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The impact of carbon disclosure on corporate financial performance: an empirical study of Indian firms

Pranjal Phatak

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MASTER THESIS IN FINANCE
The impact of carbon disclosure on corporate financial performance
An empirical study of Indian Firms

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Master 2 - Finance
Advances in Finance & Accounting
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ABSTRACT

This study examines the relationship of carbon disclosure and carbon performance and the impact of carbon disclosure on corporate financial performance in the Indian context. The carbon disclosure scores provided by the Carbon Disclosure Project (CDP-India) to 140 participating Indian firms during the period of 2017-2022 has been used to analyze the impact of carbon disclosure. Further, Return on Assets (ROA) is being used as a proxy to measure corporate financial performance. After classifying the participating firms according to the sectors and controlling the firm's variables, such as firm's size which is measured by the sales of the respective firms and firm's age, we observed that the carbon disclosure has overall no impact on their performance. This indicates that there is insignificant relationship between carbon disclosure and carbon performance. Moreover, the results of regression analysis reveal that carbon disclosure has neutral impact on corporate financial performance in the short-term. Our findings have remarkable implications for managers and investors as many firms use carbon disclosure moderately for impression management. These findings are useful to evaluate the economic consequences of voluntary carbon disclosure by the firms operating in the emerging countries.

KEYWORDS: India, carbon disclosure, carbon performance, corporate financial performance, ESG, CSR, Carbon disclosure project (CDP), CDP-India, Return on Assets (ROA), Firm's size, Firm's age.

RESUMÉ

Cette étude examine la relation entre la divulgation des émissions carbone, la performance carbone et l'impact sur la performance financière des entreprises dans le contexte indien. Les scores de divulgation carbone fournis par le « Carbon Disclosure Project » (CDP-India) à 140 entreprises indiennes participantes au cours de la période 2017-2022 ont été utilisés pour analyser cet impact. De plus, le rendement des actifs (ROA) est utilisé comme indicateur pour mesurer la performance financière des entreprises. Après avoir classé les entreprises participantes selon les secteurs et contrôlé les variables de l'entreprise, telles que la taille de l'entreprise qui est mesurée par les ventes des entreprises respectives et l'âge de l'entreprise, nous avons observé que la divulgation du carbone n'a globalement aucun impact sur leur performance. Cela indique qu'il existe une relation insignifiante entre la divulgation et la performance du carbone. De plus, les résultats de l'analyse de régression révèlent que la divulgation du carbone a un impact neutre sur la performance financière des entreprises à court terme. Nos résultats ont des implications remarquables pour les gestionnaires et les investisseurs, car de nombreuses entreprises utilisent modérément la divulgation des émissions carbone pour la gestion des impressions. Ces résultats sont utiles pour évaluer les conséquences économiques de la divulgation volontaire du carbone par les entreprises opérant dans les pays émergents.

MOTS CLÉS: L'inde, Divulgation Carbone, La performance carbone, La performance financière des entreprises, Environnement, Social & Gouvernance (ESG), Responsabilités Sociales des Entreprises (RSE), Carbon Disclosure Project (CDP), CDP-India, Le rendement des actifs (ROA), La taille de l'entreprise, L'âge de l'entreprise

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LIST OF ABBREVIATIONS AND ACRONYMS

GHG	:	Greenhouse Gas Emissions
CD	:	Carbon Disclosure
CCD	:	Corporate Carbon Disclosure
CP	:	Carbon Performance
CCP	:	Corporate Carbon Performance
CID	:	Carbon Information Disclosure
CDP	:	Carbon Disclosure Project
ESG	:	Environmental, Social, and Governance
CSR	:	Corporate Social Responsibility
CSP	:	Corporate Social / Sustainability Performance
CFP	:	Corporate Financial Performance
ROA	:	Return on Assets
ROE	:	Return on Equity

INTRODUCTION

Climate change causes undiversified risks to the global economy. It has been highlighted by the G20's project through the Task Force for Climate-related Financial Disclosures (TCFD)¹. Such risks include natural calamities like droughts, sea-level rise, the adaptation risks as the economy proceed towards low-carbon solutions and technologies and the litigation risks as society concerns to rectify damages caused by and to the environment and economy. An alarming level of global warming caused mainly by rapid increase in greenhouse gas emissions (GHG) which is a real threat to the existence of life on earth. This excess of GHG present in the earth's atmosphere has led to adverse effects on the environment and created global warming (Liu et al. 2015). The reduction in greenhouse gas emission is essential to mitigate climate changes. Green finance can be an effective tool to weaken greenhouse gas emissions. The purpose of green finance is to provide financial support for energy conservation and emission reduction activities.

Green finance is an emerging topic which is widely discussed in circumstances of adjusting and mitigating environmental deterioration due to climate change. As a motivational mechanism, it provides robust support for carbon emission reduction. The limited research has been conducted on the amalgamation of green finance and carbon emission reduction. (Zuocheng et al. 2022). Green finance is a significant bridge between pro-environmental behavior and the financial business world (Scholtens, 2017), Few studies have link finance with ecology. Scholtens (2009) studied the relationship between the performance and social responsibility of financial institutions. According to Li and Jia (2017), sustainable finance is the most effective way to reduce environmental degradation.

Taken into consideration the past literature from 2010-2021, Zuocheng et al. applied a bibliometric analysis to study green finance and carbon emission reduction. Over the last two decades, bibliometric analysis, which is a quantitative way of discovering and assessing articles in the corresponding research field, has been in use. (Zupic and Čater, 2015). Due to the complexity of the environmental issues, research might be conducted in a versatile approach, with the collaboration of universities, laboratories, non-governmental organizations, and financial institutions.

¹<https://www.greenfinanceplatform.org/themes/climate-change>

Due to carbon emission, economic and social development, natural systems are undergoing rapid changes. Even though, CO₂ emissions were declined during the outbreak of COVID-19, the global CO₂ emissions still reached 41.4 billion tons in 2020. (Zuocheng Zhang et al. 2022). The excessive emission of CO₂ and a consequential global issue, such as glacial meltdown, sea level rise and uttermost regional climate change (Diffenbaugh et al. 2017; Garbe et al. 2022; Gomez et al. 2020; Tabari 2020; Yalew et al. 2020). The United Nations initiative to avoid unalterable calamities, the United Nations Framework Convention on Climate Change (UNFCCC) was formed. In 1997, the Kyoto Protocol was accepted to encourage developed countries to meet their legal obligations to reduce GHG emissions. In 2009, the Copenhagen Protocol was adopted to restore the obligations of developed and developing countries to reduce emissions (Grubb et al. 2018). According to the Copenhagen Protocol 2009, the commitment of developed and developing countries to reduce emissions has been renewed (Grubb et al., 2018).

Companies are the largest emitters of GHG, so they are always held responsible for this issue (Hoffmann & Busch, 2008). Since mid-1990s, more attention has been given to global warming and climate change, companies worldwide try to publish non-financial information including social matters, ecological conservations, and intellectual capital (Dhaliwal et al. 2014; Tang et al. 2011).

A lot of regulations were put into action in the last few years to hold industries accountable for their gas emissions with the aim to achieve sustainable development by reducing their carbon footprint. The Kyoto protocol was the first attempt to limit GHG emissions in industrialized countries. It was created by the United Nations in 1997 with the aim to reduce and manage carbon dioxide emissions and under which the participating countries agreed to reduce their GHG emissions by an average of 5% during their first commitment period. Since then, more and more regulations emerged to prevent global warming and at the same time sustain a healthy environment for people. In 2015, the “Paris agreement” was adopted collectively by 195 countries and the European Union at the Paris Climate change conference as an effort to act on climate change. On top of that, a lot of mandatory initiatives were introduced to increase transparency and help with emissions management at many countries. “Paris agreement” says to limit global warming to 1.5°C, GHG emissions must peak before 2025 at least and decline 43% by 2030 (UNFCCC).

For instance, in India, The Companies Act, 2013 introduced the ESG disclosure requirements for companies and mandates companies to include a report by their Board of Directors on conservation of energy, along with annual financial statement. Additionally, the Corporate Average Fuel Efficiency/ Economy (CAFÉ) norms were established in 2017 and aimed to bring down average corporate emissions. Companies in the United States that produce a threshold of 25,000 metric tons of CO₂ are forced to disclose their emissions. (U.S. Environmental Protection Agency, 2012). Similarly, in the UK, all listed firms are required to disclose their GHG emissions (U.K. Government, 2013). Many more initiatives have been adopted in a lot of other countries. Disclosure of carbon information is mandatory by ISO 14064-1 (Peng, Sun, and Luo, 2015).

As per (IPCC, 2014), from 1970 to 2010, the combustion of fossil fuels and other industrial processes' CO₂ emissions contributed about 78% of the total increase in global GHG emissions. In attempt to decrease carbon emissions, many countries engaged in meeting emission reduction targets and issued policies and regulations to control companies' carbon performance. For example, over the past 20 years the carbon disclosure project (CDP), a US non-profit organization, has been strongly advising and encouraging the world's 500 largest firms to measure, manage, disclose, and eventually reduce their carbon footprint. Currently, companies are motivated to report their carbon related activities alias carbon disclosure to meet their stakeholders' expectations (Li et al., Meng et al., 2016). Companies attempt to reduce carbon emission through various channels. Moreover, firms have started communicating on voluntary basis in the form of stand-alone reports like CDP and additional reports within their annual reports, for instance United Kingdom. In Japan, it is mandatory to provide carbon emission reports within their annual reports.

Recently, carbon disclosure has gained more attention from stakeholders, such as shareholders, consumers, legislators, and scholars (e.g., Stanny, 2013; Matsumura et al. 2014). Carbon disclosure enables the government and the public to observe keenly the companies carbon activities especially carbon emissions, which is meant to result in substantial corporate carbon performance. Consequently, all over the last decade, corporate carbon disclosure has arisen in both scale and complexity. (Peng et al., 2015). As stated by This is certainly because of the companies believed in CSR activities and engaging themselves in that is more enriching than besetting. (Margolick & Russell, 2004, The World Bank, 2018).

The stock market has started to acknowledge the remarkable effect of a lessen carbon economy which would have on the prolonged value of enterprises. (Goldman Sachs Sustain, 2014). The financial markets appreciate the eco-efficient firms and sanction their eco-friendly activities. Consequently, many companies have invested considerable funds into transmitting information about the CSR activities to stakeholders. (Siddiqui et al., 2021). Currently, many companies have taken remarkable measures to reduce their carbon emissions to minimize the impact on environment. Due to the over manipulation of natural resources, recently firms have realized the prospective business risks related to climate change, global warming, and health hazards. (Lampert, 2019). Now firms are likely to play an important role in reducing their carbon emissions and supporting to sustainable economy (Luo,2019).

The aspect of carbon reporting has been recognized by businesses for various reasons but mainly the increasing awareness of climate change among the corporate world, the political and social pressure on such issues and the introduction of various regulations to deal with the issue of global warming can be identified as the reasons behind the increasing demand of carbon reporting. The regulations such as the Emission Trading Scheme in the European Union and carbon penalties in many countries like India, Australia, Japan, South Korea, Norway, and Switzerland (Tang and Luo, 2011; Li et al. 2016; Rai et al. 2019; Gallucci and Dimitrova, 2020).

The corporate carbon disclosure (CCD) has been highlighted in the existent literature and has an important aspect for various stakeholders. The previous studies examined the impact of CCD described in the CDPs on the carbon emissions performance scopes and corporate financial performances (CFPs). The previous literature gave the empirical evidence about CCD and carbon performance, CCD, and its correlation with the CFPs only. Since carbon reporting is new emerging research field, moderate research has been conducted on the relation between carbon disclosure, carbon performance and corporate financial performance and the findings of these studies have been uncertain with conflicting results. Our thesis paper contributes in several ways to the existing literature. Previous studies have explored the impact of carbon disclosure on firm's financial performance and on firm's value. But to our knowledge Yasean A. Tahat et al. (2021), analyzed the association between CCD and CFP using voluntary disclosure theory and only Siddiqui (2021) studied the interrelation between carbon reporting, carbon performance and financial performance. So, accordingly, our study plays an important role to investigate this relationship. Professor Siddiqui's research was conducted on the 500 largest global firms over the years 2011 to 2015. We chose to work on Indian firms, since the

country is considered as a “rising power” that reported 40% increase in environmental disclosures across CDP’s three themes – climate change, water security and forests in 2022, an impressive increase against the 28% growth reported in 2021.

Furthermore, the existing research on carbon information disclosure (CIDs) mainly concentrate on the empirical study of firms in developed countries (Kolk et al., 2008; Haque and Deegan, 2010; Freedman and Jaggi, 2005). The corporate CIDs in developing countries has been less addressed in the literature. The previous studies either focus on a certain country context or on a global context to test the impact of carbon disclosure on the firm’s value or performance. Previous studies on Indian firms focus only on the impact of climate change disclosure on financial performance, impact of carbon emission on financial performance and the relation between corporate sustainability and corporate financial performance. So, to the best of our knowledge, the relationship of carbon disclosures and carbon performance of Indian firms were never studied before. To fill the gap between the previous literature, our study investigates the relationship of carbon disclosures and carbon performance and analyze the impact of carbon disclosure on corporate financial performance. This proposed extension will help researchers to compare results from other context with our finding with reference to Indian firms. Our paper is one of the very few literatures to investigate the number of companies responded in the CDP-India disclosures as well as carbon performance in determining the relationship between carbon disclosure and financial performance which is considered a methodological contribution.

Previous research on the impact of carbon disclosure on financial performance are indecisive. Freeman & Evan (1990), Porter & van der Linde (1995), Aragon-Correa (2008) and Al-Najjar et al (2012) reported positive effect. As carbon disclosure reflects firm’s transparency (Freeman & Evan.1990), it can reduce information asymmetry between stakeholders and therefore positively impact financial performance through lower risk. But according to Dixon-Fowler, Johnson, Ellstrand, & Romi. (2013), which followed the “traditional economic trade-off argument” explains that the costs of improving carbon performance offset the financial gains, few researchers claim a negative relationship or no significant relationship (Freedman & Jaggi, 1986).

These conflicting results lead to our central research question:

To which extent carbon disclosure is beneficial to the firm?

This paper is constructed as follows.

Chapter I is assigned to defining the main concepts and terms discussed in the thesis.

Chapter II explains the theoretical framework and related literature on carbon related information and financial performance leading to the hypothesis development.

Chapter III is divided into 3 sections.

- Section 1 focuses on the sample selection and variables' measurements.
- Section 2 presents the regression analysis.
- Section 3 discusses the research methodology, summarizes the empirical findings.

CHAPTER I: ENVIRONMENTAL, SOCIAL AND GOVERNANCE (ESG) FRAMEWORK AND CORPORATE SOCIAL RESPONSIBILITIES (CSR)

INTRODUCTION

In recent years, firms started realizing the possible business risks related to climate change and hazardous waste caused by the over-exploitation of natural resources (Lampert, 2019) and have been taking measures to mitigate its impact on their performance. According to the world health organization, an estimate number of 7 million deaths is recorded annually due to an exposure to air pollution causing a loss of around 5.11 trillion dollars globally. Moreover, health risks associated with climate change are especially pronounced on children with more than 88% of diseases related to environmental issues, impact children under the age of 5 (Zhang et al, 2022). These alarming realities have pushed authorities to implement regulations that pressurize companies for adopting eco-friendly practices and abandon their unsustainable products and practices. Since carbon emissions have been proven to be the major cause of global warming, many companies have decided to voluntarily report their carbon emissions and have taken an active stance to reduce their carbon footprint. Corporate incentives to disclose carbon information stem from social and governmental pressure where firms feel obliged to adhere to social norms to protect their brand image and claim their legitimacy. In this research paper, we plan to study thoroughly the impact of carbon disclosure on both carbon performance and corporate financial performance and with the aim to understand these relationships it is essential to understand the fundamental concepts, frameworks related to social, environmental, corporate responsibilities and theories that explain the link between carbon reporting, carbon performance and financial performance.

