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Article

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CEO power, regulatory pressures, and carbon emissions: An emerging market perspective

Jamaliah Abdul Majid^{1*}, Noriah Che Adam¹, Norbaya Ab Rahim² and Razita Razak³

Abstract: This study examines whether powerful CEOs and the strength of the regulatory pressures influence firms' decisions to disclose their carbon emissions. Powerful CEOs are examined in three dimensions, i.e. CEO ownership power, CEO structural power, and CEO expert power. Focusing on firms listed on Bursa Malaysia and employing logistic regression models with clustered standard errors, the results show a negative association between CEO ownership power, measured in terms of ownership interest, and firms' decisions to disclose carbon emissions. These results align with the findings of prior studies and provide support for agency theory, suggesting that entrenchment effects occur when CEOs own large ownership interest in the firms, thus adversely impacting carbon disclosure decisions. The results also show a positive association between the strength of the regulatory pressures and carbon disclosure decisions, supporting the institutional theory prediction that firms respond to external pressures by adjusting their organizational structure. These inferences are robust to additional sensitivity analyses, including the Heckman's (1979) selection bias correction, alternative specifications of the ownership interests, and validation of the regulatory pressures. The results demonstrate that an indirect pressure exerted by Bursa Malaysia through the adoption of mandatory sustainability reporting has a positive impact on carbon disclosure. To further enhance carbon emissions reporting, it is timely for regulators to consider implementing direct measures, such as mandatory GHG reporting, to address associated challenges.

Subjects: Environmental Policy; Asian Studies; Sustainable Development; Business, Management and Accounting

Keywords: climate change; carbon emissions; carbon disclosure; CEO ownership; CEO power; Malaysia; regulatory pressures; sustainability reporting

1. Introduction

At present, the world is experiencing an increasing frequency of extreme weather events, including floods, heatwaves, and wildfires. In the case of Malaysia, these extreme weather events, coupled with haze crisis resulting from deforestation, both within the country and from neighboring countries, often lead to various harmful effects on the environment and the public health (Khan et al., 2020; Sulong et al., 2017). These unnatural occurrences have heightened both government

and public interest in global warming and greenhouse gas (GHG) emissions on a global scale. In line with the increment in GHG emissions is the growing research on corporate carbon disclosure (see for example, the review of literature by Borghei, 2021; Hahn et al., 2015; He et al., 2022; Shui et al., 2022; Velte et al., 2020), as transparency and accountability for carbon emissions by corporations are seen as one of the steps in reducing GHG emissions (Chithambo et al., 2020; Hahn et al., 2015).

In this study, we examine whether powerful CEOs and the strength of the regulatory pressures influence firms' decisions to disclose their carbon emissions. Powerful CEOs are examined from three dimensions, namely, CEO ownership power (proxied by CEO ownership interest, and the status of the CEO as a founder), CEO structural power (proxied by CEO duality), and CEO expert power (proxied by CEO tenure). Meanwhile, the strength of the regulatory pressures is examined based on three different levels of the firms' market capitalization. Our focus is on listed firms in Malaysia both before and after the implementation of the mandatory sustainability reporting.

We are motivated to examine these issues for the following reasons. First, even though research on corporate carbon disclosure is growing, the literature is still in the formative stage (He et al., 2022) and the empirical evidence on the impacts of firms' internal mechanisms (e.g., the roles of CEOs) on climate change disclosure is rather inconclusive and still underexplored (Chithambo et al., 2020; Khalid et al., 2022; Shui et al., 2022). For example, in the case of CEO duality, prior studies observed that it had varying effects on carbon disclosure, including positive (Giannarakis et al., 2017), negative (Amran et al., 2014) and non-significance (Al-Qahtani & Elgharbawy, 2020; Ben-Amar et al., 2017; Hossain et al., 2017; Liao et al., 2015). Since decisions made by CEOs affect firm outcomes (Lewis et al., 2014), and the CEO is one of the internal mechanisms who can be used to pressure firms to improve their corporate environmental sustainability (Karn et al., 2022), the inconsistent empirical evidence on the role played by CEOs in relation to carbon disclosure suggests that further studies are needed.

Second, most of the prior studies on carbon disclosure (e.g., Al-Qahtani & Elgharbawy, 2020; Ben-Amar et al., 2017; Dhanda & Malik, 2020; Giannarakis et al., 2017; Liao et al., 2015; Shan et al., 2021) focused on firms in developed countries or large firms due to their reliance on Carbon Disclosure Project (CDP) data (He et al., 2022). Further studies are needed to investigate carbon disclosure in developing countries, as these countries may have managers with different approaches toward carbon disclosure than those in the developed countries¹ (He et al., 2022). Thus, it is an empirical issue to determine how CEOs respond to the carbon disclosure in a developing country.

Third, there is a lack of research that examine the impact of disclosure regulation on voluntary environmental disclosure (Liu et al., 2017; Rahman et al., 2019). Thus, we are motivated to address this research gap by examining whether firms' compliance with the mandatory sustainability reporting encourage them to voluntarily disclose their carbon emissions.

We focus on listed firms in Malaysia, as an example of listed firms in emerging markets because owner-managed firms are prevalence in Malaysia (Claessens et al., 2000; Mohd Ghazali & Weetman, 2006). This particular type of firms not only have a culture of relative secrecy but strive to restrict external involvement, thereby ensuring that information is disclosed exclusively within the firms and financiers (Mohd Ghazali & Weetman, 2006). Accordingly, this institutional feature serves as an appropriate setting for our investigation of the influence of CEO ownership as one source of CEO power on carbon disclosure. In doing so, we respond to He et al. (2022) call to investigate carbon disclosure in developing countries, where managers may approach it differently than in developed countries.

In addition, in Malaysia, starting from 2016, the Malaysian Stock Exchange (Bursa Malaysia) mandated the disclosure of sustainability statements for its listed firms on a staggered basis. Along with this requirement, Bursa Malaysia has issued Sustainability Reporting Guidelines,

encouraging listed firms to prepare their sustainability statements in line with the Global Reporting Initiative (GRI) guidelines, which include the reporting of GHG emissions. These initiatives aim to improve sustainability matters and attract investors with a focus on sustainability to the Malaysian capital market (Bursa Malaysia, 2015). Thus, the initiatives make Malaysia an ideal setting to examine the effects of disclosure regulation (in our case the mandatory sustainability reporting) on voluntary environmental disclosure (i.e., carbon disclosure), as highlighted by Liu et al. (2017) and Rahman et al. (2019).

Our study contributes to the literature on carbon disclosure in the following four ways. First, prior studies have highlighted the lack of empirical evidence on the impact of firms' internal mechanisms on climate change disclosure (Shui et al., 2022). We investigate the impact of CEO power, one of the firms' internal mechanisms that has been less explored, on carbon disclosure. Thus, our study contributes to the literature by providing empirical evidence that CEO ownership power (measured in terms of ownership interests) impedes carbon disclosure while CEO structural power (measured in terms of CEO duality) promotes carbon disclosure only under strong regulatory pressure.

