The Impact of Climate Risk Disclosure as Risk Management Tool on Firm Financial Performance: The Role of Board Characteristics
"Evidence from an Emerging Environmental Regime"

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Abstract

Purpose – Firms with high intensity of environmental investments have concern over the cost of meeting environmental regulations. This study aims to investigate how climate risk disclosure affects firm financial performance through examining the effect of disclosing about carbon emissions on firm`s ROA. In addition, this study extends prior literature by examining the role of board characteristics in promoting climate risk disclosure impact on firm financial performance**.**

Design/Methodology/Approach – This study uses the Carbon Disclosure Project (CDP) annual questionnaire to measure climate risk disclosure and uses ROA to measure firm financial performance. In addition, study`s model is developed by adding board characteristics to capture its effect on the relationship between climate risk disclosure and firm financial performance.

Findings - The empirical results demonstrate that: i) firm financial performance is positively associated with firm environmental performance. ii) no significant difference in ROA between firms disclose about climate risk than other firms. iii) the enhancement in financial performance of firms that disclose about climate risk is greater with more board size.

Research limitations/implications - The study is based solely on emerging environmental regime and does not consider mandatory disclosure about climate risk in developed regimes. Future research will be useful to conduct comparative studies of climate risk disclosure between developed and emerging regimes and their impact on financial performance. In addition, this study considers whether firms disclose about climate risk and does not consider level of disclosure nor level of carbon emissions. However, there is abundant room for further progress in determining levels of climate risk disclosure and carbon emissions.

Practical implications – One of the significant implications of this study is to advance understanding of how climate risk disclosure affects disclosure quality and how this would be reflected on financial performance as an approach of risk management.

Originality/Value – There are several important areas where this study makes an original contribution to accounting literature. This study extends the scope of the literature on risk management by providing evidence that climate risk disclosure could be considered as a main determinant of risk management. In addition, firms with environmental performance maintain their financial performance overtime.

Keywords – value-creation theory; value-destruction theory; agency theory; climate risk disclosure; financial performance; board characteristics.

1. Introduction:

In the new global economy, climate change has become a central issue for environmental affairs. As climate change is increasingly recognized as serious and worldwide public concern. Climate risk could be categorized into two board types of physical climate risk and transitional climate risk. Implications of Physical climate risk include the possibility that firms incur burden to face physical climate changes (e.g., water flood, global warming, and pandemics). While implications of transitional climate risk reflect the possibility that firms incur burden to comply with environmental regulations and litigation (Ndonde and Bei, 2021). Indexes are introduced by German Watch[1] are one of the most widely used measures of physical and transitional climate risk disclosure.

Firms have experienced an increase pressure from stakeholders to disclose about climate risk. This is complying with establishing national and international climate regulations in developed and emerging environmental regimes. To date different countries have developed and issued acts to encourage and obligate firms to disclose about carbon emissions and climate risk. More specifically, climate risk disclosure has been raised in different jurisdictions and by several organizations. Carbon Disclosure Project[2] (CDP), for example, encourages firms to disclose about environmental information and risk management related to carbon emissions. In 2010, the Environmental Protection Agency (EPA) lunches a program of Greenhouse Gas Reporting Program (GHGRP). In 2013, British government obligates

[1] GermanWatch is a non-profit, non-governmental organization based in Germany. It seeks to influence public policy on trade, the environment and relations between countries.

[2] Non-profit organization started in UK in 2000 then expanded with a membership of 6 countries of China, Germany, India, Japan, United Kingdom, and the United States of America.

publicly traded firms to disclose about climate risk in their annual published reports.

Investigating climate risk disclosure is a continuing concern within scholars and academics. Therefore, climate risk disclosure is fast becoming a key instrument in the implications of environmental accounting. Stakeholders tend to be more informed with climate risk disclosure and carbon emissions whereas they have a very definite awareness of the consequences of climate risk on firm performance (Diaz-Rainey et al., 2023). Given a rising stakeholder awareness of the importance of climate risk disclosure would lead to increase their investment intensity in a net-zero carbon projects. To do so, relevant disclosure about climate risk using carbon emissions data is urgently requesting by market regulators and standards setters.

In the literature of firm performance, the relationship between firm financial performance and firm environmental performance has been subject to considerable debate. Explanatory theories for such relationship are value-creation theory and value-destruction theory. Value-creation theory confirms that firm financial performance is positively associated with firm environmental performance. Proponents of the value-creation theory agree that firms with high intensity of environmental investments have better financial performance (Guenster et al., 2011; Ye et al., 2013). Along with this growth in firm environmental performance, however, there is increasing concern over the cost of meeting environmental regulations. This cost might outweigh its benefit and violate principle of owners' wealth maximizing (Diaz-Rainey et al., 2023). Value-destruction theory further supports the idea of negative relationship between firm financial performance and firm environmental performance. Since proponents of the value-destruction theory agree that firms may rule out real investment opportunities through environmental investments this decreases owners' wealth (Kroes et al., 2012; Oberndorfer et al., 2013). However, such explanation tends to overlook the fact that spending on environmental aspects could generate competitive edge for firms (Xie et al., 2019). Therefore, it is likely that the firm financial performance would be improved. Based on value-creation theory; this study investigates whether climate risk disclosure, through enhancing disclosure quality, leads to enhancement in firm financial performance. Given that board characteristics play an important role in the maintenance of disclosure quality and climate risk disclosure varies across firms according to board

characteristics (Firnanti et al., 2019). Therefore, the critical role of climate risk disclosure in shaping firm financial performance is likely to be increased with strong board characteristics. Therefore, this distinction is further exemplified by exploring the impact of board characteristics in promoting climate risk disclosure impact on firm financial performance. Eventually, results of this study will then be compared in the light of the explanatory theories of value-creation theory and value-destruction theory.