The magnitude of corporations' benefit or harm to the social welfare has gained an extensive attention. The corporations' actions in this field are referred as Environmental, Social and Governance (ESG), or Corporate Social Responsibility (CSR). From corporate perspective, the interest in ESG/CSR is indicated by Governance & Accountability. ESG refers to the way corporations and investors amalgamate environmental, social and governance concerns into their business models. In response to a call from Kofi Anon, Secretary-General of United Nations¹ in 2004, an abbreviation ESG has been developed by 20 financial institutions. ESG contributes more quantitative measures of sustainability. ESG improves valuation of the business and focuses on material risks and opportunities. CSR is more oriented towards

supporting company's values. The companies disclose their information via ESG reporting are based on their materiality in relation to the companies' operations and business model. ESG incorporate governance clearly and CSR includes governance affairs indirectly as they refer to environmental and social considerations. So ESG tends to be more extensive phraseology than CSR. The interrelationships between a company's governance structure and its environmental, social activities can be scrutinize by ESG/CSR. ESG reflects a company's external impact, and the CSR is an internal initiative to attain a corporate purpose.

¹ See "Who Cares Wins" <https://www.ifc.org>.

SECTION 1: THE ESG CONCEPT

Human society never stops chasing the progress. With the advanced technology and economic, social development, the world is not only taking the advantage of many opportunities but also facing many challenges. The COVID-19 pandemic caused four meltdowns in the US stock market in a fortnight. World survived through another year of pandemic in 2021 and a global outbreak of monkeypox in 2022. Ethiopia and Ukraine have been confronted with destruction due to war. Such environmental (E), social (S), and governance (G) issues have caused global concern. The concern of comprehensive and sustainable development has become a controversial affair worldwide. The sustainable development action plans like ESG to strengthen a comprehensive development framework for society have been proposed to solve the extreme sustainable problems in the environment, society, and international corporate world. The underlying principle behind ESG-based investing lies in identifying and quantifying the intangible value possessed by socially responsible, environment-friendly firms with robust governance policies in place. The firms reveal better risk management measures on ESG parameters, which reward value for investors with long-lasting sustainable business models. These ESG parameters represent the non-financial performance of an enterprise and are numerous, ever shifting. They include:

- Environmental: Climate change, greenhouse gas emissions, resource depletion including water, waste and pollution, and deforestation.
- Social: Working conditions including slavery and child labor, local and indigenous communities, conflict, health and safety, employee relations and diversity.
- Governance: Executive compensation, dis-honesty, political influence and charity, board diversity, and tax strategy.

An organization's business practices and performance on various sustainability and ethical issues are evaluated by ESG is a framework. Following the official proposal in 2004, the ESG principles have been developed for 19 years. In accordance with these principles, all countries promote the coordinated development of environment, society, and governance. ESG is a strategy used by investors to evaluate corporate behavior and financial performance. While measuring the sustainable development of companies, the three fundamental factors of ESG are the essence to be examined in the process of investment analysis and decision making. Furthermore, ESG factors helps to evaluate the feasible and social impact of business activities. ESG may have positive or negative impact on the financial performance. Thus, as an advantage of sustainable and coordinated development that consider economic, environmental, social, and governance interest, ESG is an investment theory that follow prolonged value growth, and it is a comprehensive, practical, and reasonable governance method.

1.1 ESG AND CORPORATE FINANCIAL PERFORMANCE (CFP): INDIAN CONTEXT

To enhance risk management and extensive feasible yields for investors, responsible investment strategies take ESG aspects into investment decisions. According to previous studies, good corporate ESG performance magnifies financial performance estimated through accounting as well as market-based measures. The study featured the requirement of sustainability reporting, including disclosure of ESG scores. For few years, scholars have been researching the correlation between economic growth and its impact on ecosystem. In this field of research, The Environmental Kuznets Curve (EKC) hypothesis is one of the central theories. This hypothesis proposes that inceptive economic growth causes negative ecological impact and as the economy grow, it increases till a turning point after which the environmental damage stabilizes and start to fall while economic growth pursues (Kuznets, 1995). According to the forecasts of the Asian Development Bank, the Indian economy is expected to be the fastest growing economy in Asia with a 7.3% rise in GDP in the current fiscal and projected to advance to 7.6% in FY20 (Economic Times, 2018). As per few researchers, India will take consideration time to reach such turning point where the economic activities stabilize due environmental damage. In the past, the Indian regularly framework has observed several notable policy changes. In 2013, the Companies Act was revised; now section 135 of the Act requires eligible companies to spend 2% of their net annual profit on CSR activities (Companies Act, 2013). From investors' point of view, the emphasis on sustainable and responsible investment

strategies has been steadily on the rise. ESG based portfolio selection strategy under the broader theme of sustainable and responsible investment has gradually gained popularity among investors primarily due to the intervention of regulators like the United Nations Environment Program Finance Initiative.

In India, the ESG Index was launched through a joint venture of Credit Rating Information Services of India Limited (CRISIL) and the National Stock Exchange of India Limited (NSE). The objective of this index is to measure the exposure to securities meeting sustainability investing criteria. On July 2011, National Voluntary Guideline (NVG) on environmental, social, and economic responsibilities of corporates been issued by Ministry of corporate affairs. From 2012, Securities & Exchange Board of India (SEBI) has made obligation for the listed firms to issue Business Responsibility Report along with Annual Report. (Amritha M. et al. 2019).

The past studies conducted research on ESG for the developed economies. The actual state of ESG practices and its impact on companies from emerging economies have not been adequately studied. The companies with higher ESG scores have better financial performance. (Dalal, Karishma et al, 2019). These authors studied the influence of ESG on the financial performance of listed Indian Public Limited companies with reference to profitability and firm's value. The annual ESG data of 65 Indian firms listed on the NSE 100 ESG Index database from 2015-2017 had been taken into consideration. Investors always prefer companies with better carbon footprints, greater social acceptance, and transparent governance policies. The companies with lower ESG risks have more possibility of delivering a sustainable financial performance and have more chances of attracting investors for long-term. The good corporate ESG performance enhances financial performance. (Hemlata Chelawat et al. 2016). From policy perspective, ESG score is an emerging indicator for promising future financial performance and risk mitigation strategies. (Rupamanjari S. Ray et al. 2022). The investors can implement an ESG strategy where a focus on ESG-rating, corporate governance, board function and compensation policy results in a positive effect for society and financial performance. (Amritha M. et al. 2019).

The considerable ESG literature investigates the relationship with corporate financial performance (CFP), most studies have focused on developed countries indicating a positive association. The evidence emerging from the reviewed literature remains fragmented for developing countries. (Oussama O. Janah et al. 2021).

While analyzing the corporate sustainability performance (CSP) and corporate financial performance (CFP), professors [Milind K. Jha and K. Rangarajan \(2020\)](#) studied the sample of top 500 Indian firms from the period of 2008-2018. At an individual level, negative association is observed between CSP and CFP, showing that Indian firms do not get financial performance benefits from investments specific on sustainability. Firms with higher or lower CSP with ESG framework will perform correspondingly with CFP. Furthermore, the firms with higher CFP are not certainly leading to more CSP, preferably an increase in CFP may lead to a decrease in CSP.

Barclay's - Sustainable Investing and Bond Returns studies' (2018) impact series report declared that the influence of ESG needs not only to be on equity and additionally can be claimed on credit markets and showing a positive ESG tendency which can be followed in a constant performance advantage. Companies that disclose ESG practice are reported to have improved their reputation, increasing investor confidence, making better use of resources, and staying competitive. Market capitalization has a negative significant relationship with the cost of debt component, and the total debt to total assets had a significant direct relationship with cost of debt component. The relationship between cost of debt component and net debt to equity ratio, on the other hand, is insignificant. The influence of ESG Score have impact on cost of debt component which means that superior the ESG score, inferior the cost of debt component for the firm. Among ESG Scores, the social score was the highest notable level element for the cost of debt component. The ESG Disclosure Scores and if considered individual scores of environments, social and governance then it had a reverse relationship with the cost of debt component ([Ankit Arora et al. 2022](#)).

SECTION 2: THE CSR CONCEPT

Along with the fast evolution of world's economy, the global environmental problems caused by the GHG emissions are notably increasing. The unpredictable sustainability challenges are fraught with financial and ESG crisis. Hence there is an urgency for making sustainable development goals a global priority. (Earth Summit 1992, 2002, and 2012, IIRC 2012: Rio+20 policy).

CSR essentially refers as firms are and should be socially responsible to their clients and stakeholders and instead of only focusing on their financial gains. CSR is a concept which is in constant evolution and may have unlike meaning in different places to different people

(Campbell, 2007; Frynas & Stephens, 2015). Previous studies have given several definitions that could help to understand the CSR concept.

In 1953, CSR concept was highlighted by an American economist Howard Bowen in his seminal book, *Social Responsibilities of the Businessman*. The socially responsible firms had been existed the concept of CSR but never been discussed before in literature. CSR defined by H. Bowen (1953) as the commitment to follow the policies, to make responsible decisions, or to follow fundamental actions which are responsible objectives and values of our society. William C. Frederick, an eminent advocate to CSR practices, explained the three main principles which included the corporate managers as public trustees and social stewards, the consideration of the competing claims of all stakeholders, and corporate philanthropy. (Frederick 1998). Many scholars spoke about the uncertainty of adopting CSR practices. In 1958, Theodore Levitt expressed his criticism against CSR profitability in an important Harvard Business Review article, declaring that businesses are only expected to engage in honesty and to gain. Milton Friedman responded him in opposing CSR describing it as a “fundamentally subversive doctrine”. Despite the disapproval, the concept of CSR gained popularity during the 1960s because of the uprising of many social movements especially in the US including civil rights, women's rights, consumers' rights, and the environmental movement. Keith Davis indicated that social responsibility is a “decision of businessmen and relative actions taken beyond the firm's direct economic or technical interest” (Davis 1960) and Joseph McGuire proclaimed that social responsibility forces firms to incorporate social and environmental issues into their corporate strategy beyond their economic gains. (McGuire 1963). Carroll (1979) initiated the modern definition of CSR by explaining that CSR refers to corporate behavior that is economically profitable, legal, ethical, and socially acceptable. Carroll's (1979) definition was represented through a pyramid of responsibilities where economic responsibilities came at the bottom of it followed by legal then ethical responsibilities with humanitarian, charitable contributions at the top. With the help of this model, professor wanted to provide a framework that helps to understand theoretically the core principles of CSR and prompt managers to use it as a strategic tool. (Lee, 2008).

The concept of CSR pursued to captivate the attention of scholars and as well as business practitioners throughout the decades, most studies were devoted in examining the relationship between corporate responsibility and corporate social performance (CSP). The terms of CSR and CSP were often linked to each other in empirical studies (Margolis et al., 2007). The CSP

helps to understand the concept of CSR as it describes the outcomes of adopting social responsibility. CSP is reviewed as a multidimensional construct where firm's operations should be aligned with firm's economic, legal, ethical, and philanthropic responsibilities (Wood, 1991; Carrol, 1999). According to this definition, enhancing the shareholder's wealth is nevermore a priority to a business, rather corporations should act in favor to society's demands. The target stakeholder group indicated that CSR activities are classified into internal and external CSR. Both impacts positively on financial performance but internal CSR is a main factor of firm performance than the external CSR (Habaragoda B.S, 2018).

In the last ten years, many academist have looked for in explaining the reasons behind firm's implementation of CSR activities. Many theories were used to study these reasons and the most prominent ones in the literature are stakeholder theory, legitimacy theory, voluntary disclosure theory, signaling theory and instrumental stakeholder theory (Mellahi et al, 2016; Frynas & Yamahaki, 2016). These theories will be explained in the next chapter that deals with the theoretical framework of our research.

2.1 THE CSR AND CORPORATE SOCIAL PERFORMANCE (CSP-CFP) : INDIAN CONTEXT

CSR and sustainability reporting has been significantly considered in the past few decades (Margolis et al. 2007) but the conditions of emerging economies mainly remain unaddressed excluding few survey reports like US SIF Foundation (2012); Social Investment Forum (2009); GIZ India et al. (2012); and KPMG (2011) ⁽¹⁾. In this section we focus on explaining the revolution of CSR in Indian economy, as well as the relation of investments under CSR criteria and corporate financial performance of Indian companies.

In India, On 29th August 2013, the Companies Act of 1956 got replaced by new rules and regulations, describing it as the Companies Act 2013, preceding to this act, CSR has conventionally been seen as a philanthropic activity. As per the Indian tradition and culture, it was believed that each company has an honorable responsibility to play an active role in releasing the social obligation, conditional to the financial health of the company. In the beginning of 90's Mahatma Gandhi brought out the concept of trusteeship helping socio-economic growth ⁽²⁾. CSR was impacted by family values, traditions, culture, and religion. Under this act, India became the primary country to constitutionalize the demand to accept CSR activities and obligatorily report the CSR initiatives. This is the beginning of a new era for CSR

in India. The New Act has initiated extensive changes that influence company formation, administration, governance and includes a supplemental Section- 135, the clause protects the essentials concerning to the implementation, funds allocations and reporting for successful project execution.

In 2016, Federation of Indian Chambers of Commerce & Industry (FICCI: a non-government, not-for-profit organization) conducted a survey to acknowledge the execution of the Companies Act 2013, how companies are amalgamating CSR reporting into their conventional business activities. This survey provided important information about the management in CSR implementation, the companies lavish portfolios and their strategies towards projects execution.
(1)

¹ <https://csrcfe.org/about-csr-in-india-public-policy/>

² <https://www.hindustantimes.com/brand-post/amit-sachdeva-the-man-behind-modern-corporate-social-responsibility-in-india-101628247471776.html>

The guidelines for CSR disclosure are obligatory in India by The Ministry of Corporate Affairs, India (2009), the Guidelines on CSR for Central Public Sector Enterprises (2010, 2012) and the Companies Bill 2012.

India represents an interesting case for CSR. India is one of those few countries that made the CSR payments obligatory for corporations with legal regulations (Pandey & Pattnaik, 2017). For a considerable period, CSR in India endured a charitable activity, with large businesses and enterprises making voluntary contribution in educational sector, for religion and cultural associations (Jayakumar, 2016; C. Lakshman, 2009). There was a real transformation in the 1990s after the post-liberation era in the corporation with social stakeholders (Singla & Singh, 2018). Consequently, in India, CSR practices are more strategic than just being philanthropic. CSR practices are applicable for building brand image, better connections with communities and enhancing firm value (Shirodkar et al., 2018). These firms accept CSR practices to highlight business ethics, human rights also to contribute to the national building (Garg & Ambrosius, 2018; Jain et al., 2021). According to the prior studies, managers respect to the market conditions because market reactions are sensitive in relation to organizational events and policies (Anwar et al., 2021). Therefore, Indian companies are progressively responsive towards CSR practices.

On the contrary, few scholars believe that Indian firms have non-identical views and no motives about CSR, that it is a window-dressing and conflicting the growth and profitability of business. Additionally, many companies believe that CSR enhances the company's image and helps in prolonged sustainability of the business (Shweta Verma, 2011). There is unbiased, however unassuming negative relation between CFP and CSR. The research used S&P ESG Index as an alternative of CSR of Indian firms over 2005-2011 (Rupal Tyagi, 2013). In developed countries, the corporations and regulatory authorities' actions are transparent to some extent but in developing nations CSR ventures by financial institutions are not prosperous. There is a constant stipulation that Financial Institutions should take the initiative to abolish poverty, impartial and liable systems of governance and establish environmental security. The CSR practices in Indian banking sector are common in public and private sector banks. These practices include children and community welfare, poverty elimination, education, rural development, women's empowerment, protection of girl child and employment. The previous studies indicated the problem in differentiation of corporate houses and deciding the CSR rating. Most of the banks use CSR practices as a marketing tool and many are not taking initiatives for social benefits. Many banks improvised CSR and detached with their business transactions and do not specify how much they spent on CSR activities (Deepika Dhingra et al. 2014). The firm's CSR activities have positive effect on its brand's equity. The brand awareness, loyalty and purchase policies contemplate the relationship of CSR activities and brand equity (Anupam Singh et al. 2017). The adequate measures are needed to create awareness among public about CSR. The companies normally invest 2% of their investment in CSR but government has not specified any minimum investment. So, the appropriate actions and clear polices should be specified. It is also companies' responsibility to take initiative in publishing punctual and quantitative CSR reports of their practices (Shweta Verma 2011). Monika et al. (2014), studied the magnitude of CSR in fast emerging Indian economy with its large corporate sector. In this academic article, they studied various financial and non-financial determinants of CSR disclosure in India. The findings of CSR disclosure are low in developing countries. The result indicated that a firm's industry connection and profitability remarkably affect the CSR disclosure. Moreover, the profitability decides CSR disclosure in a positive manner, but this study could not verify any relation between CSR disclosure and risk.