Second, by selecting listed firms in Malaysia, where owner-managed firms are prevalence, we responded to the call made by He et al. (2022) to investigate carbon disclosure in developing countries. In these countries, managers may approach carbon disclosure differently than their counterparts in developed countries (He et al., 2022). Our results demonstrate that in firms that are led by powerful CEOs due to their large shareholdings, they are less likely to disclose carbon emissions. These results are consistent with the empirical evidence reported by prior studies (e.g., Kim & Kim, 2023; Liao et al., 2015; Shan et al., 2021; Tauringana & Chithambo, 2015). Accordingly, our results suggest that in developed countries, managerial ownership serves as an incentive mechanism for managers to align their interests with those of external shareholders, thereby increasing firms' voluntary disclosure. In Malaysia, however, ownership interest often provides a path for CEOs to entrench themselves and pursue their self-interests rather than the interest of the external shareholders, which has an adverse effect on carbon disclosure decisions. Thus, our results provide support for agency theory, which suggests that entrenchment effects occur when managers (CEOs) own large ownership interest in the firms, thus adversely impacting carbon disclosure decisions (Shan et al., 2021).

Third, by investigating carbon disclosure among listed firms in Malaysia, we provide empirical evidence on the low responses toward carbon disclosure in the country. Thus, these results complement the existing research and provide a balanced view of efforts, or the lack of it, by corporations in addressing climate change issues by being transparent with their carbon emissions.

Fourth, Liu et al. (2017) and Rahman et al. (2019) highlighted the lack of research investigating the impact of disclosure regulation on voluntary environmental disclosure. We attempted to address this research gap by analyzing the impact of mandatory sustainability reporting on firms' voluntary disclosure of carbon emissions. Our results suggest that regulatory pressures, manifested in the form of mandatory sustainability, along with the publications of sustainability reporting guidelines, including the GRI guidelines by Bursa Malaysia, serves as both coercive and normative pressures to motivate listed firms in Malaysia to voluntarily disclose their carbon emissions. Our results are consistent with prior studies (e.g., Hahn et al., 2015; He et al., 2022; Houqe & Khan, 2022; Tauringana & Chithambo, 2015; Velte et al., 2020) that indicate firms engage in carbon reporting in response to regulatory pressures. Thus, our results demonstrate the applicability of institutional theory in explaining carbon disclosure decisions among listed firms in Malaysia, as an example of listed firms in developing countries.

The remainder of this paper is structured as follows: Section 2 provides the background of the study. Sections 3 and 4 present the theoretical and empirical review of the literature, respectively. Section 5 describes the research design. Section 6 presents and discusses the empirical results. Section 7 ends the study.

2. Background

Malaysia has demonstrated its commitments in addressing climate change and reducing GHG emissions as early as 1994 through its involvement with the United Nations Framework Convention on Climate Change (UNFCCC) (Abdul Majid et al., 2023). At the third Conference of Parties (COP 3) held in Kyoto, Japan, the Kyoto Protocol was established, requiring industrialized countries and economies to reduce their GHG emissions (Bursa Malaysia, Undated). Despite not being among the primary targets, Malaysia demonstrated its support for the GHG emissions reduction initiatives by ratifying the Kyoto protocol in 2002. In addition, the Prime Minister of Malaysia announced the country's commitment to reduce GHG emissions intensity of GDP by up to 40% relative to its 2005 level by 2020 at the Conference of Parties 15 (COP15) in Copenhagen, Denmark in 2009 (NRE, 2015; UNDP, 2013).

Following from this commitment, a number of initiatives were implemented. One that directly relates to corporate carbon emissions was the launch of the National Corporate Greenhouse Gas Reporting Programme for Malaysia (also known as MyCarbon program) in December 2013 (NRE, 2015). It was a voluntary reporting mechanism, which aims to develop a reporting framework for GHG emissions by the corporate sector (NRE, 2015). To encourage participation, the government offered tax deductions as incentives for expenses related to participating organizations (NRE, 2015). As of 2015, 26 organizations took part in the program (NRE, 2015).

In 2015, Bursa Malaysia made amendments to its Listing Requirements as part of its sustainability framework enhancement, which required its listed firms to include a sustainability statement within their annual reports (Bursa Malaysia, 2015). The amendments aim to improve sustainability-related practices and reporting and to attract investors with sustainability focus into the Malaysian capital market (Bursa Malaysia, 2015). The sustainability statement contains a narrative description of how listed firms manage the material economic, environmental, and social risks and opportunities (Bursa Malaysia, 2015). To support listed firms in this endeavor, Bursa Malaysia introduced Sustainability Reporting Guidelines, which is aligned with the GRI guidelines (Bursa Malaysia, 2015). These guidelines encompass various aspects, including the reporting of GHG emissions (Bursa Malaysia, 2015). Thus, even though Bursa Malaysia does not explicitly mandate the disclosure of GHG emissions within the sustainability statement, if companies considered the GHG emissions as material to their business activities, they would disclose such information, as part of their sustainability risk considerations.

The mandatory sustainability statement was implemented on a staggered basis over a period of 3 years, starting from 31 December 2016 to 31 December 2018 (Bursa Malaysia, 2015). In 2016, firms that are listed on the Main market and with a market capitalization of at least RM2 billion as of December 2015 were required to include the sustainability statements in their annual reports for the year ended on or after 31 December 2016 (Bursa Malaysia, 2015). In 2017, firms that are listed on the Main market and with a market capitalization between RM1 billion and less than RM2 billion are required to incorporate the sustainability statements in their annual reports for the year ended on or after 31 December 2017. Finally, in 2018, firms that are listed on the Main market, which are not covered in the previous 2 years, along with all firms listed on the ACE market were required to include sustainability statements in their annual reports for the year ended on or after 31 December 2018 (Bursa Malaysia, 2015).

Despite significant progress in sustainability initiatives, including GHG reporting as detailed earlier, there are at least three main challenges in reporting GHG emissions in Malaysia. First, carbon reporting is voluntary (Borie & Decq, 2019), and there is no standardized format. Consequently, only a small number of companies have publicly disclosed their carbon emissions (Ahmad & Hossain, 2015; Amran et al., 2014), and the level of carbon disclosure varies among companies.

Second, the government faces challenges in effectively implementing policies related to climate change issues (including GHG emissions) to produce concrete results (NRE, 2015). In the case of the MyCarbon program, it proved ineffective due to a lack of positive responses from the private sector (Fernando et al., 2021). Despite offering tax deduction incentives, as of 2015, only 26 organizations had participated in the program.

Third, the predominance of owner-managed companies in Malaysia has a detrimental effect on voluntary disclosures. For example, Mohd Ghazali and Weetman (2006) examined voluntary disclosure among the top 100 listed firms in Malaysia in 2001, immediately after government reforms aimed at increasing transparency following the Asian financial crisis in 1997. The study revealed that owner-managed companies tend to have lower levels of voluntary disclosure. This indicates that the historical culture of maintaining relative secrecy within such companies outweighs the government efforts to enhance disclosure (Mohd Ghazali & Weetman, 2006). Likewise, a recent study by Abdul Latif et al. (2023) reported a negative impact of CEO ownership interest on the quality of sustainability disclosure among plantation-listed firms examined between 2016 and 2018.

The commitments in reducing GHG emissions and in implementing sustainability initiatives, as presented by Malaysia, coupled with the challenges it encounters in reporting GHG emissions, as discussed above, provide a suitable setting for our study. This setting raises an important question of whether the mandatory sustainability reporting requirements set forth by Bursa Malaysia can exert an indirect pressure to promote carbon disclosure among listed firms in Malaysia.

3. Theoretical literature review

We draw on agency theory and institutional theory to examine the influence of CEO power and regulatory pressures on firms' decisions to disclose their carbon emissions. Agency theory conceptualizes the relationship between a principal and an agent (Abdul Majid, 2013; Eisenhardt, 1988, p. 490). In this theory, it is assumed that both parties aim to maximize their utility (Abdul Majid, 2013; Jensen and Meckling, Jensen & Meckling, 1976). Accordingly, agency theory predicts that the agent may not consistently act in the principal's best interests, thus giving rise to agency conflict between the two parties (Abdul Majid, 2013; Eisenhardt, 1989; Elmghamez et al., 2023; Jensen & Meckling, 1976).

