

CARBON DISCLOSURE: A SYSTEMATIC LITERATURE REVIEW OF DETERMINANTS

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Abstract: *This paper aims to review the status of literature on carbon disclosure to synthesise mounting literature to identify any gaps in current research to suggest areas for further study. A total of 54 articles from referred journals from 2016 to 2020 are reviewed using a systematic literature review method. The review suggests that determinant factors such as corporate governance, firms' characteristics, environmental performance, guidelines and regulations, socio-economic, management structures and practices, and stakeholders factors are important drivers of the disclosure of carbon information. Most of the studies on determinants of carbon disclosure focused on the developed countries environment, with most of the sample using data from the Carbon Disclosure Project (CDP). This paper contains a comprehensive listing of publications on carbon disclosure and its classification according to determinant factors. The paper will be useful to researchers, accounting professionals and others concerned with carbon disclosure and reporting to understand the importance of carbon disclosure and reporting.*

Keywords: *Carbon Disclosure, Systematic Literature Review, Literature Review, Content Analysis*

Introduction

Integrating climate change and its negative impacts into the business's strategy is considered a critical decision. Companies should recognise the possible effect of climate change on their business decisions while fulfilling their obligation to consider the environmental impact of their activities. Consequently, global climate change resulting from the rise in greenhouse gas (GHG) or carbon emission is caused primarily by business activities, particularly the energy consumption and the burning of fossil fuels (Intergovernmental Panel on Climate Change, 2001, 2007). Therefore, companies are expected to play an important role to deal with environmental issues and publicly report information about greenhouse gas emission

(interchangeably using the term "carbon emission") to various stakeholders, including regulatory bodies, investors, and shareholders (Hossain & Farooque, 2019).

As carbon disclosure is becoming more common in the corporate reporting landscape, it is useful to examine the disclosure practice affected by the impacts of climate change. Furthermore, due to the worldwide regulatory developments on the carbon-related issue, alongside the recognition of carbon emissions direct and indirect impacting the business environment, research on carbon disclosure has become crucial and gained attention. Against this backdrop, this study provides an overview of the current state of research in the area of carbon disclosure by organising a systematic review of the literature.

Stechemesser & Guenther (2012) previously published a review that extensively covered the topic of carbon accounting, while Ascuri (2014) focuses on carbon accounting within social and environmental accounting (SEA) literature. The most recent review on carbon-related disclosure is centered on the main premise of identifying governance-related determinants and financial consequences of carbon performance and disclosure, alongside the connection between carbon performance and carbon disclosure (Velte, Stawinoga, & Lueg 2020).

In contrast to these previous reviews, this paper aims to contribute to the literature by reviewing and roadmap the determinants in carbon disclosure and reporting research. In addition, this review discusses the proxies and measurements used. This paper extends and complements the current body of knowledge on carbon-related disclosure by providing an international overview of the current understanding of carbon disclosure and reporting. Finally, the shortcomings and gaps in recent scholarly research that should be addressed to develop our understanding of carbon disclosure are identified and further elaborated and discussed.

This review is organised as follows: After an introduction to carbon-related disclosure, the next section explains the purpose of conducting a systematic review, while the second section details the methodology section and the Preferred Reporting Items Systematic Reviews and Meta-Analysis (PRISMA) approach used. In addition, the section provides detailed systematic reviews and synthesises the scientific literature to identify, select and appraise relevant research. The fourth section presents a detailed discussion based on reviewed articles to pin down and attest to the necessity for the research objective identified earlier. Then, the last section identifies the conclusion and the policy recommendations.

Literature Review

This review focus is on carbon disclosure as a sub-domain under the term carbon accounting. As regards, carbon accounting is emerging as a subset of the environmental accounting concept, just as environmental accounting has emerged from a subset of accounting (Schaltegger, 2001). The terms carbon disclosure and carbon reporting are often used interchangeably; however, there are slightly different. For carbon reporting, prior research emphasises the information requirements by companies to addressees the carbon reporting and the specific methods or standard of reporting and denoting whether the reporting is a voluntary or mandatory basis (Pattberg, 2017). Carbon reporting is generally utilised as a medium to demonstrate the firm's accountability to its stakeholders, including shareholders, potential investors, suppliers, customers, etc. As regards the reporting status, across the nations, carbon reporting contains a mixture of both mandatory and voluntary, financial and non-financial, and quantitative and narrative information.