As per the previous literature, at the aggregate level, there is lack of variables between the Corporate Social Performance (CSP) and Corporate Financial Performance (CFP) in either direction or propose the inconsequential connection of CSP-CFP for Indian firms. Some

negative relation was observed between CSP and CFP at an individual level. At both the levels, this association has an unfavorable impact on CSP-CFP connection, which indicates Indian firms do not get the benefits of financial performance over the investments done for sustainability. The result of this relation also indicates that firms with lower or higher CSP on CSR and ESG dimensions will also perform likewise with reference to CFP ([Milind Kumar et al. 2020](#)).

SECTION 3: CARBON DISCLOSURE, CARBON PERFORMANCE AND FINANCIAL PERFORMANCE

Over the last 20 years, because of the increasing social and environmental awareness and regulatory supervision, carbon disclosure practices have rapidly increased. The essence of carbon disclosure is to help firms in the preparation of climate crisis. A trustworthy carbon reporting is important for stakeholders as well to take accurate investment decisions. Stakeholders pressure was disclosed as the main reason behind firms' CSR implication and carbon reporting. The extensive and transparent disclosure policies that can provide standardize reporting guidelines are needed to allow businesses to focus their activities on, to gain the environmental sustainability. The reliability of company's reporting is based on authenticate reporting standards. Besides this social pressure many firms select to report persistently their GHG emission because they can gain remarkable benefits. Carbon disclosure adjoins the firm's transparency which helps stakeholders while taking their investment decisions. Carbon disclosure enclose all information on its GHG emission, energy consumption, carbon reduction strategy, carbon intensity and GHG decarbonization objectives made public by the firm ([Siddiqui, 2021](#)). Hence, it provides as a tool for institutional investors and government to trace and manage firms carbon emission. Such communal investigation encourages firms to conduct carbon emission initiative. Therefore, carbon disclosure contributes to an enhanced carbon performance which sequentially has an impact on the financial performance ([Shen et al., 2019](#)). The association of financial performance and carbon performance is cryptic. According to [Zhao-Yong Sun et al. \(2022\)](#) carbon performance has a positive impact on corporate financial performance in the short and long term, although consumer awareness towards CSR activities has opposite moderating effects on corporate financial performance. Additionally, companies should enhance corporate value by improving carbon performance. Furthermore, carbon performance contributes to corporate financial performance. So, by developing low-carbon technologies allows companies for carbon emission reduction in the production process,

therefore enhancing carbon performance. Developing low-carbon technologies enables companies to reduce carbon emissions in the production process, thus improving their carbon performance.

Previous literature provided arguable results and was indecisive. Hence, it is very interesting and important to further investigate the impact of carbon disclosure on carbon performance additionally the relationship between carbon performance and financial performance. The following sections will focus on defining these terms for greater understanding of the relationship that exists between them.

3.1 CARBON PERFORMANCE

The carbon performance of a firm is estimated through a set of standardized indicators (Hoffmann & Busch, 2008), such as its carbon dependency, carbon intensity, carbon risk and carbon exposure. The first two indicators measure the physical aspect of carbon performance, and the last two indicators explain the financial impact of carbon. Carbon dependency is explained as the percentage change in emissions intensity within a certain time. It refers to the company level of dependency over the fossil fuel industry for its chain of production. Carbon intensity connects carbon consumption to business performance to the extent of firm's operations are dependent on carbon usage for a specific scope and the fiscal year. It can be calculated by dividing carbon consumption by financial parameters (like interest rates, sales, investment returns, etc..) over that same period. Carbon risk represents the percentage of change in fiscal carbon performance during a specific period. It also refers to the negative effect of unexpected changes in carbon prices on firms and equity portfolio. At last, the carbon exposure is correlated with the financial results of carbon consumption over a particular interval.

As stated by the Greenhouse Gas Protocol, Corporate Accounting and Reporting Standards, a firm's GHG emissions are classified into three scopes. Scope 1 are the company's direct emissions of carbon-di-oxide which means the emissions which are directly released to the earth's atmosphere due to firm's operating activities. There are four classification of Scope 1 emissions. The first category is static ignition which includes all types of fuel that produce GHG emission (e.g., emissions related to fuel combustion in boilers, heating sources). The second category is mobile combustion which includes burned fuel by vehicles owned or control by a firm. The third category is devoted to transitory emissions which represent accidental leaks from GHGs like refrigeration or air conditioning units which are much more hazardous than

carbon emissions. Scope 2 emissions are indirect emission of CO₂ caused by steam, heat or cooling consumed by the company. These types of emissions are not directly caused by the firm's operation, but they are included in GHG inventory because they are associated with firm's use of energy. Scope 3 emissions refer to indirect emissions, which are within its value chain including upstream (employee commuting, business travel) and downstream (transportation & distribution, processing, and use of sold products) emissions, even though not owned by the company. Scope 1 and 2 are mostly in firm's control, as they can get the required data to convert purchase of gas and electricity into a value in tons of GHGs. But the Scope 3 emission are beyond the firm's control. It is the social responsibility of every company to measure all these 3 scopes to acknowledge their GHG impact. Hence, companies are motivated to disclose GHG emission to focus on depletion of carbon emission and finally leads to a low carbon economy.

3.2 FINANCIAL PERFORMANCE

Financial performance is an extensive term which express the state of firm's monetary affairs over a given period. It mentions how financial targets are being achieved by the firms. Financial performance measures the firm's ability of using the corporate assets to initiate profit and pays its debts. The evaluation of financial performance is very important as investors make their decision based on this information while buying any stocks of a particular firm. Financial performance evaluation is not only beneficial to shareholders but also for managers to understand the company's allocation of resources and to financial analysts to understand gains and growth of the company. There are different performance indicators, known as key performance indicators (KPI), to estimate the financial performance of a company. The most universally used indicators are Return-on-Assets (ROA), Return-on-Equity (ROE), earnings per share, financial leverage, operating cash flows, net profit margin. In this empirical study, we will use ROA, as financial performance metrics.

SECTION 4: CARBON DISCLOSURE PROJECT (CDP)

To create the awareness and expand the growth of corporate carbon disclosure, the advanced countries have started a carbon disclosure project. Its goal is to collect the climate change related information. These data are put in the public domain to enable investors who are interested in climate change to make decisions to lead management in the responding firms.

Founded in 2002, Carbon disclosure project (CDP) is a not-for-profit organization which has headquarter in London and have regional offices in 50 countries including India, Japan, Germany, China, and United States of America that collects voluntary disclosed environmental data from companies, cities, states, and regions. Over 21 years, CDP manages data from companies and cities to reduce GHG emissions, protect water resources and prevent deforestation. CDP's fundamental mission is to promote for a low-carbon economy by motivating firms to promulgate reports on their carbon disclosures, risks, opportunities, schemes, and strategies (www.cdp.net). CDP has one of the most extensive and substantial databases in the world. The CDP has more than 680 investors and assets of over US\$130 trillion and with such authority, CDP uses its investors power to convince companies into disclosing and managing their environmental impacts.

In 2022, more than 280 immense buyers with US\$ 6.4 trillion purchasing power asked for thousands of companies to disclose their data through CDP. Consequently, this is a record breaking more than 18,700 corporate disclosures, which is a 233% increase since 2015, Paris Agreement (CDP-India Annual Report 2022).

The carbon reporting process is initiated by acknowledging comprehensive questionnaire for fundamental areas of business operations. The climate change, forests and water security are the three major sections of their questionnaire. The climate change section focuses on the financial risks, opportunities of global warming for companies and investment portfolios in the short, medium, and long-term perspective. The energy related questions and inquires related to carbon emissions and carbon pricing are also the part of the climate change questionnaire. The companies submit their responses every year latest before July. CDP helps firms with completing questionnaire and offers them precise guidance to establish a significant quality of climate disclosure. At a disclosure level, companies get approximately one point per data point declared. To encourage companies in measuring and managing environmental impacts through answering the CDP's questionnaire related to climate change, forest, and water security, CDP uses different scores techniques. CDP's questionnaire has an independent scoring methodology. To assist the engaged countries with the disclosure process, the organization have local representation in different countries. In 2022, 147 European companies were listed on CDP's "A" lists for climate change, forests, and water security, 183 "A" list scores were awarded among these countries, 139 for climate change, 15 for forests and 29 for water security (www.cdp.net). Till 2021, 10,400 companies with more than 680 financial companies

voluntarily requested their carbon disclosure information with this organization. For every company, reporting to the CDP is a beneficial technique to gain appreciable insight into the resources of environmental impacts in addition to carbon performance. The CDP measures and discloses the management of environmental warnings through leveraging investors and authorities. This project gives incentives to global organizations to report and measure their environmental data. In addition, the CDP also assist firms to control potential risk of information asymmetry due to lack of environmental reporting standards (Praveen Kumar et al., 2018).

4.1 CARBON DISCLOSURE PROJECT AND INDIA

Currently, India is one of the flourishing economies in the world. Through the data-insight from disclosure, CDP India is helping Indian economy towards its transformation to sustainable economy by directing climate actions. CDP India is functioning since 2012 and has progressed to become one of the most effective disclosure platforms. Currently over 120 Indian companies and 14 Indian cities voluntarily disclosure their carbon activities thorough this platform. Moreover, this organization also helps stakeholders in decarbonization expedition through Supply Chain Engagement, Science-Based Targets (SBT) and Internal Carbon Pricing (ICP) mechanisms, Renewable Energy (RE100), etc. Additionally, CDP India is carrying out a Financial Institution's Working Group to support financial administrators in designing sustainable financial measures which will help the economy transition. Being a single NGO assigned in India's INDC (Intended Nationally Determined Contribution) to the UNFCCC on account of its corporate environmental data repository and tracing emissions and mitigation data from the Indian Industry. Lately, CDP-India also assisted driving climate action during COP27 (27th Conference of the Parties to the UNFCCC).

By virtue of women empowerment, participation of women on corporate boards is increasing rapidly across the globe. Women directors are more interested in directing the new strategic issues of climate change, enhance GHG emission disclosure strategy and effectively communicate the actions to the stakeholders. The presence of women on board enhances board capital strength in various dimensions (as per Board Capital Theory) and boards with minimum three or more female directors influence the board's decision-making procedure which leads to successful environmental disclosure (as per Critical Mass Theory). According to prior studies, female executives and directors conduct different ethical values and qualitative decision-making (Charumathi, B., and Rahman, Habeebu, 2019). Furthermore, Charumathi, B. (2019)

stated that after the initiative of obligatory Business Responsibility Reporting in FY 2012-13 and Paris Agreement in 2015, there is remarkable enhancement in the level of climate change disclosure to CDP in India. Currently Ms. Prarthana Borah is the Director of CDP-India.

4.2 CLIMATE CHANGE MITIGATION FRAMEWORK IN INDIA

Climate change is a harsh reality and affecting daily lives across the planet. Incorporated by other factors of environmental changes, like natural resources degradation, land-use changes, etc., the climate change impacts on natural systems intensify extreme events and disasters, creating serious damages to lives, infrastructure and resources. The climate change mitigation requires global actions, systematic and planned international strategies and national action plans as well. All financial proceeds need to be compatible to reduce GHG emissions and sustainable development as specified in Article 2.1(c) of the Paris Agreement (UNFCCC, 2015).

In India, different frameworks have been designed by diversified expertise and interventions at different extent to identify the knowledge gap in this area. The country has made remarkable steps in improving energy access but needs to develop the energy framework and diversify its fuel mix. [Sarah Colenbrander et al. \(2023\)](#) indicated that India's financial sector is heavily exposed to low-carbon transition risks than faced by ordinary borrowing categories. The electricity production, which is the biggest source of carbon emissions, contributed 5.2% of outstanding credit, not only 17.5% of this lending is to pureplay renewables. In an emerging economy, there is considerable financial-sector exposure to low-carbon transition risks combined with absence of inductive approach to handle those risks, the financiers, policymakers should act rapidly to verify well organized transition to net-zero.

In 1993, India signed the United Nations Framework Convention Change (UNFCCC) and has been one of the promoters for CSR commitment and environmental protection. In 2014, it was the first country to implement an obligatory regulation about corporate social responsibility. According to the Company's Act, firms with certain income and profitability need to allocate minimum 2% of their revenue during the last three fiscal years to social conscience. India wants to achieve five sustainability goals by the year 2030 that promote the transition to a low-carbon economy by switching to non- fossil fuel energy, meeting the target of having at least 50% of energy captured from renewable energy sources, reducing carbon emissions by one billion tons, and cutting down carbon intensity by less than 45% (CDP-India Disclosure Report 2022). Due to the absence of comprehensive legal framework that regulates the carbon economy achieving

these emission reduction goals may be challenging. Indian authorities are trying to initiate reliable and convincing schemes and mechanisms to ensure sound environmental governance. For example, to motivate the generation of electricity using renewable energy, the Ministry of Power has issued The National Tariff Policy in 2016. To lower GHG emissions, the policy lays out the clean development mechanisms (CDMs) to accept electricity projects. In 2019, to encourage the production of electric vehicles, the National Electricity Mobility Mission Plan was undertaken by the Ministry of Heavy Industries and Public Enterprises. The motive of issuance of this policy, the government aims to increase the number of electric vehicles by 30% by the year 2030 to reduce GHG emission.

On 30th June 2008 National Action Plan on Climate Change (NAPCC) launched by the Government of India, defining eight National Missions on climate change. The most important among these missions are National Solar Mission, National Mission for Enhanced Energy Efficiency, Sustaining the Himalayan Eco-system, Water mission, Sustainable Agriculture and Sustainable Habitat (www.dst.gov.in/climate-change-programme).

India has co-founded the International Solar Alliance (ISA) with France in 2015. The main objective of ISA is to rescale solar energy, narrow down the cost of solar power generation through accumulation of demand for solar finance, innovation, R&D, technologies (www.mnre.gov.in/isa). Furthermore, Climate Risk Management (CRM) Framework is developed under “Climate Change Adaption in Rural Areas (CCA-RAI, 2018-2019)’s project. With collaboration with Germany, an Indo-German Technical Cooperation on Climate change which is funded by German Federal Ministry of Economic Cooperation and Development (BMZ), (Deutsche Gesellschaft Für Internationale Zusammenarbeit) GIZ-India is implementing CCA-RAI project association with the Ministry of Environment, Forest, and Climate Change (MoEF&CC), Government of India. (CRM Framework for India, addressing Loss & Damage, 2019) ¹.

On 3 August 2022, under the Chairmanship of the Prime Minister, the Union Cabinet passed an improved Nationally Determined Contribution (NDC) for consideration by the UNFCCC under the Paris Agreement to reach India’s goal of net zero emissions by 2070 (ispp.org.in). Now India ranked 8th according to Climate Change Performance Index (CCPI, 2023). India ameliorates two ranks in CCPI 2023 released in COP 27, evaluating 59 countries and European Union on climate change actions and polices. (pib.gov.in). India has been placed amongst the

top five countries in the world and the best among G20 countries, based on its Climate Change Performance.

