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CARBON DISCLOSURE AND FIRM PERFORMANCE: THE ROLE OF THE UPPER ECHELONS

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Abstract

The characteristics of the upper echelons reflect the propensity of firms to disclose their carbon. This study examines gender diversity and family ownership in Indonesia as the instrumental variables in mediating the relationship between carbon disclosure and firm performance. The sample consists of 423 firm-year observations from 2008 to 2020. The findings validate gender diversity and family firm as instrumental variables. Women within the Board of Commissionaires (BoC) and the Board of Directors (BoD) positively impact carbon disclosure, while family firms are found to disclose less. Furthermore, the supervisory function of the BoC has a positive effect on carbon disclosure in companies with low carbon disclosure scores, while companies with high scores are more prone to strategies adopted by the BoD. This research contributes to prolong the discussion about which upper echelons' characteristics influence carbon disclosure.

Keywords: Carbon disclosure; family firms; firm performance; gender diversity; upper echelon theory

Received
July 12th 2022
Review
July 27th 2022
Publish
December 31st 2022

AFEBI Management and Business Review (AMBR)

P-ISSN 2548- 530X
E-ISSN 2548-5318

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INTRODUCTION

The demand for environmental commitment is regularly heard in Indonesia. The 2018 World Air Quality Report designates Jakarta as the most polluted city in Southeast Asia (Greenpeace Indonesia, 2019a). In 2019, a civil lawsuit was filed against several government officials (Greenpeace Indonesia, 2019b). During the 2021 United Nations Climate Change Conference (COP26), Indonesia reassured its commitment to mitigating climate change (Reuters, 2021). Under Act 51 of 2017 of the Financial Services Authority, financial service institutions, issuers, and public companies in Indonesia were obligated to prepare sustainability reports. The report should describe the number of emissions produced (OJK, 2017a) as well as efforts and achievements in reducing them (OJK, 2017b). Indonesia is now the world's eighth-largest GHG (Reuters, 2021).

Upper echelon theory demonstrates that a company's action, as well as its success, is a reflection of its upper echelons' characteristics (Hambrick & Mason, 1984). Thus, it is impossible to underestimate the influence of upper echelons' characteristics on firms' carbon disclosure. Among the characteristics are gender diversity and ownership concentration. Studies which assess the impact of gender diversity on sustainability reporting in African and Asian countries are still rare (Cicchiello, Fellegara, Kazemikhasragh, & Monferrà, 2021; Tilt, Qian, Kuruppu, & Dissanayake, 2021). Previous studies are more concentrated in the United States and European countries, and less concentrated in the Asia-Pacific region (Lin, Liu, Huang, & Chen, 2018). Less developed nations have different characteristics in terms of gender inequalities, hence they might provide more insights (Cicchiello et al., 2021). Aksoy, Yilmaz, Tatoglu, and Basar (2020) classified four ownership structures that influence firms' voluntary disclosures, among which are family ownership, foreign ownership, institutional ownership, and public ownership. Businesses in Indonesia are 95% family-owned (PwC, 2014), hence mimicking the family ownership structure of Aksoy et al. (2020).

Corporate sustainability reporting will increase firms' long-term performance (Oncioui et al., 2020). However, gender diversity within the board (Gordini & Rancati, 2017; Kılıç & Kuzey, 2016) and family ownership structure (Badrul Muttakin, Khan, & Subramaniam, 2014; Shyu, 2011) are also found to directly influence firm financial performance. Madaleno and Vieira (2020) used the generalized method of moments (GMM) and found that sustainability initiatives and firm performance have a mutual relationship.

Hence, this study aims to explore the relationship between carbon disclosure and firm performance when intermediated by gender diversity and family ownership. This study contributes by using the two-stage least-squares (2SLS) regression method. This study also conducted an ordinary least-squares (OLS) regression method to measure the impact of gender diversity and family ownership on carbon disclosure. In the following sections, we will first elaborate on the literature relevant to our hypotheses development, describe our research design, and discuss the results and implications of our research.

LITERATURE STUDY

How upper echelons impact firm carbon disclosure

According to upper echelon theory, the outcomes of an organization or firm are subject to the characteristics of its upper echelons (Hambrick & Mason, 1984). This is mainly because the strategic choices taken by the upper echelons influence firms' performance (Hambrick & Mason, 1984). Many studies have attempted to link the characteristics of upper echelons and firms' environmental strategies. For instance, Elsayih, Datt, and Hamid (2021) provided empirical evidence on how CEO executive experience and CEO duality positively affect the carbon performance of Australian firms.