For the carbon disclosure concept, Pattberg (2017, p.1441) elaborated as "to translate corporate carbon profiles into assessments of risks, and market opportunities with clear financial implications for firms and investors and the focus are less on the overall process and methodology but rather on the broader societal purpose of reporting and accounting". Furthermore, Hahn, Reimsbach, & Schiemann (2015) stated that the output of carbon disclosure involves organisational practices to systematically collect data, measure direct and indirect carbon emissions, and communicate with third parties regarding information needs or guidance.

Various initiatives have taken place on carbon-related disclosure and reporting. This includes the Carbon Disclosure Project (CDP), by the Climate Disclosure Standards Board (CDSB), which works closely with Deloitte, Ernst & Young, KPMG, and PricewaterhouseCoopers to develop robust accounting standards in a directed effort to enable carbon reporting through the medium of corporate reporting. The CDP was formed way back in 2000 as a non-profit making organisation that gathers information related to carbon emissions, climate change risks and the opportunities and management strategies of the largest companies across the world. This information is gathered by distributing a standard and well-designed questionnaire from the largest companies. Consequently, CDP seeks to provide information related to actions undertaken by the companies to reduce and minimise the adverse effects that the companies would have impacted on the environment in general and climate change specifically.

Five significant climate change-related events increased attention to both academics and practitioners to climate change-related disclosure. The Earth Summit at Rio de Janeiro in 1992 was the first significant climate-change event, followed by the Kyoto Protocol in 1997, next, the Ratification of Kyoto Protocol Globally in 2005, the Climate Change Conference of Parties (COP15) Copenhagen in 2009 and the most recent event, Paris Climate Agreement in 2015. The recent developments at the Paris Climate Agreement showed that most countries are now are seemingly open in their efforts to reduce carbon emissions (UNFCCC 2016). Accordingly, the level of awareness among the companies on this issue has heightened significantly. The Paris Climate Agreement establishes a framework for global climate action that replaces the Kyoto Protocol representing the first time nations agreed to mandate country-specific emissions with reduction targets legally. One of the Paris Climate objectives is to limit the global temperature rise to 2oC above the pre-industrial level and pursue efforts to limit the rise to 1.5°C (UNFCCC, 2016).

Several countries such as the European Union, the United States, Canada, Japan, South Korea, and New Zealand have committed to reducing greenhouse gas emissions by issuing mandatory regulations for companies to disclose information related to carbon emissions (World Resources Institute, 2015). However, carbon disclosure is still non-mandatory for companies in most countries. For disclosures that inhibit a voluntary nature, it provides flexibility to the firms and management to choose between various methods for calculating and reporting carbon emissions.

Corporate disclosures play an important role in the financial market, as the distribution of such information increases companies' reputation and facilitates the optimal functioning of an effective capital market (Healy & Palepu, 2001). In this instance, carbon disclosure emerges as a tool for promoting climate change mitigation (Harmes, 2011). Research on carbon disclosure indicates that researchers agreed with the need for carbon disclosure and have begun

to include environmental issues as general and the organisational impact on climate change, specifically in their research agendas.

Businesses are significant polluters and benefit at the expense of the broader public through largely costless externalities (Dahlmann, Branicki, & Brammer, 2019). Companies are not only exposed to the direct physical impacts of climate change, but they also face regulatory risks from impending legislation concerning their carbon emission (Halkos & Skouloudis, 2016). Therefore, businesses face moral responsibilities to mitigate their impacts by reducing their carbon emissions as part of a transition to a sustainable corporation besides achieving low-carbon strategies (Breton & Aggeri, 2019).

Disclosure of detailed information on carbon-related will allow the stakeholders to access and evaluate carbon performance and take appropriate actions within the market control framework to discipline managers if they are not performing their job well (Hahn et al., 2015). The detailed information presented truly must reflect carbon performance because the disclosures will ultimately influence the stakeholders' evaluation of the firm. Furthermore, improving the disclosures of carbon information will further induce investors' interests, apart from providing the business with a competitive business environment. In this case, firms may then be viewed as a dedication to accountability, especially if the firms overtly undertake attempts to tackle challenges and opportunities associated with climate change, and such moves are identified as the criteria for evaluating the credibility and legitimacy of an entity (Alsaifi, Elnahass, & Salama, 2020).

Methodology

The system used to retrieve papers relating to reporting or disclosure of carbon disclosure is discussed in this section. This paper used Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to run the systematic review, eligibility and exclusion criteria, steps of the review process (identification, screening, eligibility) and data abstraction and analysis.

Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA)

PRISMA is an established standard protocol to conduct a systematic literature review. This protocol is expected to provide authors with the relevant and appropriate details that will allow them to determine and evaluate the quality and rigour of a review. Following Mohamed Shaffril, Samsuddin, & Abu Samah (2020), PRISMA provides guidelines that describe the process of SLR in an organised manner, including the data demonstration phase. PRISMA methods provide advantages over other systematic reviews methods because it can guide the systematic reviews of other fields of study that involve the assessments of interventions (Mohamed Shaffril et al., 2020).