From the perspective of agency theory, CEOs (agents) who are powerful may exploit their power to promote their self-interests rather than those of the shareholders (principal) and other stakeholders (Muttakin et al., 2018). For example, the disclosure of carbon emissions may benefit firms in the long run as it reduces the carbon information asymmetry (Shan et al., 2021). However, in the short run, this disclosure may not benefit the CEOs (Shan et al., 2021). Consequently, powerful CEOs might lack motivation to promote corporate carbon disclosure (Muttakin et al., 2018; Shan et al., 2021). Prior studies that employed agency theory to explain voluntary disclosure of sustainability-related matters include Amran et al. (2014), Ben-Amar and McIlkenny (2015), Hossain et al. (2023), Muttakin et al. (2018), and Shan et al. (2021). Using agency theory, these studies examined CEOs ownership interest, duality, and tenure as independent variables and argued that these characteristics influenced firms' voluntary disclosure decisions.

While agency theory focuses on agency conflicts, institutional theory emphasizes on external pressures that influence firms to respond and adopt certain practices (Abdul Majid et al., 2023; Amran et al., 2016; Damert & Baumgartner, 2018; Haque & Ntim, 2022; Ntim & Soobaroyen, 2013; Orazalin et al., 2023). The external pressures are in the form of coercive (i.e., through strict regulation), normative (i.e., the need for complying with social norms) and mimetic (i.e., imitating the behaviors of competitors) (Amran et al., 2016; Damert & Baumgartner, 2018; Houque & Khan, 2022; Shui et al., 2022). Institutional theory suggests that firms respond to these external pressures by adjusting their organizational structure, to achieve conformity with social values (Faller & Zu Knyphausen-Aufseß, 2018).

In the case of carbon disclosure, it is seen as one of the responses made by firms toward external pressures arising from climate change (Faller & Zu Knyphausen-Aufseß, 2018; Herold et al., 2019). Applying institutional theory, prior studies (Houqe & Khan, 2022; Tauringana & Chithambo, 2015) incorporate specific regulations or reporting guidelines as independent variables and show a positive impact of these institutional pressures on GHG/carbon disclosure. For example, Tauringana and Chithambo (2015) examined the effect of the guide on GHG emissions measurement and reporting issued by the Department for Environment, Food & Rural Affairs (DEFRA) on GHG disclosure by 215 UK FTSE 350 companies from 2008 to 2011 and found that DEFRA's (2009) guide acts as coercive pressures to improve GHG emission disclosure. In a similar vein, Comyns (2016), Houqe and Khan (2022), and Rankin et al. (2011) incorporate firms' adoption of GRI guidelines as an independent variable and report that this normative pressure promotes the transparency of GHG reporting.

4. Empirical literature review and hypotheses development

4.1. CEO power and the transparency of carbon emissions

Power is defined as the capacity for an individual to exert his or her will (Brown & Sarma, 2007, p. 363; Haleblan & Finkelstein, 1993, p. 848). Finkelstein (1992) developed and validated four dimensions of power wielded by top managers, i.e., structural, ownership, expert, and prestige. In this study, we apply the framework developed by Finkelstein (1992) to investigate the potential effects of CEO power on firms' decisions to disclose carbon emissions. Our measure of CEO power considers structural, ownership and expert power.²

4.1.1. CEO ownership power

CEO ownership power is examined based on ownership interest and the status of the CEO as a founder of the firm (Daily & Johnson, 1997; Finkelstein, 1992). As for the CEO ownership interest, prior studies argue that CEOs holding significant shares in firms are likely to be more powerful than CEOs without such shareholdings (Daily & Johnson, 1997; Finkelstein, 1992; Lewellyn & Fainshmidt, 2017; Lisic et al., 2016). By owning significant shares, the CEOs are availed with voting power, which allow them to influence strategic decisions and bargaining power over the boards of directors (Brookman & Thistle, 2009; Daily & Johnson, 1997; Lewellyn & Fainshmidt, 2017).

Drawing on agency theory, prior studies (e.g., Abdul Majid, 2015; Lennox, 2005; Shan et al., 2021) suggest that there are two contrasting effects of managerial ownership on agency costs, namely, the convergence of interest, and the entrenchment effects. The convergence of interest hypothesis suggests that when managers possess a greater ownership interest in the firms, they have stronger incentives to align their actions with the interests of external shareholders (Lennox, 2005; Shan et al., 2021). Thus, agency costs reduce as managerial ownership increases. This implies that as CEOs own more shares, their interests will be aligned with those of their shareholders, which motivate them to disclose more information, such as carbon disclosure to the shareholders (Elsayih et al., 2018; He et al., 2022; Tauringana & Chithambo, 2015). This is because the disclosure of carbon emissions reduces carbon information asymmetry between the CEOs and the external stakeholders (Fan et al., 2021). Thus, ownership interest acts as an incentive mechanism in hindering CEOs from acting in their self-interest at the expense of the shareholders' interests (Florackis & Ozkan, 2009).

In contrast, the entrenchment effects perspective suggests that beyond a certain level of shareholding, entrenchment effects take over the alignment effect (Kim & Lu, 2011). At this point, the agency conflicts become severe (Elyasiani & Zhang, 2015). Thus, greater ownership interest provides the CEOs more opportunities to entrench themselves and, consequently, a greater scope to engage in opportunistic behavior (Lennox, 2005, p. 208; Morck et al., 1988). This implies that with large ownership interest, CEOs have more power to advance their self-interests. As a result, the entrenched CEOs are less likely to disclose carbon emissions that expose the company's environmental impact.

Although the empirical findings have demonstrated the effect of CEO ownership interest on carbon disclosure, the direction of this relationship is inconclusive (Faller & Zu Knyphausen-Aufseß, 2018; Karn et al., 2022). For example, while Elsayih et al. (2018) found a positive impact of CEO ownership interest on carbon disclosure, Taurigana and Chithambo (2015) showed a negative influence of directors' ownership interest and GHG disclosure index. In addition, Shan et al. (2021) reported a non-linear relationship between managerial ownership interest and firms' responses to the CDP questionnaire.

In the context of Malaysia, in the absence of climate change law, and with the prevalence of owner-managed firms, we apply the entrenchment perspective and posit a negative association between CEO ownership power (measured based on ownership interest, CEOownership) and firms' decisions to disclose carbon emissions, as follows:

H1: The stronger the concentration of ownership power among CEOs (CEOownership), the less likely for firms to disclose carbon emissions.

The second form of ownership power is the status of the CEO as the founder of the firm. Founder CEOs have considerable influence and wield decision-making power in their firms owing to their ownership rights and entrepreneurial status (Fahlenbrach, 2009; Gedajlovic et al., 2004). As individuals who establish firms, founders are highly committed and exert strong efforts to create value for firms (Deb & Wiklund, 2017; Palia et al., 2008). However, having both ownership power and decision-making rights concentrated in the hands of CEOs create opportunities and incentives to pursue options that best serve their personal needs (Gedajlovic et al., 2004).

Prior studies (e.g., Block & Wagner, 2014) argue that founder CEOs tend to focus mainly on the growth of the business. If disclosing carbon emissions limit the firm's growth by exposing their environmental impacts, founder CEOs may be reluctant provide such disclosure. Thus, consistent with the entrenchment effects perspective, we posit a negative association between CEO ownership power (measured based on the status of the CEO as the founder of the firm, CEOfounder) and firms' decisions to disclose carbon emissions, as follows:

H2: Firms with concentration of ownership power among CEOs (CEOfounder) are less likely to disclose carbon emissions than other firms.