¹ Climate Risk management (CRM) Framework of India, Addressing Loss& Damage, 2019: ISBN No. 978-93-82571-25-4. <https://nidm.gov.in>

CHAPTER II: THEORETICAL FRAMEWORK AND LITERATURE REVIEW

INTRODUCTION

During the last 20 years, because of intense research by scholars and theorist, numerous reasons have been explained the effects of climate change. However, the most important reasons are its potential to cause everlasting damage to life and endangering effects on human health and adverse effect on global economies. (Jung, Herbohn, & Clarkson, 2018; Labatt & White, 2007). Many businesses were pushed to implement carbon reduction initiative and to engage more in CSR activities. But despite this desire to switch to low carbon economy, the actuality is far from achieving that goal. Most companies operating in carbon-intensive industries are faced with difficulties when following the CSR regulations. These companies' operations are heavily dependent on fossil fuel consumption, perhaps reducing their GHG emissions might result in less productivity, if there is lack of availability of any substitute for fossil fuel and consequently this can negatively impact their financial performance (Freedman & Jaggi, 2004). Moreover, not choosing to participate in carbon reduction initiatives leads the company towards extreme investigation from shareholders and stakeholders and if the company operates in a country with obligatory CSR framework, then there is tremendous risk either on the market or by the regulators. Such corporate decisions carry tremendous burden on the firm's corporate performance. The complexity of carbon disclosure and the limited research on this subject have been the main motive of conducting this research paper, especially on Indian firms. There are many theories explain the carbon disclosure decision of corporate world. In this chapter, we will review those theories that will explain why firms choose to disclose their carbon performance and furthermore we will be studying extensively the relation that exists between carbon disclosure, carbon performance and financial performance. The theoretical background intends to lead towards our hypothesis development, followed by the literature review which helped remarkably in writing this master's thesis. The following multidimensional corporate climate change disclosure theories structure the theoretical background that helped to develop our hypothesis and support our findings.

SECTION 1: THEORETICAL FRAMEWORK

Mostly climate change classifies as a CSR or environmental issues, many theories are developed in the field of CSR and environmental disclosure by previous studies. Prior literature conducted comprehensive survey and gave us the detailed theoretical framework which explain the intension, reasons behind the company's disclosure polices which indicates the impact of climate change on their corporate activities. These theories are agency theory, signaling theory, voluntary disclosure theory, political theory, legitimacy theory, stakeholder theory and instrumental stakeholder theory. According to previous literature two types of theories that analyze the relationship between CSR disclosure and financial performance. The signaling theory and voluntary disclosure theory are part of the economic-based category while the legitimacy theory and stakeholder theory suited under the socio-political category (Siddiqui, 2021). In this section, we are going to focus on voluntary disclosure theory, signaling theory, legitimacy theory, stakeholder theory and instrumental stakeholder theory in detail.

1.1 VOLUNTARY DISCLOSURE THEORY

This theory states that mangers take tremendous caution to disclose corporate information based on an evaluation of costs and benefits (Verrechia, 1983). The disclosure of information voluntarily is supplementary but essential segment of the global corporate reporting framework that the firms selected to fulfill the stakeholders' expectations regarding firm's transparency. (Meek, Roberts & Gray 1995). Professor Meek et al. (1995) explain this theory as a choice of managers to publish their corporate information which is relevant and valuable to their stakeholders. Through this voluntary disclosure, firms prefer to reduce information asymmetry and resolve agency conflicts between managers and shareholders also promising their stakeholders about continued future growth (Healy & Palepu, 2001). To explore the motivations and factors of corporate environmental disclosures, Professors Cormier & Magnan (1999) applied the cost-benefit analysis. According to their studies, the mangers prefer to disclose additional environmental information to the public when the benefits exceed the cost of reporting. The prospective benefits incorporate the lower capital costs as the additional information increases investors' confidence in the firm by increasing the transparency (Scott, 1994).

The voluntary disclosure theory claims that the firms with superior environmental performance will choose to disclose non-financial information according to their positive CSR activities to

distinguish themselves from their competitors with poor environmental performance (Clarkson et al., 2008). So, this theory provides information to the market and since the stock market rewards companies implementing social and environmental strategies, the socially responsible firm's cost of capital is possibly decrease (Dhaliwal, Li, Tsang, & Yang, 2014) and their market value will improve (Clarkson et al., 2013; de Villiers & Marques, 2016). Such disclosure enables firms' greater advantages over their competitors. Therefore, the quality of disclosure of information is a dominant aspect of the voluntary disclosure theory. Based on this theory, company managers prefer to cautiously disclose their climate change-related measure to meet the external investors need and demands for climate risk, eventually improve companies' earnings, and value reducing information asymmetry and accomplish adequate allocation of capital market resources (Griffin & Sun, 2013; Griffin et al., 2017; Lemma et al., 2019; Matsumura et al., 2014). Most firms are inclined to bias regarding CSR disclosure (Hummel and Schlick, 2016). The firms disclose high quality information when they have a positive environmental performance and little reluctant in reporting when have a poor environmental performance, just to public criticism and reputational damage. According to Professor Clarkson et Al (2008), a positive performance binds environmental performance to the level of CSR disclosure. When the environmental performance of the company improves, the accuracy of disclosed environmental data tends to increase. The excellent disclosure represents the firm's willingness to differentiate themselves from other firms with inferior environmental performance impacted by enhance market value, lowered capital cost and reduced information asymmetry. The disclosure costs can take place if non-shareholder stakeholders use such additional information against the firm (Healy & Palepu, 2001). For instance, voluntary disclosure of negative events might affect adversely the firm's reputation, or additional environmental disclosure might capture attention of regulators or environmental protection agents.

1.2 SIGNALING THEORY

Signaling theory was first suggested in the labor market research on information economies (Spence, 1973). This theory can be used in accounting and business research as it allows us to consider the information asymmetry intrinsic in the system of reporting (Yekini & Jallow, 2012). Due to the information asymmetry between firms' managers and its stakeholders, managers normally have private information about the firm's operation. The well-informed investors make more beneficial investments than the less-informed investors (Connelly et al., 2011). Therefore, according to signaling theory, the market honor companies that declare

essential information by giving them a lower cost of capital (Healy & Palepu, 2001). Hence the signaling theory is an extension of the voluntary disclosure theory and both these theories explain the reasons of firms' disclosure policies. The signaling theory deals with information asymmetry problems (Akerlof 1970; Levin, 2001; Morris, 1987). Information asymmetry is basically occurring when one party has more or better information than others and the well-informed party do not disclose the information and use it for personal or professional benefits. The signaling theory tries to explain how the information asymmetry issues affects the market value of well performing companies. Being less informed by companies, investors may undervalue the well-performed companies' performance as the companies fail to report adequate information and investors may overvalue the poor performance because the other company tend to disclose more information even if its low-quality disclosure. This issue leads to substandard resources allocation on the capital market. The only solution for this information asymmetry is improving the quality and quantity of information disclosure to the market to convey positive signals to investors related to the firm's corporate performance. The prior research has proved that firm's that significantly report carbon related information to their stakeholders are rewarded with superior market value and insignificant cost of equity (Toms, 2002; Clarkson, Li, Richardson, & Vasvari, 2008; Luo & Tang, 2014). Like voluntary disclosure theory, firms with appreciable environmental performance seek to differentiate themselves from their competitors with poor environmental performance by signaling their higher carbon performance to their stakeholders. The prior studies indicated that the increase in disclosure normally signal feedback to social demands for disclosure but does not communicate active corporate community involvement. From Signaling theory's viewpoint, the successful companies tend to provide adequate information to the market to signal their competitive benefit (Miller, 2002). By taking the benefits of signaling mechanism, firms that have made efficient efforts to reduce climate change risks are more enthusiastic to disclose their information to signal a better impression in the market (Clarkson et al., 2008; Cormier et al., 2005). These positive signals indicate that firms are performing better than the other companies those are operating in the same sector and eventually attract investor's attention and improve firm's reputation. There are different ways that a company can send favorable signals about its performance to investors. The voluntary disclosure of accounting-based information has proved most effective means as it's approved by literature (Ross, 1979; Watson et al., 2002 and Xiao et al., 2004). Firms make sure that their market valuation is protected and improved by maintaining high quality of carbon disclosure and thus gain a competitive advantage (Clarkson et al., 2008). The companies can use climate change disclosure reports as a positive signal to

assist investors in their investment decision and thereby increasing firms' potential market value (Matisoff et al., 2013; Prado-Lorenzo et al., 2009).

1.3 LEGITIMACY THEORY

Legitimacy Theory explains the company's relatedness with society. It declares that companies constantly trying to verify that they carry out corporate activities equivalent to social boundaries and norms (Deegan et al., 2002). There are many definitions of this theory defined by previous literature. In this section we are trying to focus on few definitions. Legitimacy theory is defined as an existence of a state or status of an entity's value system is compatible with the value system of the larger social system where the entity is a part of the larger system (Lindblom, 1994; Deegan, 2002). When the harmony between these two systems is disturbed, normally due to incompliance of the organization to the social norms, the legitimacy of the entity is cross-examined and pressurized. Especially the social contract between the company and the society means that corporations and organizations are carrying responsibilities and they are accountable to society's well-being, they are dependable on social acceptance of their corporate activities. Legitimacy, permissibility is only initiated or established when society believes that the company's operations are in accordance with its set of morals and norms. Therefore, most organizations struggle to declare their legitimacy respecting to the social contracts that exist between them. The ultimatum towards their legitimacy often encounters with detailed strategies to reclaim this legitimacy and they must convince their stakeholders about their performance. Many scholars used this theory to explain environmental and social disclosure (Campbell, Craven and Shrivies, 2003). For satisfying stakeholders' demands for intensive transparency, companies focus on disclosing environmental and social information sequentially strengthens the company's legitimacy claims (Cormier, Magnan, & Van Velthoven, 2005; Solomon & Lewis, 2002). This theory is a system-oriented approach of the firms and society, it allows us to focus on the importance of information disclosure and its correlation between the firms, society, individuals, and groups (Gray et al. 1996). This theory proposes that regarding CSR disclosure, companies are focusing to recognize a social acceptance about the environmental impacts generated by their activities. Consequently, the social pressure inclines the firms to use disclosure as a tool to greenwash and hide their poor environmental performance (Deegan & Gordon, 1996; Patten, 2002; Michelon, Patten, & Romi, 2019). As per Professor Lindblom, to minimize the legitimacy gap, many strategies are implemented by the companies, such as, redirecting the management's behavior into fulfilling more of society's demands, trying to get society's attention or approval for their corporate activities by conviction or unethical means

like manipulation or diversion without adjusting their course of action supplemental to eco-friendly (Siddique et al., 2021). While implementing these strategies, businesses try to gain stakeholder's trust, sequentially helps them maintain their legitimacy (Deegan & Gordon, 1996; Deegan & Rankin, 1996). Most of the corporations are focus on profit-maximization, their concerns for environmental protection are fictitious. So, corporations' commitment for CSR activities and the CSR disclosure might be illustrative instead of factual and sincere. In case of companies operating in carbon-intensive industries, they struggle more to reduce their carbon emissions because of the nature of their fundamental business. Simultaneously, these companies must fulfil their stakeholders' expectations related to environmental protection. Under such social pressure, many companies tend to report misleading and insignificant data-related information to prove their carbon reduction efforts, but they continue to emit large quantities of GHG emissions (García-Meca & Sanchez-Ballesta, 2010). In other words, legitimacy can also be defined as a perception or speculation that the company's actions are appropriate, sensible within the norms, value, beliefs of the society (Suchman, 1995). For concluding, it can be feasible to say that the companies prefer to disclose more positive social and environmental information when they realize that they can be cross-examined by the society for their legitimacy claims. These disclosers are supposed to be in accordance with their legitimacy and gain stakeholder's trust.

1.4 STAKEHOLDER THEORY

As per Clarkson (1995) definition, the stakeholders are persons or groups who have claim, ownership, rights, or interest in any corporation and within its current, past, or future activities. Professor R. Edward Freeman (1990) initiated the stakeholder theory while working on the organizational management and business ethics which introduce the importance of values and ethics within a company culture. This theory is a guideline categorization of theories that assist scholar, managers to acknowledge the relationship between firms and their stakeholders and performance results of this connection (Jones et al., 2018). The theory specifies that the firm should operate their activities not only for creating value for stakeholders but also in favor of all the entities involves in the operations. In other words, stakeholders could recognize as any individual or group who get affected by the achievement of an organization's activities (Freeman & Reed, 1983). In this study Professors tried to explain that as per legitimacy approach which focus on the macro-view of the social contract between the corporation and its social factors, the stakeholder theory highlights a micro-view of the social contract, where the firms review the demands and expectations of the different stakeholders and not only its

shareholders. As per Professor [Cotter & Najah, 2012](#), the understanding of business operation differs among different stakeholders' groups. There can be several social contracts with different stakeholders' group instead of having a single contract with entire social context. In this theory, a firm's existence and success depend on the relationship between the firm and its different stakeholders.

The involved parties could be internal or external to the company depending on the nature of the relationship between them. Internal stakeholders who work within the company and have direct relationship with it, may include as employees, board of directors and investors. They are considered as a primary stakeholder because their presence is essential for the company's survival. On the contrary, external stakeholders are not directly related to the company, they do not have financial interest in the company, but they are affected by the company's decision and performance. Customers, creditors, suppliers, and the government are all considered as external stakeholders. Like legitimacy theory, stakeholder theory was evolved inside a political economy framework, where society, economics and politics are entangled ([Gray et al., 1995](#)). With the disclosure of CSR and the increasing concerns for the environmental problems, this theory began to get more acknowledgement in corporate management. As per Professor [O'Dwyer \(2005\)](#), while considering the requisite of the stakeholder theory, both internal and external stakeholders should have basic rights irrespective of the company's policy for profit maximization. The availability of information and transparency are extensively essential for stakeholder and should be included among these rights to estimate company's universal performance and corporate actions which can affect them directly or indirectly.

There are four strategies specified by [Wartick & Cochrane, 1985](#); [Dawkins & Fraas, 2011](#) for acknowledging the stakeholders' expectations: reactive, defensive, accommodative, and proactive. To maximize profits, firms tend to negotiate the social contracts. Along with these strategies, there are two main branches of stakeholder theory: ethical or moral and positive or managerial branch ([Deegan, 2002](#)). The ethical approach represents the core of CSR. It forms the directions that managers should follow to fulfil stakeholders demands and expectations. It is to decide whether they should prioritize the demands of a group of stakeholders over the another based on justifiable claims ([Margolis and Walsh, 2007](#)). This theory shows the way in recognizing the ethical obligation that an organization has towards all appropriate stakeholders. The normative branch proposes the significant of stakeholders' true rights which need to be treated reasonably and equally, whether their contribution towards the company's financial

performance is worthy or not (Deegan, 2002). Because of the intense global warming and increasing awareness regarding the reduction of carbon emissions, stakeholder pressure has been recognized as the main factor for corporate sustainability reporting activities (Deegan & Blomquist, 2006; Giannarakis et al., 2018; Liesen et al., 2015). Few emerging companies have motivated to proactive carbon strategies and indicating reliability and future provisions for climate change risks (Córdova et al., 2018; Freedman & Jaggi, 2005, 2011; TCFD, 2018).

1.5 INSTRUMENTAL STAKEHOLDER THEORY

Instrumental stakeholder theory examines the performance outcomes for firms with distinctly ethical relationship with their stakeholders, distinguish with greater level of trust, cooperation, and information sharing (Jones et al., 1995). As outlined by Professor Jones, according to this theory, firms' contracts between managers and its stakeholders based on mutual trust and collaboration will have a significant advantage over those firms which do not have such contract (Jones et al. 1995). In other words, this theory indicates that firms have provisions for all its stakeholders can achieve higher profits, stability, and growth. It suggests that by applying stakeholder management, firms can have a competitive advantage (André, 2021). This means, companies can achieve high profits that fulfil their shareholders expectations and simultaneously maintain significant ethical relationships with their stakeholders by providing them the adequate transparency through information disclosure, trust and cooperation. This theory is used to identify the connection or lack of connection, between stakeholder management, and the accomplishment of conventional objectives (Donaldson & Preston, 1995). To conclude, firms those are fortunate in developing a reliable relationship may have a sustainable competitive advantage, as such proficiency is occasional, rare, and difficult to achieve. Such relationship ability can exceed the costs of a strategy which is been applied to develop and maintain it (Jones et al., 2018).