Resources

The review research was carried out on two main journal databases: Web of Science (WOS) and Scopus. These two bibliographic databases widely used for systematic review previously (see Daddi, Todaro, De Giacomo, & Frey, 2018; Mohamed Shaffril et al., 2020). Besides, these two leading indexed databases were chosen to ensure high-quality journals can be accessed

The systematic review phases

Phase 1: Identification

The systematic review process begins by choosing several relevant articles for the present study. The first phase is the recognition of the keyword, followed by the search process for related and similar words based on the thesaurus, dictionaries, encyclopedia, and prior study. Therefore, search strings on Scopus and the Web of Science database were developed in June 2020 (Refer Table 1) after all relevant keywords were determined. Similar to other carbon disclosure systematic review, where the selection of articles is the integration of climate change disclosure and carbon disclosure because the climate change disclosure focuses on corporate emissions (see Hahn et al., 2015; Velte et al., 2020). In the first stage of the systematic review process, 383 articles from both databases were retrieved from the current research work.

Table 1: The Search String

Database	Search String
Scopus & Web of science	"carbon disclosure" OR "greenhouse gas disclosure" OR "greenhouse gas emission disclosure" OR "global warming disclosure" OR "climate change disclosure" OR "carbon report*" OR "greenhouse gas report*" OR "greenhouse gas emission report*" OR "global warming report*" OR "climate change report*" OR "carbon accounting" OR "greenhouse gas accounting" OR "accounting carbon footprints"

Phase 2: Screening

The second phase in this methodology was screening. In this phase, 75 duplicated articles that appear both in the Scopus and Web of Science database have been removed carefully. This review focus solely on the empirical articles (research articles), whereas systematic review, review, meta-analysis, meta-synthesis, book series, book, chapter in a book, and conference proceeding were excluded. Furthermore, this review focused only on articles published in English, and the timeline has been selected for a 5-year duration (2016-2020 as of 30 June). The 5-year duration from 2016 is after the significant event of the Paris Climate Agreement in 2015 until the recent year. Most notably, the selection of articles published in the fields of social sciences, management, economics, business and business finance has been chosen to increase the possibility of retrieving relevant articles. The review also was not limited to any specific theory and country of origin of the studies (Refer to Table 2).

Table 2: The Inclusion and Exclusion Criteria

Criteria	Inclusion	Exclusion
Literature type	Journal (research articles)- ranked journal	Concept paper, review paper, book series, book, chapter in the book, conference proceeding
Language	English	Non-English
Timeline	Between 2016 – 2020 (as at 30 June 2020)	<2016
Subject area	social sciences, management, economics, business and business finance	Other than social sciences, management, economics, business and business finance
Number of articles	308 total articles	75 duplicated articles

Phase 3: Eligibility and exclusion criteria

The third stage is eligibility, where the abstract and full articles were accessed. A total of 174 articles were removed after abstracts were assessed for eligibility due to articles related to hard science, operations management, business strategy, energy, policy, and supply chain. Then, after careful examination, the main content of articles, a total of 80 articles were excluded as some did meet the objective of this review. The last stage of review resulted in a total of 54 articles that were used for the qualitative analysis (see Figure 1).

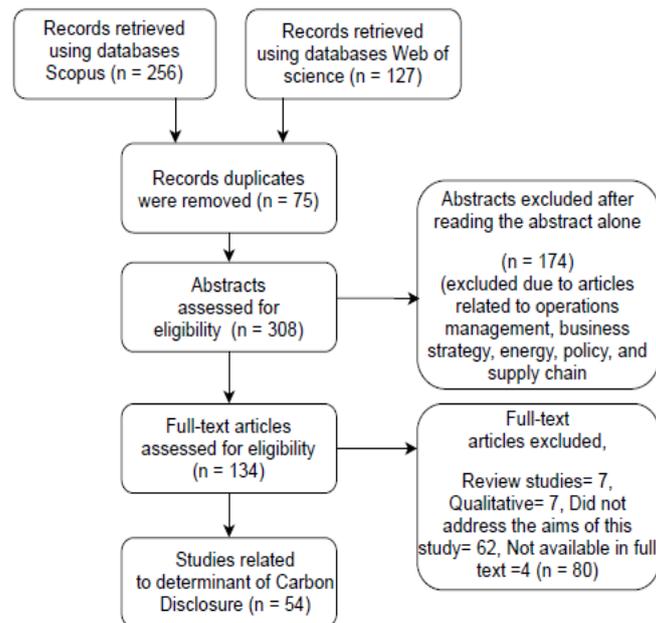


Figure 1: The Flow Diagram of the Study.
(Adapted from Shaffril, Krauss, & Samsuddin, 2018)

Data Abstraction and Analysis

The next step was to classify the study type by reading the full text of those articles. There are various research lines on carbon disclosure that show a wide range of different research interests. The determinants study will be identified by reviewing the full content of the articles. Determinants studies are devoted to identifying determinants that explain why firms report on carbon-related or factors that explain the extent and quality of reporting; the corporate carbon disclosure and reporting measure is the dependent variable in the analysis.

