

Article

The Impact of Family Firms and Supervisory Boards on Corporate Environmental Quality

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Abstract: This paper examines the impact of family ownership and supervisory board characteristics on carbon emission disclosure. It uses balanced panel data and a matched-pair design of 124 non-financial firms listed on the Indonesia Stock Exchange from 2017 to 2019. This study finds that family firms and larger boards improve, while female board members harm carbon emission performance. Further analyses reveal non-linear relationships between family ownership and carbon performance. When control rights are limited, family firms prioritize controlling managers and improving carbon quality. Conversely, they prioritize personal objectives over environmental concerns when there are high control rights, resulting in decreased carbon emission performance. Additionally, family board members generate more carbon information, indicating the family owners effectively utilize their position on the supervisory boards to influence the company's carbon emission performance. Finally, the study reports that more faculty member boards seem to hurt carbon emission reduction efforts. This result suggests that the diversity of their professional experiences does not affect the environmental effectiveness of supervisory boards. Our findings highlight the importance of understanding SEW principles and their connection to families in comprehending Indonesian corporate carbon emissions disclosures. The findings of this study enrich the worldwide literature by exploring the potential benefits of family business environmental performance. This study also adds to the literature on corporate governance, especially the role played by supervisory boards. Our findings align with the resource dependence theory, emphasizing the central function of supervisory boards as a monitoring tool. This study is constrained by its reliance on carbon emission data extracted from the annual reports of public firms, with a particular emphasis on pre-COVID-19 data. Future research should focus on sustainability reports and explore the time frame encompassing COVID-19 (2020–2022 datasets) to determine any differences in the findings.

Keywords: family firms; supervisory boards; carbon emission; Indonesia stock exchange

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1. Introduction

Numerous countries are witnessing a growing public concern regarding a range of environmental problems. Carbon emissions are widely recognized as the primary factor behind environmental issues such as climate change, rising sea levels, and more frequent extreme weather events (Jia et al. 2024; Liu et al. 2022; Ramanathan and Feng 2009; Wang et al. 2022). According to Lin and Zhang (2024), the BP Statistical Review of World Energy 2023 highlights a 0.8% increase in carbon dioxide emissions in 2022 compared to 2021. There is a concerning forecast that global CO₂ emissions could potentially result in a rise in Earth's temperature by 1.5 to 2 degrees Celsius, which poses a severe threat to the survival and development of humanity (Du et al. 2023; Li et al. 2023). In 2016, a historic global climate change agreement, known as the Paris Agreement, was signed by 178 countries worldwide (Liu and Yang 2021). This agreement aims to decelerate climate warming and

enhance the capacity to combat climate change by limiting global warming to 1.5 degrees Celsius. However, this topic holds particular significance for the BRICS countries due to their rapid economic growth and substantial contribution to global economic expansion (Gyamfi et al. 2022; Khattak and Ahmad 2022).

The carbon management practices of Indonesian-listed companies have been subject to rigorous scrutiny, mainly attributed to Indonesia's massive population, surpassing 270 million, resulting in substantial carbon emissions (Chariri et al. 2019). Business entities in Indonesia are under tremendous pressure to reduce their carbon emissions, both from domestic and international communities (Rokhmawati 2020). The Indonesian government, via Kementerian Energi dan Sumber Daya Mineral Republik Indonesia, has mandated that the manufacturing sector reduce its carbon emissions in response to internal pressure through Regulation No. 70/2009. In light of global carbon emission concerns, the government has committed to lowering greenhouse gas emissions by 29% by the year 2030. In addition to government regulations, Indonesian companies are also facing pressure from consumers and investors, who are increasingly concerned about the environmental impact of their products and services. To meet these market demands, enterprises must adopt sustainable approaches, assess their carbon emissions, set targets for reducing emissions, promote energy efficiency, and utilize renewable energy sources. The increasing demand to comply with regulations and appeal to environmentally responsible customers and stakeholders drives companies to shift towards greater transparency in sustainable practices (Rahmaniati and Ekawati 2024).

Numerous studies have been conducted to analyze the carbon emission disclosures (CED) provided by companies, with a specific focus on identifying the factors that impact the level of CED. Still, the majority of studies, such as those by Gray et al. (1995), Iyer and Lulseged (2013), and Baalouch et al. (2019), have focused on the UK, the US, and European countries. The type and scope of corporate disclosure in Asia, notably Indonesia, have not been thoroughly studied. Chau and Gray (2002) claim that Asian companies are less willing to disclose information publicly than their Anglo-American counterparts. In addition, Lam et al. (1994) found that the management and ownership structures of Asian firms significantly impacted the information they provided. Several research studies have been conducted on the voluntary disclosure of carbon emissions within the Indonesian context. For instance, Faisal et al. (2018), Hermawan et al. (2018), Pratiwi et al. (2021), as well as Wahyuningrum et al. (2024), analyze the company's specific characteristics to predict the disclosure of greenhouse gas emissions. Qosasi et al. (2022) study the relationship between ownership structure and carbon performance. Meanwhile, Andrian (2021) places significant importance on investigating the impact of the board of directors, institutional ownership, and firm performance on the disclosure of carbon emissions. Most prior empirical studies have focused on a specific predictor in isolation rather than combined. This paper investigates the effect of family-controlled firms and supervisory board mechanisms on CED. As Vafeas and Theodorou (1998) remark, studying key related firm or corporate governance characteristics in isolation may hide meaningful inferences, leading to misleading findings. This study is essential because research on the relationship between family ownership and carbon performance in developing countries is limited. For several reasons, understanding the relationship between family ownership and carbon performance in Indonesia is essential. First, Indonesia is one of the world's largest emitters of greenhouse gases, primarily due to its reliance on fossil fuels for energy production (Wijaya et al. 2017). Second, Joni et al. (2020) report that family business groups control most of Indonesia's listed companies, with about 95% being family-owned. Family-owned companies generate millions of jobs and play an essential role in developing the Indonesian economy (PriceWaterhouseCoopers 2018). As such, their environmental practices directly impact the overall sustainability of the economy and the population's well-being. This research can give us insights into family-owned businesses' decisions regarding environmental and social governance (ESG). This information can be used to develop targeted policies and initiatives that encourage these businesses to adopt more sustainable practices and reduce their carbon footprint. Overall, understanding the association between family ownership

and carbon performance in Indonesia is crucial for promoting environmental sustainability, mitigating climate change, and ensuring the long-term prosperity of the country.

Good corporate governance practices are essential to promoting investments and boosting the economy in Indonesia (Deloitte 2020). Some regulations, such as Law No. 40/2007 on Limited Liability Companies and Law No. 25/2007 on Investment, have been released to ensure the professional, accountable, and transparent business practices of companies listed on the IDX. According to Jain and Jamali (2016), the literature on corporate governance notes a robust theoretical link between better corporate governance practices and a firm's corporate social responsibility performance (CSR). The link between corporate governance and CSR can be understood through various mechanisms. Firstly, improved corporate governance practices, such as the presence of independent directors, effective board oversight, and transparent reporting, can enhance accountability and transparency within an organization. Consequently, this can lead to better management of social and environmental risks and improved stakeholder engagement. Secondly, effective corporate governance mechanisms can facilitate the adoption of CSR-related policies and practices throughout the organization. For instance, an effective board of directors is crucial in guiding management in implementing CSR initiatives, establishing goals, and tracking progress. Through this, CSR can be integrated into the organizational culture and day-to-day activities, fostering the adoption of sustainable and ethical business practices. In light of this, this study explores How family ownership and supervisory board¹ characteristics impact carbon emission disclosure in Indonesian non-financial listed firms.

The remainder of this paper is organized as follows: The next section provides a literature review and research hypotheses. The third section describes the study's sample, data, and model. The fourth section presents the results, tests, and analysis. The final section concludes the study.

2. Literature Review and Hypotheses Development

Most of the past research regarding family businesses argues that family management uses their concentrated ownership to confiscate the earnings of minority shareholders. This problem is commonly called principal–principal conflict (Miller and Le Breton-Miller 2006). Nevertheless, Anderson and Reeb (2003) note that concentrated ownership in listed family-controlled businesses minimizes the traditional issues of managerial expropriation because the family's wealth is closely associated with business welfare. Moreover, Andres (2008) provides evidence that families prioritize non-monetary goals and are worried about the firm's reputation and existence.