SECTION 2: LITERATURE REVIEW AND HYPOTHESES DEVELOPMENT

In this section, we will investigate the previous literature to understand deeply the concept of carbon disclosure and learn more about the relationship which is already exist in between carbon disclosure and carbon performance and then relationship between carbon disclosure and the firm's financial performance. Previous literature showed the conflicting results regarding these two relationships. According to few studies, stakeholder theory and legitimacy theory showed negative relationship, while voluntary disclosure theory and signaling theory presented

a positive relationship. The instrumental stakeholder theory is in favor of the positive relationship between carbon disclosure and financial performance and of the positive relationship between carbon disclosure and carbon performance. To be specific, carbon disclosure generates higher profits to the firms and so motivates in regulating more carbon mitigation activities which positively impact the firm's carbon performance.

Most of the previous studies described a positive relationship, a considerable number of studies highlighted a negative, a neutral or a mixed relationship. We will discuss in detail the causes behind these conflicting findings and present our own hypotheses based on that. To proceed further in this section, first we will start by studying the relationship between carbon disclosure and carbon performance, then moving ahead to investigating the relationship between carbon disclosure and financial performance and at the end of this section, we will summarize the literature review in a tabular format.

2.1 CORPORATE CARBON DISCLOSURE AND CARBON PERFORMANCE

The corporate carbon disclosure (CCD) is enhanced as a voluntary disclosure instrument which is used by internal and external users to help them to take the investment decisions (Hahn et al., 2015). For example, corporate carbon performance assists corporate strategies in term of carbon risk management and opportunities (Harmes, 2011). The carbon disclosure is a new field of research with limited studies on the relationship between carbon disclosure and carbon performance. Most of the previous literature showed the contradictory results regarding the relationship between environmental/carbon disclosure and environmental/carbon performance. (Bewley & Li, 2000; Cho & Patten, 2007; Clarkson et al., 2011; Deegan & Gordon, 1996; Farag, Meng, & Mallin, 2015; Freedman & Jaggi, 1982; Freedman & Wasley, 1990; Luo, 2019; Fujii, & Managi, 2019). The findings of these studies were explained according to legitimacy theory and stakeholders' theory which provided a negative relationship between carbon disclosure and carbon performance while the signaling theory and the voluntary disclosure theory suggested a positive relationship (Siddique et al., 2021). Currently corporates or businesses are facing risks linked with climate change issues, firms those are continuously producing high carbon emissions without thinking about the solutions to reduce their carbon footprints are held socially irresponsible and lacking the social awareness (Luo, 2019). Their reckless behavior and ignorance to social and environmental issues faced with heavy criticism by public that could deteriorate their corporate reputation and directly threatening to their legitimacy status (Bansal & Clelland, 2004; Pfeffer & Salancik, 2003). Consequently, firms

with low environmental performance might utilize voluntary carbon disclosure procedure to portray themselves as socially responsible and gain the confidence of society which can help them to sustain their corporate image and get the public approval (Bansal & Roth, 2000; Cho & Patten, 2007). The corporates can disclose the inferior-quality, insufficient and superficial carbon information and purposely hide the truth about their poor performance but they can be successful in maintaining their legitimacy claims (Hummel & Schlick, 2016). Hence, as per the legitimacy theory and stakeholders' theory, firms with inferior quality of environmental performance tend to declare carbon information to achieve stakeholders trust and maintain their legitimacy. So, according to these studies, the relationship between carbon disclosure and carbon performance is negative. More carbon disclosure is shown to the public with less effective carbon performance. Therefore, based on these theoretical frameworks, we are proposing our first hypothesis:

➤ **Hypothesis 1:** The relationship between carbon disclosure and carbon performance is negative.

However, other research based on the signaling theory and voluntary disclosure theory indicates an opposite hypothesis. In fact, as per the signaling theory, to circumvent the risk of adverse selection by distinguishing themselves from firms with inferior environmental performance, the firms with higher environmental performance would voluntarily disclose their detailed carbon information (Luo, 2019). Additionally, firms with good environmental performance are honored with lower cost of capital, greater market value and an attractive public image. So, voluntary carbon disclosure procedure can be used as tool to display the firm's true indication regarding social and environmental issues. So, when firm is enhancing its environmental performance, it is more likely to declare information related to its environmental performance. Most of the previous research studied the impact of carbon performance on the firm's voluntary carbon disclosure but few scholars conducted analysis on the correlation which might exist between carbon disclosure and carbon performance. As per Professor Siddiqui (2021), there is a positive relation between carbon disclosure and firm's carbon performance. In fact, the instrumental stakeholder theory proposes that by considering stakeholder management, firms can claim valuable financial benefits which sequentially can motivate them to maintain great ethical relationship with their stakeholders by enhancing their environmental performance. Yasean et al., (2021) supports Siddiqui's findings. By using voluntary disclosure theory, they explained that corporate carbon disclosure enhances carbon performance. This academic paper

has two main objectives to prove the relationship between corporate carbon performance and carbon performance. Firstly, they examined the latest state of corporate carbon performance reporting among firms and their determinants. Secondly, they tested the association between corporate carbon performance and firms' carbon emission performance as specified by Hoffmann and Busch, (2008). Their findings indicated that corporate carbon disclosure is remarkable and positively connected with firm's carbon performance. Hence, carbon disclosure is correlated with higher profits and thus encourages firms to implement carbon mitigation activities which positively impacts the firm's carbon performance. Based on these theories and following Siddiqui (2021) and Yasean et al., (2021) models, we can hypothesize as:

➤ **Hypothesis 2:** The relationship between carbon disclosure and carbon performance is positive.

Fundamentally, the relationship between carbon disclosure and carbon performance depends on the quality and reliability of disclosure. The superior quality disclosure which is related to the higher environmental performance, sequentially motivated by higher market value and less cost of capital. On the other hand, inferior quality disclosure, which is related to low environmental performance and consequently, firms misled their poor-quality carbon performance to keep their legitimacy.

2.2 CORPORATE CARBON DISCLOSURE AND CORPORATE FINANCIAL PERFORMANCE

The existing literature on carbon accounting indicating extensive arguments on the relationship between carbon disclosure and financial performance. The carbon disclosure is a part of environmental disclosure, so studying link between the corporate social performance (CSP) and corporate financial performance (CFP) assists to understand the relationship that exists between carbon disclosure and financial performance. Previous researchers focused their attention on two main elements while evaluating the link between corporate social performance and corporate financial performance, such as:

- The direction of determinants:

Previous literature focus on partial relationship which exists between corporate social performance and corporate financial performance. Waddock and Graves (1997), Siegel and Vitaliano (2007), Surroca et al. (2009), such scholars measured the one-dimensional

correlation but failed to appreciate bidirectional relationship. [Milind Kumar et al. \(2020\)](#) evaluated the bidirectional causality and strength of corporate social performance and corporate financial performance relationship by applying the Granger causality test and multiple regression for panel data of top 500 Indian firms during 2008-20018.

- The pattern of the relationship:

Intense research was conducted to explore empirically the relationship between corporate social performance and corporate financial performance. But the conflicting results leads to undecisive conclusion regarding this relationship. Previous literature initiated four different types of relations, such as: positive, negative, neutral, and mixed.

The carbon disclosure level changes with the change in carbon performance and this can be examined by considering the direct & indirect carbon emission intensities. In higher energy-intensive firms, the relation between carbon disclosure and performance is notably weaker. ([Wei Qian, Stefan Schaltegger, 2017](#)). [Saka and Oshika \(2014\)](#) explained that the link between disclosure and corporate value is based on the actual volume of corporate carbon emissions. Hence, the link between disclosure and corporate value should be investigated by considering the volume of actual carbon emissions which affects corporate value. Moreover, the corporate GHG emissions policies' success depends in firm's net financial benefit with improvement in their environmental performance. To study these relationships many scholars applied different methods, models, and concepts.

[Swarnodeep Homroy \(2023\)](#) investigated the impact of corporate GHG emissions on profitability of the companies by considering the CEO's female children. The study shows precise increase in profitability for lower GHG emissions. The profit increased by 0.14 of standard deviation when GHG emissions decreased by one standard deviation. Furthermore, the study revealed that CEOs having daughters are generally appreciate climate-integrated business strategies and set emission reduction targets than CEOs with only sons. Additionally, when firms have better industry environmental performance are nicely prepared for negative industry shock and take the advantage of lower operating and financing costs. However, when [Rupal Tyagi \(2013\)](#), used S&P ESG Index as an alternative of CSR of Indian firms for the period 2005-2011. The findings revealed impartial but modest negative relation between corporate social performance and corporate financial performance also indicating that if there will be any relation in future the going to be negative. [Margolis and Walsh \(2003\)](#) conducted 109 studies to explore the partial relation corporate social performance to financial

performance. Among the 109, 54 described a positive relationship between the two. Only seven studies anticipated a negative relationship while remaining disclosed the link between corporate social performance and corporate financial performance is either neutral or mixed. These unclear results carry the conflicting judgements regarding the relation between two variables. These findings are like those forecasted for environmental disclosure and financial performance. However, most literature showed the positive financial impact from enhanced carbon performance and improved carbon disclosure. Very few studies indicated negative, mixed, or no significant relationship. Furthermore, by taking the reference from [Siddiqui et al., \(2021\)](#), who applied two interdependent financial measures to study the relationship between carbon disclosure and financial performance, which will lead us towards the another hypothesis of our thesis. Professor Siddiqui studied how relationship of these two variables exists in short-term and long-term. The short-term financial performance measures the current cash flow in the present market environment, whereas the long-term financial performance measure examines the future profitability estimates given by the suggested legislation to indicate climate change. The short-term financial performance factor studies the present performance while the long-term financial performance factor highlights future performance ([Siddiqui et al., 2021](#)).

❖ **Positive Relationship:**

[Freeman & Evan, \(1990\)](#); [Porter & van der Linde, \(1995\)](#); [Hart, \(1995\)](#); [Aragon- Correa, \(1998\)](#); [Margolis and Walsh \(2007\)](#); [Al-Najjar et Al, \(2011\)](#); [Andrew and Cortese, \(2011\)](#); [Dixon-Fowler, Slater, Johnson, Ellstrand, & Romi, \(2013\)](#) such majority of previous studies indicated positive relationship between carbon disclosure and financial performance. The positive correlation had been realized by considering the results of innovation offset which exceeded cost of compliance, efficient management capabilities, firm's legitimacy, and willingness of stakeholders and considered the main causes backing the positive impact of environmental performance on the firm's financial performance. By involving in CSR activities, this positive correlation proves its existence. Instead of just depending on perceptive CSR, firms should think about executing CSR operational strategies and consider it as a source of cost to enhance their reputation, reinforce their legitimacy claims and improve their market value by reducing cost and risk ([Porter and Kramer, 2006](#)). During the study of the industrial competitiveness model in association with the firm's environmental goals, [Porter et al \(1995\)](#) were the first authors to initiate this positive relationship. They proclaim that in a fixed operating setting, it's simple for environmental regulations to hold up to the firm's total costs, by reducing its market shares and damage its competitive advantage. Innovation in CSR is

examined by the planned measures required to treat environmental issues, such as refining toxic materials and emissions, the efforts taken to reduce carbon emissions through advanced and less expensive material which can substitute the hazardous materials or effectively using the materials in production process. The approach of handling environmental issues can exceed their cost of CSR involvement when they get the benefits from innovations. According to [Mohamed A. Boutabba \(2014\)](#), indicated that there has a long-run positive impact of carbon emissions on financial development. The author suggested that financial development enhances environmental degradation. Moreover, Granger causality test specified a log-run one directional causality conduct from financial development to carbon emissions and energy use. Hence, it's advisable to consider financial development to carbon emissions and energy use in financial system. Furthermore, an efficient stakeholder-management relationship is another effective tool for a positive link between environmental disclosure and financial performance ([Donaldson and Preston, 1995](#)). Well-maintained and mutual relationship with the company's stakeholders gives an advantage to managers in fulfilling firm's financial goals (Jones,1995). [Freeman & Evan \(1990\)](#) also emphasized the importance of satisfying stakeholders' desires in generating positive financial outcomes for the firm. [Al Najjar et Al \(2011\)](#) as well support the positive link between environmental performance and financial performance. By analyzing listed firms on UK stock exchange, the authors indicated that firms with remarkable environmental performance are more valued and benefited with enhanced financial performance than the firms those do not conduct the eco-efficient activities. Very few prior studies considered environmental disclosure, environmental performance, and economic performance together. After considering these three facts' interrelations with simultaneous equations models, the results indicated good environmental performance is remarkably linked with good economic performance and related to the environmental disclosures of pollution measures ([Sulaiman et al., 2003](#)). Additionally, carbon disclosure reduces information asymmetry and carbon performance increases financial performance ([Patrick et al., 2020](#)).

[Sinkin et al., \(2008\)](#) defined eco-efficiency as a sustainability tool to limit the hazardous impact of the business activities on the environment along with promising the maximization of profit for shareholders. By examining the current state of carbon disclosure among a sample of Financial Times Stock Exchange (FTSE) 350 Index non-financial firms in the period of 2015-2018, [Yasean et al. \(2021\)](#) indicated that the carbon disclosure is statically and positively related with firm's financial performance. When scholars believed that CSR would guide to corporate benefits, CSR generates greater revenues, lesser risk and costs, these benefits are higher than CSR costs and leading to a positive relation between CSP and CFP. ([Arpita Ghosh, 2013](#)).

❖ Negative Relationship:

As per the traditional economic trade-off theory, the cost of compliance cannot get balanced by the financial benefits gained from CSR engagement (Friedman, 1970). The prior studies have indicated a negative or non-significant relationship (Freedman & Jaggi, 1986). There is detailed research conducted on carbon accounting and numerous arguments on the relationship between corporate carbon disclosure and financial performance (Clarkson et al., 2011; Busch and Hoffmann, 2011; Prakash et al., 2011; Hartmann et al., 2013; Saka and Oshika, 2014). For example, Prakash et al. (2011) studied the effect of corporate carbon disclosure on corporate financial performance and firm value using USA firms' samples and indicated a negative association among them, showing a notable decrease in the value of the firm. However, by using the similar sample, Clarkson et al. (2011) established a positive and remarkable association between corporate carbon disclosure and the market value of corporate financial performance. Further, proposing that corporate carbon disclosure affect the corporate financial performance of firms with greater cash inflow and a lower ratio to debt. Supporting these results, Busch, and Hoffmann (2011) also indicated that the corporate carbon disclosure and climate change issues have a remarkable negative impact on the corporate financial performance. So, they have suggested that the cost related to carbon disclosure may exceed the benefits and consequently the sampled firms need to take more efforts for carbon management (Yasean et al., 2021). Supporting to this argument, Neo-classicists also proclaimed that when a considerable investment is put into research and development for the innovation of green processes or products to enhance the firm's environmental performance as well as to follow the mandatory regulations (Freedman and Jaggi, 1982; Ingram and Frazier, 1980; and Walley and Whitehead, 1994), such investment becomes costlier to the firm. Furthermore, by using a sample of 13 USA firms having 81 plants operating in pulp & paper industry, Friedman, and Jaggi, (1992) examined the impact of pollution performance on firm's financial performance and its market value. The result of this study indicated negative impact on the relationship between pollution performance and economic performance. Furthermore, when CSR costs are higher than its benefits then the relation is negative and after following such strategy the valuation of company's resources to non-beneficial actions lead the firms towards disadvantageous corporate values (Arpita Ghosh, 2013).