Discussion

This paper aimed to identify these studies using the systematic review approach to answer our research question: what are the determinant factors of carbon disclosure placed in empirical research? The bibliographical data for this review were stated in the first step. This review found a total of 54 articles that are related to determinants of carbon disclosure or reporting. Figure 2 shows the frequency of the studies in this area since 2016. The low number for 2020 refers to only the first six months of the year.

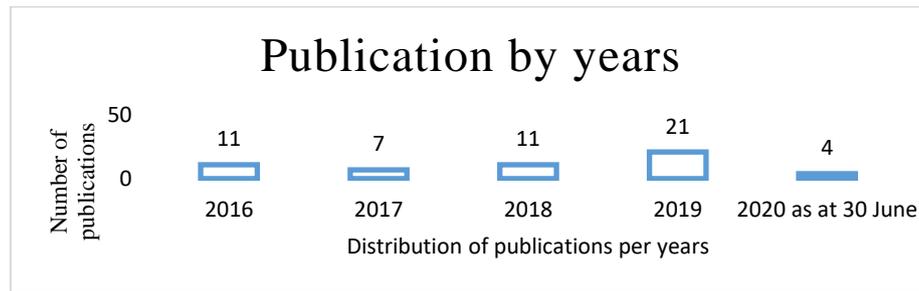


Figure 2: Distribution Publication Over Time

All selected articles were published in journals related to accounting, finance, business, management and sustainability topics in the social science area; 22 by journals from the accounting and finance subject area; another 32 in journals from the general business and management area or in other specialty journals subject area. The distribution of journals represents the general acceptance of carbon disclosure and reporting topic across various subject areas. Here, this review highlights seven possible explanations on determinants of disclosure and reporting factors, namely, 1) corporate governance, 2) firms' characteristics 3) environmental performance 4) guidelines and regulations, 5) socio-economic, 6) management structures and practices, and 7) stakeholders factors.

Among the significant corporate governance determinants that influence carbon disclosure is the board's attributes. The structure of the board of directors attributes could be viewed as a significant factor that could influence carbon disclosure because the board of directors directly formalises the disclosure policies and strategies detailed voluntary disclosure of the firm (Akbaş & Canikli, 2019; Ararat & Sayedy, 2019; Charumathi & Rahman, 2019) and determine the quality of disclosure (Grigoris Giannarakis, Zafeiriou, Arabatzis, & Partalidou, 2018; Hollindale, Kent, Routledge, & Chapple, 2019). Amongst the boards' attributes, the most common determinants are the board size, independent board of directors, board gender and CEO duality (Table 3). In particular, as one of the components of board governance, the board committee received more attention. Review shows the board committee such as environmental committee, sustainability committee, risk management committee and audit committee are more heterogeneous. Certain board determinants, such as board's background and tenure are still limited findings.

Table 3: Corporate Governance Factors

No.	Author(s), Year	Country	Period covered	Board gender	Board size	CEO Duality	Board Committee	Independence Board	Board tenure	Board's Background
1	Hossain, Al Farooque, Momin, & Almotairy (2017)	33 countries	2011-2013	(+)	(-)	(No)				
2	Nurunnabi (2016)	Bangladesh	2010-2011				AC (-)			
3	Kumar & Firoz (2019)	India	2011-2015					(+)		
4	Darus, Mohd Zuki, & Yusoff (2019)	Malaysia	2017			(no)		(no)		