Gender diversity is another characteristic that has been regularly examined. Gender diversity is found to improve firms' public disclosure, which enhances stock price informativeness (Gul, Srinidhi, & Ng, 2011). Gender diversity in the upper echelons also increases the probability of a firm obtaining ISO 14001 certification (Saeed, Riaz, Liedong, & Rajwani, 2022), environmental transparency (Post, Rahman, & Rubow, 2011; Van Hoang, Przychodzen, Przychodzen, & Segbotangni, 2021), and corporate governance practices (Ararat, Claessens, & Yurtoglu, 2021). Meanwhile, family firms generally invest less interest in environmental matters, resulting in lower participation in pollution prevention, green supply chain management, and green product development (Miroshnychenko & De Massis, 2022).

To measure the amount of carbon disclosure, we used a checklist developed by Choi, Lee, and Psaros (2013), which is based on the Carbon Disclosure Project (CDP) Information Request sheets. The checklist consists of five main categories, which are further classified into 18 components (Choi et al., 2013). Among the categories included are the implication of climate change toward the firm, carbon emission accounting, energy consumption accounting, targets or strategies for reducing emissions, and the existence of an internal supervision mechanism within the firm (Choi et al., 2013). Each criterion is equally-weighted and will be given a score of one if satisfied (Choi et al., 2013). Hence, the maximum score is 18 (Choi et al., 2013).

Firms' carbon disclosure and firm performance

Sustainability reporting is an aspect of firms' public relations, but it could also become a tool to assess firms' strengths and weaknesses (Oncioui et al., 2020; Sukitsch, Engert, & Baumgartner, 2015). As a form of accountability, public firms might disclose their financial and non-financial information (Oncioui et al., 2020). However, by disclosing more non-financial information such as carbon disclosure, firms will reach a wider audience and attract new sources of funding (Chen, Feldmann, & Tang, 2015; Oncioui et al., 2020), compared to only disclosing their financial information targeted for the current investors (Oncioui et al., 2020). Investors' attention toward sustainability reporting is increasing (Oncioui et al., 2020). This is because sustainability reporting is perceived as a tool to lower information asymmetry and ensure the quality and transparency of disclosure (Oncioui et al., 2020).

There is potential to gain superior financial performance by disclosing more. According to the voluntary disclosure theory, there should be a positive relationship between carbon disclosure and performance (Oncioui et al., 2020; Siddique, Akhtaruzzaman, Rashid, & Hammami, 2021). When firms are more transparent about their carbon-related activities, they will generate lower financial performance in the short term, but this will gradually increase in the long term (Siddique et al., 2021). Therefore, lower-performing firms may want to increase their environmental, social, and governance (ESG) disclosures to yield better performance (Mohammad & Wasiuzzaman, 2021).

Previous studies that assess the mutual relationship between carbon disclosure and firm performance are still rare. Madaleno and Vieira (2020) posit a mutual relationship between sustainability initiatives and firm performance. The propensity of firms to engage in sustainable activities depend on their financial abilities (Madaleno & Vieira, 2020). Firms that are inferior in carbon performance disclose more to satisfy their key stakeholders and maintain their legitimacy (Siddique et al., 2021). However, the potential gains from carbon disclosure also depend on the quality of the disclosure itself (Abdullah, Hamzah, Ali, Tseng, & Brander, 2020). A previous study found that Indonesian public firms that disclose their environmental activities didn't generate a significantly positive impact on their performance because they possess lower accountability and transparency than their Malaysian counterparts (Abdullah et al., 2020). Hence, better accountability and transparency disclosure demonstrated by the Malaysian firms contribute to higher performance (Abdullah et al., 2020).

Higher-quality carbon disclosure is found to increase long-term financial performance (Siddique et al., 2021). Superior ESG disclosures also lead to a higher competitive advantage (Mohammad & Wasiuzzaman, 2021). Hence, to generate higher financial performance, firms must first ensure both the quantity and quality of the environmental disclosures (Abdullah et al., 2020). Firms must also acquire sufficient funds to enhance their sustainability initiatives (Madaleno & Vieira, 2020). To ensure that both characteristics are found in our data, we follow Choi et al. (2013). We arrive at our first research hypothesis, as follows:

H1: Carbon disclosure has a significantly positive relationship with firm performance.