Additionally, the similar findings were reported for the relationship between pollution performance and market performance. These results indicated that investors are not interested in the companies having higher pollution disclosure and performance. In the short run, to

enhance the environmental performance, whichever investments are carried out on capital expenditure, negatively impact the firm's profitability, and decreases the productivity. Higher risk is associated with such firms and consequently negative market reaction would be reported. A negative relationship between environmental and economic performance for firms operating in the European paper manufacturing industry has been predicted by [Wagner et al \(2002\)](#). The traditional theory explained the negative relationship between environmental disclosure and financial performance which specifies that the costs applied for the eco-friendly practices burden the firm's profitability and cannot be adjusted with the financial gains generated by these initiatives. Consequently, reduced profits are allotted to the shareholders. Therefore, there is a possibility that management are pressurized by shareholders to limit their social and environmental expenses to protect the firm's financial performance. To support this argument, there is evidence from [Walker and Wan \(2012, p. 227\)](#), that there is a difference between symbolic and substantial action i.e., "green washing" measures which negatively impact financial performance. They stated that the firms that talked about "greenness" without demonstrating or involving in the green activities were negatively impacted in their financial performance. The "process-based Corporate Environment Performance" (CEP) like a misuse of resources, affect negatively upon the correlation of the environment performance and financial performance ([Busch and Hoffmann, 2011, pp.242 – 243](#)). Furthermore, the process-based CEP cannot include the actual outcome-based CEP and neglecting the measures for resource consumption and optimization of emission ([Busch and Hoffmann, 2011, pp.242](#)).

❖ **Neutral Relationship:**

When firm's financial performance is not affected by the environmental performance or disclosure, the relationship is said to be neutral. When too many variables are involved in the analysis that might destroy the efficiency of the results because of no significant relationship between corporate economic performance and environmental, social performance ([Waddock & Graves, 1997](#)). If market examines the corporate social performance have no effect on financial performance, the relation is said to be neutral. If the benefits of CSR are expected to be nullifying or equalizing the costs of CSR then the relation is neutral, similarly if market is unable to recognize the social performance accurately then relation is going to be neutral ([Arpita Ghosh, 2013](#)).

[Ullmann \(1985\)](#) claimed that after analyzing the data of Fortune 500 countries as a sample to study the influence of carbon disclosure on financial performance, the results indicated the

impact of carbon disclosure on the firm's financial performance is limited and negligible in the short run for carbon-intensive sectors (Lu et al., 2019). Firms that disclose huge information about pollution and firms that report the minimum amount of disclosure related to pollution, there is insignificant relation between market reactions towards it. (Freedman & Jaggi, 1986).

❖ **Mixed Relationship:**

Few researchers had different views related to carbon disclosure and financial performance. According to Shen et al. (2019), the association between environmental performance and financial performance is not direct, which means that firm's profitability is influenced differently as per the level of environmental performance. The mixed relationship specifies that to draw a general conclusion related to the impact of environmental disclosure on financial performance is very difficult. The mix results indicating the relationships between carbon performance, carbon reporting and firm performance are due to prior literatures' methodology (Noor R. A. Rahman et al. 2014). The scholars that support the mixed relationship theory, stated that there is possibility of having an ideal level for environmental disclosure and environmental performance that enhance the financial benefits which a company can accomplish from following the obligatory rules and regulations related to environmental protection by choosing to voluntarily disclosing the information about its environmental performance (Mintzberg, 1983; Shen et al, 2019).

After considering all the information from prior studies, we would like to proceed with constructing our hypothesis about the impact of carbon disclosure on the firm's financial performance. As mentioned earlier, by following Siddiqui (2021) model, we are considering the voluntary disclosure theory and the signaling theory to construct our hypothesis. These two theories analyze the cost and reliability of the private information that company shares with its stakeholders. The voluntary theory highlights that the company prefer to disclose the information which is beneficial to them and tend to hide adverse information that might affect their corporate value. As per signaling theory, investors appreciate genuine and legitimate carbon information should be disclosed by the company and sequentially improves market value and enhance economic benefits. But pessimistic information destroys the firm's reputation and damage its future development. These two theories provide concrete information and detailed knowledge about the market, so based on this, our research paper argues that greater financial performance is associated with high-quality carbon disclosure. Additionally,

as per previous literature, the firm's involvement and initiative taken by them in disclosing the carbon information majorly depend on their level of carbon emission.

As per signaling theory, investors generally thoroughly analyze the information shared by the companies while taking any investment decisions. Hence, the impact of shared information is not immediate, it takes time to reflect its effects. Additionally, implementing and disclosing CSR practices are expensive, it raises firm's costs, reduces its revenues because low carbon emissions could result in less productivity (depending on the nature of firm's operation). This can negatively impact the financial performance in the short run. On the other hand, the firms can take financial benefits from their enhanced carbon performance and carbon disclosure can exceed their costs in the long run. In our analysis we are considering the impact of carbon disclosure on firm's financial performance in the short term only, so we are proposing our final hypothesis:

➤ **Hypothesis 3:** The impact of carbon disclosure on the company's financial performance is negative in the short term.

2.3 LITERATURE REVIEW

Year	Details
1988	<p>Author: Freedman Martin, Bikki Jaggi</p> <p>Title of Article: An Analysis of the Association between Pollution Disclosure and Economic Performance</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Pollution disclosure index - ROE & ROA for economic performance <p>Results: Inconsequential relation between economic performance and pollution disclosure.</p>
1995	<p>Author: Porter, M. E., & van der Linde, C.</p> <p>Title of Article: Toward a new conception of the environment–competitiveness relationship</p> <p>Methodology / Variables: Qualitative analysis:</p> <ul style="list-style-type: none"> -No empirical test -The findings were based on previous literature with significant evidence. <p>Results:</p>

	Financial performance can be affected with better environmental performance, if companies developed innovative products that could give advantage and reduce cost.
1996	<p>Author: Deegan, Craig & Ben Gordon</p> <p>Title of Article: A Study of the Environmental Disclosure Practices of Australian Corporations</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Negative Disclosure (NEG): Number of words counting for negative disclosure - Positive Disclosure (POS): Number of words counting for positive disclosure - Content analysis method. <p>Results:</p> <ul style="list-style-type: none"> - Firms prefer to disclose positive information over the unfavorable. - Increase in social awareness and regulations resulted in an expansion of environmental disclosure.
2003	<p>Author: Sulaiman A. Al-Tuwaijri, Theodore E. Christensen, K. E. Hughes II</p> <p>Title of Article: The relations among environmental disclosure, environmental performance, and economic performance: A simultaneous equations approach</p> <p>Methodology / Variables:</p> <p>Endogenous Variables:</p> <ul style="list-style-type: none"> -non-directional null hypotheses -Three stage Least Square (3SLS) method used -Joint-estimation research design. <p>Results:</p> <ul style="list-style-type: none"> - Positive relation between environmental performance and economic performance. - Positive relation between environmental performance and environmental disclosure.
2004	<p>Author: Freedman, Martin, Bikki Jaggi</p> <p>Title of Article: Carbon dioxide emissions and disclosures by electric utilities</p> <p>Methodology / Variables: -Dependent Variables: Scores for pollution disclosure</p> <p>-Independent Variables: To measure pollution emission</p> <p>-Control Variable: Beta, ROA</p> <p>Results:</p> <ul style="list-style-type: none"> -In 1998, the electric utilities contributed an increase of 35% to the total amount of CO2 emission compared to 1990. - Positive relationship between pollution disclosures and pollution emissions, electric vehicles do not disclose much CO2 emissions.
2006	<p>Author: Freedman, Martin, Bikki Jaggi</p> <p>Title of Article: An examination of the impact of pollution performance on economic and market performance: Pulp and paper firms</p>

	<p>Methodology / Variables: Pollution performance: Pollution index clarified from Pollution emission reports Economic performance: ROA, ROE, Net income, Equity/cash flow & Assets Market performance: - Price/Earnings ratio, systematic risk - The Pearson correlation test used to analyze relation between variables.</p> <p>Results: Better pollution performance negatively affects the firm's economic performance - Firms with better pollution performance and disclosure had negative stock market reaction - Heavy expenses are linked with improved environmental pollution which weaken firm's profitability, lower market value would be allotted by - Demotivation for management to reduce pollution.</p>
2008	<p>Author: Gerwin Van der Laan, Hans van Ees, Arjen van Witteloostuijn Title of Article: Corporate Social and Financial Performance: An Extended Stakeholder Theory, and Empirical Test with Accounting Measures</p> <p>Methodology / Variables: -Corporate Social Performance Indicators: Employee relations, diversity, human rights, customers, investors, and community -Financial Performance Indicators: ROA, Earnings per share (EPS)</p> <p>Results: -Inferior corporate social performance has a significant impact on financial performance than superior corporate social performance. -If EPS used to estimate financial performance, then larger firms perform better than smaller firms.</p>
2011 (Indian context)	<p>Author: Shweta Verma Title of Article: Why Indian Companies Indulge in CSR</p> <p>Methodology / Variables: Qualitative analysis -No empirical test -Based on secondary data for understanding the concept of CSR & SRI</p> <p>Results: Long-term sustainability is the major motivational factor Companies invest 2% of their investment in CSR</p>
2012	<p>Author: Al-Najjar, Basil, et Aspioni Anfimiadou Title of Article: Environmental Policies and Firm Value</p> <p>Methodology / Variables: -Dependable Variable: Stock price -Independent Variable: Book value, EPS, market price, R&D, leverage</p>

	<p>Results: Firms having ISO-14001 certificate and declare annual CSR reports for their stakeholders have good market value than those do not have the certification and no declaration.</p>
<p>2013 (Indian context)</p>	<p>Author: Rupal Tyagi Title of Article: Corporate Social Performance and Corporate Financial Performance: A Link for the Indian Firms</p> <p>Methodology / Variables: - Dependable Variable: Corporate financial performance (CFP) Market based: EPS, Value of stock, Profit Payout Accounting based: ROE, ROA</p> <p>- Independent Variable: Corporate social performance (CSP) Scoring process of “Quantitative Assessment”: Each company is allotted a quantitative ranking based on transparency & disclosure (T&D, ESG criteria)</p> <p>- Control Variable: Industry sector, size, risk & R&D expenses</p> <p>Results: -Financial measure contributes to the outcome -No relation between dependent and independent variables</p>
<p>2013 (Indian context)</p>	<p>Author: Arpita Ghosh Title of Article: Corporate Sustainability and Corporate Financial Performance: The Indian Context</p> <p>Methodology / Variables: - Dependent Variables: For Financial performance: ROA, ROE, and Tobin’s Q ratio</p> <p>-Independent/ control variable: Size, financial risk; profit, liquidity, R&D intensity, many other variables</p> <p>Results: -The large firms with less leverage, having higher R&D expenditure, working in emission sensitive industries are superior in sustainability, guiding to higher financial performance. -Used Ohlson (1995)’s model to acknowledge the market values of CSP in Indian context and obtained the positive results.</p>
<p>2014</p>	<p>Author: Le Luo, Qingliang Tang Title of Article: Does Voluntary Carbon Performance reflect underlying Carbon Performance?</p>

	<p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependable Variable: Leader Index and Carbon disclosure - Independent Variable: Carbon Intensity <p>Four Proxies:</p> <ul style="list-style-type: none"> - CP1 & CP2 for carbon emission performance - CP3 & CP4 for carbon mitigation performance <p>Results:</p> <ul style="list-style-type: none"> - Positive and significant relationship between carbon disclosure and carbon performance - Firms voluntarily engage in CDP, declare reliable information related to carbon performance
<p>2014 (Indian context)</p>	<p>Author: Monika Kansal, Mahesh Joshi, Gurdip Singh Batra</p> <p>Title of Article: Determinants of corporate social responsibility disclosures: Evidence from India</p> <p>Methodology / Variables: Content Analysis method - Financial Explanatory Variables: Sales, total assets (proxy: size), PAT, ROCE, market price, Beta for systematic risk- stock & financial market, DER for accounting measure of financial leverage</p> <p>Results:</p> <ul style="list-style-type: none"> - Low comprehensive disclosure - A company's industry connections and profitability notably affect its CSR disclosure - No relation between CSR disclosure and risk
<p>2014 (Indian context)</p>	<p>Author: Deepika Dhingra and Rama Mittal</p> <p>Title of Article: CSR Practices in Indian Banking Sector</p> <p>Methodology / Variables: Qualitative analysis</p> <ul style="list-style-type: none"> - No empirical test - The findings were based on previous literature with significant evidence - Details of CSR practices in India. <p>Results:</p> <ul style="list-style-type: none"> - Few banks use CSR practices as marketing tools - Making unreliable announcements related to socio-environmental issues - Few banks clearly declare the CSR activities
<p>2014</p>	<p>Author: Noor Raida Abd Rahman, Siti Zaleha Abdul Rasid, Rohaida Basiruddin</p> <p>Title of Article: Exploring the relationship between carbon performance, carbon reporting and firm performance: A conceptual paper</p> <p>Methodology / Variables: Qualitative approach</p> <ul style="list-style-type: none"> - Textual analysis techniques from selected companies' documents

	<ul style="list-style-type: none"> - Carbon Reporting Index - Performance-based measures: Volume of carbon emissions, as a proxy carbon performance <p>Results: The findings are more useful for carbon reporting literature, Malaysian companies, and accounting regulation body</p>
<p>2014 (Indian context)</p>	<p>Author: Mohamed Amine Boutabba Title of Article: The impact of financial development, income, energy, and trade on carbon emissions: Evidence from the Indian economy</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Granger causality test: - Cointegration: Carbon emissions, financial development, Economic growth, Energy consumption, and Foreign trade <p>Results: There are causal relationships between carbon emissions, financial development, income, energy use and open trade in the long run.</p>
<p>2015</p>	<p>Author: Andrea Liesen, Andreas G. Hoepner, Dennis Patten, Frank Figge Title of Article: Does stakeholder pressure influence corporate GHG emissions reporting? Empirical evidence from Europe</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent Variable Carbon Disclosure: A dummy variable equivalent to one when firm declares its activities - Independent Variable: Stakeholders proxies: Media coverage proxy- NGO pressure OWN-PF proxy for investor's constraint: Pension Fund owned by Companies, Energy tax level – government constraint - Leverage: a proxy for lender's constraint : estimate firm's level of debt. <p>Results: Findings support Stakeholders Theory indicated that firms report GHG emissions to fulfill external stakeholders demand -Support Legitimacy Theory stating that firms involve in carbon disclosure procedure to greenwash, may pretend like they are environmentally responsible while continuing intense emission activities.</p>
<p>2016</p>	<p>Author: Diah Iskandar., SE., M.Si, Efita Fran., SE Title of Article: The Effect of Carbon Emissions Disclosure and Corporate Social Responsibility on the Firm Value with Environmental Performance as Variable Control</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent Variable: Tobin's Q ratio-market value - Independent Variable:

	<p>Carbon disclosure and CSR disclosure (dummy variables) equivalent to 1 when firm responds to the survey.</p> <p>Results:</p> <ul style="list-style-type: none"> -When investors charge high fines/penalties for high carbon emission to the firms; carbon disclosure negatively affects firm value. -When stakeholders tend to admire firms those are involved in sustainability practices, CSR disclosure significantly and positively impacts firm value.
2017	<p>Author: Christian Blanco, Felipe Caro, Charles J.</p> <p>Title of Article: An Inside perspective on Carbon Disclosure</p> <p>Methodology / Variables: Supervise interviews of 38 firms in 7 different countries, disclosing carbon information through CDP.</p> <p>Results:</p> <ul style="list-style-type: none"> - Advantages from emission reduction initiatives can be operational, strategic, internal & external - Even if firm's do not disclose carbon information, participating in the disclosure procedure can be advantageous.
2017 (Indian context)	<p>Author: Anupam Singh, Priyanka Verma</p> <p>Title of Article: How CSR affects Brand Equity of Indian Firms</p> <p>Methodology / Variables: Questionnaire-based online survey -Structure equation modelling (SEM) technique used AMOS 22.0</p> <p>Results:</p> <ul style="list-style-type: none"> - Brand equity (BE) has positive impact of firm's CSR activities. - The relation between CSR and BE concerns the brand image, brand loyalty, purchase intention and brand awareness.
2017	<p>Author: Wei Qian, Stefan Schaltegger</p> <p>Title of Article: Revisiting carbon disclosure and performance: Legitimacy and management views</p> <p>Methodology / Variables: Total emission intensity, ROA, Firm size, Sales growth, Liquidity, Capital intensity, R&D intensity, Environmental exposure</p> <p>Results:</p> <ul style="list-style-type: none"> - By examining the direct & indirect carbon emission intensities, the change in carbon disclosure level is link with the change in carbon performance. - In higher energy-intensive firms, the relation between carbon disclosure and performance is notably weaker.
2018	<p>Author: Habaragoda B. S</p> <p>Title of Article: Corporate Social Responsibility (CSR) and Firm Performance: Impact of Internal and External CSR on Financial Performance</p>