5	Al-Qahtani & Elgharbawy (2020)	UK	2017	(+)				(no)	Board's Background (-)
6	Jaggi, Allini, Macchioni, & Zagaria (2018)	Itali	2010-2013				EC (+)	(+)	
7	He, Shen, Zhang, & Ren (2019)	China	2009-2015.	(+)	(-)			(+)	
8	Hossain & Farooque (2019)	38 countries	2011				RMC (+)		
9	Hollindale, Kent, Routledge, & Chapple (2019)	Australia	2007	(+)					
10	Jaaffar, Yeap, Amran, & Ooi (2019)	Malaysia	2016	(+)	(no)		AC (no)	(+)	foreign director (no)
11	Ararat & Sayedy (2019)	Turkey	2010-2019	(no)	(no)	(no)		(+)	
16	Charumathi & Rahman (2019)	India	2017	(+)	(no)	(-)		(+)	number board meeting (no)
18	Akbaş & Canikli (2019)	Turkey	2014-2016		(mixed)			(no)	
19	Córdova, Zorio-Grima, & Merello (2018)	South America	2013-2016				EC (+)		
20	Bui, Houqe, & Zaman (2020) - score	U.S	2014 and 2015	(no)	(no)	(no)	EC (no)	(No)	board compensation (No)
21	Chithambo & Tauringana (2017)	UK	2011		(no)			(No)	
22	Elsayih, Tang, & Lan (2018)	Australia	2009-2012	(+)			EC (no)	(+),	
23	Ben-Amar, Chang, & McIlkenny, (2017)	Canada	2008-2014	(+)					
24	Kılıç & Kuzey (2019)	Turkey	2011-2015.	(no)	(no)		EC (+)	(+)	foreign director (+),

(+) = positive influence of determinant on dependent variable; (no) = no significant influence; (-) = negative influence; AC= Audit Committee; EC = Environmental related Committee (including CSR); RMC = Risk Management Committee

A large body of work examines the detailed content of carbon disclosure and focuses on firms' characteristics such as firm size, profitability, leverage, industry types, listing status, and firm age. Table 4 shows that firm size (measured by total assets, turnover, number of employees, or market size) has been frequently emphasised in the current literature as a determinant of voluntary carbon disclosure. This might happen because large firms are likely to be more visible and better known among market participants. Furthermore, this review finds mixed results on profitability (measured by return on assets (ROA), return on equity (ROE), net profit margin or return on capital employed) and leverage (measured by total debt divided by total assets) towards voluntarily reporting of emission activities. The type of industry shows inconsistent and ambiguous findings that high-profile or low-profile industrial types will directly impact the environmental issue around the company. However, listing status, firm age received far less academic attention.

Table 4: Firms' Characteristics Factors

No.	Author(s) Year,	Country	Period covered	Firm size	Profitability	Leverage	Industry	Listing status	Firm age	Others
1	Nurunnabi (2016)	Bangladesh	2010–2011	(+)				Multinational structure firm (No)		
2	Kumar & Firoz (2019)	India	2011 - 2015	(+)	(no)	(+)	(+)	cross-border listing (+),	(+)	Growth (+)
3	Darus et al. (2019)	Malaysia	2017		(+)	(-)				Growth (no)
4	Faisal, Andiningtyas, Achmad, Haryanto, & Meiranto, (2018)	Indonesia	2011-2014	(+)	(+)	(-)	(+)			
5	Hossain & Farooque (2019)	38 countries	2011						(+)	
6	Halkos & Skouloudis (2016)	Greece	first quarter of 2011	(no)	(no)		(no)			International presence (+)
7	Pitrakkos & Maroun (2019)	South African	2016				(+)			
8	Hermawan, Aisyah, Gunardi, & Putri (2018)	Indonesia	2014–2016.	(+)	(+)					
9	Kılıç & Kuzey (2019a)	Turkey- 24 banks	2010 - 2016	(+)	(+)			Listing status (+)	(+)	
10	Ott, Schiemann, & Günther (2017)	60 countries	2006 - 2010.	(-)	(+)					Market concentration (+), substitutability (+),
11	Akbaş & Canikli, (2019)	Turkey	2014–2016	(+)	(+)	(no)	(no)			Market Value (no)
12	Córdova et al. (2018)	South American	2013-2016	(+)	(no)	(no)	mixed			
13	Tang & Luo (2016)	Global 500	2009	(+)		(+)	(+)			
14	Kalu, Buang, & Aliagha (2016)	Malaysia	2013		(no)					

(+) = positive influence of determinant on dependent variable; (no) = no significant influence; (-) = negative influence

Environmental performance factors have gained relevance in research on carbon disclosure. Particularly, carbon emissions or company actual GHG emissions represent an inverse variable of environmental performance. These studies usually use two different theoretical frameworks: legitimacy and signalling theory or voluntary disclosure theory, with mixed empirical findings to predict the relationship. Table 5 shows nearly all studies used greenhouse gas emissions as indicators of environmental performance and finds a significant effect on the level of disclosure uses voluntary disclosure, signalling, and stakeholder theory. As regards, this predicts that a company with high environmental performance would raise its transparency level to keep investors and stakeholders updated and distinguish from companies with low environmental performance. Contradict with legitimacy underpinning theory, studies find negative relationship as these companies with low environmental performance are forced to include more detail in their environmental disclosure since they are more vulnerable. This review also finds there is no empirical evidence in the emerging county context.

