countries, especially how much each is contributing to global emissions. To measure the control variables of this study, there are two groups which are: board composition and corporate characteristics. In terms of the board composition, female board, board meeting, board age, board size, and ESG/SDG/CSR board are used as control variables in this study (Khunkaew et al. 2023; Suttipun and Boonlai 2019; Rosati and Faria 2018; Suttipun and Saelee 2015). In terms of corporate characteristics as the control variables in this study, firm size, firm risk, profitability, industry, and year were measured by the proxies that were used in the previous related studies (Suttipun et al. 2021; Huaypad 2019; Suttipun and Nuttaphon 2014). All

variables' measurements and notations used are indicated in Table 1 below.

Within the main objective of this study, descriptive analysis by mean and SD was used to investigate the extent, pattern, and level of carbon emissions of the top 100 listed companies from the SET from 2020 to 2022. A correlation matrix was used to test for multicollinearity problems between all variables used. Finally, multiple regression was used to examine the possible impact of co-opted board on the carbon emissions of the top 100 listed companies from the SET from 2020 to 2022. The multiple regression equation is as follows:

$$\text{Carbon}_{i,t} = \alpha + \beta \text{Cob}_{i,t} + \gamma \text{Controls}_{i,t} + \varepsilon_{i,t}$$

## Findings and results

To investigate the extent, pattern, and level of carbon emissions of the top 100 listed firms from the SET from 2020 to 2022, 291 firms-years are used as samples of this study. The proxy of carbon emissions is used to measure and disclose by ton-kilogram of corporate carbon emissions. As a result, the average gas emissions are 6,366,017.764 ton-kilogram (SD = 3,317,411.398). The pattern of gas emissions is increasing from 6,033,895.706 average ton-kilogram (SD = 3,356,911.029) in 2020 to 6,374,336.647 average ton-kilogram (SD = 3,350,940.218) in 2021, and 6,670,143.181 average ton-kilogram (SD = 3,423,827.650) in 2022. The reason for carbon emissions' increase may be because the data were collected from 2020 to 2022, when every firm around the world would have to face with COVID-19 crisis. Although there was a poor level of production in 2020, the production for export in Thailand has increased dramatically from 2021 until now. Therefore, the carbon emissions are directly correlated with production process of listed companies in Thailand.

Table 2 indicates the descriptive analysis of all variables used in this study. As the results, for example, the average of

**Table 1** Variables' measurement

Variables	Definition
Carbon	Carbon emissions—level of carbon emissions
Cob	Co-opted board—whether there is change of board of director
Fmb	Female board—whether there are three or more women on board of director
Meet	Board meeting—frequency of board meeting
Age	Board age—average age of board of director
Board	Board size—number of directors on board
Esg	ESG board—whether there is ESG board in the firm
Roa	Return on assets—net income divided by total assets
Leverage	Leverage—total debt divided by total equity
Industry	Industry—whether it is high environmentally and socially profile industry
Year	Year fixed effect



**Table 2** Descriptive analysis of all variables used in this study

Variables	N	Mean	SD	Max	Min
Carbon	291	6,366,017.764	3,317,411.398	291,170,000,000.000	0.000
Cob	291	0.312	0.464	1.000	0.000
Feboard	291	0.120	0.325	1.000	0.000
Meet	291	9.591	4.279	26.000	1.000
Age	291	67.663	8.094	88.000	46.000
Board	291	11.711	2.986	29.000	6.000
Esg	291	0.751	0.432	1.000	0.000
Roa	291	8.010	10.246	67.170	-29.460
Leverage	291	1.997	1.871	8.510	0.020
Industry	291	0.309	0.462	1.000	0.000

carbon is 6,366,017.764 ton-kilogram (SD=3,317,411.398), while the average of cob is 0.312 (SD=0.464). In terms of other board compositions' variables, the average of the Feboard is 0.120 (SD=0.325), the board meeting per year is 9.591 average times (SD=4.279), the average board age is 67.663 years (SD=8.094), the board size is 11.711 average person (SD=2.986), and the average of ESG board is 0.751 (SD=0.432). In terms of corporate characteristics' variables, ROA is found as 8.010 (SD=10.246), the average leverage is 1.997 (SD=1.871), and the industry is 0.309 (SD=0.462).

Table 3 indicates whether the data are not multicollinear in the variables included in the analysis that were first tested. The correlation matrix used to test multicollinearity between the nine variables used in this study consists of one dependent variable, one independent variable, and nine control variables. According to Yoon et al. (2018) and Field (2024), the correlation between a pair of variables should not exceed 0.700 and 0.800, respectively, to avoid multicollinearity concerns. In this study, the highest Pearson correlation was 0.589, observed between the variables 'roa' and 'board,' indicating that multicollinearity is not a problem in this dataset. To consider the correlation of carbon with the

other variables used, this study found a negative relationship between carbon and cob (Pearson correlation = -0.108), carbon and Feboard (Pearson correlation = -0.132), and carbon and age (Pearson correlation = -0.164) at 0.01 and 0.05 levels, while there is a positive correlation between carbon and industry (Pearson correlation = 0.254), carbon and meet (Pearson correlation = 0.171), and carbon and board (Pearson correlation = 0.189).