4.1.2. CEO structural power

Structural power, which is also known as hierarchical power, is based on a formal organizational structure (Daily & Johnson, 1997; Finkelstein, 1992). Most prior studies have examined structural power in terms of CEO duality, i.e., when a CEO also serves as the chairperson of the board of directors (Dunn, 2004).

In the context of climate change, carbon reduction initiatives may require large funding and the outcome of such initiatives will only be visible in the long run (Haque, 2017). Thus, if CEOs are concerned with maximizing short-term financial goals at the expense of the long-term investments in environmental opportunities, such as green investments, they may be reluctant to undertake such carbon reduction initiatives (De Villiers et al., 2011). Thus, even though carbon disclosure decision does not require huge investment, the CEOs may be less likely to disclose such emissions, as doing so may reveal the impact of their business activities on the environmental, especially when there is no reduction initiatives implemented. From an agency theory perspective, a CEO who also holds the chairman's position, may be able to discourage the board from disclosing the carbon emissions. Consequently, the agency theory posits a negative relationship between powerful CEOs (measured in terms of CEO duality) and firms' decisions to disclose carbon emissions.

Extant literature has reported mixed results regarding the implications of combined CEO-chairman roles on carbon disclosure (Liao et al., 2015). For example, Giannarakis et al. (2017) found that from 2009 to 2013, the United States (US) listed firms that had combined CEO-chairman roles, reported higher carbon disclosure; while Amran et al. (2014) show that the 111 listed firms in developed and emerging countries in Asia Pacific in 2008 that had combined CEO and chairman positions, reported lower climate change disclosure. In addition, Al-Qahtani and Elgharbawy (2020), Ben-Amar et al. (2017), Hossain et al. (2017), and Liao et al. (2015) found no statistically significant relationship between CEO duality and corporate carbon disclosure.

In Malaysia, the Malaysian Code on Corporate Governance (MCCG) for the years 2000 and 2007 recommends the separation of the roles of CEO and chairman to prevent any single individual from having unfettered power over the decision-making process (MCCG, 2017). The MCCG in 2017 further emphasizes on the separation of the roles by requiring public listed companies to “apply or explain an alternative” when combining the positions of CEO and chairman (PwC, 2017). With this additional requirement, CEOs with dual roles may perceive that regulators are monitoring their behavior. Consequently, this perception may motivate them to provide more information, including carbon disclosure, to demonstrate to regulators and the market the effectiveness of their corporate governance system.

Following the requirement of the (MCCG, 2017) for firms to “apply or explain an alternative” for the combined roles of CEO and chairman, we posit a positive association between CEO structural power (CEO duality) and firms’ decisions to disclose carbon emissions, as follows:

H3: Firms with concentration of structural power among CEOs (CEOduality) are more likely to disclose carbon emissions than other firms.

4.1.3. CEO expert power

Expert power concerns top managers’ capacities to manage environmental contingencies and to contribute to firm success (Finkelstein, 1992). A common proxy for CEO expert power employed in prior studies (e.g., Gupta et al., 2018; Han et al., 2016; Lewellyn & Muller-Kahle, 2012; Lisic et al., 2016) is CEO tenure. A longer CEO tenure is often associated with higher levels of expert power among CEOs (Brookman & Thistle, 2009; Greve & Mitsuhashi, 2007; Lewellyn & Fainshmidt, 2017; Wang et al., 2016). The rationale is that a longer tenure provides CEOs with opportunities to gain valuable knowledge and expertise of a firm and its industry to yield higher levels of expert power (Greve & Mitsuhashi, 2007; Lewellyn & Fainshmidt, 2017).

In addition, with longer tenure, CEOs have ample time to cultivate social capital in their firms through their interpersonal interactions with subordinates (Brookman & Thistle, 2009; Greve & Mitsuhashi, 2007; Wang et al., 2016). They are also presented with more opportunities to develop their credibility among board members, which may increase their willingness to support the decisions made by such CEOs (Lewellyn & Fainshmidt, 2017). By developing expertise, interpersonal relationships and support from the board of directors, CEOs become more autonomous, and thus, achieve more expert power (Greve & Mitsuhashi, 2007; Wang et al., 2016).

Research has consistently demonstrated a negative effect of CEO tenure on organizational change, in that, as the tenure progresses, CEOs become less willing to undertake innovative strategies (Lewis et al., 2014). In the early years of their tenure, CEOs will be more willing to embark on major projects or pursue innovative strategies; however, in the later years, as they become more used to routines, the long-tenured CEOs become reluctant to adopt new management styles (Chithambo et al., 2020).

Morck et al. (1988) argue that managers (CEOs) could potentially become entrenched due to their prolonged tenure. Applying the entrenchment effects hypothesis, prior studies (e.g., Shan et al., 2021) argue that the entrenched CEOs are less likely to disclose carbon emissions that expose the firms' performance. Consistent with the entrenchment effects hypothesis and following prior studies, we posit a negative association between CEO tenure (CEOtenure) and firms' decisions to disclose carbon emissions, as follows:

H4: The stronger the concentration of expert power among CEOs (CEOtenure), the less likely for firms to disclose carbon emissions.

4.2. Regulatory pressures and the transparency of carbon emissions

The influence of regulatory pressures on corporate environmental sustainability or carbon disclosure is often explained using institutional theory. The theory emphasizes the role of institutional pressures, which exist in the form of coercive, normative, and mimetic, that are imposed on the organization (Comyns, 2016; Damert & Baumgartner, 2018; Oliver, 1997). The institutional theory assumes that organizations responded to these pressures by changing their practices and structures in order to gain legitimacy for their business activities (Alatawi et al., 2023; Amran et al., 2016; Daddi et al., 2020).

In the case of carbon disclosure, prior studies provide evidence that regulatory pressures are one of the institutional pressures that have a positive impact on climate change issues, including carbon disclosure (He et al., 2022; Okereke & Russel, 2010). The regulatory pressures that have been examined by prior studies include direct and indirect pressures (Mateo-Márquez et al., 2019). Direct regulatory pressures include legislations that require firms to disclose their GHG emissions in countries, such as the UK, Australia, France, and New Zealand (Houque & Khan, 2022; Liu et al., 2017; Tauringana & Chithambo, 2015). There is also direct regulation in the form of specific requirements that focus on highly polluting industries (Scholtens & Kleinsmann, 2011). Meanwhile, the indirect regulatory pressures include the number of environmental initiatives implemented by government (Chithambo et al., 2020).

In Malaysia, regulatory pressures on the reporting of environmental issues are manifested in the form of mandatory sustainability reporting, which is required by Bursa Malaysia via its listing requirement, i.e. (Bursa Malaysia, 2015), Practice Note 9 (Bursa Malaysia, 2015). The implementation of the mandatory sustainability reporting involved three stages depending on the market capitalization of listed issuers. The first stage of the mandatory sustainability reporting was in 2016 and it involved listed issuers on the Main market with market capitalization of RM2 billions and above. The second stage of the mandatory sustainability reporting was in 2017 and it applied to listed issuers on the Main market with market capitalization of RM1 billions and above but less than RM2 billions. The third stage of the mandatory sustainability reporting was in 2018, and it focused on all listed issuers not included in the first two stages. Even though the mandatory sustainability reporting does not require listed firms to report their GHG emissions, the sustainability reporting guidelines issued by Bursa Malaysia encourages these firms to prepare their sustainability statement in accordance with GRI guidelines, which include the reporting of GHG emissions.