This study uses the socio-emotional wealth (SEW) concept to explain the behavior of family-controlled firms regarding corporate social responsibility activities. The SEW approach argues that the primary goal of the family owners is to preserve the family's SEW (Berrone et al. 2012; Gómez-Mejía et al. 2007). Specifically, Berrone et al. (2012) and Brune et al. (2019) indicate that a critical aspect of SEW is that the decision-making processes in family firms are driven not only by economic goals but also by non-economic objectives. Thus, SEW refers to the non-financial aspects that support the family's needs. These elements include family control and influence, family members' identification with the business, tying up social ties, emotional attachment, and upholding the family's reputation and status in the community (Berrone et al. 2012). The desire to protect SEW may lead family firms to positive outcomes by actively participating in social initiatives such as preserving environmental quality (Cennamo et al. 2012).

This study also refers to the corporate governance philosophy, as it is designed to enhance efficiency and ensure management accountability in the utilization of resources. In the literature, effective corporate governance is frequently associated with high-quality financial reporting and companies' disclosure performance (Arora and Dharwadkar 2011; Martinez-Ferrero et al. 2020; Peasnell et al. 2005). The resource dependence theory offers justifications for the distinctive traits of corporate governance, especially the board of supervisors or board of commissioners. According to resource dependence theory, supervisory

boards are essential for allocating external resources (including image, expertise, background, reputation, and capabilities) and connecting with external organizations. When supervisory boards offer expertise, experience, knowledge, or skills, they are supplying human capital to the board. Likewise, supervisory boards contribute social capital by accessing outside resources and connecting with other organizations (Haynes and Hillman 2010). Thus, supervisory boards are expected to bring different resources to the company. The boards provided with social and human capital might perform their duties and responsibilities more effectively (Ramon-Llorens et al. 2020), which could have a favorable effect on firms' strategic decisions, like supporting corporate social responsibility (CSR) disclosure (Wang and Dewhirst 1992).

In conclusion, Ramon-Llorens et al. (2020) argue that companies with diverse boards will improve information flow by better-influencing decision-making. These firms prefer to share CSR-related information, which could strengthen their connections and relationships with outside stakeholders and organizations. As a result, resource dependence theory adds another viewpoint to governance research by emphasizing the notion that supervisory boards are a company's most important resource (Chalu 2021; Pfeffer and Salancik 1978) and provide stakeholders with better CSR information (Allegrini and Greco 2013).

2.1. Family Ownership and Carbon Emission Disclosure

Aligned with the socio-emotional perspective, families that prioritize self-actualization and the well-being of others may create an atmosphere that is more conducive to meeting higher-level needs, such as increased carbon emission disclosure. Berrone et al. (2012) and Brune et al. (2019) have conducted a study highlighting an essential aspect of socio-emotional wealth in family-run businesses. According to their findings, the decision-making processes in these businesses are not solely driven by economic objectives but also influenced by non-economic goals. In preserving the family's socio-emotional wealth, family owners are willing to take on a higher risk of experiencing poor economic performance (Chua et al. 2015; Stockmans et al. 2010).

Indeed, Cruz et al. (2014) note that different socio-emotional wealth reference points may justify family owners' varied responses to the various strategic outcomes. When family owners prioritize family control, they focus on retaining control over their company to protect their socio-emotional endowment (Anderson and Reeb 2004). Consequently, they may refrain from engaging in corporate social responsibility endeavors that could potentially jeopardize their control (Ashiq Ali and Radhakrishnan 2007). On the other hand, if family owners prioritize family identity, they may place greater importance on acting socially responsibly to uphold a positive family image and protect the family's reputation (Healy and Palepu 2001; Martin et al. 2016).

Research gaps exist regarding the impact of socio-emotional wealth reference points on family firms' involvement in corporate social responsibility. Family businesses often hesitate to disclose their corporate governance practices to maintain control over top management positions without interference from non-family shareholders (Rees and Rodionova 2015). This reluctance to share information is driven by a desire to avoid setting a precedent (Graham et al. 2005). Once information is disclosed, the firm becomes committed to ongoing voluntary disclosures, which may be challenging to stop in the future (Diamond and Verrecchia 1991; Verrecchia 2001). There is some evidence suggesting that non-family businesses tend to prioritize self-interested and self-serving goals rather than focusing on generating CED (Corbetta and Salvato 2004; Le Breton-Miller and Miller 2009). By contrast, family-owned firms have a higher awareness of maintaining a firm's sustainability and increasing the activity of CSR (Dyer and Whetten 2006; Iyer and Lulseged 2013; Zellweger et al. 2011), thus pursuing family-centered non-financial objectives (Andres 2008; Chrisman et al. 2012) that generate SEW (Berrone et al. 2012; Gómez-Mejía et al. 2007; Iyer and Lulseged 2013). Accordingly, our first hypothesis is:

H₁: *Family-controlled firms disclose more carbon emission information.*

2.2. Supervisory Boards Characteristics and Carbon Emission Disclosure

The resource dependence theory suggests that the board of commissioners is central to a company's internal governance (Pfeffer and Salancik 1978). They play a fundamental role in ensuring the company's social and environmental commitment (García-Sánchez and Martínez-Ferrero 2017). Gray et al. (1995) argue that firms with more effective boards will encourage engagement in and facilitate the disclosure of CSR issues. Nam and Nam (2004) claim that a board's size is an essential determinant of a board's effectiveness. Arguably, limited members of the board of commissioners benefit from good communication and coordination, which might lead to better monitoring and control of management (Dey 2008). However, small members might suffer from high workloads and responsibilities, hindering their monitoring role (Beiner et al. 2004). Beiner et al. (2004) claim that more members sitting on the board of commissioners reflect more resources to monitor and evaluate management decisions. Jizi (2017) and Ramon-Llorens et al. (2020) argue that larger boards will be more effective in setting firms' CSR agendas and encouraging the communication of CSR information because they bring various perspectives and backgrounds to the boards. Moreover, previous studies (e.g., Cancela et al. 2020; Mallin and Michelon 2011; Walls et al. 2012) report that the number of board members has a significant and positive impact on the extent of disclosure regarding corporate environmental sustainability. Overall, the research suggests that having a larger board of directors can lead to more comprehensive and transparent reporting on environmental sustainability practices within a company. Furthermore, the diverse perspectives and experiences brought by a larger board can also contribute to more effective decision-making processes when it comes to setting CSR priorities and strategies.

Dechow et al. (1996) suggest that the ability of the supervisory boards to act as an effective monitoring mechanism depends on their independence from management. From a resource-dependence point of view, independent boards are considered resources less allied with the management and family owners (Napitupulu et al. 2020). Greater board independence is associated with more effective monitoring of managerial opportunism; thus, companies can be expected to have more corporate disclosure (Fama and Jensen 1983; Jizi 2017). Previous studies (Adams and Hossain 1998; García-Meca and Sánchez-Ballesta 2010; Patelli and Prencipe 2007) document a positive and significant relationship between the larger proportion of independent members on the board of commissioners and corporate environment disclosure. Independent boards of commissioners are more likely to push for greater transparency and disclosure of corporate information, as they are not directly tied to the management team and are focused on protecting the interests of shareholders.

Prior studies have identified diligence as one of the most critical measures in quantifying the board of commissioners' effectiveness. Although greater time spent by board members does not always translate into more monitoring activities (Menon and Williams 1994), Davidson et al. (2005) contend that frequent board meetings often improve the board's oversight function. Such time must be used for various governance tasks to enhance organizational performance and monitor corporate actions or strategies (Wijethilake et al. 2015). In other words, supervisory boards that meet frequently will likely perform monitoring and advisory duties effectively (Davidson et al. 2005; Lipton and Lorch 1992; Vafeas 1999). Several studies (Allegrini and Greco 2013; Davidson et al. 2005; Kent and Stewart 2008; Lipton and Lorch 1992) note that companies with more frequent board meetings tend to have better disclosure performance. In summary, regular board meetings create a culture of transparency and accountability within the company, providing a platform for open discussions and information sharing. Consequently, this cultivates improved disclosure practices, as companies are inclined to offer precise and timely information to their stakeholders.