Gender diversity within the upper echelons and firm carbon disclosure

Gender inequality within African and Asian countries caused a disparity in the participation of women on the board (Cicchiello et al., 2021). This is unfortunate since gender diversity is one of the characteristics that influence a company's decision-making process, including those related to environmental management (Van Hoang et al., 2021). Gender diversity within the board will also increase the firms' initiatives to reduce the number of emissions (Cicchiello et al., 2021; Haque, 2017).

Women are said to possess different characteristics compared to men when placed in the upper echelon positions. Female directors tend to be more sensitive toward the common interest and hold higher moral standards and ethics compared to male directors (Cicchiello et al., 2021; Yasser, Al Mamun, & Ahmed, 2017). Female CEOs are also said to take fewer risks compared to male CEOs (Daily & Dalton, 2003; Malik, Wang, Naseem, Ikram, & Ali, 2020). Hence, female CEOs are more sensitive to stakeholder demands to increase environmental disclosure (Daily & Dalton, 2003; Malik et al., 2020).

Environmental disclosure increases if there are at least three women on the board (Post et al., 2011; Van Hoang et al., 2021), while male-dominated firms disclose less about their environmental stance (Pucheta-Martínez & Gallego-Álvarez, 2019; Van Hoang et al., 2021). When women are more involved within the board of directors (BoD), there is less manipulation found in the firms' environmental disclosure (Prado-Lorenzo & Garcia-Sanchez, 2010; Van Hoang et al., 2021). Women also increase the quality of firms' CSR disclosure, which will in turn increase the firms' economic prospects (Nekhili, Nagati, Chtioui, & Nekhili, 2017; Van Hoang et al., 2021). In this study, we focus on gender diversity within the BoD, the board of commissionaires (BoC), and the corporate secretary. Based on previous studies, the amount of gender diversity in these positions should increase the amount of carbon disclosure. Hence, we argue for the second hypothesis as follows:

H2: Gender diversity within the upper echelons has a significantly positive relationship with carbon disclosure

Family ownership and firm carbon disclosure

95% of Indonesian businesses are family-owned (PwC, 2014). This is similar to most emerging markets, in which firms are mostly family-owned (Aksoy et al., 2020). The impact of family ownership on corporate sustainability remains debatable. Aksoy et al. (2020) find that family ownership has no significant impact on corporate sustainability performance. A study conducted in 45 countries also found that family firms participate less in pollution prevention, green supply chain management, and green product development (Miroshnychenko & De Massis, 2022).

In general, the propensity of family firms to disclose more of their ESG activities depends on the opinions of the shareholders. When both shareholders and society have voiced similar interests in investing in the environment, family firms tend to do more or less the same as non-family firms (Abeysekera & Fernando, 2020). However, family firms tend to lower their environmental investments when they will not be profitable for the shareholders (Abeysekera & Fernando, 2020).

The degree of their involvement also depends on the family members' positions within the firm. As owners, family firms are less likely to comply with the standards of sustainability reporting or corporate sustainability activities since they are not profitable in the short term (Aksoy et al., 2020). When family members own shares of the company but are not involved in day-to-day activities as managers, family firms are more likely to possess higher socioemotional considerations (Ernst, Gerken, Hack, & Hülsbeck, 2022). When family members act as managers, however, they are more likely to be risk-averse in increasing corporate sustainability (Ernst et al., 2022). This is because sustainability initiatives are believed to be more prone to risk and yield uncertain returns (Ernst et al., 2022). As carbon disclosure is likely to be lower for family firms, the third research hypothesis is as follows:

H3: Family ownership has a significantly negative relationship with carbon disclosure.

RESEARCH METHODOLOGY

Methodology

The analysis conducted in this study is divided into two parts. In the first part, hereby referred to as Model 1, we examined the impact of the instrumental variables gender diversity and family ownership in mediating the relationship between carbon disclosure and firm performance. This study implemented the 2SLS regression method in Model 1 to measure the relationship between the predicted values of carbon disclosure (firm performance) toward firm performance (carbon disclosure). The findings of Model 1 will be applied to answer Hypothesis 1. Furthermore, in Model 2, we examined the instrumental variables' degrees of impact. To do this, we implemented the ordinary least-squares (OLS) regression method. The objective of Model 2 is to determine our stance on Hypothesis 2 and Hypothesis 3.