Following the prediction of the institutional theory, we expect a positive association between the strength of the regulatory pressures, measured in terms of the three stages of the market capitalization of listed issuers, and firms' decisions to disclose carbon emissions, as follows:

H5: The stronger the regulatory pressures (RegPressures), the more likely for firms to disclose carbon emissions.

5. Research design

5.1. Sample selection

Our initial sample comprises all firms listed on Bursa Malaysia in both years 2015 and 2020. 2015 represents a year prior to the implementation of the mandatory sustainability reporting while 2020 represents 2 years after the implementation of the mandatory sustainability reporting. The final number of observations is 970, which is after excluding observations with lack of data on CEO positions and CEO characteristics, and missing cases on financial and non-financial data (see Table 1). Non-financial data, including CEO characteristics and carbon disclosure, are hand-collected from annual reports and/or sustainability reports, while financial data are drawn from Thomson Reuters DataStream.

5.2. Variable measurement

5.2.1. Dependent variable

Our dependent variable is a firm's decision to disclose carbon emissions. It is a binary variable that is set to 1 when a firm disclosed its carbon emissions, and zero otherwise. This approach is similar to prior studies that examine firms' carbon disclosure decisions, such as Ben-Amar et al. (2017), Dhanda and Malik (2020), and Peters and Romi (2014). However, unlike these prior studies that rely on CDP data, in our study, the disclosure or non-disclosure of carbon emissions is hand-collected from annual reports and/or sustainability reports because many companies in developing countries (including Malaysia) do not participate in the CDP survey (Lee, 2012).

5.2.2. Independent variables

Five independent variables are employed in this study. First, CEO ownership interest (CEOownership, tested in H1), which is a proxy for CEO ownership power. It is measured based on the ratio of shares held directly by a CEO to the total shares outstanding.

Second, CEO founder status (CEOfounder, tested in H2), which is also a proxy for CEO ownership power. It is set to 1 when a CEO is a founder of the firm, and zero otherwise.

Third, CEO duality (CEOduality, tested in H3), which is a proxy for CEO structural power. It is set to 1 when a CEO is also a chairman of the board of directors, and zero otherwise.

Fourth, CEO tenure (CEOtenure, tested in H4), which is a proxy for CEO expert power. It is measured based on the number of years a CEO has held the position.

Fifth, the strength of the regulatory pressures (RegPressures, tested in H5), which is proxied by three different levels of the market capitalization. It is a categorical variable that contains three categories: (1) if a firm is listed on the Main market with a market capitalization that is less than RM1 billion, or if it is listed on the ACE market, (2) if it is listed on the Main market with a market capitalization at RM1 billion or more but less than RM2 billion, and (3) if it is listed on the Main market with a market capitalization at RM2 billion or more.

Table 1. Sample selection

Description	No.
Total number of firms listed on Bursa Malaysia in both 2015 and 2020	1,256
Less: Observations with no CEO position, lack of data on CEO characteristics and other variables	286
Final observation	970

5.2.3. Control variables

Our control variables include board independence (BODIndp), financial performance (ROA), and year and industry effects, which have been found by prior studies (Ben-Amar et al., 2017; Chithambo et al., 2020; Jaggi et al., 2018; Kim & Kim, 2023; Lewis et al., 2014; Liao et al., 2015; Mahmudah et al., 2023; Ofoegbu et al., 2018; Velte et al., 2020) to affect carbon disclosure. Board independence is measured as the proportion of independent directors on the board of directors (Ben-Amar et al., 2017; Velte et al., 2020), ROA is computed based on net income before preferred dividend and after adjusting interest expense, deflated by average total assets (Thomson, 2007, p. 443), industry effects is measured based on an industry dummy across five industry categories, using Datastream classification level two, and year effects is a binary variable set to 1 for the year 2020, and 0 for the year 2015.

5.3. Model specification

We estimated the likelihood that a firm would disclose its carbon emissions using a binomial logistic regression model, as per Equation (1).

$$\Pr(CD_{it} = 1) = \alpha_0 + \alpha_1 \text{CEOOwnership}_{it} + \alpha_2 \text{CEOfounder}_{it} + \alpha_3 \text{CEOduality}_{it} + \alpha_4 \text{CEOtenure}_{it} + \alpha_5 \text{RegPressures}_{it} + \alpha_6 \text{BODIndp}_{it} + \alpha_7 \text{ROA}_{it} + \alpha_8 \text{Industry} + \alpha_9 \text{Year} + \varepsilon_{it} \quad (1)$$

Where CD represents firms' decisions to disclose carbon emissions, $\alpha_0 \dots \dots \alpha_9$ represent regression coefficients, subscripts i and t represent firm and year, respectively, ε represents the error term, and independent and control variables are defined in Table 2.

To account for heteroskedasticity and correlation in the error terms, which may arise due to repeated measures, we follow Lewis et al. (2014) and employed robust standard errors clustered by firms.

6. Empirical results and discussion

6.1. Results of the descriptive statistics

The results of the descriptive statistics (see Table 3) show that the number of firms that disclosed their carbon emissions has improved from 8% in 2015 to 14% in 2020 (see Panel A). However, the disclosure rate in 2020 is still too low, even after the implementation of the mandatory sustainability reporting. Possibly, this is because the mandatory sustainability reporting represents an indirect pressure for firms to disclose the carbon emissions. These results are consistent with the findings of Guo and Pan (2022), analyzing carbon disclosure of listed firms in a developing country of China. The study reported a low level of carbon disclosure by 118 automobile manufacturing firms listed on the Juchao and Shanghai stock exchange from 2017 to 2021. If the reporting of carbon emissions is considered as a measure of good carbon management (Smith, 2016), then most of the firms examined have poor carbon emissions management.

See Table 2 for variable definitions. On average, the majority of the sampled firms have CEOs with significant shareholdings (CEOOwnership; mean 13.314) who have been the CEO for more than 10 years (CEOtenure; mean 10.715) (see Panel B). Moreover, CEOs are the chairman (CEOduality), 8.8% of the time and founders (CEOfounder), 20.3% of the time (see Panel B). The low percentage of CEO duality documented reflects that firms are following recommendations to separate the roles as specified by the MCCG. This is consistent with the findings of Khong et al. (2021), who showed that 10.4% of the 6,166 firm-years listed on Bursa Malaysia from 2009 to 2017, had CEO duality.

Our test of differences shows that the disclosure group has lower levels of CEO ownership power (CEOOwnership, and CEOfounder) and CEO expert power (CEOtenure) than the non-disclosure group (see Panel B). The two groups also differ significantly with regard to the strength of the regulatory pressures (RegPressures) (see Panel B). In addition, the disclosure group has higher proportion of independent directors on their board (BODIndp) and reported higher financial performance (ROA) than the non-disclosure group (see Panel C).

Table 2. Description of all variables

Variable	Symbol	Description
Dependent variable		
Firms' decisions to disclose carbon emissions	Pr(CD = 1)	A binary variable set to one 1 if a firm disclosed its carbon emissions, and 0 otherwise.
Independent variables		
CEO ownership interest	CEOownership	The ratio of shares held directly by a CEO to the total shares outstanding.
CEO founder	CEOfounder	A binary variable set to one if a CEO is a founder of the firm, and 0 otherwise.
CEO duality	CEOduality	A binary variable set to one if a CEO is also a chairman of the board of directors, and 0 otherwise.
CEO tenure	CEOtenure	The number of years a CEO has held the position.
The strength of the regulatory pressures	RegPressures	A categorical variable with three categories: (1) if a firm is listed on the Main market with a market capitalization that is less than RM1 billion, or if it is listed on the ACE market, (2) if it is listed on the Main market with a market capitalization at RM1 billion or more but less than RM2 billion, and (3) if it is listed on the Main market with a market capitalization at RM2 billion or more.
Control variables		
Board independence	BODIndp	The proportion of independent directors on the board of directors.
Return on assets	ROA	Net income before preferred dividend and after adjusting interest expense, deflated by average total assets.
Industry effects	Industry	Industry dummy across five industry categories based on Datastream classification level two.
Year effects	Year	Year dummy, 1 if year 2020, and 0 if year 2015.