One specific goal of the board of commissioners is to promote diversity within the organization's governance structures (Millet-Reyes and Zhao 2010). However, Mahadeo et al. (2012) highlight how board diversity might be conceptualized. Board gender diversity forms a new corporate governance dimension. Numerous initiatives have been implemented worldwide, particularly in Indonesia, to increase gender diversity on the board of commissioners. The Financial Service Authority in Indonesia encourages companies to develop a policy on gender diversity in their executive teams and supervisory boards. The observance of this policy should be noted in the companies' yearly reports (OJK 2014). Huse and Solberg (2006) claim that, compared to males, females are likelier to have better communication skills, personality, commitment, and diligence. Thus, the presence of women on corporate boards will provide more charitable contributions and have higher environmental involvement and social welfare activities (Post et al. 2011; Williams 2003). Previous research (Barako and Brown 2008; Liao et al. 2015; Mallin and Michelson 2011) reports that higher female participation on boards positively influences the effectiveness of a firm's social and environmental profile. These studies highlight the positive impact that gender diversity on corporate boards can have on a company's social responsibility initiatives. Having women on boards can bring different perspectives and priorities to decision-making, leading to a greater focus on sustainability, community engagement, and ethical business practices. Based on the corporate governance and resource dependence theories, we pose the following hypotheses:

H₂: *Firms with a larger board of commissioners disclose more carbon emission information.*

H₃: *Firms with a higher proportion of independent members on the board of commissioners disclose more carbon emission information.*

H₄: *Firms with more frequent board of commissioner meetings disclose more carbon emission information.*

H₅: *Firms with a higher proportion of female members on the board of commissioners disclose more carbon emission information.*

3. Data and Methodology

3.1. Data Collection

This research utilizes balanced panel data and a matched-pair design to examine the environmental performance of both family-owned and non-family-owned companies. Initially, we identified family-controlled companies by referring to the Globe Asia Business Magazine (GlobeAsia 2019). We proceeded to track down the websites of every company group and discovered 62 non-financial family firms that consistently released their annual reports from 2017 to 2019. A matched-control sample of non-family enterprises was carefully selected to ensure a comparison between the two groups was accurate and unbiased. This selection process was based on three specific criteria: fiscal year, industry classification, and the closest total asset amount. The independent-sample *t*-test (results not included for brevity) indicates that the means of total assets of family and non-family firms are not significantly different. Hence, the dataset consists of 124 non-financial companies listed on the IDX that consistently published their annual reports from 2017 to 2019. The analysis was conducted on a balanced panel of 124 firms, resulting in 372 observations over the three years (see Table 1).

The data in Table 1 shows that companies in the property, real estate, and building construction sectors comprise the largest sample size, with 114 observations (30.65%). The second largest is the basic industry and chemical firms, with 30 observations (16.13%). In contrast, the smallest group of firms is in the agriculture and infrastructure, utilities, and transportation sectors, with 24 observations (6.45%), respectively.

Table 1. Sample by the IDX industry classification.

Sector	Industry Classification	2017–2019	
		N	%
1	Agriculture	24	6.45%
2	Mining	36	9.68%
3	Basic industry & chemicals	60	16.13%
4	Miscellaneous industry	24	6.45%
5	Consumer goods industry	54	14.52%
6	Property, real estate & building construction	114	30.65%
7	Infrastructure, utilities & transportation	24	6.45%
9	Trade, services & investment	36	9.68%
Total		372	100.00%

Note: This study excludes industry sector number 8 for finance firms.

3.2. Dependent Variable

The study employs the CED level as the dependent variable and implements a carbon emissions checklist developed by [Choi et al. \(2013\)](#). The measurement of the dependent variable follows the unweighted approach, which assigns equal weight to each disclosure item. This method is more objective than a weighted index approach ([Cooke 1993](#)). The indicator variable is assigned a score of 1 if company *j* discloses information based on the checklist items and 0 if not.

3.3. Independent Variables

We employ family ownership and four dimensions of supervisory board characteristics (board size, board independence, board meeting frequency, female board) as explanatory variables in the model. Family firms are identified by the percentage of equity ownership and the presence of family members in executive or supervisory positions ([Anderson and Reeb 2003](#)).

3.4. Control Variables

In line with prior studies into environmental disclosure, we controlled for variables that might impact the level of carbon emission disclosure. The agency conflicts that arise when firm ownership is dispersed might differ from those when it is concentrated ([Jensen and Meckling 1976](#)). To control the effect of ownership characteristics, we include concentrated ownership as a percentage of outstanding shares owned by the largest shareholder ([Pindado et al. 2008](#); [Yin et al. 2012](#)). The audit committee size is incorporated to address agency issues and minimize information asymmetry between internal and external stakeholders ([Al-Shaer and Salama 2015](#); [Collier 1993](#)). Firm size, leverage, and profitability are included to control for the effect of a firm's visibility, risk, and financial performance ([Al-Tuwaijri et al. 2004](#); [Clarkson et al. 2011](#); [Martinez-Ferrero et al. 2020](#); [Pucheta-Martinez and Gallego-Alvarez 2020](#)). Big4 auditors are incorporated to control the impact of audit quality on disclosure performance. It is a commonly held belief that companies audited by Big4 accounting firms tend to disclose a greater amount of information compared to those audited by non-Big4 firms. ([Craswell and Taylor 1992](#); [Rover et al. 2016](#)). Additionally, we control for price-to-book ratio, cash flow from operations, and firm age due to their documented effects on environmental quality ([Madden et al. 2020](#); [Ramon-Llorens et al. 2020](#); [Tran and Adomako 2020](#)). Table 2 provides a detailed description of the variables.

Table 2. Description of variables.

Title	Description	Source
<i>Dependent variable</i>		
CED	Carbon emission disclosure index. The indicator variable scored 1 if the company discloses information as determined in the checklist items and 0 otherwise.	Faisal et al. (2018); Kalu et al. (2016)
<i>Independent variables</i>		
FAM	The percentage of outstanding shares owned by family members	Anderson and Reeb (2003)
BOARD	The total number of board members as reported by the company	Martinez-Ferrero et al. (2020); Ramon-Llorens et al. (2020)
BOIND	The proportion of independent members on the boards	Patelli and Prencipe (2007); García-Meca and Sánchez-Ballesta (2010)
BOMEET	The number of board meetings held yearly in the company	Martinez-Ferrero et al. (2020); Ramon-Llorens et al. (2020)
FEMALE	The percentage of female board members at the end of the fiscal year	Patelli and Prencipe (2007); García-Meca and Sánchez-Ballesta (2010)
<i>Control variables</i>		
TOP	The percentage of outstanding shares owned by the largest shareholder.	Pindado et al. (2008); Yin et al. (2012)
AC	The total number of audit committees	Collier (1993); Al-Shaer and Salama (2015)
Size	The natural log of total assets	Martinez-Ferrero et al. (2020); Pucheta-Martinez and Gallego-Alvarez (2020)
Leverage	Total debt to total assets ratio	Martinez-Ferrero et al. (2020); Pucheta-Martinez and Gallego-Alvarez (2020)
ROA	Net income to total assets ratio	Martinez-Ferrero et al. (2020); Pucheta-Martinez and Gallego-Alvarez (2020)
Big4	Take a value of 1 if the company's auditor is a Big4 audit firm and 0 otherwise	Craswell and Taylor (1992); Rover et al. (2016)
Age	The natural logarithm of the number of years since the company was established	Ramon-Llorens et al. (2020); Tran and Adomako (2020)
P/B Ratio	The company's stock price per share divided by its book value per share	Madden et al. (2020); Ramon-Llorens et al. (2020)
CFO	Cash flow from operations to total assets ratio	Ramon-Llorens et al. (2020); Tran and Adomako (2020)