This study contributes to the growing literature of climate risk disclosures on fourfold. First, previous studies have reported the determinants of climate risk disclosure (Kolk et al., 2008; Choi et al., 2013; Diaz-Rainey et al., 2023), others paid attention to the consequences of climate risk discourse under a certain environmental regulation (Matisoff 2013; Tomar, 2019). Some studies investigate mandatory climate risk disclosure in regimes with a clear carbon emissions pricing index (Jouvenot and Krueger 2020). This study extends prior literature of climate risk disclosure with analysis in emerging environmental regime. A major aspect with this kind of investigation is that the implication of climate risk disclosure on firm financial performance is on an emerging environmental regime, more specifically, in Egypt. Second, the impact analysis of climate risk disclosure undertaken here, has extended the knowledge of the role of board characteristics. To the author`s best knowledge, this study is the first to empirically examine the role of board characteristics in shaping the relationship between climate risk disclosure and firm financial performance in an emerging environmental regime.

Third, this study goes beyond of Downar et al. (2022) which focus on the impact of carbon emissions disclosure on financial and operating performance. This study splits climate risk disclosure into two board categories of climate risk disclosure in developed and emerging environmental regimes. Despite its importance on the aggregated nature, this study offers some insight into the differentiation between climate risk disclosure in developed and emerging environmental regimes. Fourth, this study aims to shine new light on this continuous debate about the best theory to explain the relationship between firm financial performance and firm environmental performance of value-creation theory or value-destruction theory.

The debate continues about the best theory to explain this relationship of value-creation theory or value-destruction theory. If the debate is to be moved forward, a better understanding of climate risk disclosure within emerging environmental regimes and its impact on firm financial performance needs to be developed. Therefore, the questions in this study sought to determine:

1-Whether climate risk disclosure, through enhancing disclosure quality, leads to enhancement in firm financial performance?

2- Whether effective board increases the positive impact of climate risk disclosure on firm financial performance?

The study proceeds as the following structure: Section II provides literature review and develops research hypotheses. Section III defines variables, provides descriptive statistics for the full sample and section IV develops empirical models. Section V shows empirical results, section VI provides robustness test, section VII discusses main results and section VIII concludes.

2. Prior Literature and Hypotheses Development

2.1. Climate Risk Disclosure "Country-Level Background"

Climate change is increasingly recognized as serious and worldwide public concern. However, research has consistently shown that lack of climate risk disclosure has existed as a disclosure problem for many stakeholders (Diaz-Rainey et al., 2023). Since 1990, US has report about greenhouse gas (GHG) emissions. There were limited similarities between emissions disclosure expressed by firm level or entity level. This inconsistency leads the US Environmental Protection Agency (EPA) in 2009 to obligate firms to disclose about GHG emissions. With the aim of assessing the importance of disclosing about carbon emissions; GHG emissions set out guideline to better understand the mechanisms of carbon sources and to provide a framework based on carbon emissions reduction. In addition to the significant new knowledge about the role of EPA; the Securities and Exchange Commission (SEC) in 2010 issued guidance on how climate risk disclosure would be implied with accounting standards (Gary and Romi, 2014).

In 2000, Carbon Disclosure Project (CDP) was lunched, the initial objective of the project was to encourage firms to disclose about environmental information and risk management related to carbon emissions. In 2021, over 14 thousand entities respond to CDP and disclose about carbon emissions. In UK the synthesis of climate risk disclosure was done according to the procedure of Act 2006 which was issued in 2013. All publicly traded firms in UK are mandated to report about carbon emissions in strategic report and directors' report where all non-financial data should be disclosed. Prior to undertaking the Act, climate risk disclosure was obtained voluntary by firm at individual level (Downar et al., 2022).

The model of processing corporate governance used by Canada is comparable to that used by UK, Australia, and other European countries. They adopt principle-based approach which contrast with rule-based approach which is adopted in the United States. It is worth noting that before withdrawing from Kyoto[3] agreement in 2008, Canadian companies find it is not necessary to disclose about carbon emissions. In 2011, the Canadian government obligates listed firms in Toronto Stock Exchange (TSX) to reduce their carbon emissions and comply with GHG program of Canadian environment (Cleary and Hakes, 2021). As a result, listed firms on TSX are disclosing about climate risks on Management Discussion and Analysis (MD&A) report.

Egypt, as a member in the United Nations, in 2011 addresses climate change risk via issuing a strategy to reduce the impact of climate change and disaster risk. Egyptian parliament in 2017 ratifies Paris agreement to adopt climate change risk agreement. In 2018, to align with 2030 vision, Egypt lunches Low Emission Development Strategy (LEDS) to ensure adopting sustainable development and low emissions approach. Moreover, Egypt has adopted a climate change 2050 vision of National Climate Change Strategy (NCCS) to maintain green economy and mitigate carbon emissions. Egypt`s climate change 2050 vision includes programs and plans in all industries which is considered as a comprehensive framework to raise life

[3] The 1997 Kyoto Protocol – an agreement under the United Nations Framework Convention on Climate Change (UNFCCC) – is the world's only legally binding treaty to reduce greenhouse emissions.

quality of Egyptian citizens. In parallel with lunching NCCS, Egypt hosts the 27th round of the Conference of the States Parties to the UN Framework Convention on Climate Change (COP27) in Sharm El Sheikh, November 2022.