To test the impact of the co-opted board on carbon emissions of top 100 listed firms in the multiple regression models were used and are examined in Table 4. During models 1 to 4, the R squared ranged from 0.013 to 0.145. As a result, there is a significant negative impact of cob on carbon at 0.01, 0.05 and 0.10 levels in all models of study. With control variables of corporate characteristics, in models 2 and 4, the study finds a positive impact of industry on carbon at 0.01, while there is no correlation between roa, leverage, and carbon at 0.10 level. To consider the control variables in terms of board composition (see models 3 and 4), the results indicate that there is a significantly positive relationship between board and carbon at 0.01 level, but a negative impact of Feboard at 0.05 and 0.10 level on carbon is shown in this study. In addition, model 3 finds a positive impact of

**Table 3** Correlation matrix

Variables	cob	Roa	Leverage	industry	meet	Board	Feboard	Esg	Age
Carbon	-.108*	-.032	-.033	.254**	.171**	.189**	-.132*	.106	-.164**
Cob	1	-.067	.115*	.094	.025	.060	-.084	.199**	-.051
Roa		1	.568**	.141*	.422**	.569**	-.058	.370**	-.143*
Leverage			1	-.188**	.194**	.287**	.086	.192**	-.075
Industry				1	.215**	.165**	-.078	.109	-.168**
Meet					1	.187**	-.039	.262**	-.206**
Board						1	.024	.240**	-.091
Feboard							1	.101	.023
Esg								1	-.012
Age									1

\*, \*\*, and \*\*\* indicate statistical significance at the 10% ( $p < 0.10$ ), 5% ( $p < 0.05$ ), and 1% ( $p < 0.01$ ) levels, respectively



**Table 4** Impact of co-opted board on carbon emissions

Variables	Model 1	Model 2	Model 3	Model 4
Cob	-8.145* (-19.00)	-10.468** (-2.490)	-11.354*** (-2.680)	-12.095*** (-2.880)
Roa		-0.093 (-0.470)		-0.093 (-0.480)
Leverage		0.476 (0.440)		-1.025 (-0.870)
Industry		19.470*** (4.650)		14.042*** (3.230)
Meet			0.868* (1.880)	0.631 (1.350)
Board			1.927*** (2.880)	1.832*** (2.640)
Feboard			-9.201** (-2.310)	-7.706* (-1.950)
Esg			6.176 (1.310)	5.837 (1.250)
Age			-6.319 (-1.020)	-7.543 (-1.230)
Constant	7.593*** (2.160)	1.618 (0.340)	-22.372** (-2.520)	-20.794** (-2.330)
Year	Yes	Yes	Yes	Yes
R square	0.013	0.085	0.100	0.145
Adj R square	0.010	0.064	0.089	0.135
Observation	291	291	291	291

\*, \*\*, and \*\*\* indicate statistical significance at the 10% ( $p < 0.10$ ), 5% ( $p < 0.05$ ), and 1% ( $p < 0.01$ ) levels, respectively

meet on carbon at 0.10 level, while there is no possible correlation between variables in model 4 at 0.10 level. However, the study finds no impact of ESG and age on carbon at 0.10 level in models 3 and 4.

## Discussion

The result of the negative correlation between the co-opted board and carbon emissions of this study is consistent with the previous studies of Gull et al. (2023). From our samples, the majority of companies are operated in agriculture and food, industries, and resources, where there is often a presence of board members knowledgeable about environmental concerns. Having a co-opted board could lead to a reduction in carbon emissions, particularly co-opted board who have capabilities in waste management. Selecting board members who are experts and have capabilities in environmental issues could enable them to provide practical suggestions to teams on how to effectively reduce carbon emissions (Robertson & Barling 2017; Cordeiro et al. 2020). Additionally, the co-opted board might get pressure from a closer CEO to reduce waste generation (Gull et al. 2024). This alignment

supports the legitimacy and signaling theory, suggesting that a higher proportion of co-opted board members correlates with a lower percentage of carbon emissions. Additionally, the companies with a higher number of co-opted directors could have fewer potential environmental liabilities because they are committed to adopting environmentally friendly practices. These directors, who are experts in environmental issues, can influence the company's decision-making processes toward sustainable actions, thereby helping to mitigate environmental risks and reduce the likelihood of facing liabilities related to environmental damage or non-compliance with regulations (Luo & Tang 2021).

The result of this study does not support the agency theory and contradicts the findings of García-Sánchez et al. (2019), who mentioned that the greater the number of co-opted directors, the greater the carbon emissions. Having a larger number of co-opted directors might lead to increased bureaucracy or conflicting interests within the board, which could hinder the implementation of effective sustainability strategies and result in higher carbon emissions. Therefore, co-opted directors tend to have poorer ESG performance (Maneenop et al. 2024).