3.5. Empirical Model Equations

The primary statistical technique to test the hypotheses is ordinary least squares (OLS) multiple regression. The OLS multiple regression is a highly utilized and adaptable statistical technique that plays a crucial role in analyzing hypotheses and facilitating well-informed decisions through empirical data. The regression models are defined in the following equation:

$$CED_i = a_i + \alpha_{i1}FAM_{it} + \alpha_{i2}BOARD_{it} + \alpha_{i3}BOINDP_{it} + \alpha_{i4}BOMEET_{it} + \alpha_{i5}FEMALE_{it} + \alpha_{i6}Top_{it} + \alpha_{i7}AC_{it} + \alpha_{i8}SIZE_{it} + \alpha_{i9}LEV_{it} + \alpha_{i10}ROA_{it} + \alpha_{i11}BIG_{it} + \alpha_{i12}AGE_{it} + \alpha_{i13}P/BRATIO_{it} + \alpha_{i14}CFO_{it} + IndustryFE_{it} + YearFE_{it} \varepsilon_i$$

4. Findings and Discussions

4.1. Descriptive Statistics

The descriptive statistics and early indications of the relationships between the key variables of interest are shown in Tables 3–5. As exhibited in Table 3, AC-1 was the most published item (96.77%, 100%, and 100%, respectively). Following that is RC-1 (81.45%, 81.45%, and 83.87%, respectively), and the least disclosed item is RC-4 (0.81%, 1.61%, and 0.81%, respectively). Table 3 also demonstrates an upward trend in carbon emission disclosure, which increased from 33.69% in 2017 to 34.95% in 2018 and 36.92% in 2019. These numbers reflect a rise in companies' spending on environmental initiatives. The carbon emission items revealed by family and non-family businesses varied significantly. Family firms provide much more information on the CC-2, EC-3, RC-1, and AC-1. In contrast, non-family companies disclose more information about CE-3, CE-4, CE-7, EC-1, RC-3, and RC-4.

Table 3. Percentage firm disclosed per item by years and family versus non-family.

Code	Carbon Emission Details	Full Sample				Sub-Sample		
		2017	2018	2019	Mean	Family	Non-Family	t-Value
CC1	1. Assessment/description of the risks (regulatory, physical, or general) relating to climate change and actions taken or to be taken to manage the risks	57.26	56.45	61.29	58.33	62.9	53.76	1.791
CC2	2. Assessment/description of current and future financial implications, business implications, and opportunities of climate change	24.19	23.39	23.39	23.66	32.26	15.05	3.976 *
CE1	3. Description of the methods used in calculating GHG emissions (e.g., GHG protocol or ISO)	16.94	18.55	19.35	18.28	18.82	17.74	0.268
CE2	4. Existence of external verification of quantity of GHG emission- if so, by whom and on what basis	13.71	15.32	16.13	15.05	13.98	16.13	−0.579
CE3	5. Amount of GHG Emissions – metric tones CO ₂ -emitted	11.29	11.29	13.71	12.1	5.38	18.82	−4.051 *
CE4	6. Disclosure of scopes 1 and 2 or related to the direct GHG emissions	4.03	3.23	5.65	4.3	1.61	6.99	−2.571 *
CE5	7. Disclosure of GHG emissions based on the sources (e.g., coal, electricity, etc.)	31.45	39.52	42.74	37.9	34.41	41.4	−1.389
CE6	8. Disclosure of GHG emissions based on the facility or level of segment	34.68	35.48	36.29	35.48	33.87	37.1	−0.649
CE7	9. Comparison of the amount of GHG emissions with last year	9.68	11.29	11.29	10.75	1.61	19.89	−5.940 *
EC1	10. Total amount of energy consumption (e.g., tera-joules or petajoules)	23.39	29.84	33.87	29.03	16.67	41.4	−5.446 *
EC2	11. Total amount of energy used from renewable sources	35.48	34.68	38.71	36.29	34.95	37.63	−0.538
EC3	12. Disclosure based on types, facilities, or segments	69.35	67.74	72.58	69.89	76.88	62.9	2.965 *
RC1	13. Detail of plans or strategies to reduce GHG emissions	81.45	81.45	83.87	82.26	87.63	76.88	2.734 *
RC2	14. Specification of GHG emissions reduction target and target year	10.48	6.45	8.87	8.6	6.45	10.75	−1.48
RC3	15. Emissions reductions and associated costs or savings	12.9	13.71	12.9	13.17	7.53	18.82	−3.257 *
RC4	16. Cost of future emissions factored into capital expenditure planning	0.81	1.61	0.81	1.08	0	2.15	−2.016 **
AC1	17. Indication of which board committee (or other executive body) has overall responsibility for actions related to climate change	96.77	100	100	98.92	100	97.85	2.016 **
AC2	18. Description of the mechanism by which the board (other executive body) reviews the company's progress regarding climate change	72.58	79.03	83.06	78.23	77.42	79.03	−0.376
Mean		33.69	34.95	36.92	35.19	34.02	36.35	−1.414

Legend: * and ** indicate significance at $p < 0.01$ and $p < 0.05$ (based on two-tailed tests). CC = Climate change: risks and opportunities; CE = Carbon emissions; EC = Energy consumption; RC = Carbon emission reduction and cost; AC = Carbon emission accountability.

Table 4. Number of items disclosed per theme by industry.

Industry Sector Classification	Percentage of Items Disclosed Per Theme					Mean
	CC	CE	EC	RC	AC	
1-Agriculture	60.42	35.12	47.22	31.25	89.58	45.14
2-Mining	61.11	22.22	60.19	25.69	94.44	41.67
3-Basic industry & chemicals	53.33	28.81	55.00	28.75	99.17	43.70
4-Miscellaneous industry	18.75	12.50	30.56	36.46	81.25	29.17
5-Consumer goods industry	36.11	18.78	50.00	25.46	87.96	35.08
6-Property, real estate & building construction	37.72	8.27	33.04	23.03	85.96	27.58
7-Infrastructure, utilities & transportation	35.42	38.10	68.06	32.29	95.83	47.92
9-Trade, services & investment	23.61	15.87	37.04	20.14	73.61	27.62
The mean of disclosure per the theme	40.99	19.12	45.07	26.28	88.58	35.19

Legend: CC = Climate change: risks and opportunities; CE = Carbon emissions; EC = Energy consumption; RC = Carbon emission reduction and cost; AC = Carbon emission accountability.

Table 5. Descriptive statistics.

	Mean	Median	Std Dev	Min	Max
Panel A—Continuous Variables					
Independent Variable:					
FAM	54.44	52.72	15.78	24.05	92.4
BOARD	4.92	5	1.84	2	11
BOIND	41.21	40	11.08	20	100
BOMEET	7.53	6	3.85	2	31
FEMALE	0.11	0	1.27	0	0.67
Control Variables:					
AC	3.15	3	0.49	2	5
TOP	58.98	57.27	17.43	23.32	96.31
SIZE (Total Sales in million IDR)	12,614,178	3,917,768	25,172,610	24,569	239,205,000
LEV	46.47	48.11	19.46	4.15	97.26
ROA	4.84	3.76	8.17	−40.14	50.67
AC	37.5	37.08	17.2	3.17	98.92
TOP	2.53	1.13	5.57	0.09	46.5
SIZE (Total Sales in million IDR)	5.73	4.89	9.72	−27.69	
Panel B—Categorical Variables				Freq.	%tage
Control Variables:					
NON-BIG4				208	55.91
BIG4				164	44.09

Table 4 presents the percentage of items disclosed per theme by each industry. The firms that disclose the greatest (47.92%) carbon emission information are those in the infrastructure, utilities, and transportation sectors. Firms in the agriculture sector (45.14%) come in second, while companies in property, real estate, and building construction (27.58%) have the lowest disclosure levels. Table 4 shows that the theme for the AC category has received the highest disclosures (88.58%) by the sample firms, followed by the themes for the EC (45.07%) and the CC categories (40.99%). Interestingly, the CE is the lowest disclosed by the sample firms. With a mean of 35.19%, the CED score varies between 27.58% (in the property, real estate, and building construction sectors) and 47.92% (in the infrastructure, utilities, and transportation sectors). This score is significantly less than the results of 52.8% by [Faisal et al. \(2018\)](#). The reason could be that most companies in our sample are from the property, real estate, and building construction industries, with the least disclosed carbon

emission items. The mining, basic industry, and chemicals, infrastructure, utilities, and transportation sectors have been designed as sensitive industries under Government Law No. 32/2009 on environmental protection and management. In line with Law No. 32/2009, our findings imply that companies in these industry sectors take the lead in providing information on carbon emissions.