Data collection method

Most of our data were collected by using Thomson Reuters Eikon. The firms included in the sample are listed on the Indonesia Stock Exchange (IDX). The first step is collecting carbon disclosure information for each firm. Even though mandatory carbon disclosure in Indonesia started in 2017, some of the data were available for collection from 2008 until 2020. Hence, we set the years from 2008 to 2020 as our research period. The second step was to collect data on gender diversity, family ownership, and financial statements. The shape of the data was unbalanced because we omitted all the missing data. During the data collection period, we were able to gather 432 firm-year observations.

Research variables

For Model 1, we use the natural logarithm of the carbon disclosure score based on Choi et al. (2013), hereafter referred to as *DISCLOSURE*. It becomes a proxy for the carbon disclosure score. Among the many proxies for firm performance, we use one of the most common proxies, return on assets (ROA). In this study, we define *ROA* as net profit divided by total assets based on Hongming et al. (2020).

Among the instrumental variables are *FCEO, FDIR, FCOM,* and *FCORSEC* which are proxies for gender diversity within the upper echelons' positions. For *FCEO* and *FCORSEC,* we use dummy variables to denote the existence of a female CEO (Gul et al., 2011) and female corporate secretaries within the companies. To determine *FDIR* and *FCOM,* we used the percentages of women within the BoD (Gul et al., 2011) and BoC.

The independent variable *FAMILY* is a dummy variable for family firms, for which we followed Santoso (2017) in classifying family-owned firms in Indonesia. The remaining variables are control variables. *GHG* refers to the total of Scope 1 (direct) and Scope 2 (indirect) GHG emissions (Konadu, Ahinful, Boakye, & Elbardan, 2022); *SIZE*, measured as the natural logarithm of total assets (Elsayih et al., 2021; Konadu et al., 2022; Malik et al., 2020); *LEVERAGE*, or the natural logarithm of total debt divided by total assets (Elsayih et al., 2021); and the dummy variable *D_2020* to signify the year 2020 or the COVID-19 pandemic. The last control variable would be useful for assessing whether the results differed before and after the pandemic. Table 1 below summarizes our discussion.

Variables	Description
DISCLOSURE	The dependent variable for Model 1 – the natural logarithm of the carbon disclosure score (Siddique et al., 2021).
ROA	The dependent variable for Model 2 – net profit divided by the total asset (Hongming et al., 2020).
FCEO	Independent variable – dummy variable, "1" if the CEO is female and "0" if the CEO is male (Gul et al., 2011; Kubo & Nguyen, 2021).
DIR	Independent variable – the natural logarithm of the number of Executive Directors within the company (Gul et al., 2011).
FDIR	Independent variable – the percentage of females within the Executive Directors position (Gul et al., 2011; Konadu et al., 2022; Kubo & Nguyen, 2021).
COM	Independent variable – the natural logarithm of the number of Commissionaires within the company.
FCOM	Independent variable – the percentage of females within the Commissionaires position.
FCORSEC	Independent variable – dummy variable, "1" if the Corporate Secretary is female and "0" if the Corporate Secretary is male.
FAMILY	Independent variable – dummy variable, "1" if the company is considered a family firm and "0" if it isn't (Santoso, 2017).
GHG	Independent variable – the natural logarithm of total emission produced, measured as the total of Scope 1 and Scope 2 emissions (Konadu et al., 2022).
SIZE	Control variable – the natural logarithm of the total asset (Elsayih et al., 2021; Konadu et al., 2022; Malik et al., 2020).
LEVERAGE	Control variable – the logarithm of the total debt divided by the total asset (Elsayih et al., 2021).
D_2020	Control variable – dummy variable, "1" to denote the year 2020 and "0" for the rest of the period.