In July 2021, the Egyptian Financial Regulatory Authority (FRA) obligates firms that are listed on the Egyptian stock exchange (EGX) and nonbank financial companies (NBFCs) to disclose about their environmental, social and governance activities as ESG reports within annual financial reports starting from 2022. It has commonly been assumed that these ESG disclosures support the conceptual premise that would attract many international investors who reformulate their approaches to invest in green projects. This new regulation reveals that there has been a gradual rise in the number of firms listed on EGX which adopt sustainable development principles. Notwithstanding, this indicates a research gap which required to determine the efficiency of the new regulations of Egyptian FRA about ESG disclosures on listed firms` financial performance.

2.2. *Corporate Governance "Board Characteristics"*

In accordance with the applications of agency theory, previous studies have demonstrated that corporate governance maintains disclosure quality (Fritsch et al., 2022). The key aspects of corporate governance of publicly traded firms can be defined as characteristics of board members (Merendino and Melville, 2019). Board members` effectiveness plays an important role in the maintenance of agency problem between managers and shareholders (Bzeouich et al., 2019). Literature has emerged which offers contradictory findings about the impact of board effectiveness on disclosure quality. Tran et al. (2020) find a negative relationship between CEO duality and disclosure about intellectual capital. Also, Monteiro et al. (2023) find that there is a positive impact of board independence on the level of voluntary disclosure in countries with high level of investor protection. A further result is given by Khlif et al. (2021) who document the same findings with voluntary disclosure. Firnanti et al. (2019) find corporate governance decreases earnings management. Kanapathippillai et al. (2019) reports that the compensation

committee`s size and meeting frequency positively impact the level of disclosure. Arayssi et al. (2020) find that board of directors` effectiveness relates positively to environmental, social and governance (ESG) reporting disclosure.

In contrast to earlier findings, Boateng et al. (2022) find a negative relationship between voluntary disclosure and the representation of non-executive members at board of directors. Also, Haniffa and Cooke (2005) find a negative impact of the high representation of non-executive members at board of directors on social disclosure. Karamanou and Vafeas (2005) demonstrate that the size of audit committee is negatively associated with disclosure level about management forecasts. Tran et al. (2020) show a negative relationship between committees' independence and voluntary disclosure about intellectual capital. Surprisingly, some scholars document no significant difference is found in the relationship between board effectiveness and corporate disclosure. Michelon and Parbonetti (2012) find no significant evidence is detected about the impact of board independence on the activities of corporate social responsibility (CSR). Also, the results of Frias-Aceituno et al. (2013) show no significant increase in social disclosure within more representation of non-executive members at board of directors.

The stakeholder-agency framework, which introduced in 1992 by Hill and Jones, assists in the understanding of the supervising role of board members over managers to maintain their actions towards maximizing owners' wealth and work in the favor of stakeholders. Board members as important component of corporate governance system play a key role in risk management. This may be understood by the fact that climate risk disclosure would have been more convincing if it had been considered as means of risk management (Cardinaels et al., 2022). Many types of risk can result at least in part from climate change; including physical, transitional, regulatory, reputational and litigation risks. There is some evidence that these sorts of risk may affect negatively firm financial performance and reduce its competitive advantage. The investigation of Rankin et al. (2011) and Fritsch et al. (2022) demonstrate the possibility to hypothesize that carbon emissions disclosure is more likely to occur

in firms with strong corporate governance. In addition, Walls et al. (2012) find that board composition would have played more useful role if environmental activities had been adopted. A further result is given by Naciti (2019) who finds that both climate risk disclosure and sustainability performance are affected by board structure.
Given the unambiguous relationship between corporate governance and disclosure quality, this also indicates a research gap which raises the need to understand the various perceptions of board characteristics that affect disclosure. This study examines the role of board characteristics on the impact of climate risk disclosure on firm financial performance. Effective board would take actions to mitigate climate risk and increase level of climate risk disclosure to respond to the growing demands for increasing levels of disclosures.

2.3. Hypotheses Development

Spending on environmental aspects could affect firm financial performance since firms may rule out real investment opportunities through environmental investments (Kroes et al., 2012; Oberndorfer et al., 2013). However, spending on and disclosing about environmental aspects would have been more convincing if they had considered as means of risk management. Therefore, ESG reporting has important implications for achieving climate risk management (Cardinaels et al., 2022). Boubaker et al. (2020) finds that ESG reporting is important factor in eliminating firm financial distress risk. Rezaee et al. (2021) note that environmental disclosure helps firms in building trust and mitigating reputational risk. Koh et al. (2014) argue that firms with social and environmental activities may avoid litigation risk. However, these interpretations contrast with that of Kroes et al., (2012) and Oberndorfer et al. (2013) who argue that firm environmental performance relates negatively to firm financial performance. Kling et al. (2021) document that climate vulnerability has negative impact on cost of capital. Eventually, these experimental data are rather controversial, and there is no general agreement about the type of relationship between firm environmental performance and firm financial performance.