Table 5 exhibits the univariate descriptive statistics of the independent and control variables in the study. Panel A displays the statistical summary for continuous variables, while Panel B demonstrates the dummy regression variables.

According to Table 5, Panel A, on average, family members own about 54.44% of the stock in the sample company. The board size ranges from two to 11 members, with a mean of five. The percentage of independent members on the board of commissioners is 41.21%, somewhat more than the 33.33% mandated by Financial Services Authority Regulation (POJK) No. 33/2014. The board meeting frequency ranges from two to 31, with an average of eight. According to POJK 33/2014, the board of commissioners must meet at least once every two months. Of the total number of board members, women make up 11%. This lower percentage of female board members reflects the corporate governance practices in Indonesia. The average number of members of audit committees is three. This number complies with POJK No. 55 of 2015, which calls for at least three audit committee members. More than half (58.98%) of the outstanding shares of the firms are held by the top ten stockholders, with a median shareholding of 57.27% and a standard deviation of 17.43%.

The mean of companies' total sales in the sample years is IDR12,614,178 million, with a median of IDR3,917,768 million. The median value is much lower than the mean figure, suggesting a small number of substantially capitalized companies in the sample firms. The sample's total sales likewise have a wide range of minimum and maximum values, and the data indicate that total sales are skewed to the left. Consistent with the methodology applied in other studies, this study converts total sales into the natural logarithm to determine a firm's size. The average total debt-to-assets ratio (LEV) is 46.47%, with a median of 48.11%. The low mean ROA (4.84%) indicates that firms experienced financial hardship during the sample year periods. The AGE variable averages 37.50 years and has a median of 37.08 years. The mean market-to-book value is 2.53%. In addition, our sample firms generate small amounts (5.73% of the total assets) of cash flow from operations. Finally, Panel B shows that the Big 4 firms audited around 44.09% of the sample observations, suggesting they are a prominent source of audit services for the Indonesian capital market.

4.2. Correlations

Table 6 illustrates the Spearman correlation matrix to assess for multicollinearity among the variables employed in this study. Correlation results support the study's hypotheses, except for independent boards (BOIND). The results reveal that family ownership (FAM), board size (BOARD), and board meeting frequency (BOMEET) are significantly positively correlated (at $p < 0.01$) with CED. Additionally, there is a negative and significant (at $p < 0.01$) relationship between women's boards of directors (FEMALE) and CED. The correlation coefficients of all variables are lower than the critical threshold of 0.80 (Cooper and Schindler 2003). Hence, we assert that there is no indication of multicollinearity among the variables in the regression models.

Table 6. Correlation matrix.

	CED	FAM	BOARD	BOIND	BOMEET	FEMALE	AC	TOP	SIZE	LEV	ROA	BIG4	AGE	P/B RATIO
FAM	0.139 *													
BOARD	0.392 *	−0.052												
BOIND	−0.053	−0.048	−0.018 *											
BOMEET	0.208 *	−0.123 **	0.134 *	−0.077										
FEMALE	−0.159 *	−0.002	0.096	0.009	0.121 **									
AC	0.250 *	−0.170 *	0.264 *	−0.139 *	0.229 *	−0.043								

Table 6. Cont.

	CED	FAM	BOARD	BOIND	BOMEET	FEMALE	AC	TOP	SIZE	LEV	ROA	BIG4	AGE	P/B RATIO
TOP	0.008	−0.002	−0.084	−0.022	0.046	−0.101 *	0.082							
SIZE	0.465 *	0.035	0.425 *	0.049	0.132 *	0.028	0.288 *	−0.099						
LEV	0.199 *	−0.124 **	0.099	−0.012	0.164 *	0.148 *	0.160 *	−0.179 *	0.246 *					
ROA	0.238 *	0.176 *	0.175 *	0.082	−0.085	−0.126 **	0.079	−0.003	0.342 **	−0.234 *				
BIG4	0.296 *	0.060	0.343 *	−0.064	0.048	−0.140 *	0.234 *	0.05	0.440 *	−0.026	0.207 *			
AGE	0.222 *	−0.076	0.259 *	−0.033	0.284 *	0.054	0.180 *	0.061	0.310 *	0.092	−0.030	0.175 *		
P/B RATIO	0.230 *	0.111 **	0.102	0.083	0.065	−0.008	0.124 **	−0.022	0.271 *	−0.020	0.513 *	0.184 *	0.071	
CFO	0.288 *	0.142 *	0.192 *	0.068	−0.066	−0.024	0.068	0.042	0.346 *	−0.147 *	0.553 *	0.302 *	−0.006	0.464 *

Legend: * and ** indicate significance at $p < 0.01$ and $p < 0.05$ (based on two-tailed tests).

4.3. Multivariate Regression Results

Table 7 provides the outcome of multiple regression for testing our main hypothesis. Panels A to E present results from regressions with only one independent variable. Panel F shows the results of all independent variables in one multiple regression. The highest reported VIF is 2.694 (not included in the table), thus confirming that multicollinearity is not a concern. The results of regression analyses support the hypotheses that family firms (H_1) and firms with larger board sizes (H_2) disclose more carbon emission information. However, our research findings do not provide evidence supporting the notion that having independent supervisory board members (H_3) and board meeting frequency (H_4) is linked to better carbon performance. Finally, our research reveals that, contrary to H_5 , the presence of women on corporate boards has a negative impact on the carbon performance of Indonesian firms.

Table 7. Main regression results.

	Panel A		Panel B		Panel C		Panel D		Panel E		Panel F	
	Beta	t-Stat	Beta	t-Stat	Beta	t-Stat	Beta	t-Stat	Beta	t-Stat	Beta	t-Stat
(Constant)												
FAM	0.052	−3.161 *		−2.325 **		−2.436 *		−2.611 **		−2.763 *	0.057	−2.461 *
BOARD		2.772 *	1.121	3.333 *							1.265	3.118 *
BOIND					−0.054	−1.096					1.265	3.756 *
BOMEET							0.193	1.296			−0.035	−0.713
FEMALE									−7.240	−2.203 **	0.257	1.761
AC	2.772	2.337 **	1.779	1.524	2.070	1.751	1.825	1.511	2.067	1.762	−1.566	−2.244 **
TOP	0.056	1.733	0.064	1.994 **	0.053	1.638	0.051	1.564	0.049	1.518	1.764	1.472
SIZE	1.659	3.907 *	1.431	3.306 *	1.764	4.135 *	1.787	4.191 *	1.738	4.095 *	0.059	1.872
LEV	2.415	0.718	1.720	0.517	1.608	0.476	1.005	0.297	2.455	0.724	1.366	3.192 *
ROA	−0.776	−0.075	0.817	0.079	0.772	0.074	−0.336	−0.032	−1.808	−0.173	3.116	0.938
BIG4	0.424	0.333	0.043	0.034	0.576	0.448	0.683	0.530	0.311	0.242	−2.286	−0.223
AGE	1.474	1.423	0.889	0.857	1.331	1.275	1.043	0.979	1.557	1.491	−0.226	−0.179
P/B RATIO	0.364	2.869 *	0.337	2.679 *	0.334	2.619 *	0.330	2.591 *	0.303	2.380 **	0.878	0.841
CFO	−0.562	−0.066	−1.890	−0.222	−0.443	−0.051	1.706	0.197	2.631	0.306	0.341	2.736 *
YEAR FE	Yes		Yes		Yes		Yes		Yes		0.040	0.005
INDUSTRY FE	Yes		Yes		Yes		Yes		Yes		Yes	
Adj. R-Sq.	0.385		0.391		0.374		0.375		0.380		0.412	
F-Statistic	13.239 *		13.542 *		12.667 *		12.709 *		12.989 *		12.307 *	
Sample	372		372		372		372		372		372	

Legend: * and ** indicate significance at $p < 0.01$ and $p < 0.05$ (based on two-tailed tests).