Table 1. Research Variables

RESULT AND DISCUSSION

Summary Statistics

Variables (N = 423)	Mean	Median	Standard Deviation	Minimum Value	Maximum Value
DISCLOSURE	1.841	1.792	0.207	1.609	2.398
ROA	0.093	0.061	0.121	-0.567	1.190
GHG	12.339	11.866	2.363	6.326	20.996
FCEO	0.021	0.000	0.144	0.000	1.000
DIR	8.965	8.000	4.241	2.000	38.000
FDIR	0.145	0.125	0.151	0.000	0.667
FCORSEC	0.322	0.000	0.468	0.000	1.000
COM	7.307	7.000	3.006	1.000	19.000
FCOM	0.072	0.000	0.102	0.000	0.500
FAMILY	0.303	0.000	0.460	0.000	1.000
SIZE	15.219	15.010	1.304	12.392	18.491
LEVERAGE	-2.007	-1.554	1.529	-10.465	0.370
D_2020	0.118	0.000	0.323	0.000	1.000

Source: The authors' calculations.

Table 2. Descriptive Statistics

Table 2 provides the descriptive statistics of our data. In our study, only nine female CEOs were recorded. To put it into perspective, there is only 2.1% of firms led by female CEOs, while the other 97.9% are lead by male CEOs. There are approximately 14.5% female BoD and 7.2% female BoC members. The percentage is higher for female corporate secretaries, with an average of 32.2% for each firm. In addition, out of the 423 firm-year observations, there were a total of 128 samples regarded as family firms. In other words, we have approximately 30.3% of family firms in our data.

Table 3 denotes Pearson's correlation matrix. As there are no correlation coefficients greater than 0.80, there is no multicollinearity problem in our data (Konadu et al., 2022). Since there is no correlation coefficient higher than 0.5, we can also say that there is no high degree of association between the variables included (Priyastama, 2020).The distribution of the carbon disclosure scores among the samples is shown in Table 4. No firm received the maximum score of 18. Only 1.7% of the total sample received the highest score of 11. Meanwhile, 33.1% of the samples received the lowest score of five. The average carbon disclosure score among the sample was approximately 6.4.

Table 3.
Pearson's Correlation Matrix

Variable	(1) *DISCLOSURE*	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(2) ROA	0.129							
(3) GHG	0.389	0.128						
(4) FCEO	0.043	-0.069	-0.150					
(5) DIR	-0.057	-0.249	-0.115	0.055				
(6) FDIR	-0.140	0.044	-0.249	0.220	-0.023			
(7) FCORSEC	-0.024	-0.047	-0.020	0.179	0.104	0.490		
(8) COM	0.178	-0.262	0.103	0.094	0.417	-0.188	0.071	
(9) FCOM	-0.024	-0.034	-0.116	0.061	-0.074	0.186	0.089	-0.076
(10) FAMILY	-0.312	-0.007	-0.082	-0.097	-0.097	0.386	0.042	-0.311
(11) SIZE	-0.029	-0.436	-0.057	0.003	0.499	-0.157	0.019	0.443
(12) LEVERAGE	0.155	-0.164	-0.064	0.103	-0.003	-0.001	0.000	0.038
(13) D_2020	0.134	-0.159	-0.087	0.048	0.109	0.050	0.046	-0.020

Variable	(9)	(10)	(11)	(12)
(10)	0.294			
(11)	-0.021	-0.304		
(12)	0.022	0.172	-0.120	
(13)	0.061	0.062	-0.021	0.014

Source: The authors' calculations.
Note: The numbers included in the table above denotes the Pearson's correlation.

Table 4.
Carbon Disclosure Scores Distribution

Score	Frequency	Percentage
5	140	33.1
6	98	23.2
7	99	23.4
8	45	10.6
9	31	7.3
10	3	0.7
11	7	1.7
Total	423	100

Source: The authors' calculations.

Empirical findings

Variable	*ROA*			*DISCLOSURE*		
	Coefficient	P-value	Standard Error	Coefficient	P-value	Standard Error
Constant	0.274*	0.036	0.152	-0.415	0.2665	0.666
DISCLOSURE	0.245***	0.003	0.088			
ROA				2.989***	0.001	0.969

DIR	0.002*	0.098	0.002	-0.007*	0.068	0.005
COM	-0.007***	0.002	0.002	0.026***	0.000	0.007
GHG	-0.003	0.187	0.004	0.018**	0.017	0.008
SIZE	-0.037***	0.000	0.005	0.109***	0.005	0.042
LEVERAGE	-0.011***	0.002	0.004	0.028*	0.074	0.019
D_2020	-0.089***	0.000	0.019	0.298***	0.000	0.078
R-square		0.315			0.295	
Adjusted R-square		0.297			0.276	
F-statistics	9.768***		0.000	2.296*		0.045
N		423			423	
Tests of endogeneity (*H0*: variables are exogenous)						
Durbin (score) chi2 (1)	5.004**		0.025	29.655***		0.000
Wu-Hausman F(1.414)	4.957**		0.027	31.213***		0.000
Tests of overidentifying restrictions						
Sargan (score) chi2 (4)	2.831		0.586	3.467		0.483
Bassman chi2 (4)	2.769		0.597	3.396		0.494

Table 5. Model 1 2SLS Regression Results

Source: The authors' calculations.