Climate risk management could be achieved by reducing the adverse impact of climate change and take actions towards sustainability and circular economy (Cardinaels et al., 2022). Climate risk disclosure enables firms to create value through increasing stakeholders` awareness. Stakeholders tend to be more concerned with the impact of climate risk whereas managers have a very definite awareness of the climate risk disclosure. Firms which spend on and disclose about environmental aspects have competitive edge over other firms, as increasing disclosure about valuable information increases information quality (Hope et al., 2016). Consequently, the market rewords these firms since increasing level of information symmetry between market participants (Xi et al., 2023). In the same way, disclosure about climate risk rises the financial performance of reporting firms. Proponents of the firm environmental performance agree that financial aspects may be lost as well as moral aspects gained when firms reduce carbon emissions and disclose about climate risk. Such moral capital increases firms value and reduces the negative impact of climate risk litigation (Koh et al., 2014; Lu et al., 2021).

Based on prior literature and value-creation theory this study investigates the relationship between climate risk discourse and firm financial performance within an emerging environmental regime of Egypt. Expectations have identified climate risk disclosure in emerging environmental regime enhances firm financial performance measured by ROA, thus the first hypothesis could be formulated as follows:

H_1: Firms that disclose about climate risk in emerging environmental regime have higher ROA than other firms.

Corporate governance plays an important role in the maintenance of agency problem between control and ownership (Bzeouich et al., 2019). It may be defined as a systematic process which is subject to many external and internal mechanisms (e.g., internal control system, audit committee and external auditor). Prior studies outline the essential role of corporate governance in monitoring managerial behavior and maintaining the information quality of financial reporting through different tools (e.g., monitoring internal control system, risk management and going concern). Corporate governance is significant to the level where it can influence and direct managers` decisions and actions. Eventually, strong corporate governance can use its mechanisms to control opportunistic managerial behavior and enhance reporting quality. Previous research has indicated that various corporate governance

mechanisms have a positive impact on climate risk management (De Villiers et al., 2011; Walls et al., 2012; Cardinaels et al., 2022). For instance, Naciti (2019) finds that board structure is an important factor in maintaining climate change risk management. However, climate risk disclosure would have been more persuasive if it had considered as a mean of risk management which varies across firms according to level of firms governing.

Board characteristics are considered to be the most important internal mechanism of corporate governance, such as board size, the independence of board members from executives, board structure, CEO duality, meetings frequency and independence of board committees (Vitolla et al., 2020). As it has been shown by Naciti (2019) and Fritsch et al. (2022) the effectiveness of board members, as an internal mechanism of corporate governance, enhances reporting quality. It has commonly been assumed that effective board members may have played a vital role in bringing about competitive advantage and increase firm value. Given the probability that climate risk disclosure relates positively to firm financial performance, this study examines the role of board effectiveness on such positive relationship. More effective board members would increase the level of climate risk disclosure to reduce information asymmetry and information risk. Expectations have identified the positive impact of climate risk disclosure in emerging environmental regime on firm financial performance is greater for firms with more effective board members. Effective board members would take actions to mitigate climate risk and increase level of climate risk disclosure to respond to the increasing demands for climate risk disclosure. Thus, the second hypothesis could be formulated as follows:

H_2*: The positive impact of climate risk disclosure in emerging environmental regime on ROA is greater for firms with more effective board members.*

The effectiveness of board members may be defined as a systematic process which consists of many elements of board characteristics such as board size, the independence of board members from executive managers, board structure, CEO duality, meetings frequency and independence of board committees (Vitolla et al., 2020). However, this study uses board size and CEO duality as a proxy for board characteristics. It is expected that more board members and splitting between CEO and chairman would promote climate risk disclosure impact on firm financial performance**.**

Therefore, the sub-hypotheses of the second one could be formulated as follows:

H_{2a}: The positive impact of climate risk disclosure in emerging environmental regime on ROA is greater for firms with more board members.

H_{2b}: The positive impact of climate risk disclosure in emerging environmental regime on ROA is greater for firms with less CEO duality.

In summary, this study aims to investigate how climate risk disclosure affects firm financial performance through examining the effect of disclosing about carbon emissions on firm`s ROA. In addition, this study extends prior literature by examining the role of board characteristics in promoting climate risk disclosure impact on firm financial performance**.**

3. Data and Methodology

3.1. Data and Sample Selection

The data is extracted from the annual reports of listed firms in the Egyptian stock exchange (EGX). The sample consists of all industrial firms listed in EGX100 between 2018 and 2021. The study uses a convenience sample time-farm as in 2017 Egypt ratifies Paris agreement to adopt climate change risk agreement. The sample frame ends with 2021, as the Egyptian FRA starts to obligate firms listed on EGX to disclose about their environmental, social and governance activities as ESG reports within annual financial reports starting from 2022. The eligibility criteria of the study`s sample requires firms with voluntary disclosure about ESG activities.

Data about climate risk disclosure is hand-collected from annual reports and ESG reports. ROA data used in this study is retrieved from financial statements. Data about board characteristics are hand-collected from financial reports and firms` official websites. Observations falling in the bottom or top percentiles of each variable have been removed to reduce the effect of outliers. The final sample represents 296 firm-year observation of 74 firms. Table (1) provides definitions of all variables used in this study.