To test the possibility of multicollinearity issues between independent variables as well as control variables, we computed Pearson product-moment correlation coefficients. We also calculated the Variance Inflation Factor (VIF) and the tolerance (1/VIF). The results (see Table 4) show that none of the independent variables is significantly correlated (at more than 0.5) with one another or with the control variables. Moreover, none of the VIF and 1/VIF value exceeds the threshold value of 10 and 1, respectively (Gujarati, 2003), suggesting that multicollinearity may not be a serious threat in our multivariate analysis.

As for the four measures of CEO power, the results (see Table 4) show that the correlations between these measures are relatively low. The highest correlation is found between CEO ownership interest (CEOownership) and CEO founder (CEOfounder) (at 0.29 with p-values of less than 1%). Similar to Adams et al. (2005), Gupta et al. (2018) and Han et al. (2016), these results suggest that the four measures capture different aspects of CEO power.

Table 3. Descriptive statistics

Panel A: Dependent variable Decision to disclose carbon emissions				2015	2020	Total
Observation				485	485	970
Disclosed carbon emissions				37 (8%)	70 (14%)	107 (11%)
Not disclosed carbon emissions				448 (92%)	415 (86%)	863 (89%)
Panel B: Independent variables		All observations (mean)	Disclosed carbon emissions (mean)	Not disclosed carbon emissions (mean)	Test of differences (Mean (p-value))	
Continuous variable						
CEOownership		13.314	2.168	14.696		0.000
CEOfenure		10.715	8.431	10.998		0.006
BODIndp		0.491	0.54	0.485		0.000
ROA		3.162	5.67	2.852		0.003
Categorical variables						
		All observations (mean)	Disclosed carbon emissions (mean)	Not disclosed carbon emissions (mean)	Chi-square test of independence	
CEOfounder		0.203	0.103	0.216	Value	Sig. (2-tailed test)
CEOduality		0.088	0.084	0.088	7.474	0.006
Regulatory pressures					0.019	0.892
Low		759	14	745		
Medium		57	10	47		
High		154	83	71		
Total		970	107	863	356.051	0.000

(Continued)

Table 3. (Continued)

Panel C: Control variables

	All observations (mean)	Disclosed carbon emissions (mean)	Not disclosed carbon emissions (mean)	Test of differences Mean (p-value)
Continuous variable				
BODIndp	0.491	0.54	0.485	0.000
ROA	3.162	5.67	2.852	0.003
Categorical variables	All observations (mean)	Disclosed carbon emissions (mean)	Not disclosed carbon emissions (mean)	Chi-square test of independence Value
Industry				Sig. (2-tailed test)
Industrials	340	22	318	
Consumer goods & services	254	31	223	
Technology & telecommunications	94	12	82	
Health care, basic materials, Oil & Gas, and utilities	160	27	133	
Financials	122	15	107	
Total	970	107	863	13.616
				0.009

Table 4. Pearson product-moment correlation coefficients

	Variable	Tolerance	VIF	Carbon_ Disclosure (1)	(2)	(3)
(2)	CEOownership	0.70	1.42	(-0.21)**	1.00	
(3)	CEOfounder	0.87	1.15	(-0.09)**	(0.29)**	1.00
(4)	CEOduality	0.95	1.05	(-0.00)	(0.15)**	(0.15)**
(5)	CEOtenure	0.88	1.13	(-0.09)**	(0.16)**	(0.18)**
(6)	RegPressures	0.87	1.15	(0.60)**	(-0.19)**	(-0.09)**
(7)	BODIndp	0.94	1.06	(0.14)**	(-0.11)**	(-0.10)**
(8)	ROA	0.88	1.14	(0.10)**	(0.13)**	(0.09)**
		(4)	(5)	(6)	(7)	
(4)	CEOduality	1.00				
(5)	CEOtenure	(0.14)**	1.00			
(6)	RegPressures	(-0.07)*	(-0.09)**	1.00		
(7)	BODIndp	(-0.04)	(-0.13)**	(0.02)	1.00	
(8)	ROA	(-0.03)	(0.03)	(0.23)**	(-0.15)**	

*, ** denote significance at the 0.05 and 0.01 level, respectively (two-tailed)

6.2. Regression results

6.2.1. Goodness-of-fit of the model

The overall goodness-of-fit of the model is evaluated using Hosmer-Lemeshow test, Wald chi-square, and pseudo-R-square. The results for all models (see Table 5, Models 1–7) show that the p-values of Hosmer-Lemeshow are greater than 0.05, indicating that these models fit the data well. For example, in Model 7, the Wald chi-square value of 186.93 at p-values less than 1% suggests that the model can differentiate the sample firms that disclosed their carbon emissions from the non-disclosure firms. In addition, the pseudo-R-square of 0.493 suggests that the model can explain 49.3% of the variation in the probability of the firm to disclose carbon emissions in their annual/sustainability reports.

6.2.2. Multivariate analyses

Table 5 presents the results of multivariate analyses. The dependent variable is firms' decisions to disclose carbon emissions while the independent variables are CEO power and the strength of regulatory pressures. The CEO power is investigated from three dimensions, i.e., CEO ownership power (proxied by CEO ownership interest, and the status of the CEO as a founder), CEO structural power (proxied by CEO duality), and CEO expert power (proxied by CEO tenure).

With regard to CEO ownership power, the results (see Table 5, Models 2 and 7) show that the coefficients of CEOownership are negative and strongly significant. These results provide support to H_1 and indicate that the higher the shares owned directly by the CEOs, the less likely for the firms to disclose their carbon emissions. When the CEOs owned significant shares, they gained access to voting power, which enable them to exert influence over firms' strategic decisions (Brookman & Thistle, 2009; Daily & Johnson, 1997; Lewellyn & Fainshmidt, 2017), such as the carbon disclosure decisions. At the same time, by holding significant shares, it affords the CEOs more opportunities to become entrenched, thus providing them a greater scope to pursue their self-interests rather than the interest of external shareholders and stakeholders (Lennox, 2005, p. 208; Morck et al., 1988; Muttakin et al., 2018). As a result, the entrenched CEOs are less likely to disclose carbon emissions (Muttakin et al., 2018; Shan et al., 2021) that expose the firms' environmental impact and hence their performance.

The results of our study align with the findings of prior studies (e.g., Tauringana & Chithambo, 2015), indicating that firms led by powerful CEOs (managers), due to their large shareholdings, are less likely to provide voluntary disclosure of GHG emissions. These results confirm the prediction of agency theory, which suggests that entrenchment effects take place when managers (CEOs) own large shares of the firms (Shan et al., 2021). Thus, our results demonstrate the applicability of the entrenchment effects hypothesis in explaining the decisions to disclose carbon emissions by listed firms in Malaysia.