	<p>Methodology / Variables: -Dependent Variable: Accounting-based performance measure for firm's financial performance: ROA, ROE, and ROS. - Independent Variable: Internal & External CSR study, CSR expenses data - Control Variables: Firm size, financial leverage, and industry</p> <p>Results: - The internal and external CSR activities affect positively on financial performance. - The internal CSR is main factor of financial performance than the external CSR.</p>
<p>2018 (Indian context)</p>	<p>Author: Praveen Kumar & Mohammad Firoz Title of Article: Impact of Climate Change Disclosure on Financial Performance: An Analysis of Indian Firms</p> <p>Methodology / Variables: - Dependent Variable: Financial performance using ROA, ROE - Control Variables: Beta, R&D, leverage, size -Climate change disclosure scores from CDP.</p> <p>Results: -Higher ROE for firms with higher environmental disclosure scores. -Insignificant relationship between ROA and corporate climate change disclosures.</p>
<p>2018</p>	<p>Author: Roel Brouwers, Frederiek Schoubben, Cynthia Van Hulle Title of Article: The influence of carbon cost pass through on the link between carbon emission and corporate financial performance in the context of the European Union Emission Trading Scheme</p> <p>Methodology / Variables: - Dependent Variable: Financial performance using ROA, Tobin's Q, ROE - Independent variable: Emission performance-industry and year-modified carbon intensity.</p> <p>Results: - Carbon performance is positively related to financial performance. - The firm that can carry forward the costs to the end consumers bears the less negative impact of carbon emission performance on its economic performance.</p>
<p>2019 (Indian context)</p>	<p>Author: Dalal Karishma K., Thaker Nimit Title of Article: ESG and Corporate Financial Performance: A Panel Study of Indian Companies</p>

	<p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent Variable: ROA, ROE, total assets and return on sales, Tobin's Q - Independent variable: ESG disclosure scores - Control variables: Leverage and size of the company. <p>Results:</p> <p>Evaluation through accounting and market-based measure: The study indicated that the better corporate ESG performance improves financial performance.</p>
<p>2019 (Indian context)</p>	<p>Author: Amritha M. & Dr. P. Balasubramanian</p> <p>Title of Article: A Study on Relationship Between Corporate Financial Performance and Environmental Social & Governance Score (ESG Score)</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent Variable: Tobin's Q (a proxy for the firm value directing the corporate financial performance. - Independent Variable: ESG rating - Control Variables: R&D expenses, Return on asset, Sales growth, and firm size <p>Results:</p> <ul style="list-style-type: none"> - ESG subsection impacted Tobin's Q value. The negative social score affected Tobin's Q value negatively. -Negative impact of governance score on Tobin's Q value. -The firm size impacted the firm value negatively.
<p>2019 (Indian context)</p>	<p>Author: Charumathi, B., and Rahman, Habeebu</p> <p>Title of Article: Do Women on Boards Influence Climate Change Disclosures to CDP? Evidence from Large Indian Companies</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent Variable: CDP by sample companies. - Independent Variables: board size, board meetings per year, Percentage of independent directors, Percentage of women directors on board and CEO Duality. - Control variables: Energy consumption by the company, market capitalization as a proxy for firm size and Return on Asset as a proxy for profitability. <p>Results:</p>

	<ul style="list-style-type: none"> - Notable company-wise, year-wise, and sector-wise variations in climate change disclosure to CDP by Indian companies. - Positive impact by the percentage of women directors, percentage of independent directors and market capitalization CEO duality and ROA. - The presence of one female director did not make much impact compared to the presence of three-women directors on board while making the climate change disclosure to CDP.
<p>2020</p> <p>(Indian context)</p>	<p>Author: Milind Kumar Jha and K. Rangarajan</p> <p>Title of Article: Analysis of corporate sustainability performance (CSP) and corporate financial performance (CFP) causal linkage in the Indian context</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent & independent variables: CSP and CFP are used interchangeably -Reputation rating, -Bloomberg scores (as a proxy for CSP measurement) - ESG scores (as a proxy for CSP measurement) -ROA, ROE, Tobin's Q <p>- Control Variables: Firm size, sector, risk, and R&D intensity.</p> <p>Results:</p> <ul style="list-style-type: none"> - At Individual level: negative relation was found between corporate sustainability performance and corporate financial performance which indicates that Indian firms don't get the financial performance benefits for sustainability investments. - At comprehensive level: Insignificant relationship between corporate sustainability performance and corporate financial performance.
<p>2020</p>	<p>Author: Patrick Velte, Martin Stawinoga, Rainer Lueg</p> <p>Title of Article: Carbon performance and disclosure: A systematic review of governance-related determinants and financial consequences</p> <p>Methodology / Variables:</p> <p>Variables: Financial performance & capital costs: ROA, ROE, ROI, ROIC, ROS, Tobin's Q, WACC</p> <ul style="list-style-type: none"> - Value relevance: Stock price/market value of equity (Ohlson model), Cumulative abnormal returns (CAR) - Country and Firm-related governance <p>Results:</p> <ul style="list-style-type: none"> -The study indicated that the board framework positively impacts carbon performance and disclosure. - The governance-related determinants and financial results of carbon performance, disclosure is depending on firm- and country-related context variables. - Carbon performance and carbon disclosure are positively related.

	- The governance-related determinants and financial results are very diversified to perform general meta-analysis.
2021 (Indian context)	<p>Author: Iram Hasan, Shveta Singh, Smita Kashiramka</p> <p>Title of Article: Does corporate social responsibility (CSR) disclosure impact firm performance? An industry-wise analysis of Indian firms</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - ESG score: a proxy for CSRD to identify the relationship between market-based and accounting-based financial performance measures for Indian companies. <p>Results:</p> <ul style="list-style-type: none"> - CSR disclosure are different effects on CFP factors. For consumer goods, consumer services and heavy engineering of industries, CSR disclosure is positively related to CFP. - For healthcare, energy and utility firms, the link between CSR disclosure and CFP is negative. -The type of financial performance indicators show variations in CSR disclosure and CFP
2021	<p>Author: Renato Garzón-Jiménez, Ana Zorio-Grima</p> <p>Title of Article: Effects of Carbon Emissions, Environmental Disclosures and CSR Assurance on Cost of Equity in Emerging Markets</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent Variable: Cost of Equity (COE) - Independent Variable: Carbon emission, CSR assurance, Environmental scores <p>Results:</p> <ul style="list-style-type: none"> - Firms with intense carbon emission have higher equity cost. - Firms with higher environmental disclosure have lower cost of equity. - The sustainability reporting encourages legitimacy and reduces information asymmetry.
2021	<p>Author: Santosh K. Mahapatra, Tobias Schoenherr, Jayanth Jayaram</p> <p>Title of Article: An assessment of factors contributing to firms' carbon footprint reduction efforts</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent Variable: Carbon emission (Scope 1,2,3) - Independent Variables: For Internal factors: Proxy for climate change, percentage of energy consumption, emission trading disclosure For External factors: Proxy for customer and supplier contract <p>Results:</p> <ul style="list-style-type: none"> - Carbon emission reduction seems ineffective. - Corporations efforts in reducing carbon emission are contradictory with positive environmental and economic outcomes.

<p>2021 (Reference article)</p>	<p>Author: Md Abubakar Siddique, Md Akhtaruzzamn, Afzalur Rashid, Helmi Hammami Title of Article: Carbon Disclosure, Carbon Performance and Financial Performance: International Evidence</p> <p>Methodology / Variables: - For carbon disclosure: The carbon disclosure score as a proxy.</p> <p>For carbon performance: -ROA to measure financial performance in the short- run -Tobin's Q to measure financial performance in the long- run.</p> <p>Results: - In accordance with Voluntary disclosure theory and Signaling theory, carbon disclosure has positive impact on carbon performance. - Carbon disclosure has a negative impact on the financial performance in the short term. - Carbon disclosure has a positive impact on the financial performance in the long term.</p>
<p>2021 (Reference article)</p>	<p>Author: Yasean A. Tahat, Ghassan H. Mardini Title of Article: Corporate carbon disclosure, carbon performance and corporate firm performance</p> <p>Methodology / Variables: Variables: - The scores of corporate carbon disclosure reported by CDP - ROA, ROE, EPS</p> <p>Results: - Corporate carbon disclosure is positively & remarkably linked with a firm's carbon performance. - Corporate carbon disclosure is positively & precisely related to firm's corporate financial performance.</p>
<p>2021</p>	<p>Author: Zahra Borghei Title of Article: Carbon disclosure: a systematic literature review</p> <p>Methodology / Variables: Qualitative analysis: - A structured literature review of the carbon disclosure by using bibliographic mapping. - A keyword search: used the Social Sciences Citation Index (SSCI) and Science Citation Index Expanded (SCI-EXPANDED) by Thomson Reuter Web of Sciences (WoS).</p> <p>Results: - The carbon disclosure should be linked to climate-related risk disclosure. - The firm's impact on climate change and the climate change effects on firm's value, performance is still confusing.</p>

2021	<p>Author: Wenting Lu, Naiping Zhu and Jing Zhang (2021)</p> <p>Title of Article: The Impact of Carbon Disclosure on Financial Performance under Low Carbon Constraints</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent variables: ROA - Independent variables: Carbon disclosure - Control Variables: NPM, Leverage, Size, Growth rate of total operating income <p>Results:</p> <ul style="list-style-type: none"> - For carbon-intensive companies, carbon disclosure is insignificantly contributing to the enhancement of the financial performance. - For non-carbon-intensive companies, carbon disclosure is positively and significantly contributing to the enhancement of the financial performance.
2022	<p>Author: Zhao-Yong Sun, Meng-Jie Li, Dongdong Li</p> <p>Title of Article: Carbon performance (CP) and corporate financial performance (CFP): The moderating role of consumer awareness of corporate social responsibility</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent variable: ROA for short-term and Tobin's Q for long-term CFP - Independent variable: Carbon performance. - Control variable: Size, financial leverage, corporate growth, capital intensity <p>Results:</p> <ul style="list-style-type: none"> - Positive impacts of CP on CFP in the short and long term. - Improving consumer awareness of CSR is an efficient tool to promote CFP.
2022 (Indian context)	<p>Author: Ankit Arora & Dr. Dipasha Sharma</p> <p>Title of Article: Do Environmental, Social and Governance (ESG) Performance Scores Reduce the Cost of Debt? Evidence from Indian firms</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent variable: Cost of debt - Independent variable : ESG scores, individual E,S,G score - Control variables: Market capitalization, net debt to equity ratio, percentage of women on board and total debt to total asset ratio <p>Results:</p> <ul style="list-style-type: none"> - Findings shows the impact of ESG practices on corporate bond performance. - The link between ESG practices & cost of debt has many limitations.
2022 (Indian context)	<p>Author: Meenakshi Sharma, Akanksha Choubey</p> <p>Title of Article: Green banking initiatives: a qualitative study on Indian banking sector</p> <p>Methodology / Variables:</p> <p>Qualitative analysis: semi structured interviews of 36 middle to senior-level managers of 12 public and private banks</p> <p>Results:</p>

	<p>The findings indicated that more than 60% respondents believed that green banking initiatives have positive impact on gaining customers' trust through improving Green brand image.</p>
2023	<p>Author: Swarnodeep Homroy Title of Article: GHG emissions and firm performance: The role of CEO gender socialization</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - Dependent Variables: GHG emission (Eikon, Scope 2,3, CDP); ROA, Firm size, capital intensity, debt to equity ratio, EBITDA, Tobin's Q - Control variables: Governance characteristics :Board size, CEO duality, Law Expert - Instrumental variable : CEO characteristics: CEO daughter, No. of CEO's children & daughters, Female CEO, CEO Age <p>Results:</p> <ul style="list-style-type: none"> - The findings revealed that CEOs with daughters are precisely adopting climate-integrated business strategies and set emission reduction targets. - Considerable increase in profitability for lower GHG emission.
2023 (Indian context)	<p>Author: Sarah Colenbrander, Prashant Vaze, Cymroan Vikas, Sourajit Ayer, Neha Kumar, Namita Vikas, Lily Burge Title of Article: Low-carbon transition risks for India's financial system</p> <p>Methodology / Variables:</p> <ul style="list-style-type: none"> - A set of three questionnaires shared with ten state-owned and private financial institutions. <p>Results:</p> <ul style="list-style-type: none"> - The detailed examination of individual loans and bonds indicated that three-fifths of lending to the 'mining' sector is for oil and gas extraction, one-fifth of manufacturing debt is for petroleum refining and related industries. - Limited efforts had been taken to identify, measure or manage low-carbon transition risks.

CHAPTER III – METHODOLOGY AND EMPIRICAL RESULTS

In this chapter, we focus to answer our research questions developed in the theoretical chapters through analyzing the relationship between carbon disclosure and the firm's carbon performance, additionally the relationship between carbon disclosure and financial performance. In dept, we aim to determine whether the type of the relationship is positive or negative in the context of Indian firms through conducting a regression analysis by using panel data. In our study, carbon disclosure and performance scores are obtained from Carbon Disclosure Project (CDP)- India from 2017-2022 as it is the most extensive database of carbon and climate change-related information (Griffin, Lont & Sun 2017). The CDP is the comprehensive environmental disclosure platform, declaring information from more than 18600 firms across 13 industries in 135 countries. The reason for choosing Indian firms for analysis is that limited research has been conducted on emerging countries. We intend to study empirically the following hypotheses:

- **Hypothesis 1:** The relationship between carbon disclosure and carbon performance is negative.

- **Hypothesis 2:** The relationship between carbon disclosure and carbon performance is positive.

- **Hypothesis 3:** The impact of carbon disclosure on the company's financial performance is negative in the short-term.

This chapter is designed as follows: **Section 1** explains the detailed information of our sample selection and data sources which elaborate measures for carbon disclosure, carbon performance and financial performance. **Section 2** describes the methodology used to test our hypotheses, discusses the regression and the STATA results which support our empirical results.

SECTION 1: SAMPLE SELECTION, DATA, AND MEASURES

In this section, we describe our sample and provide information regarding the data sources.

1.1 SAMPLE SELECTION

The primary database covers a comprehensive environmental data of 144 Indian companies over the period of 2017-2022 disclosed in CDP-India annual reports. Data to measure financial performance are obtained from the TSR and Screener online databases. Following Siddiqui et al. (2021), we excluded the firms with missing carbon information from our data set which shows the total sample of 140 Indian firms and 411 observations.

The following [Table 1](#) explains the distribution of sample firms according to their primary industry sectors (CDP-ACS classification).