Notes:

*** *p < 0.01.*

** *p < 0.05.*

* *p < 0.1.*

Table 5 presents the regression results for Model 1. We run endogeneity tests for *DISCLOSURE* and *ROA* using the Durbin and Wu-Hausman tests. While the null hypothesis states that the variables are exogenous, all of the coefficients are statistically significant. Hence it will be better for us to use 2SLS since the results can justify the possibility of both variables being mutually related. We also run tests for overidentifying restrictions by implementing the Sargan (1958) and Basmann (1960) tests. The null hypothesis suspects an overidentification within the model. Our findings confirm that the instruments used in this study are valid because there is no significant Sargan score and Bassman chi2. Hence, the findings of Model 1 as included in Table 5 are valid.

The findings demonstrate that the predicted values of *DISCLOSURE*, when mediated by *FCEO*, *FDIR*, *FCOM*, and *FCORSEC*, generate a positive relationship with *ROA* with a coefficient of 0.245 (p-value < 1%). On the other hand, the predicted values of *ROA*, influenced by *FCEO*, *FDIR*, *FCOM*, and *FCORSEC*, also contribute to a significantly positive relationship with *DISCLOSURE* with a coefficient of 2.989 (p-value < 1%).

The findings signify a mutual relationship between firms' carbon disclosure and firms' financial performance. Our findings indicate the direction to be positive. In other words, firms with higher transparency and higher quality carbon disclosure are more likely to achieve higher financial performance. Our findings suggest that they generate a 24.5% higher financial performance. Additionally, superior firms are more likely to disclose their carbon-related activities. Gender diversity within the upper echelon positions and family ownership structure mediate this relationship. Hence, we have enough evidence to substantiate Hypothesis 1.

Variable	Coefficient	P-value	Standard Error
Constant	1.607***	0.000	0.141
ROA	0.134*	0.054	0.083
FCEO	0.073	0.123	0.063
DIR	-0.002	0.184	0.002
FDIR	0.107*	0.082	0.076
FCORSEC	-0.031*	0.078	0.022
COM	0.011***	0.001	0.003

Table 6. Model 2 OLS Regression Results

FAMILY	-0.143***	0.000	0.023
GHG	0.033***	0.000	0.004
SIZE	-0.017**	0.028	0.009
LEVERAGE	-0.013**	0.016	0.006
D_2020	0.126***	0.000	0.027
R-square	0.319		
Adjusted R^2	0.299		
F-Statistic	16.014***	0.000	
Standard error	0.174		
N	423		

Source: The authors' calculations.

Notes:

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.1$.

Meanwhile, OLS regression is used to test for the relationship between the instrumental variables toward *DISCLOSURE*. Table 6 summarizes the findings of Model 2. Our model generated significant results for *FDIR*, *FCOM*, *FCORSEC*, and *FCOM*. Both *FDIR* and *FCOM* have a significantly positive relationship with *DISCLOSURE*. These findings suggest that for every additional woman within the BoD and BoC positions, the propensity of firms to disclose their carbon emissions increases by 0.107 (p-value < 10%) and 0.203 (p-value < 5%) units, respectively.

Meanwhile, *FCORSEC* is found to have a negative relationship with carbon disclosure with a coefficient of -0.031 (p-value < 10%). Female CEOs in Indonesian public companies, denoted by *FCEO*, do not significantly impact carbon disclosure. This might be because there are only a small number of female CEOs in the sample. Therefore, our findings suggest that the participation of women in increasing firms' carbon disclosure is only visible if there is an increase in the proportion of women in the BoD and the BoC. That said, we have enough evidence to partially support the second hypothesis.