To consider the impact of corporate governance represented by board composition on carbon emissions, this study finds the negative impact of the female board on carbon emissions. At the same time, there is a positive relationship between board size, board meetings, and carbon emissions. In terms of the negative impact of the female board on carbon emissions, the study's result is similar to the prior studies of Suttipun (2021), Jizi (2017), Rouf (2015), and Frias-Aceituno et al. (2013). It can be assumed that ESG performance, including carbon emissions, is affected by female board. This is because female board have different multitasking skills, communicating abilities, and operating ways as compared to their male counterparts (Schubert 2006). In terms of corporate sustainable development, it is also believed that the female board can play a better role on both communicating and decision-making processes to corporate stakeholders (Frias-Aceituno et al. 2013).

Numerous female directors provide greenhouse gas emissions disclosures of superior quality (Hollindale et al. 2019), which could be beneficial for the firms. In addition, the female board can enhance corporate effectiveness in pursuing socially and environmentally friendly strategies to satisfy social expectations and stakeholder demands (Glass et al. 2016). The positive relationship between board size and carbon emissions in this study is similar to some studies (Suttipun 2021; Haji and Ghazali 2013; Abeysekera 2010). The logical reason is that the board committee is working to reduce the conflicts of interest between top management and shareholders as well as the information asymmetries, although there was an increase in carbon emissions during period being studied (Haji and Ghazali 2013). In addition,



larger board sizes can enhance both the quality and quantity of sustainable development (Suttipun 2021). The positive correlation between board meeting and carbon emissions in this study is consistent with McMullen and Raghunandan (1996). The reason may be because too much meeting frequency can also create a lack of unity in decision-making, and the corporations have to spend a lot of money on board meeting allowance to all committees each time.

In terms of the relationship between corporate characteristics and carbon emissions, this study finds only industry types influencing carbon emissions, while there is no correlation between profitability, firm leverage, and carbon emissions. The positive relationship between industry type and carbon emissions of this study is consistent with Suttipun and Nuttaphon (2014) and Suttipun and Boomlai (2019), who classify two different industry types as high environmental impact industry and low environmental impact industry. In Thailand, listed companies are classified into eight industries by the Stock Exchange of Thailand (SET) which are agriculture and food industry, consumer products, financials, industrials, property and construction, resources, services, and technology. The high environmental impact industries consist of the agriculture and food industry, industrials, and resources, while consumer products, financials, property and construction, services, and technology are in the low environmental impact industries (Suttipun and Nuttaphon 2014). Therefore, the firms in the high-profile industry produce more carbon emissions than the other firms in the low-profile industry.

## Conclusion

To answer whether there is a possible impact of a co-opted board on carbon emissions of Thai listed companies from 2020 to 2022, the study finds a significantly negative impact of a co-opted board on carbon emissions. To consider the impact of corporate governance represented by board composition on carbon emissions, this study finds the negative impact of the female board on carbon emissions. At the same time, there is a positive relationship between board size, board meeting, and carbon emissions. However, there is no correlation between ESG board, board age, and carbon emissions. To consider the carbon emissions of Thai listed firms, the average gas emissions are 6,366,017.764 ton-kilograms. The pattern of gas emissions is increasing from 2020 to 2022.

There are several contributions and implications from the study's findings. From a theoretical perspective, the study results demonstrate that agency, stakeholder, signaling, and legitimacy theories can be used to explain the significantly negative impact of the co-opted board on carbon emissions. The study results also indicate the contribution

of literature on corporate governance and environmental management that the study has focused on the impact of co-opted board on carbon emissions in Thailand, where (1) is an emerging economic country and (2) is lack of evidence.

In terms of practical contributions and implications, the results can guide Thai listed companies that should have co-opted boards because they will balance economic, environmental, and social perspectives to satisfy stakeholder demands and reduce information asymmetries and conflicts of interest. Moreover, the board of directors also plays an important role in driving the corporations to sustainable development. The corporations themselves can be guided to pay attention to carbon emissions because it can (1) reduce or close information asymmetries, agency costs, and conflicts of interest, (2) satisfy their stakeholder demands, and (3) send a good signal to their stakeholder. Finally, policy setters and regulators can contribute to implementing mandatory ESG.

However, there are some limitations that should be mentioned in this study. Firstly, this study focuses on only carbon emissions which is one of the mandatory ESG performances in Thailand. It is because there are 3 ESG performances which Thai listed companies have provided and disclosed since 2020, consisting of carbon emissions, provident funds, and human lawsuits. Next, this study aims only one country, Thailand, to investigate provident funds and test for the impact of the co-opted board on carbon emissions. Next, carbon emissions are used as a proxy to measure corporate environmental management, while the prior related studies use carbon disclosure or reduction that makes a positive relationship between co-opted board and the carbon emissions or reduction is good, but the positive correlation between co-opted board and carbon emissions provides different meaning and direction. Finally, there are only three years to collect the data of co-opted board on carbon emissions. Therefore, to suggest for the future study, the other mandatory ESG performances of group of countries using carbon reduction will be investigated, such as the ASEAN Economic Community (AEC) or the European Union (EU). In addition, a longitudinal study of five to ten years is also used for the future study collected by data mining.

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

**Data availability** The data that support the findings of this study are available on request.

## Declarations

**Conflict of interest** We declare that we have no conflicts of interest related to this work. There are no financial or personal relationships with other people or organizations that could influence our work.



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