Meanwhile, for the second form of ownership power, i.e., the status of the CEO as the founder of the firm, the results (see Table 5, Models 3 and 7) show that the coefficients of CEOfounder are statistically non-significant in both models. Hence, we could not find enough evidence to support H_2 . Likewise, the results show that the coefficients of CEOtenure, a measure of CEO expert power, is marginally significant in Model 5 but statistically non-significant in Model 7. Thus, our study could not find enough evidence to support H_4 , which test the influence of CEO expert power on carbon disclosure decisions. These results are consistent with the findings of Chithambo et al. (2020) who reported non-significant association between CEO tenure and the GHG reporting of 215 FTSE 350 UK listed companies in 2011.

As for the CEO structural power, which is measured using CEO duality, the results (see Table 5) show that the coefficients of CEOduality is non-significant in Model 4 but statistically significant, in a positive direction, in Model 7. These results will be further analyzed in the robustness test.

Table 5. The influence of CEO power and regulatory pressures on firms' decisions to disclose carbon emissions

	1	2	3	4	5	6	7
Intercept	-5.359 (0.56)***	-4.299 (0.54)***	-5.155 (0.56)***	5.405 (0.57)***	-4.927 (0.63)***	-7.388 (0.88)***	-6.751 (0.95)***
BODIndp	3.775 (0.89)***	3.529 (0.87)***	3.669 (0.88)***	3.810 (0.89)***	3.501 (0.91)***	4.823 (1.29)***	4.594 (1.32)***
ROA	0.054 (0.01)***	0.056 (0.01)***	0.055 (0.01)***	0.054 (0.01)***	0.054 (0.01)***	-0.012 (0.01)	-0.006 (0.02)
<i>Independent variables</i>							
CEOownership (H ₁)		-0.085 (0.02)***					-0.044 (0.02)***
CEOfounder (H ₂)			-0.618 (0.44)				0.079 (0.48)
CEOquality (H ₃)				0.228 (0.45)			1.316 (0.54)**
CEOtenure (H ₄)					-0.031 (0.02)*		-0.015 (0.02)
RegPressures (H ₅) - Low pressures							
• Medium pres- sures						2.556 (0.50)***	2.500 (0.51)***
• High pressures						4.646 (0.44)***	4.531 (0.46)***
Year effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	970	970	970	970	970	970	970
Wald Chi-Square	83.94***	54.82***	80.94***	83.50***	91.24***	170.32***	186.93***
Hosmer-Lemeshow	0.876	0.111	0.938	0.214	0.183	0.794	0.860
Pseudo R-square	0.091	0.166	0.096	0.091	0.099	0.467	0.493

Robust standard errors clustered by firms are reported in parentheses. *, ** denote significance at the 0.05 and 0.01 level, respectively (two-tailed)

In our study, regulatory pressures on the reporting of environmental issues are manifested in the form of mandatory sustainability reporting, which is imposed by Bursa Malaysia on a staggered basis, depending on the levels of the market capitalization. We assessed the strength of these regulatory pressures (RegPressures) using three levels of firms' market capitalization. Our results (see Table 5, Models 6 and 7) show that the coefficients of RegPressures are positive and strongly significant, supporting H₅. These results indicate that the stronger the regulatory pressures, the more likely for firms to disclose their carbon emissions. The reason behind the improvement in voluntary carbon disclosure, arising from mandatory sustainability reporting, is that the latter, along with the publication of sustainability reporting guidelines, including the GRI guidelines issued by Bursa Malaysia, serves as both coercive and normative pressures to encourage firms to disclose their carbon emissions. Prior studies (e.g., Houqe & Khan, 2022; Taurigana & Chithambo, 2015) explained that firms follow the disclosure regulation and the reporting guidelines to gain legitimacy and to prevent additional government intervention.

Our results align with prior evidence in Comyns (2016), Houqe and Khan (2022), Rankin et al. (2011) and Taurigana and Chithambo (2015) who documented evidence of firms improving their voluntary GHG/carbon reporting in response to disclosure regulation and/or specific reporting guidelines. These results also align with the predictions of institutional theory, which emphasizes the role of external pressures that influence firms to respond and embrace specific practices (Amran et al., 2016; Damert & Baumgartner, 2018; Faller & Zu Knyphausen-Aufseß, 2018; Houqe & Khan, 2022; Shui et al., 2022). Consequently, our results illustrate the applicability of institutional theory in explaining carbon disclosure decisions among listed firms in Malaysia, as a representative example for developing countries.

In the regression equations, we include control variables as identified by prior studies. We find that the coefficients of BODIndp, and ROA are positive and statistically significant in almost all models. Similar to prior studies (e.g., Ben-Amar et al., 2017; Ben-Amar & McIlkenny, 2015; Elsayih et al., 2018; Jaggi et al., 2018), these results suggest that firms with higher proportion of independent directors on the board of directors (BODIndp) and reported stronger financial performance (ROA) are more likely to disclose their carbon emissions. These results are expected, as these firms are more likely to be scrutinized by regulators and have attracted public attention due to their strong financial performance.

6.3. Further analyses

To ensure the reliability of the results, we performed several robustness tests, as discussed in the following sections.

6.3.1. Robustness test for CEO ownership variable (CEOownership)

We assess whether the empirical results of the CEO ownership (CEOownership) would be sensitive to the specification of the ownership interest. Thus, we re-defined CEO ownership interest (CEOownership) as the total ownership interest³ held by CEOs, and re-estimate Equation (1) using CEO total ownership interest. The results (see Table 6, Model 8) show that the coefficients of CEOownership and all other variables are largely consistent with the primary analyses, suggesting that the main results are robust to the specification of the CEO ownership interest.

6.3.2. Validation of the regulatory pressures (RegPressures)

We further validate our empirical evidence that regulatory pressures, proxied by three levels of the market capitalizations, increases the likelihood of firms to disclose their carbon emissions. This is accomplished by dividing the sample into two groups, one for the year prior to the implementation of mandatory sustainability reporting (i.e., 2015) and another for the year following the implementation (i.e., 2020). We then re-estimate Equation (1). The results show that prior to the implementation of the mandatory sustainability reporting (in 2015) (see Table 6, Model 9), the regulatory pressures had a positive impact on carbon disclosure only for firms with the largest market capitalization (market capitalization at RM2 billions or above, RegPressures—High). On the other hand, after the implementation of the mandatory sustainability reporting (in 2020) (see Table 6, Model 10), RegPressures are

Table 6. Further analyses

	8 CEOownershipTotal	9 pre-Mandatory SR	10 post-Mandatory SR	11 Matched-pair	12 First-stage	13 Second-stage
Intercept	-7.027 (0.90)***	-8.740 (5.07)***	-5.030 (1.09)***	-4.368 (1.05)***	1.277 (0.37)***	-7.084 (0.99)***
BOD_Size	-	-	-	-	-0.014 (0.03)	-
BODIndp	4.629 (1.29)***	6.821 (2.29)***	3.345 (1.49)**	5.216 (1.69)***	-1.842 (0.57)***	4.987 (1.30)***
ROA	-0.007 (0.02)	-0.029 (0.42)	-0.001 (0.01)	-0.009 (0.03)	0.012 (0.01)	-0.009 (0.01)
<i>Independent variables</i>						
CEOownership (H ₁)	-0.020 (0.01)**	-0.027 (0.02)*	-0.158 (0.06)**	-0.033 (0.02)**	-	-0.044 (0.02)***
CEOfounder (H ₂)	0.068 (0.45)	-0.749 (0.70)	0.603 (0.63)	0.117 (0.56)	-	0.068 (0.47)
CEOduality (H ₃)	1.503 (0.51)***	1.127 (1.00)	1.369 (0.60)**	1.289 (0.66)*	-	1.323 (0.53)**
CEOtenure (H ₄)	-0.012 (0.02)	-0.019 (0.03)	-0.016 (0.02)	-0.003 (0.02)	-	-0.016 (0.02)
IMR	-	-	-	-	-	0.009 (0.01)
<i>RegPressures (H₅) - Low pressures</i>						
• Medium pressures	2.499 (0.50)***	2.027 (1.25)	2.754 (0.55)***	0.269 (0.57)	-0.575 (0.33)*	2.602 (0.51)***
• High pressures	4.531 (0.46)***	5.483 (0.90)***	4.125 (0.47)***	2.168 (0.47)***	-0.781 (0.22)***	4.693 (0.48)***
Year effects	Yes	-	-	Yes	Yes	Yes
Industry effects	Yes	Yes	Yes	Yes	Yes	Yes