In Hypothesis 3, we predicted that family ownership has a negative relationship with carbon disclosure. In Model 2, the dummy variable *FAMILY* is found to have a significantly negative relationship with carbon disclosure, with a coefficient of -0.143 (p-value < 1%). Hence, in general, family firms in Indonesia disclose 14.3% less carbon disclosure than other firms. This result substantiates our third hypothesis

Robustness test

Our findings add to the discussion of the impact of gender diversity and family firms on carbon disclosure. In particular, we find that *FDIR* and *FCOM* are significantly positive, whereas *FCORSEC* is the opposite. To ensure the robustness of our findings, we conducted a robustness test by replicating Van Hoang et al. (2021), who divided the samples based on the environmental disclosure score (EDS). In Table 4, our carbon disclosure scores are distributed between the scores 5-11. Hence, the first category includes samples that received carbon disclosure scores between 5-7, which accounts for 79.7% of the total samples. Those with carbon disclosure scores of 8-11 are gathered in the second category. The results of the robustness test are shown in Table 7.

Table 7.
Robustness test

Variable	Category 1: Scores 5-7			Category 2: Scores 8-11		
	Coefficient	P-value	Standard Error	Coefficient	P-value	Standard Error
Constant	1.454***	0.000	0,112	2,792***	0,000	0,213
ROA	0.038	0.296	0,070	-0,394***	0,001	0,118
FCEO	0.038	0.230	0,051	0,013	0,416	0,060
DIR	-0.004**	0.015	0,002	0,006**	0,042	0,004
FDIR	0.095*	0.059	0,061	0,311***	0,000	0,083
FCORSEC	-0.026*	0.068	0,017	0,029	0,136	0,026
COM	0.005**	0.027	0,003	-0,003	0,263	0,004
FCOM	0.108*	0.065	0,071	-0,361***	0,001	0,110
FAMILY	-0.104***	0.000	0,019	-0,076***	0,005	0,029
GHG	0.022**	0.000	0,003	-0,001	0,424	0,005
SIZE	0.004	0.296	0,007	-0,042***	0,001	0,012
LEVERAGE	0.003	0.319	0,005	-0,005	0,150	0,005
FCOM	0.203**	0.011	0.089			

D_2020	0.083***	0.000	0,022	0,040*	0,065	0,026	
R-square	0.269			0.482			
Adjusted R^2	0.242			0.397			
Standard error	0.123			0.075			
F-Statistic	9.929***	0.000		5,655***	0,000		
N	337			86			

Source: The authors' calculations.

Notes:

*** $p < 0.01$.

** $p < 0.05$.

* $p < 0.1$.

For the first category, the results of our robustness check were consistent with those of Model 2. Every additional female BoD and BoC member will increase the propensity of firms with lower carbon disclosure scores to disclose their carbon. Female CEOs do not significantly affect firms' carbon disclosure score, while female corporate secretary negatively affects firms' carbon disclosure. Hence, the findings of the first category are more or less the same as the findings of Model 2. Hypothesis 2 is also partially supported for firms with lower carbon disclosure scores. Family ownership structure has a negative relationship with carbon disclosure for firms in the first category. This result is in line with the OLS regression in Model 2, hence Hypothesis 3 is validated.

We test the same for the firms within the second category. The findings for *FCEO* and *FDIR* are in line with Model 2. However, for the second category, we find that *FCOM* affects *DISCLOSURE* negatively. Furthermore, every additional member in the BoD (BoC) increases (decreases) firms' carbon disclosure. These conditions are the opposite of what we found in the first category, in which firms' carbon disclosure increases (decreases) as a response to an additional member within the BoC (BoD). These could further suggest that firms with lower carbon disclosure scores require higher supervision by the BoC to increase the transparency and quality of their carbon disclosure. However, when firms have reached certain scores, the corporate strategies taken by the BoD are more significant in increasing carbon disclosure. Family ownership structure also has a significantly negative relationship with firms' carbon disclosure. This result is consistent with Model 2; hence we can move to substantiate Hypothesis 3.

Discussion

This section discusses the implications of the findings. This study examines how gender diversity and family ownership mediate the relationship between firms' carbon disclosure and firm performance. Model 1 indicates a reciprocal relationship between firms' carbon disclosure and firm performance. The direction of the relationship is found to be positive. This corroborates the findings of Madaleno and Vieira (2020), who found a mutual relationship between firms' sustainability initiatives and firms' financial performance. Hence, Hypothesis 1 is substantiated.