Table 1. Variables Definition

VARIABLE	DEFINITION	MEASUREMENT
MODEL VARIABLE		
$CRD_{i,t}$	Climate risk disclosure for firm i at year t	Equals one if data about carbon emissions are disclosed in ESG reports, and zero otherwise.
$ROA_{i,t}$	Returns on assets for firm i at year t	The percentage of net income to average total assets
$ROE_{i,t}$	Returns on equity for firm i at year t	The percentage of net income to average total equity
$B.Size_{i,t}$	Board size for firm i at year t	The total number of board members
$CEO.Du_{i,t}$	CEO duality for firm i at year t	Equals one if CEO functions as chairman, and zero otherwise.
CONTROL VARIABLE		
$Size_{i,t}$	Firm size for firm i at year t	The natural logarithm of total assets.
$Lev_{i,t}$	Leverage for firm i at year t	The ratio of total debt to equity.
$OptIncm_{i,t}$	Operating income for firm i at year t	Operating income after depreciation.
$Lib_{i,t}$	Liabilities for firm i at year t	The natural logarithm of total liabilities.

3.2. Measurement and Methodology

This study investigates the impact of climate risk disclosure on firm financial performance. This distinction is further investigated by exploring the effect of board characteristics in promoting climate risk disclosure role on firm financial performance. Based on value-creation theory; climate risk disclosure enhances firm financial performance. This positive impact would be increased when firms have effective board members.

Measuring Climate Risk Disclosure:

Much of the current literature on climate risk disclosure pays particular attention to develop a framework to measure climate risk disclosure. However, this study follows prior literature of Griffin et al. (2017), Clarkson et al. (2014) and Matsumura et al. (2014) in measuring climate risk disclosure that to determine whether firm disclose about carbon emissions in its financial and environmental reports. Therefore, in study`s model, climate risk

disclosure ($CRD_{i,t}$) equals one if carbon emissions are disclosed in ESG reports, and zero otherwise.

Measuring Financial Performance:

Financial performance may be classified on the basis of measurement into accounting-based approach and market-based approach. Almost every study that has been written on firm financial performance includes model or more relating to accounting-based approach such as returns on assets (ROA), return on equity (ROE), and/or gross margin. Accounting-based approach differs from that of market-based approach that the last considers stock price and market reaction in valuating firm financial performance (Clarkson et al., 2014; Matsumura et al., 2014). Eventually, the accounting-based approach is one of the more practical ways of measuring firm financial performance which could be measured through data provided in published financial statements. In this study, firm financial performance is measured through ROA as the percentage of net income to average total assets as the following formula. Furthermore, ROE as an alternative measure of firm financial performance is used in robustness test part as additional check.

$$ROA_{i,t} = \frac{NI_{i.t}}{TA_{i,t}} (1)$$

Measuring Board Characteristics

Board characteristics are considered as a key aspect of corporate governance and associated with reducing the agency problem between management and ownership (Bzeouich et al., 2019). This study is specifically designed to evaluate factors related to board characteristics such as board composition and board structure through representative measures of board size and CEO duality. Board size ($B.Size_{i,t}$) is measured as the total number of board members. CEO duality ($CEO.Du_{i,t}$) equals one if CEO functions as chairman, and zero otherwise.

Control Variables

Several firm characteristics that have been identified as determinants of firm financial performance such as firm size, leverage, operating income, total liabilities, growth rate, capital intensity, industry type, market-to-book value. Following prior literature (e.g., Clarkson et al. 2011; Wang et al. 2014) this study is controlled by firm characteristics at year t. The study`s model is controlled by firm size ($Size_{i,t}$) and leverage ($Lev_{i,t}$). $Size_{i,t}$ is the natural

logarithm of total assets for firm i at year t and $Lev_{i,t}$ is the ratio of total debt to equity for firm i at year t. Table (2) presents descriptive statistics about final sample.

Table 2. Descriptive Statistics

Variable	Mean	Standard Deviation	Min	25th Percentile	Median	75 Percentile	Max
$CRD_{i,t}$	0.489	0.501	0	0	0	1	1
$ROA_{i,t}$	5.963	9.434	-50.224	1.088	4.020	10.325	39.848
$ROE_{i,t}$	-709.1	14664	-248690	1.633	8.394	22.694	36108
$B.Size_{i,t}$	8.323	2.078	4	7	8	10	15
$CEO.Du_{i,t}$	0.074	0.263	0	0	0	0	1
$Size_{i,t}$	8.966	0.784	7.492	8.320	8.998	9.445	10.983
$Lev_{i,t}$	136.3	1879	-282.1	0.300	0.880	1.649	30963

It can be seen from the data in Table (2) that the average firms disclose about climate risk amounting to 48.9% of total sample and the average of firms return on assets is 5.963%. The average total no of board members is 8 members and the average of firms with CEO duality is 7.4% of total sample. The table also shows that the mean (median) of the natural logarithm of total assets is 8.966 (8.998). Similarly, the mean (median) of the ratio of total debt to equity is 136.3 (0.880).

4. Empirical Model

This study investigates the effect of climate risk disclosure on firm financial performance. It is hypothesized that firms that disclose about carbon emissions in the previous year achieve better financial performance in the next year measured by ROA. This expectation has been examined through testing the first hypothesis. This study uses similar model to the market valuation model, that Ohlson has introduced in 1995, however, the application is on financial performance within emerging environmental regime. More specifically to test H_1, ROA has been regressed on climate risk disclosure after controlling for firm size and leverage. The following model has been developed to test 1st hypothesis:

$$ROA_{i,t} = \beta_0 + \beta_1 CRD_{i,t-1} + \sum Controls_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where $ROA_{i,t}$ refers to return on assets for firm i at current year, $CRD_{i,t-1}$ is dummy variable refers to whether firm discloses about carbon emissions in the previous year or not and $Controls_{i,t}$ refers to variables that used in prior literature to control firm financial performance. It is expected a positive and significant β_1 at model 2.