Table 5: Environmental Performance Factors

No.	Author(s) Year	Country	Period covered	Environmental Performance	Measurement	Theory
1	Giannarakis, Konteos, Sariannidis, & Chaitidis (2017)	Standard & Poor's 500	2009-2013	Environmental performance (+)	corporate GHG emissions	voluntary disclosure
2	Luo (2019)	32 countries	2008– 2015	Carbon Performance (-)	carbon emission intensity	legitimacy
3	Giannarakis, Zafeiriou, & Sariannidis (2017)	UK	2014	Environmental performance (+)	environmental intention-Climate change policy (CCP)	voluntary disclosure
4	Guenther, Guenther, Schiemann, & Weber, (2016)	Global 500, S&P 500, and FTSE 350	2008- 2011	Carbon Performance (+)	Greenhouse Gas Emission	Stakeholder
5	Cong, Freedman, & Park (2020)	U. S	2010-2011	Environmental performance (-)	Greenhouse Gas Emission	legitimacy
6	Giannarakis, Zafeiriou, Sariannidis, & Efthalitsidou (2016)	23 countries	2009– 2013.	Environmental performance (+)	Greenhouse Gas Emissions	voluntary disclosure
7	Grigoris Giannarakis et al. (2018)	European 500 index	2014	Environmental performance (+)	Greenhouse Gas Emissions	voluntary disclosure
8	Ott et al. (2017)	60 countries	2006 - 2010.	Environmental performance (+)	carbon emissions	voluntary disclosure
9	Bui et al. (2020)	U. S	2014 and 2015	Carbon performance (+)	Emissions intensity	Signalling
10	Datt, Luo, & Tang (2019)	U.S	2011- 2012.	carbon performance (+)	carbon intensity	signalling
11	Luo, Tang, & Peng (2018)	32 countries	2008 - 2013.	Carbon performance (-)	carbon emissions	legitimacy

(+) = positive influence of determinant on dependent variable; (-) = negative influence

Prior studies show that environmental regulations and guidelines have motivated the level of carbon disclosure (see table 6). Studies within the context of regulations and guidelines as determinants of disclosure placed attention for a better understanding of the current state of the disclosure, generally, both before and after the rules and in recent years. Numerous steps have been taken worldwide and governmental initiatives related to climate change issues such as Emission Trading Schemes (ETS), National Greenhouse and Energy Reporting (NGER) Act, and Carbon Tax. Nearly all study shows a required significance level between related regulations to disclose their carbon information and to take action to reduce carbon emissions. This review also revealed most of such studies focusing on global companies from developed countries since

Table 6: Regulations and Guidelines Factors

No.	Author(s) Year	Country	Period covered	Main Findings
1	Grauel & Gotthardt (2016)	51 countries (CDP)	2011 - 2013.	level of environmental regulation (+), legal origin (common law), environmental regulation (Multinational)
2	Hossain & Farooque (2019)	38 countries	2011	emission trading system (ETS) (+)
3	Liu, Abhayawansa, Jubb, & Perera (2017)	Australia	2007, 2009, 2010, 2012, and 2014	NGER reporting status (+), Carbon Tax period (-)
4	Kraft (2018)	U. S	2000 - 2010	Introduction of State and National Laws (no effect), Access to Regulatory Processes (no effect), Mandatory green power marketing laws (+)
5	Yang & Farley (2016)	China	2006 and 2010	partial convergence in climate-change reporting coexists with divergent specific interpretations of climate-change reporting by Chinese authorities
6	Mateo-Márquez, González-González, & Zamora-Ramírez (2019)	12 countries	2015	regulatory pressure regards climate change regulation (+)
7	Tang & Luo (2016)	Fortune Global 500	2009	ETS (+), Stringency of environmental regulation (+)
8	Perera, Jubb, & Gopalan (2019)	Australia	2009 to 2011 (before and after NGER)	NGER Act (+), mandated disclosure EMISSIONS (+),
9	Hsueh (2019)	Fortune Global 500	2011– 2015	domestic regulatory and global regime contexts, (developed countries, corporate, domestic, and global governance positively reinforce each other)
10	Hsueh (2019b)	Fortune Global 500	2011– 2015	show that both U.S. and non-U.S. based businesses acted pre-emptively in anticipation of a more stringent regulatory environment in the U.S.