Panels A and F report that the coefficients on the FAM are positive and significant at $p < 0.01$ related to the level of CED, suggesting that family members control a large proportion of companies' shares associated with an increasing level of CED. Thus, the result supports H_1 . Our findings demonstrate the advantages of family-controlled businesses over non-family firms, most likely due to decreased agency costs in publicly traded companies in Indonesia (Anderson and Reeb 2003). Our findings confirm the SEW hypothesis that family businesses are more likely to uphold an outstanding image for the company, which results in increased awareness and orientation toward sustainability and CSR initiatives (Dyer and Whetten 2006; Iyer and Lulseged 2013; Zellweger et al. 2011). Therefore, the results are consistent with previous studies, which show that family owners prioritize

social rights and non-economic goals by maintaining better environmental quality (Andres 2008; Berrone et al. 2012; Chrisman et al. 2012; Gómez-Mejía et al. 2007; Iyer and Lulsegged 2013). However, our finding contradicts prior studies (Akrouf and Othman 2013; Chen and Jaggi 2001; Muttakin and Khan 2014; Vural 2018) that document family firms tend to be less socially responsible. This inconsistency might exist due to Indonesia's unique legal, political, and cultural values, as examined in past studies.

The regression coefficients for BOARD are positive and statistically significant at $p < 0.01$ (Panels B and F); thus, they support the board size hypothesis H₂: Firms with a larger board of commissioners disclose more carbon emission information. This finding suggests that boards with a larger number of members can bring a variety of perspectives and skills. They are better equipped to understand the needs and expectations of various stakeholders, including employees, customers, communities, and investors. This understanding can facilitate the development and implementation of CSR initiatives (Beiner et al. 2004; Gray et al. 1995) and the effective communication of CED information to meet societal needs (Jizi 2017; Ramon-Llorens et al. 2020). By promoting inclusivity, equity, and comprehensive understanding, large boards can effectively set CED agendas, make informed decisions, and contribute to the sustainable development of organizations and society. In addition, empirical evidence from previous studies (Cancela et al. 2020; Mallin and Michelon 2011; Walls et al. 2012) supports the notion that the size of the supervisory board has a positive and significant impact on the disclosure level of corporate environmental sustainability.

The findings reported in Panels C and F do not support H₃ regarding the positive effect of board independence on CED. Our results fail to support prior studies (e.g., Adams and Hossain 1998; García-Meca and Sánchez-Ballesta 2010; Patelli and Prencipe 2007) that claim that independent members on the board positively impact corporate social disclosure.

According to our results, the fact that independent members sit on the boards does not lead to a higher disclosure of carbon emission information. Yet, independent board members presume to have a broader outlook beyond companies' financial performance and to be more inclined toward social responsibility and disclosure (Arora and Dharwadkar 2011). However, our findings note that this does not guarantee that their attitude toward CED will differ from that of the other members. The relationship between independent board members and carbon emission disclosure is more complex than previously thought. While independent commissioners are expected to act in the best interest of shareholders and hold management accountable, they may not always prioritize environmental concerns or have the expertise to evaluate and push for increased disclosure of carbon emissions. A possible explanation is that our sample's proportion of independent boards is slightly larger (Table 5) than the minimum number required by PJOK No. 3/2014. Thus, an independent board of commissioners seems to comply with regulations and has not significantly impacted carbon emission performance. Despite the common belief in mainstream corporate governance practices and the requirement for Indonesian listed companies to have at least 33.33% independent commissioners, there is no clear indication that these independent commissioners significantly enhance environmental sustainability.

The coefficients on BOMEET (Panel D and F) are positive but statistically insignificant, suggesting no direct link between the diligence or overall activity of the board and carbon emission performance for our study sample. Our results are consistent with a study by Haji (2013) in Malaysia. Although previous literature (e.g., Davidson et al. 2005; Kent and Stewart 2008; Lipton and Lorch 1992; Vafeas 1999) argues that meeting frequency has been associated with better firm performance and higher reporting quality, it can turn out to have a less significant impact when the meeting is filled with less crucial agendas (Menon and Williams 1994). Further, Menon and Williams (1994) argue that the higher frequency of board meetings is seen as only a rough estimation of board activities as it does not indicate the quality and work accomplished during the meeting. In summary, the frequency of board meetings is often viewed as an indicator of the level of activity and engagement of supervisory boards in carrying out their duties; however, it is important to note that the

number of meetings does not always reflect their effectiveness or productivity or enhance monitoring quality.

Opposite to our H₅, the coefficients on FEMALE are negative and statistically significant at $p < 0.05$ (Panels E and F), suggesting that the participation of women on corporate boards has a negative influence on Indonesian firms' carbon emission reporting. This finding raises questions about the effectiveness of gender diversity in corporate governance in promoting environmental responsibility. Our results align with a study by Cucari et al. (2018) and Qosasi et al. (2022), who report a negative and significant relationship between female boards of directors and environmental, social, and governance performances. Including women in commissioner roles does not seem to result in increased oversight. Despite common arguments suggesting that diversity in board composition could bring unique perspectives and enhance monitoring effectiveness, our findings do not support this notion. The limited presence of female directors included in our sample (as indicated in Table 5) might be a contributing factor to their minimal influence on board decisions, as the majority vote often sways them. Culture could be another potential factor that may be associated with this phenomenon. Lindawati and Smark (2015) asserted that within Indonesian culture, particularly Javanese culture, a belief exists that women should not place the same level of importance on their careers as men. Women are traditionally seen as followers and expected to adhere to men's leads. Past literature argues that women's representation appears to have minimal impact unless a critical mass of at least three members is present on a board (Post et al. 2011). Our findings fail to verify a study by Barako and Brown (2008), Mallin and Michelon (2011), and Liao et al. (2015), who highlighted that a high proportion of females on boards is positively associated with companies' CSR performance. Those authors imply that the presence of a woman on the boards of directors promotes the establishment, implementation, and reporting of social and environmental-related policies. Thus, a women's board of directors enhances shareholders' social welfare and boosts the firm's reputation.

4.4. Additional Analyses

To boost the credibility of the main findings, we carried out a variety of extra analyses. First, it is suggested that family-owned businesses can have both advantages and disadvantages when running the company (Anderson and Reeb 2003). When ownership within the family is less concentrated, it has a favorable effect on business performance, supporting the monitoring hypothesis. However, as the level of family share ownership increases, the relationship between the two variables becomes negative. Combining these two assumptions leads to the prediction of a non-linear relationship between concentrated family ownership and the disclosure of carbon emissions. Similarly, Boone et al. (2007) contend that the size of a board reflects a trade-off between the specific advantages and disadvantages of monitoring within a firm. Consequently, numerous empirical studies have endeavored to determine the ideal size for a company's board of directors. Lipton and Lorch (1992) provide evidence that a board size of less than ten is optimal, as a smaller board functions more effectively and is less susceptible to manipulation by delegated directors. Conversely, Jensen (1993) proposes that supervisory board sizes in the US tend to be excessively large and recommends that boards consist of no more than eight members. Table 8 examines the nonlinearities between family ownership, board of commissioner size, and carbon emission performance.

The coefficients for family ownership and its square in Panels A and C are positive and negative ($p < 0.01$ and $p < 0.05$), showing a non-linear link between family businesses and carbon performance. The results infer that carbon performance improves as family ownership rises to a certain amount (the inflection point is 42.34%, but omitted in the table for conciseness), providing evidence for the monitoring hypothesis. Once family equity exceeds this threshold, carbon performance decreases, leading to the dominance of the expropriation hypothesis. The majority family shareholders may take advantage of their control over the company to the detriment of the minority shareholders. Our results

suggest that while family ownership can initially lead to better carbon performance due to the family's long-term perspective and commitment to sustainability, there is a tipping point where the interests of the majority family shareholders may diverge from those of the minority shareholders and the broader stakeholder community. This deterioration can be attributed to several factors. Firstly, as family ownership increases, there is often a lack of external oversight and accountability, leading to a decrease in implementing sustainable practices. Additionally, as family ownership becomes more concentrated, decision-making power becomes centralized within a smaller group of individuals. This phenomenon can lead to a lack of diversity in perspectives and ideas, hindering innovation and the adoption of environmentally friendly technologies and practices.