This study extends model (1) to capture the impact of board characteristics on the relationship between climate risk disclosure and firm financial performance. More specifically to test H_{2a}, ROA has been regressed on climate risk disclosure and board size as the following model:

$$ROA_{i,t} = \beta_0 + \beta_1 CRD_{i,t-1} + \beta_2 B.Size_{i,t-1} + \beta_3 CRD_{i,t-1} * B.Size_{i,t-1} + \sum Controls_{i,t} + \varepsilon_{i.t} \quad (3)$$

Where $B.Size_{i,t-1}$ refers to board size for firm i at year t-1. It is expected a positive and significant β_3 at model 3. Similarly, to test H_{2b}, ROA has been regressed on climate risk disclosure and CEO duality as the following model:

$$ROA_{i,t} = \beta_0 + \beta_1 CRD_{i,t-1} + + \beta_2 CEO.Du_{i,t-1} + \beta_3 CRD_{i,t-1} * CEO.Du_{i,t-1} + \sum Controls_{i,t} + \varepsilon_{i.t} \quad (4)$$

Where $CEO.Du_{i,t-1}$ refers to whether CEO functions as chairman or not for firm i at year t-1. It is expected a negative and significant β_3 at model 4.

5. Empirical Results

The Effect of Climate Risk Disclosure on Firm Financial Performance

Based on what mentioned in the literature review, value-creation theory confirms that firm financial performance is positively associated with firm environmental performance. Proponents of the value-creation theory agree that firms with high intensity of environmental investments have better financial performance. Moreover, spending on and disclosing about environmental aspects would have been more convincing if they had considered as means of risk management. It is expected that firms that disclose about climate risk in the previous year achieve better financial performance in the current year measured by ROA. It is apparent from table (3) that a positive correlation is found between climate risk disclosure in year t-1 and ROA in year t. The coefficient estimate of β_1, as consistent with prior literature, is positive of (0.109), however, it is insignificant.

Table 3. Empirical Results for H_1: "*The Effect of Climate Risk Disclosure on Financial Performance***"**

DEPENDENT VARIABLE		$ROA_{i,t}$
INTERCEPT	β_0	-0.507*** (0.612)
$CRD_{i,t-1}$	β_1	0.109*** (0.093)
$Size_{i,t}$	β_2	0.078*** (0.228)
$Lev_{i,t}$	β_3	-0.079*** (0.176)
N		296
ADJUSTED R^2		0.023

* p<0.05, ** p<0.01, *** p<0.001

The Mediated Effect of Board Characteristic

The first set of analyses examined the impact of climate risk disclosure on financial performance. The results indicate that climate risk disclosure in the previous year has positive but insignificant impact on firm financial performance in the current year. In this set of analyses the investigation has been expanded by testing whether effective board increases the positive impact of climate risk disclosure on firm financial performance. Table (4) panel (A) presents the breakdown of testing H_{2a} that the coefficient estimate of β_3, as expected, is positive and significant of (0.297). Therefore, the positive impact of climate risk disclosure on ROA is greater for firms with more board members.

In addition, CEO duality would decrease board effectiveness then decrease the positive impact of climate risk disclosure on enhancing financial performance. As shown in panel B of table (4), β_3 is negative of (-0.115), however, it is insignificant. This result indicates that no significant evidence about the role of CEO duality on shaping the relationship between climate risk disclosure and firm financial performance.

Table 4. Empirical Results for H_2: "*The Mediated Effect of Board Characteristic"*

PANEL A: BOARD SIZE, H_{2a}		
DEPENDENT VARIABLE		$ROA_{i,t}$
INTERCEPT	β_0	-0.574*** (0.567)
$\boldsymbol{CRD_{i,t-1}}$	β_1	-0.182*** (0.478)
$\boldsymbol{B.Size_{i,t-1}}$	β_2	0.014*** (0.873)
$\boldsymbol{CRD_{i,t-1} * B.Size_{i,t-1}}$	β_3	0.297*** (0.002)
$\boldsymbol{Size_{i,t}}$	β_4	0.082*** (0.205)
$\boldsymbol{Lev_{i,t}}$	β_5	-0.079*** (0.172)
$\boldsymbol{N}$		294
ADJUSTED $\boldsymbol{R^2}$		0.026
PANEL B: CEO DUALITY, H_{2b}		
DEPENDENT VARIABLE		$ROA_{i,t}$
INTERCEPT	β_0	-0.551*** (0.582)
$\boldsymbol{CRD_{i,t-1}}$	β_1	0.129*** (0.054)
$\boldsymbol{CEO.Du_{i,t-1}}$	β_2	0.071*** (0.444)
$\boldsymbol{CRD_{i,t-1} * CEO.Du_{i,t-1}}$	β_3	-0.115*** (0.210)
$\boldsymbol{Size_{i,t}}$	β_4	0.080*** (0.220)
$\boldsymbol{Lev_{i,t}}$	β_5	-0.097*** (0.123)
N		293
ADJUSTED $\boldsymbol{R^2}$		0.022

* p<0.05, ** p<0.01, *** p<0.001

6. Robustness Test

Robustness test is developed further for additional relevant results to check the robustness of the main result of this study. Model (6) shows an alternative measure of firm financial performance of return on equity (ROE).