(+) = positive influence of determinant on dependent variable; (-) = negative influence

Another determinants factor in explaining the motivations behind carbon disclosure is socio-economic attributes. Under these attributes, the nation's culture, political regime, market-based activities, geographical regions have been discussed as contributing factors to evaluate the corporate response and publicly available carbon disclosure (see Table 7). Nearly all study focusses on country-level, macro-economic factors, and developed countries. Here, it leaves room for further investigations since only Córdova et al. (2018) focus on developing economies in South American.

Table 7: Socio-Economic Factors

No	Author(s) Year	Country	Period covered	Social, Economy & Culture
1	Giannarakis et al. (2016)	23 countries	2009– 2013.	Country Risk Premium (+), Best Analyst Rating (-),
2	Laura Le Luo & Tang (2016)	33 countries	2011	Measure-individualism and long-term orientation has significant impact under the Hofstede measure, but not under GLOBE measures
3	Ott et al. (2017)	60 countries	2006 - 2010.	Market concentration (+)
4	Córdova et al. (2018)	South American	2013- 2016	company is based in either Chile or Peru (-)
5	Hoover & Fafatas (2018)	U. S	2008– 2011	political power (+)
6	Le Luo et al. (2018)	32 countries	2008 - 2013.	Power distance (PD) (-)

(+) = positive influence of determinant on dependent variable; (no effect) = no significant influence; (-) = negative influence

Prior research tends to confirm a relationship of management structures and practices on carbon disclosure. Table 8 shows the effect of management's decision where carbon disclosure recognizes as the outcome of a firm's strategic activities to manage its environmental impact. Results show that environmental management accounting, strategic CSR, innovation, management structures and policy reflect the reporting decision or the level of carbon disclosure. All of these studies focus on the drivers of the firm participation and response in the Carbon Disclosure Project (CDP) to encourage voluntary disclosure of greenhouse gas (GHG) emissions, except Jaaffar et al. (2019) using the climate change disclosure to highlight GHG emissions data disclosed by the firms.

Table 8: Management Structures and Practices Factors

No	Author(s) Year	Country	Period covered	Management Structures and Practices
1	Hsueh (2019b)	Global 500 companies.	2015	for global businesses=policy supporters in management (+), for corporations =complementary assets (+)
2	Herold & Lee (2019)	global logistics companies	2012 - 2014	carbon management practices- key internal drivers
3	Li, Huang, Ren, Chen, & Ning (2018)	China	2008 and 2012	Green process Innovation (+). Green product innovation (no)
4	Qian, Hörisch, & Schaltegger (2018)	US, Germany, Australia and Japan	2012	Environmental management Accounting (+)
5	Jaaffar et al. (2019)	Malaysia	2016	strategic CSR (+)
6	Grigoris Giannarakis et al. (2018)	European	2014	external verification (+)
7	Ott et al. (2017)	60 countries	2006 - 2010.	Environmental management system (EMS) (+)
8	Hsueh (2019c)	Global 500 companies	2011- 2015	management structures (+)

(+) = positive influence of determinant on dependent variable; (no effect) = no significant influence; (-) = negative influence

This review will classify the ownership under the stakeholders' factors. This aligns with Freeman's (1984) concept of stakeholders that identified the shareholders, customers, competitors, employees, suppliers, special interest groups, environmentalists, media, consumer advocates, governments, and the local community as the companies' stakeholders. Evidence from the prior studies shows that generally, the potential factors that enhance voluntary carbon-related disclosure in the corporate sector are driven by the pressures initiated by the different groups of stakeholders. Table 9 show the two broad classifications of stakeholders, namely, internal stakeholders and external stakeholders. Thus far, the review shows that the findings of these limited studies are mixed. Therefore, it further necessitates the importance of testing the stakeholder variables in the emerging market context in light of the growing area of carbon-related disclosure.

Table 9: Stakeholders Factors

No.	Author(s) Year,	Country	Period covered	Internal	External
1	Gonzalez-Gonzalez & Zamora Ramírez (2016)	Spanish	2012	Shareholder pressure (-)	Social pressure (+), financial market using market risk (+), International pressure (+),
2	Faisal et al. (2018)	Indonesia	2011- 2014	Ownership Government (no)	-
3	Jaggi et al. (2018)	Itali	2010- 2013	Institutional shareholders (+)	heavy polluting industries (+)
4	He et al. (2019)	China	2009- 2015.	-	State-owned firm (+)