Table 8. Nonlinearities relationship.

Variables	Panel A		Panel B		Panel C	
	Beta	t-Stat	Beta	t-Stat	Beta	t-Stat
(Constant)		−3.598 **		−3.522 *		−2.943 *
FAM	1.235	2.500 *	1.055	2.774 *	1.244	2.590 *
FAM -Square	−1.401	−1.958 **			−1.469	−2.052 **
BOARD	1.639	4.705 *	3.251	2.353 **	3.486	2.526 *
BOARD-Square			−4.133	−1.238	−4.608	−1.383
BOIND	−0.059	−1.133	−0.065	−1.261	−0.057	−1.102
BOMEET	0.339	2.132 **	0.406	2.568 *	0.357	2.242 **
FEMALE	−2.687	−3.667 *	−2.705	−3.681 *	−2.640	−3.605 *
AC	2.254	1.772	2.292	1.797	2.250	1.771
TOP	−0.041	−0.875	0.022	0.650	−0.044	−0.942
SIZE	1.799	4.382 *	1.3827	4.406 *	1.872	4.528 *
LEV	5.440	1.621	5.905	1.758	5.435	1.621
ROA	−22.493	−2.145 **	−20.863	−1.980 **	−21.565	−2.055 **
BIG4	1.314	0.992	1.168	0.882	1.472	1.108
AGE	0.993	0.918	0.918	0.845	0.937	0.867
P/B RATIO	0.134	1.056	0.159	1.262	0.130	1.030
CFO	21.527	2.522 *	21.329	2.490 *	21.232	2.490 *
YEAR FE		Yes		Yes		Yes
INDUSTRY FE		Yes		Yes		Yes
SUMMARY						
Adj. R-Squared		0.303		0.301		0.307
F-Statistic		11.885 *		12.657 *		11.290 *
Sample Size		372		372		372

Legend: * and ** indicate significance at $p < 0.01$ and $p < 0.05$ (based on two-tailed tests).

The coefficients for BOARD and BOARD-Square (Panels B and C) are positive and negative, which may indicate a non-linear relationship between board of commissioner size and carbon performance. However, the coefficients for BOARD-Square are statistically not significant and thus do not confirm a non-linear relationship between board size and carbon emission disclosure.

Second, this study examines the impact of family involvement in the firm. Family members in key management roles can better align the company's interests, enhancing firm performance and reputation (Anderson and Reeb 2003). We use two active family controls, considering the family member's participation in the CEO (FAMCEO) and the board of commissioners (FAMBOC). The value of FAMCEO is denoted as 1 if the family controls the company and a family member serves as the chief executive officer; otherwise, it is set to 0. FAMBOC is the total number of family members on the commissioners' board. Table 9 provides a summary of the outcomes of this extra examination. Panels A and C indicate a positive but statistically insignificant effect of the family CEO on the level of CED, implying that the presence of a family member in the CEO position has no significant impact on carbon emission performance. One explanation might be that a family CEO prioritizes and considers environmental performance using different frames of reference. The coefficients on FAMBOC are positive and significant at $p < 0.01$ (Panels B and C). These results are consistent with a study by Ibrahim and Angelidis (1995) and Garcia-Sanchez et al. (2014) suggesting that family members who serve on the board of commissioners

often demonstrate a greater interest in social and environmental issues while also being conscious of the public's expectations for improving the company's reputation. This finding also suggests that the family utilizes their position on the board to influence the company's carbon emission performance.

Table 9. Active family control and carbon emission disclosure.

Variables	Panel A-Family CEO		Panel B-Family BOC		Panel C-Active Family Control	
	Beta	t-Stat	Beta	t-Stat	Beta	t-Stat
(Constant)		−2.429 **		−2.605 *		−2.597 *
FAM	0.053	2.608 *	0.038	2.282 **	0.038	2.263 **
FAMCEO	0.669	0.429			0.062	0.039
FAMBOC			1.250	2.017 **	1.256	1.968 **
BOARD	1.283	3.776 *	1.209	3.592 *	1.207	3.544 *
BOIND	−0.034	−0.693	−0.027	−0.550	−0.027	−0.583
BOMEET	0.521	1.709	0.247	1.695	0.247	1.689
FEMALE	−1.640	−2.279 **	−2.014	−2.761 *	−2.009	−2.712 *
AC	1.798	1.496	2.272	1.863	2.271	1.860
TOP	0.062	1.913	0.074	1.855	0.074	1.768
SIZE	1.355	3.158 *	1.338	3.138 *	1.339	3.132 *
LEV	3.158	0.949	3.974	1.192	3.974	1.190
ROA	−2.468	−0.240	−2.546	−0.250	−2.530	−0.248
BIG4	−0.245	−0.194	−0.730	−0.569	−0.730	−0.569
AGE	0.836	0.795	0.749	0.719	0.753	0.719
P/B RATIO	0.339	2.717 *	0.327	2.633 *	0.327	2.629 *
CFO	−0.099	−0.012	0.917	0.108	0.934	0.110
YEAR FE		Yes		Yes		Yes
INDUSTRY FE		Yes		Yes		Yes
SUMMARY						
Adj. R-Squared	0.411		0.417		0.416	
F-Statistic	11.774 *		12.068 *		11.552 *	
Sample Size	372		372		372	

Legend: * and ** indicate significance at $p < 0.01$ and $p < 0.05$ (based on two-tailed tests).

The third test explores how boards' social and human capital affect carbon emission disclosure. We also examine the influence of the power of boards as moderators on the association between the supervisory board categories and CED. Haynes and Hillman (2010) argue that when board members deliver expertise, background, knowledge, or skills, they are supplying human capital to the board. The boards provide social capital when they have external resources and maintain connections with external organizations. Thus, the board of commissioners should not be considered homogeneous. Following Ramon-Llorens et al. (2020) and Armano and Scagnelli (2012), we classify members of the board of commissioners into four categories: industry experts (BOINDUS), advisors (BOADV), community leaders (BOLEAD), and academic (BOACAD) backgrounds. This category is based on the taxonomy of directors' resource dependence roles proposed by Hillman et al. (2000). Board members with industry experts (BOINDUS) when they have expertise, capabilities, and a professional background as an executive or top management. BOADV is when these boards have developed their role as insiders in auditing, accounting, financial, marketing, or other consulting companies. BOLEAD is when the members can be classified as politicians, heads of non-profit organizations, or other significant public positions. Finally, BOACAD is when they are currently or formerly a faculty member².

Panel A of Table 10 presents the effect of board members classified as industry experts, advisors, community leaders, and academic backgrounds on CED. Interestingly, the coefficients on those four categories of boards are all negative but statistically insignificant, suggesting that the attitude toward CED will not differ from those categories of boards. In addition, we investigate the moderating effect of boards under the proposition that boards expose substantial influence on CED when they have a large member size. We generate a moderator variable (board power) to test this hypothesis. Board power (POWERBO) is a dummy variable equal to 1 if the total number of board members is higher

than its median value and 0 otherwise. Panel B of Tabel 10 exhibits results from regressions with the moderating effect of board power (BOPOWER) for all board of commissioner backgrounds. The coefficients on POWERBO*BOINDUS and POWERBO*BOADV are negative but statistically insignificant, implying that the interaction effect between a board of commissioners and both specific knowledge (industry expertise and advisor) does not have a significant influence on carbon emission quality. Additionally, the positive association between POWERBO*BOLEAD and CED suggests that a more significant board member with a community leader background might make companies more sensitive to environmental issues. However, this coefficient is statistically not significant. Concerning board members with academic backgrounds, Panel B exhibits a negative and statistically significant (at $p < 0.01$) impact of boards with educational backgrounds on CED for firms with high-powered boards. This result suggests that the adverse effects of boards on CED (Panel A) are more robust for companies with a high presence of academic members on the board of commissioners. Our finding indicates that the dominance of faculty staff on the supervisory board tends to lower carbon emission performance. The possible explanation for these results is the faculty staff's lack of managerial skills and entrepreneurial experience (Cyert and Goodman 1997; Litan et al. 2007). Another argument is because of the lack of time caused by their academic commitments or the conflicts between the university and business cultures (Armano and Scagnelli 2012). Similarly, Yin et al. (2012) argue that those board members have exclusively an academic background and little practical and industrial experience, which limits their role.