$$ROE_{i,t} = \beta_0 + \beta_1 CRD_{i,t-1} + \beta_2 B.Size_{i,t-1} + \beta_3 CRD_{i,t-1} * B.Size_{i,t-1} + \sum Controls_{i,t} + \varepsilon_{i.t} \quad (6)$$

Table 5. Empirical Results for Additional Test of "*The Mediated Effect of Board Characteristic"*

DEPENDENT VARIABLE		$ROE_{i,t}$
INTERCEPT	β_0	-0.223*** (0.824)
$CRD_{i,t-1}$	β_1	-0.023*** (0.834)
$B.Size_{i,t-1}$	β_2	0.001*** (0.994)
$CRD_{i,t-1} * B.Size_{i,t-1}$	β_3	0.099*** (0.001)
$Size_{i,t}$	β_4	0.010*** (0.718)
$Lev_{i,t}$	β_5	-0.911*** (0.000)
N		294
ADJUSTED R^2		0.025

* p<0.05, ** p<0.01, *** p<0.001

As shown in table (5), the result is similar to this one carried out by the main model of this study. The coefficient estimate of β_3 is positive and significant of (0.099). Therefore, the positive impact of climate risk disclosure on firm financial performance, measured by ROE, is greater for firms with more board members. Accordingly, the robustness of Model (3) is confirmed.

Furthermore, it is interesting to note that the association between climate risk disclosure and firm financial performance can give rise to endogeneity problem. Therefore, it is necessary here to robust for the main results after controlling about endogeneity which may rise from omitted variables. Following Matsumura et al. (2014) who control for operating income and total liabilities, model (3) has been modified to include operating income ($\mathrm{OptIncm}_{i,t}$) and natural logarithm of total liabilities ($Lib_{i,t}$). Operating income has positive impact on firm financial performance, while total liabilities have negative impact on firm financial performance. Thus,

$$ROA_{i,t} = \beta_0 + \beta_1 CRD_{i,t-1} + \beta_2 B.Size_{i,t-1} + \beta_3 CRD_{i,t-1} * B.Size_{i,t-1} + \sum Controls_{i,t} + \varepsilon_{i.t} \quad (7)$$

Table 6. Empirical Results for 2nd Additional Test of "*The Mediated Effect of Board Characteristic"*

DEPENDENT VARIABLE		$\boldsymbol{ROA_{i,t}}$
INTERCEPT	β_0	2.440*** (0.015)
$\boldsymbol{CRD_{i,t-1}}$	β_1	0.113*** (0.647)
$\boldsymbol{B.Size_{i,t-1}}$	β_2	0.003*** (0.968)
$\boldsymbol{CRD_{i,t-1} * B.Size_{i,t-1}}$	β_3	0.045*** (0.004)
$\boldsymbol{Size_{i,t}}$	β_4	-0.208*** (0.177)
$\boldsymbol{Lev_{i,t}}$	β_5	-0.061*** (0.271)
$\mathbf{OptIncm_{i,t}}$	β_6	0.412 (0.000)
$\boldsymbol{Lib_{i,t}}$	β_7	0.043 (0.773)
$\boldsymbol{N}$		293
ADJUSTED $\boldsymbol{R^2}$		0.131

* p<0.05, ** p<0.01, *** p<0.001

From table (6) it can be seen that β_3 is positive and significant of (0.045). Therefore, the positive impact of climate risk disclosure on firm financial performance, after controlling of firm size, leverage, operating income, and total liabilities is confirmed.

Firms with high intensity of environmental investments have concern over the cost of meeting environmental regulations. This study aims to investigate how climate risk disclosure affects firm financial performance through examining the effect of disclosing about carbon emissions on firm`s ROA. In addition, this study extends prior literature by examining the role of board characteristics in promoting climate risk disclosure impact on firm financial performance**.** This study uses the Carbon Disclosure Project (CDP) annual questionnaire to measure climate risk disclosure and uses ROA to measure firm financial performance. In addition, study`s model is developed by

adding board characteristics to capture its effect on the relationship between climate risk disclosure and firm financial performance.

7. Discussion

According to value-creation theory firm environmental performance is positively associated with firm financial performance that firms with high intensity of environmental investments have better financial performance. The findings of this study are consistent with those of Koh et al. (2014), Boubaker et al. (2020) and Rezaee et al. (2021). The empirical results show the positive impact of climate risk disclosure on firm financial performance; however, the results are insignificant. It seems possible that these results are due to the application is on emerging environmental regime (i.e., Egypt) with growing awareness of the importance of climate risk disclosure. As only in 2017 Egyptian parliament ratifies Paris agreement to adopt climate change risk agreement. Another possible explanation for these results is that to achieve the impact of environmental activities it takes a long time as it is a long-term process therefore firms with environmental performance maintain their financial performance overtime.

However, these results are retested with investigating the role of corporate governance in promoting climate risk disclosure impact on enhancing firm financial performance. The empirical results support this hypothesis that the positive impact of climate risk disclosure in emerging environmental regime on ROA is greater for firms with more board members. The robustness check for this result is approved using different proxy of firm financial performance (ROE). In contrast to earlier findings, however, no evidence of the role of CEO duality is detected. Hence, it could conceivably accept H_{2a}that the positive impact of climate risk disclosure in emerging environmental regime on ROA is greater for firms with more board members. However, H_1 is rejected that firms that disclose about climate risk in emerging environmental regime have higher ROA than other firms and H_{2b} is rejected also that the positive impact of climate risk disclosure in emerging environmental regime on ROA is greater for firms with less CEO duality.