5	Guenther et al. (2016)	Global 500, S&P 500, and FTSE 350	2008- 2011	Employees (+)	Government, General Public, Media, & Customers (ALL +)
8	Herold & Lee (2019b)	global logistics companies	2012- 2014	-	policymakers and NGOs
10	Kraft (2018)	U.S	2000 - 2010	Shareholder Resolutions (no)	-
11	Halkos & Skouloudis (2016)	Greece	first quarter of 2011	ownership identity(no) and subscription to CSR initiatives.(+)	environmental sensitivity(+), consumer proximity, international presence(+),
13	Li et al. (2018)	China	2008 and 2012	-	Environmental Legitimacy Public (public media data) (-)
14	Hermawan et al. (2018)	Indonesia	2014– 2016.	institutional ownership(no)	regulator (+)
17	Grigoris Giannarakis et al. (2018)	European 500	2014	government ownership structure (+)	-
18	Kılıç & Kuzey (2019a)	Turkey	2010 -2016	-	Foreign capitalized (-)
19	Chithambo & Tauringana (2017)	UK	2011	ownership concentration (-), directors' share ownership (-)	-
20	Elsayih et al. (2018)	Australia	2009 - 2012	Managerial ownership (+)	-
21	Tang & Luo (2016)	Global 500 report	2009	Shareholders' interest (no)	Creditors (+)
22	Chithambo, Tingbani, Agyapong, Gyapong, & Damoah (2020)	UK	2011	Shareholder pressure (-), Employees pressure (no)	Creditor pressure (-), Regulatory pressure (+) Supplier and customer pressure (no), social stakeholders (no)
23	Calza, Profumo, & Tutore (2016)	European countries	2012	Short-term institutional ownership (no), long-term institutional ownership (no), Government ownership (+), Ownership concentration (-)	-
24	Kalu et al., 2016)	Malaysia	2013	corporate ownership (no)	social factor (+), Financial market (+)

(+) = positive influence of determinant on dependent variable; (no effect) = no significant influence; (-) = negative influence

Measurement of carbon-related disclosure

Regarding the data available for measuring carbon disclosure, several efforts have been reported as proxies to the carbon-related disclosure from different reporting schemes using secondary data as a convenient research approach. Most of the prior studies (36 studies) use data from the Carbon Disclosure Project (CDP) to measure carbon disclosure, while other studies utilised annual reports alone (5 studies), sustainability or integrated reports (2 studies), annual report and sustainability or integrated reports (5 studies) and mixed data (CDP and annual reports) (2 studies). Other sources included corporate homepages together with the annual report (3); and reports required by U.S. Securities and Exchange Commission (SEC), such as 10-K and 10-Q report (1 study).

Measuring carbon disclosure is an important topic for all carbon-related research perspectives. This review finds three general approaches used by prior studies, namely, binary variables for disclose or not disclose, carbon disclosure score by CDP and content analysis. Most previous studies had relied on responding to the disclosure, which is a binary variable indicating the decision of a company to disclose the information to the CDP. Besides, studies use the intensity

of participation by using a voluntary carbon disclosure score based on the carbon disclosure leadership (CDLI) methodology. CPLI is a proxy of climate change disclosure level based on qualitative and quantitative items calculated by the Carbon Disclosure Project (CDP). Even though the information related to GHG emissions is part of sustainability reporting provided by companies in annual, sustainability, integrated and online reports, less attention was paid to carbon-related disclosures in annual and sustainability reports.

Conclusion and Policy Recommendation

Most of the European Union (EU) countries have expressed great concern for global warming and carbon disclosures. It shows that some companies are aware of their responsibilities in controlling carbon emissions and that some of these companies are also making detailed disclosures about their carbon performance. As regards, most EU countries already had a plan to implement the Kyoto Protocol in 2008 to meet the emission targets. Carbon disclosure is still not mandatory in most countries globally, and many firms have developed different practices and approaches concerning the disclosure of carbon emissions. It is, therefore, the motivations to disclose the information on carbon-related may differ across the firms.

Thus, it would be interesting to compare findings from other different geographical regions, specifically in the emerging markets, to find whether environmental performance is a vital driver of carbon disclosure. In addition, further insights using the influence of carbon disclosure from other forms of non-financial reporting such as sustainability and integrated reporting is needed to bring useful insights as to whether it affects the behaviour of reporting with a variety of measurement. In addition, most of the multi-country level variables, for instance, emission trading schemes, legal systems, and political connections related to carbon issues in emerging countries, are still in the infant stage. Furthermore, the patterned relationship for firm-specific abilities guided by these different variables with the reporting behaviour is likely to vary. Therefore, the findings for future research will complement the results of the prior study. In addition, the integration of moderator and mediating factor should be identified and considered to assess the disclosure impact. As a result, more interdisciplinary integration between scientists, practitioners, accountants, and engineers is needed to develop functional and standardised disclosure or reporting to meet these different needs.

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