Table 10. Board characteristics and carbon emission disclosure.

Variables	Panel A		Panel B	
	Beta	t-Stat	Beta	t-Stat
(Constant)		−2.604 *		−3.119 *
FAM	0.060	3.038 *	0.067	3.365 *
BOARD	1.395	4.058 *	1.423	2.783 *
BOINDUS	−1.090	−0.284	5.263	1.121
BOADV	−0.727	−0.298	1.889	0.642
BOLEAD	−3.995	−1.660	−6.624	−2.270 **
BOACAD	−4.064	−0.906	8.398	1.368
POWERBO			14.410	1.557
POWERBO*BOINDUS			−14.023	−1.582
POWERBO*BOADV			−2.587	−0.469
POWERBO*BOLEAD			5.357	1.135
POWERBO*BOACAD			−5.448	−2.751 *
BOIND	−0.007	−0.137	0.008	0.153
BOMEET	0.319	2.065 **	0.250	1.597
FEMALE	−1.700	−2.419 *	−1.474	−2.040 **
AC	2.705	2.089 **	2.871	2.207 **
TOP	0.058	1.761	0.079	2.379 **
SIZE	1.496	3.418 *	1.413	3.227 *
LEV	1.812	0.530	2.947	0.859
ROA	−2.717	−0.265	−4.404	−0.430
BIG4	−0.770	−0.592	−0.745	−0.572
AGE	1.107	1.004	0.771	0.684
P/B RATIO	0.338	2.700 *	0.323	2.586 *
CFO	−0.579	−0.068	−0.590	−0.069
YEAR EFFECT		Yes		Yes
INDUSTRY EFFECT		Yes		Yes
SUMMARY				
Adj.R-Sq		0.410		0.420
F-Statistic		10.658 *		9.397 *
Sample		372		372

Legend: * and ** indicate significance at $p < 0.01$ and $p < 0.05$ (based on two-tailed tests).

5. Conclusions

5.1. Discussion of Results

This study investigates the impact of family ownership and supervisory board characteristics on carbon emission disclosure. This study proposes five hypotheses (H_1 to H_5): Family ownership, larger supervisory board sizes, more independent board members, frequent board meetings, and more female board members disclosing more carbon emission information. The regression analysis findings confirm that family firms (H_1) and firms with larger board sizes (H_2) tend to disclose a greater amount of carbon emission information. Nevertheless, our research results do not support the notion that having independent supervisory board members (H_3) and frequent board meetings (H_4) are associated with improved carbon performance. Lastly, our research indicates that, contrary to hypothesis H_5 , the participation of women on corporate boards has a detrimental effect on the carbon performance of Indonesian companies.

The study reveals a significant positive association between family firms and carbon emission performance. The results support the SEW theory, which argues that family-controlled firms are more likely to be driven by non-financial goals than exclusively financial objectives (e.g., [Berrone et al. 2012](#); [Chrisman et al. 2012](#); [Gómez-Mejía et al. 2007](#)). Specifically, family firms tend to maintain the firm's excellent reputation, leading to higher awareness and orientation towards sustainability and corporate social responsibility activities. Consistent with prior research ([Cancela et al. 2020](#); [Mallin and Michelon 2011](#); [Walls et al. 2012](#)), this study also finds that supervisory board size is positively associated with carbon performance. Our results align with the resource dependency theory, which contends that firms with larger and more diverse boards will be more successful in establishing their CSR agendas and promoting the dissemination of CSR information because these boards represent a more comprehensive range of perspectives and backgrounds ([Jizi 2017](#); [Ramon-Llorens et al. 2020](#)). Contrary to our expectations, the OLS model reports that independent members on the boards and board meeting frequencies do not influence the carbon emission performance of Indonesian non-financial firms. These findings negate the belief that a resource-rich board of commissioners contributes to better reporting practices. Although resource dependence theory notes that those board characteristics are assumed to be the platform to protect shareholders' interests, they have not been well demonstrated in the Indonesian context. Additionally, our result suggests that female boards of commissioners have a negative impact on Indonesian firms' carbon emission reporting.

The additional analyses confirm a non-linear relationship between concentrated family ownership and the disclosure of carbon emissions. Family firms initially improve carbon performance due to the family's long-term perspective and dedication to sustainability. However, once family equity exceeds a specific threshold, the performance of carbon emissions starts to decline. Furthermore, family board members are positively and significantly associated with carbon emission disclosure. Our findings suggest that family-controlled firms are more likely to use their indirect influence through substantial ownership and a seat on the board, corresponding to their commitment to the greater good of the environment and, thus, SEW objectives. In other words, the family remains attached to their business despite giving up executive positions. Finally, we find a negative and significant impact of boards with academic backgrounds on carbon emission disclosure for companies with high-powered boards. Our results indicate that the dominance of faculty staff on the board of commissioners tends to lower carbon performance. Faculty members, renowned for their expertise in various academic disciplines, bring a unique perspective to the supervisory board. Their presence is often sought after due to their extensive knowledge and research in environmental science, sustainability, and corporate social responsibility. While their inclusion may seem beneficial in promoting environmentally conscious practices, our findings suggest otherwise.

5.2. Theoretical Implications

This study's results infer that understanding SEW precepts and how they relate to families is crucial to comprehending Indonesian corporate carbon emissions disclosures. Family-controlled entities tend to disclose more information about their carbon emissions than non-family firms. This finding implies that the SEW agenda of family businesses may be better aligned with efforts to minimize emissions and promote transparency and accountability for their environment. Specifically, family involvement in the board of commissioners is linked to higher levels of carbon emission disclosure. The results of this research contribute to the global body of knowledge by investigating the possible advantages of family business environmental practices. Additionally, this study expands on the existing literature regarding corporate governance, mainly focusing on the significance of supervisory boards, and supports the resource dependence theory by highlighting the critical role of supervisory boards in monitoring functions. The study supports the view that board commissioners are a company's most valuable resource in improving the quality of corporate environmental disclosure (Allegrini and Greco 2013; Chalu 2021; Pfeffer and Salancik 1978).

5.3. Practical Implications

This study highlights the importance of understanding familial motivations and family board memberships when formulating policies to improve information transparency on Indonesian carbon emissions. A deeper understanding of familial SEW leanings may benefit corporate Indonesia in managing carbon emission reduction or understanding the carbon cycle. By comprehending these motivations, policymakers can tailor their strategies and initiatives to align with the values and priorities of families. The non-linear relationship between family ownership and carbon performance highlights the importance of monitoring and governance mechanisms to prevent the potential negative impacts of excessive family ownership on environmental performance. Firms with significant family ownership should consider implementing transparent reporting, independent board oversight, and stakeholder engagement to prioritize the interests of all shareholders and maintain a strong commitment to sustainability. The implications of our findings extend beyond the specific context of our study. They hold importance for other developing economies that share similar economic and cultural contexts. These economies can learn from our research and apply the insights to their family businesses and corporate governance practices.

5.4. Research Limitations

There are certain constraints associated with this study. The carbon emission data were gathered from the annual reports of publicly listed firms between 2017 and 2019. It is recommended that future research concentrate exclusively on sustainability or social responsibility reports as a data source for capturing and analyzing carbon emission information. These reports are expected to analyze event firms' communication regarding carbon emission disclosure comprehensively. Furthermore, our research thoroughly examines data before the emergence of COVID-19. Future studies may explore the time frame encompassing COVID-19 (including datasets from 2020 to 2022) to determine if there are any discrepancies in the results.

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Notes

- ¹ Indonesia has a two-tier board structure, the management team is responsible for governance, while the supervisory board is in charge of oversight. The board of commissioners has been given the formal name by the supervisory board. For this reason, throughout the paper, the terms ‘supervisory board’ and ‘board of commissioners’ will be used interchangeably.
- ² In Indonesia, the board of commissioners is not a full-time position. Thus, it is very common, for example, a professor of a university is also a member of the board of commissioners in a publicly listed company.

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