8. Conclusion

This study aims to investigate how climate risk disclosure affects firm financial performance through examining the effect of disclosing about carbon emissions on firm`s ROA. In addition, this study extends prior literature by examining the role of board characteristics in promoting climate risk disclosure impact on firm financial performance. The findings reveal that: i) firm financial performance is positively associated with firm environmental performance. ii) no significant difference in ROA between firms disclose about climate risk than other firms. iii) the enhancement in financial performance of firms that disclose about climate risk is greater with more board size.

The findings of this study suggest important practical implications for governments and market regulators to adopt. This is complying with establishing national and international environmental/climate regulations in developed and emerging environmental regimes and develop strategies to meet these laws and disclose about the firms` compliance levels with these laws. Another important practical implication of this study is that both environmental regulations and climate risk disclosure of firms should be considered when listing and delisting decisions are taken by market regulators.

Due to practical constraints, this paper cannot provide a comprehensive review of climate risk disclosure, as it is based solely on an emerging environmental regime. Future research will be useful to conduct comparative studies of climate risk disclosure between developed and emerging regimes to capture their impact on firm financial performance. In addition, it is beyond the scope of this study to examine the level of disclosure nor level of carbon emissions. However, in future investigations, it might be possible to use a different measure of climate risk disclosure in which levels of climate risk disclosure and carbon emissions are considered.

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المستخلص:

الهدف – هناك تخوف لدى الشركات ذات الكثافة العالية في الاستثمارات التي تأثر على المناخ بشأن التكلفة الخاصة بتلبية القوانين البيئية. في ضوء ذلك: تهدف هذه الدراسة إلى الوقوف على معرفة كيف يؤثر الإفصاح عن المخاطر المناخية على الأداء المالي للشركات، وذلك من خلال دراسة تأثير الإفصاح عن انبعاثات الكربون على معدل العائد على أصول الشركة. بالإضافة إلى ذلك، تضيف هذه الدراسة الى الأدبيات المحاسبية السابقة فى مجال الافصاح من خلال فحص دور خصائص مجلس الإدارة في تعزيز تأثير الافصاح عن المخاطر المناخية على الأداء المالي للشركات.

المنهجية – تعتمد هذه الدراسة بصفة اساسية على تقارير الافصاح السنوي عن انبعاثات الكربون (CDP)لقياس الإفصاح عن المخاطر المناخية، كما تعتمد على معدل العائد على أصول الشركة (ROA) لقياس الأداء المالي للشركات. علاوه على ذلك، تم تطوير نموذج الدراسة من خلال إضافة خصائص مجلس الإدارة للوقوف على تأثيرها على العلاقة بين الإفصاح عن المخاطر المناخية والأداء المالي للشركات.

النتائج – توصلت نتائج الدراسة إلى ما يلي: 1- هناك ارتباط ايجابى بين الأداء المالي وبين الأداء البيئي للشركة. 2- لا يوجد فرق معنوى بين معدل العائد على الأصول للشركات التي تفصح عن المخاطر المناخية وباقي شركات عينة الدراسة. 3- هناك زيادة معنوية في تحسن الأداء المالي للشركات التي تفصح عن المخاطر المناخية في حالة الشركات التى تتمتع بعدد أكبر لاعضاء مجالس إدارتها.

حدود البحث – تقتصر هذة الدراسة بالتطبيق على احدى الاقتصاديات الناشئة، حيث لا تأخذ في الاعتبار الافصاح الالزامي عن المخاطر المناخية في الاقتصاديات المتقدمة. وعلى هذا، توصى الدراسة باجراء أبحاث مستقبلية لمقارنة الافصاح عن المخاطر المناخية بين الاقتصاديات الناشئة والاقتصاديات المتقدمة واستعراض تأثيرها على الأداء المالي للشركات. بالإضافة إلى ذلك، تتناول هذه الدراسة ما إذا كانت الشركات تفصح عن المخاطر المناخية ولا تأخذ في الاعتبار مستوى الإفصاح أو مستويات انبعاث الكربون. وبذلك تكون هناك فرصة لاجراء ابحاث مستقبلية للوقوف على دراسة التأثير الخاص بمستويات الافصاح عن المخاطر المناخية ومستويات انبعاث الكربون.

التطبيقات العملية – أحد أهم التطبيقات العملية لهذة الدراسة هو تعزيز فهم كيف يؤثر الإفصاح عن المخاطر المناخية على جودة الإفصاح وكيف سينعكس ذلك على الأداء المالي للشركات، بإعتبار الافصاح احد مناهج إدارة المخاطر.

الأصالة – تضيف هذه الدراسة إلى أدبيات المحاسبة المالية والافصاح من خلال تقديم أدلة على أن الافصاح عن المخاطر المناخية يمكن اعتباره محددًا رئيسًا من محددات إدارة المخاطر. بالإضافة إلى ذلك، تحقق الشركات التى تفصح عن المخاطر المناخية تحسنًا في أدائها المالي في الاجل الطويل.

الكلمات المفتاحيه – نظرية خلق القيمة؛ نظرية اضمحلال القيمة؛ نظرية الوكالة؛ الافصاح عن المخاطر المناخية؛ الأداء المالي للشركة؛ خصائص مجلس الإدارة.