(Continued)

Table 6. (Continued)

	8	9	10	11	12	13
	CEOownershipTotal	pre-Mandatory SR	post-Mandatory SR	Matched-pair	First-stage	Second-stage
Observations	970	485	485	214	970	970
Wald Chi-Square	179.67***	73.38***	112.53***	62.22***	102.30***	62.22***
Pseudo R-square	0.485	0.567	0.464	0.283	0.086	0.494

Robust standard errors clustered by firms are reported in parentheses. *, ** denote significance at the 0.05 and 0.01 level, respectively (two-tailed)

positive and strongly significant for all levels (in RegPressures—Medium and RegPressures—High), suggesting that the regulatory pressures drive the carbon disclosure for all firms. Thus, these results provide additional assurance that the regulatory pressures variable (i.e., RegPressures) captures the implementation of mandatory sustainability reporting.

6.3.3. Impact of CEO duality on carbon disclosure decision

The results for the association between CEO duality and carbon disclosure decision are non-significant in the test of differences (see Table 3) and the correlation analysis (see Table 4); however, in the multivariate analysis that is based on the full model (Table 5, Model 7), the coefficients of CEOduality is positive and statistically significant. To further analyze the mixed results, we re-estimate Equation (1) in two different sub-samples based on the pre-and-post mandatory sustainability reporting. The results show that the coefficients of CEOduality are statistically significant during the post-mandatory sustainability reporting period (in Model 10) and non-significant prior to the mandatory sustainability reporting period (in Model 9). Overall, these results suggest that only under strong regulatory pressures that CEO duality influences firms' decisions to disclose their carbon decisions. Possibly, this is because the (MCCG, 2017) required listed firms to comply with the recommendation of separating the roles of CEO and Chairman, or to provide explanation for the combined roles (PwC, 2017). As a result, this could incentivize the CEOs with dual positions to engage in voluntary disclosure, including the carbon emissions, to demonstrate the effectiveness of their corporate governance system to both regulators and the market.

6.3.4. Imbalance dataset

In our data, the number of firms that disclosed their carbon emissions is too small (11% from the total observations, i.e., 107 observations), which imply an imbalance dataset. To mitigate the potential bias that may arise from uneven observations, we matched-pair the group of firms that disclosed carbon emissions with the non-disclosure group, based on industry and a firm's size (measured by the nearest total assets, as suggested by Bartov et al., 2000). Next, we re-estimate Equation (1) using the matched-pair samples. The results (see Table 6, Model 11) show that the inferences on all the four measures of the CEO power, regulatory pressures, and the control variables are generally consistent with those in the primary analyses, indicating that the uneven number of observations is unlikely to have driven the primary results.

6.3.5. Endogeneity tests

To control for endogeneity issue arising from self-selection bias, we performed Heckman's (1979) two-stage model. In the first-stage, we estimate a logistic regression with CEO_power as the dependent variable. We captured CEO_power using a composite measure of all the four dimensions of CEO (i.e., CEOownership, CEOfounder, CEOduality, and CEOtenure), which is then transformed into a binary variable. Following prior studies (Breuer et al., 2022; Florackis & Ozkan, 2009), we incorporate board size as an instrumental variable into the first-stage model. We also incorporate all other variables employed in the main analyses into the first-stage model.

In the second-stage, we generate an inverse Mills ratio (IMR) using the estimated coefficients from the first-stage model, and re-estimate Equation (1) by incorporating the IMR into the analysis. The results of the first-stage and the second-stage analyses are reported in Table 6, Models 12–13, respectively. The results show that the coefficient of IMR is not statistically significant (see Table 6, Model 13), whereas the coefficients of all the other variables are generally consistent with those from the main analyses, indicating the robustness of our results to self-selection bias.

7. Summary and conclusion

Research has investigated the determinants of carbon disclosure by firms in developed countries or large firms worldwide (e.g., Al-Qahtani & Elgharbawy, 2020; Ben-Amar et al., 2017; Dhanda & Malik, 2020; Giannarakis et al., 2017; Liao et al., 2015; Shan et al., 2021). We extend this investigation to listed firms in an emerging market, i.e., in Malaysia, and test the influence of powerful CEOs, which are prevalent in many developing countries, on corporate carbon disclosure decisions. We also test the impact of regulatory pressures on firms' decisions to disclose carbon emissions.

Our investigation of carbon disclosure by listed firms in Malaysia reveals that the transparency of carbon emissions is a concern, especially due to lack of disclosures among the listed firms examined. Consequently, the more the studies that highlight carbon disclosure and its drivers as well as impediments throughout the world, the more likely that governments will focus on this issue in their pledge to cut carbon emissions to net zero.

With regard to CEO power, the results show that firms led by powerful CEOs, measured by their large ownership interest, are less likely to disclose their carbon emissions. The policy implication of these results is that policymakers should consider encouraging or requiring institutional investors to play an active role in closely monitoring and guiding firms led by powerful CEOs to become transparent with their carbon emissions. Thus, the move made by the Malaysia's Employee Provident Fund (EPF) in encouraging its investee companies to enhance their climate disclosure practices by the year 2024 is very much needed and in the right direction.

The results also show that the strength of regulatory pressures, as proxied by the three different levels of firms' market capitalization, positively impacted carbon disclosure decisions. These results are expected to be of interest to policymakers and regulators in Malaysia, as well as in emerging markets that are committed to achieving net-zero target by 2050. They demonstrate that an indirect pressure exerted by Bursa Malaysia through the adoption of mandatory sustainability reporting has a positive impact on carbon disclosure decisions. To further enhance carbon emissions reporting, it is timely for regulators to consider implementing direct measures, such as the mandatory GHG reporting.

This study has at least two key limitations. First, we employ a dichotomous measure of the dependent variable, that is, whether a firm disclosed its carbon emissions. This is due to the fact that many companies do not disclose detailed carbon emissions. Consequently, we are unable to assess the quality of the carbon disclosure. In the future, as the quality of disclosure improves, future research should consider investigating whether regulatory pressures influence the quality of carbon disclosure.

Second, our study has focused solely on annual reports and sustainability reports as the means of data collection. To gain comprehensive insight, future research might consider employing a postal survey with a diverse set of questions related to carbon emissions or conducting interviews with relevant personnel.

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Notes

1. For example, a number of CEOs from developed countries, such as CEOs of A. P. Møller-Maersk, Deutsche Post DHL, Hewlett Packard Enterprise, PepsiCo, Unilever, and many others have pledged, amongst others, to establish credible decarbonization targets, and fully disclose emissions across all scopes (World Economic Forum, 2021).
2. We exclude prestige power due to a lack of detailed information available on CEOs' educational backgrounds.
3. Total ownership interests are the summation of direct ownership interest and indirect ownership interest. The indirect ownership interest refers to a situation in which a CEO holds an ownership interest in a company through an intermediary.

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