The findings raise questions about the magnitude of influence of the two instrumental variables. In Hypothesis 2, we expect gender diversity within any upper echelon position will increase firms' carbon disclosure. Our findings in Model 2 demonstrate that while increasing the proportion of women within the BoD and BoC positions increases firm carbon disclosure, we could not state the same for other positions. Nonetheless, our findings are in line with Liao, Luo, and Tang (2015) and Van Hoang et al. (2021), who stated that the proportion of female directors on the board increases firms' GHG disclosure. Based on our results, it turns out that the female corporate secretary has a significantly negative impact on firms' carbon disclosure; hence, we cannot fully support Hypothesis 2. At best, we can distinguish which upper echelon positions benefit from inducing gender diversity.

Furthermore, our results also demonstrate that firms generally exhibit higher carbon disclosure when exposed to higher supervision by the BoC. This effect was found to be greater when there were a significant number of women in the BoC position. Hence, our results not only imply that upper echelon positions would benefit from inducing gender diversity but also indicate that superior oversight is needed to escalate carbon disclosure. However, our findings demonstrate that when firms have reached a certain degree of carbon disclosure, high supervision by the BoC will lower the propensity of firms to disclose their carbon. Firms with higher carbon disclosure scores rely more on the corporate strategies taken by the BoD.

There appears to be an ongoing debate on whether family firms differ in disclosing their ESG activities. Regarding their stance on carbon disclosure, we hypothesize that they would generally disclose less. Our findings

confirm this proposition, validating the findings of Miroshnychenko and De Massis (2022). Abeysekera and Fernando (2020) propose that this may be a result of diverging interests between shareholders and society. According to Ernst et al. (2022), family members who are involved in managerial positions are also more risk-averse toward corporate sustainability initiatives. However, as our results suggest, not only do firms achieve higher performance when they disclose more carbon-related activities, but superior firms also impose higher transparency regarding carbon disclosure. Therefore, family firms will also reap more benefits by disclosing more.

CONCLUSIONS

This study aims to analyze the relationship between the characteristics of the upper echelons and firms' carbon disclosure and whether firms will reap higher financial performance by becoming more transparent in their carbon-related activities.

Table 8.
Summary Findings

Hypothesis	Variables	Predicted	Findings	Decision
Hypothesis 1	Carbon disclosure and firm performance.	(+)	(+)	Hypothesis 1 is substantiated.
Hypothesis 2	Gender diversity and carbon disclosure.	(-)	(-)	Hypothesis 2 is partially substantiated.
Hypothesis 3	Family firms and carbon disclosure.	(+)	(+)	Hypothesis 3 is substantiated.

Source: The authors

Table 8 summarizes our findings. This study shows that gender diversity and family ownership are the instrumental variables that cause a mutual relationship between firms' carbon disclosure and firms' financial performance. These suggest that firms with higher carbon disclosure scores generally have better financial performance. Furthermore, superior firms tend to have higher carbon disclosures. Hypothesis 1 is substantiated. For the second hypothesis, we find that gender diversity within the BoD and BoC positively affects the amount of carbon disclosure. While our model finds no significant relationship between female CEOs and firms' carbon disclosure, we suspect that this might be because there is only a small number of female CEOs during our research period. It should also be noted that owing to the lack of time and manpower in conducting this research, we used secondary data to collect our samples. Thus, future studies may attempt to delve into each firm's annual reports to obtain more precise data. Nonetheless, we have enough evidence to partially support Hypothesis 2. For the third hypothesis, the results demonstrate that family firms in Indonesia generally disclose less about carbon-related activities, resulting in lower carbon disclosure scores. Thus, Hypothesis 3 is substantiated.

Our study implies that there is a mutual relationship between firms' carbon disclosure and financial performance. To achieve higher financial performance, firms should improve their environmental transparency, specifically carbon disclosure. To increase carbon disclosure, firms should involve more women, specifically within the BoD and the BoC. Higher supervision by the BoD is required to ensure the quality of carbon disclosure until firms reach a certain degree of carbon disclosure scores. Firms with higher carbon disclosure scores should focus more on implementing low-carbon strategies to further increase their carbon disclosure scores. Finally, family firms are encouraged to improve their carbon disclosure, as doing so will yield greater benefits for shareholders. Few mechanisms have been developed specifically for measuring carbon disclosure. Thus, future research should develop and implement other methodologies to extend the discussion in this area of research.

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