Table 1: Distribution of sample firms by sector

Primary Sector	2017	2018	2019	2020	2021	2022	Grand Total	Percentage
Automobile manufacturing	2	4	3	3	4	4	20	4.87%
Bars, hotels & restaurants		1	1	1	1	2	6	1.46%
Biotech & Pharma	3	4	5	4	6	14	36	8.76%
Cement & Concrete	5	5	6	7		7	30	7.30%
Chemicals	1	2	4	8		14	29	7.06%
Electrical & Electronic equipment						4	4	0.97%
Energy utility network	1	1	1	2	2	4	11	2.68%
Financial services	7	6	7	8	9	13	50	12.17%
Food & Beverage processing		2	3	2	4	5	16	3.89%
Industrials	4	1			1	4	10	2.43%
Intermodal transport & logistics		1	1	1	1	2	6	1.46%
IT & Software Development	6	7	7	7	7	10	44	10.71%
Land & property ownership & development	1	1	1	2	2	2	9	2.19%
Leisure & home manufacturing	2	2	2				6	1.46%
Light manufacturing Industries	1	1	1	2	2	2	9	2.19%
Media, telecommunications & data center services	1	1	3	3	3	3	14	3.41%
Metal smelting, refining & forming	5	5	5	4	7	11	37	9.00%
Metallic mineral mining	1	1	1	1	1		5	1.22%
Oil & gas processing	2	1	2	2	2	4	13	3.16%
Personal care & household products	1	1	1	1		1	5	1.22%
Renewable power generation				2	2	4	8	1.95%
Specialized professional services	1	1		1	2	2	7	1.70%
Textiles & fabric goods	2	2	2	1	2	4	13	3.16%
Thermal power generation	2	2	3	4	3	4	18	4.38%
Tobacco	1			1	1	1	4	0.97%
Web & marketing services						1	1	0.24%
Grand Total	49	52	59	67	62	122	411	

The financial services sector holds the highest number of companies (12.17%), following IT & Software Development sector with 10.71%. Web & marketing service sector share the lowest percentage of 0.24 but includes only a single firm. All the data is collected from the extensive TSR (www.topstockresearch.com) and Screener (www.screener.in) online databases. TSR- Technical Stock Research is India's leading stock, pattern screener with "Stock Strength Analyser" which uses interactive tables, histograms. Screener is a stock analysis tool which uses latest technology to research stocks. This platform provides the extensive information of the listed companies on the Indian Stock Exchange to the investors.

1.2 MEASURES

1.2.1 Measure for carbon disclosure and carbon performance

The carbon disclosure scores and carbon performance scores have been used in our study. The carbon disclosure scores indicate the level of specifications and extensiveness in disclosure, while the carbon performance scores indicate the level of action taken on climate change by participating companies.

1.2.2. Financial Performance

According to [Margolis, Elfenbein, & Walsh, \(2007\)](#), either accounting or market-based measures have been used in the prior literature to evaluate financial performance. Accounting based measures are used to estimate performance in short-term with respect to company's efforts to lessen costs ([Peloza, 2009](#)). On the contrary, market-based measures estimate long-term profitability of a firm with respect to its present management practices ([King & Lenox, 2002](#)). Both measures are useful and have been used to estimate financial performance. But very limited literature has used both measures to test hypotheses for the relationship between carbon performance and financial performance ([Delmas et al., 2015](#)). In our study, we use return on assets (ROA) as a short-term financial performance measure. As per [Delmas et al. \(2015\)](#), ROA contemplate current costs and appropriate revenues declared in the financial statement, with profitable pay-off for investors.

1.2.3. Control variables

Firm age and firm size (measured by sales) are used as control variables in our study. In prior literature on voluntary disclosure, a firm size has been used as their one of the control variables by many scholars ([Clarkson et al., 2011](#), [Luo, 2019](#)). The main reasons explain the relationship between carbon disclosure and firm size are, the larger firms have the physical and financial

resources required to declare extensive non-financial information and these firms are at the risk of high level of exposure and public attention (Liu & Anbumozhi, 2009; Stanny & Ely, 2008). The firm age is used as a control variable as the older firms are assumed to be concerned and involved in environmental activities as they have sufficient resources to execute such activities at a proportional lower cost (Huergo & Jaumandreu, 2004).

The following Table 2 explains the variables used in our econometric model.

Table 2: Definition of Variables

Variables	Definition	Source
Carbon Performance (CP) (Independent variable)	The natural logarithm of the scores of the carbon emission scopes	CDP
Carbon Disclosure (CD) (Independent variable)	The natural logarithm of the numeric equivalent (using the “Fibonacci Sequence”) of Carbon Performance Final Score: A= 89, A- = 55, B=34, B- = 21, C = 8, D = 3, D- = 2	CDP
Return on Asset (ROA) (Dependent variable)	Net income before remarkable items/preferred dividends, divided by total assets	TSR Database
Firm age (Control variable)	The natural logarithm of the age of the firm	Screeener Database
Firm Size (measure by sales) (Control variable)	The natural logarithm of the sales values (in crores INR) of the Indian companies	Screeener Database
Sector variables for GLS regression in STATA: Energy, Finance, Industry, and Service	The numeric value is allotted to each sector for statistical calculations: 1=Energy; 2= Finance; 3=Industry; 4=Services	CDP

For linearity purposes, we applied the logarithmic transformation on several variables which are: Carbon performance, carbon disclosure, firm’s size, firm’s age.

To study the impact of carbon disclosure (CD) of all three scopes on carbon performance and financial performance, we ran the OLS multiple regression model, the descriptive statistics based on observations and sectors.

Firstly, we considered our sample data of 140 Indian firms with their carbon emission Scope 3 records which gave us 240 observations. Secondly, we used the carbon emission all scopes data

for our sample firms which was based on 237 observations. The purpose of including the descriptive statistics based on observations is to provide information about the sample size and the completeness of our data. The number of observations reflects the size of the sample used in the analysis. Then we classified our sample data into different sectors, which was specified in the CDP-India annual reports, such as automobile manufacturing, bars & restaurants, biotech & pharma and so on.

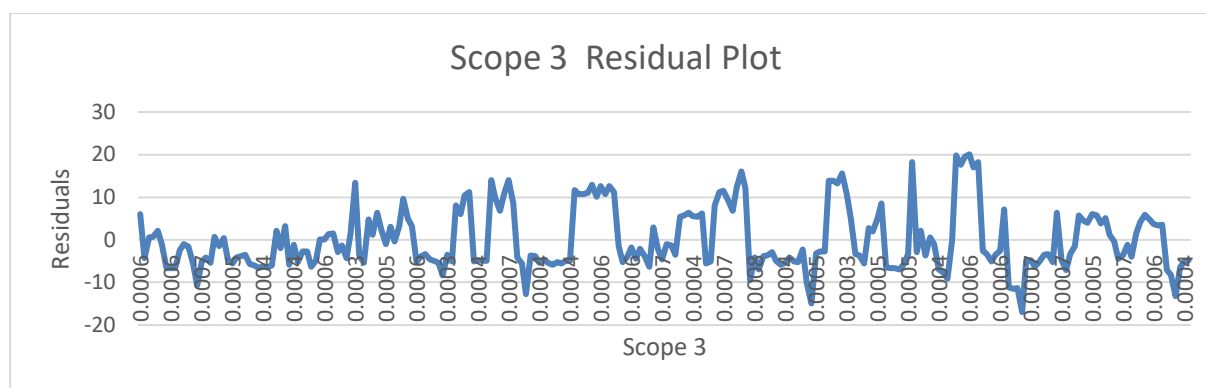
The [Table 3](#) shows the OLS regression results with panel data considering carbon emission Scope 3 values.

Table 3: OLS multiple regression model with panel data based on observations

<i>Regression Statistics</i>	
Multiple R	0.07
R Square	0.00
Adjusted R Square	0.00
Standard Error	7.25
Observations	240

ANOVA					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	55.86	55.86	1.06	0.30
Residual	238	12508.89	52.56		
Total	239	12564.75			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	5.09	1.96	2.60	0.01	1.24	8.95	1.24	8.95
Scope 3	0.38	0.37	1.03	0.30	-0.34	1.10	-0.34	1.10



This OLS regression considers 240 observations with Scope-3 carbon emission data. [Table 3](#) results indicates that $R^2 = 0.445\%$ (after considering two digits =0.00, as shown above) of movement of carbon performance is due to ROA, indicating that a very weak or no linear relationship between Scope 3 and ROA. Standard error which is same as standard deviation is 7.25. A smaller standard error indicates a better fit of the model to the data. The one-way analysis of variance (ANOVA test shows that an insignificant variation exists in the mean of carbon performance across the company's profitability ($F=1.06$). The P-value (0.0099/0.01) which is less than 0.05 indicates that our model is correctly specified. The residual plot is an important tool in regression model building so we specified it above. And the results are helpful to build econometric empirical model, which we will explain in the following sections. The above results shows that there is a insufficient evidence to conclude that there is a significant relationship between Scope 3 and ROA. Further analysis is necessary to understand this relationship.

The following [Table 4](#) shows the descriptive statistics of sample firms with carbon emission of all the three scopes' values.

Table 4: Descriptive statistics based on observation (with all three scopes)

	ROA (%)	CD	CP1 (Scope-1)	CP2 (Scope-2)	CP3 (Scope-3)	Size (measure of sales log values)	Age
Mean	7.12	31.72	4.94	5.00	5.21	4.35	1.64
Standard Error	0.47	1.49	0.11	0.05	0.08	0.04	0.02
Median	4.43	34.00	4.55	5.09	5.33	4.30	1.61
Standard Deviation	7.26	22.95	1.75	0.76	1.29	0.63	0.27
Sample Variance	52.66	526.74	3.07	0.57	1.67	0.40	0.07
Kurtosis	0.03	0.23	-1.02	0.19	-0.46	0.43	0.31

Skewness	0.79	0.72	0.20	-0.28	-0.14	-0.43	-0.50
Range	36.76	89.00	7.34	4.46	6.96	3.32	1.32
Minimum	-9.38	0.00	1.14	2.46	1.70	2.22	0.78
Maximum	27.38	89.00	8.48	6.93	8.65	5.54	2.10
Sum	1687.10	7518.00	1170.68	1186.04	1234.27	1030.17	388.85
Count	237	237	237	237	237	237	237

Table 4 explains the descriptive statistics based on 237 observations with the data of all three scopes of carbon emission. The mean value of CD which is one of the important independent variables in our study is 31.72 which is less than the 50% of the maximum (89.00) score of carbon disclosure, indicating that there is lower level of carbon disclosure. This also suggests that the sample firms are not disclosing enough data related to their climate change activities. The minimum value of CD is zero which shows that some companies did not disclose on all the parameters asked by the CDP. Besides, the maximum value of is 89.00 which indicates that some sample firms disclosed good amount of carbon information matching with all the parameters of CDP. The ROA has mean of 7.12% with a standard deviation of 7.26%. The maximum and minimum value of ROA are 27.38% and -9.38% respectively which is different from each other. These statistics suggest that sample firms include few firms with good financial performance in the market and few of having a negative return on their assets. The mean Size is 4.35, whereas for Age, its 1.64. The kurtosis of Scope-1 is -1.020, the sample distribution is platykurtic. The skewness of Scope-2 (-0.28) indicates the sample distribution is left skewed. The results of OLS regression indicates that the sample is not normally distributed so there is a need to increase the sample size.

Furthermore, we classified the firms according to the primary sectors explained in CDP-India annual reports. The following **Table 5** indicates the classification of the sample data based on sectors. To summarize the sector-wise data, we considered the average of Log values of all the variables for statistical analysis and this table is important to run the OLS multiple regression model based on sector.

Table 5: Classification of firms by sector

Sectors	Count of Organization	CD	CP1	CP2	CP3	Average of ROA (%)	Average of Size (measure of sales log values)	Average of Age
Automobile manufacturing	13	43.31	4.68	5.41	6.82	0.87	5.08	1.89
Bars, hotels & restaurants	4	6.75	4.62	5.25	4.12	0.23	3.53	2.09
Biotech & Pharma	8	32.75	5.26	5.33	5.86	6.17	4.14	1.61
Cement & Concrete	20	34.55	7.27	5.72	6.15	6.58	4.11	1.68

Chemicals	9	25.89	5.93	4.92	5.53	8.35	3.97	1.89
Electrical & Electronic equipment	1	8.00	4.18	5.32	4.05	0.71	3.76	1.54
Energy utility network	7	5.86	6.53	5.28	4.94	6.50	4.48	1.34
Financial services	44	25.77	3.23	4.75	4.15	2.85	4.50	1.46
Food & Beverage processing	13	33.85	3.71	4.28	5.36	9.17	3.75	1.70
Industrials	2	21.00	4.60	4.63	3.90	1.78	3.94	2.10
Intermodal transport & logistics	2	27.50	5.05	5.27	5.49	5.47	4.14	1.40
IT & Software Development	34	52.53	3.76	4.99	4.97	16.83	4.66	1.58
Land & property ownership & development	8	35.38	2.78	3.58	4.63	1.28	2.83	1.48
Leisure & home manufacturing	1	3.00	3.52	4.50	4.83	11.99	4.30	1.59
Light manufacturing Industries	4	16.50	5.49	5.37	4.93	2.09	4.15	1.78
Media, telecommunications & data center services	5	33.00	3.89	5.15	4.39	3.43	4.23	1.57
Metal smelting, refining & forming	20	42.05	7.15	5.83	6.57	10.32	4.69	1.77
Metallic mineral mining	2	3.00	4.49	4.80	3.26	14.21	4.13	1.81
Oil & gas processing	4	19.75	6.67	5.56	5.82	5.85	5.46	1.85
Personal care & household products	4	38.00	4.52	4.46	4.52	12.06	3.99	1.34
Renewable power generation	3	15.00	3.05	4.26	4.92	0.37	3.54	0.90
Specialized professional services	4	13.25	4.62	4.74	5.71	13.91	4.45	1.83
Textiles & fabric goods	5	17.40	5.05	5.49	5.53	2.97	4.02	1.86
Thermal power generation	16	16.88	7.64	4.36	5.07	2.47	4.40	1.68
Tobacco	4	46.50	6.07	5.43	5.40	18.93	4.70	2.05
Grand Total	237	31.72	4.94	5.00	5.21	7.12	4.35	1.64

The following [Table 6](#) provides the OLS multiple regression model based on different sectors of our sample data. We consider the carbon emission Scope1 values and the ROA to run the regression. The Scope1 emission is the company's direct emission of CO₂ which directly impacts the carbon disclosure and affects the carbon performance and as well as the corporate financial performance. These results are useful to compare the characteristics of outcomes across different sectors. The purpose of considering different sectors for regression analysis is to explore sector-specific variations and acknowledging how the relationship between variables differ in different sectors, providing more distinct understanding of our hypotheses.

Table 6: OLS multiple Regression model based on sector

<i>Regression Statistics</i>	
Multiple R	0.11
R Square	0.01
Adjusted R Square	-0.03
Standard Error	5.58
Observations	25

<i>ANOVA</i>					
	<i>df</i>	<i>SS</i>	<i>MS</i>	<i>F</i>	<i>Significance F</i>
Regression	1	8.78	8.78	0.28	0.60
Residual	23	716.93	31.17		
Total	24	725.71			

	<i>Coefficients</i>	<i>Standard Error</i>	<i>t Stat</i>	<i>P-value</i>	<i>Lower 95%</i>	<i>Upper 95%</i>	<i>Lower 95.0%</i>	<i>Upper 95.0%</i>
Intercept	4.41	4.30	1.03	0.32	-4.48	13.31	-4.48	13.31
CP1	0.45	0.84	0.53	0.60	-1.29	2.18	-1.29	2.18

The Multiple R value (0.11) indicates a weak positive correlation between the independent variable (carbon performance-Scope 1) and dependent variable (ROA). The coefficient of carbon performance (CP1) is 0.45 is not statistically significant ($p=0.60$), indicating that there is no significant correlation between carbon performance and company's profitability (ROA as a measure) to measure carbon disclosure. According to the ANOVA table, the F-statistic (0.28) with a corresponding p-value 0.60 (which is greater than 0.05) indicates that the model is not statistically significant in describing the dependent variable. The above regression analysis suggests that there is no remarkable relationship between carbon disclosure and carbon performance.

Furthermore, we ran the descriptive statistics to explore sector-specific trends, patterns and characteristics within our sample data which may enable better sector-level insights and comparison. The following [Table 7](#) provides the descriptive statistics of different sectors.

Table 7: Descriptive statistics based on sector

	<i>CD</i>	<i>CP1</i>	<i>CP2</i>	<i>CP3</i>	<i>Average of ROA (%)</i>	<i>Average of Size (measure of sales log values)</i>	<i>Average of Age</i>
Mean	24.70	4.95	4.99	5.08	6.62	4.20	1.67
Standard Error	2.84	0.27	0.11	0.17	1.10	0.11	0.05

Median	25.77	4.62	5.15	4.97	5.85	4.14	1.68
Standard Deviation	14.22	1.36	0.54	0.85	5.50	0.53	0.27
Variance	202.32	1.85	0.29	0.72	30.24	0.28	0.07
Kurtosis	-0.94	-0.65	0.22	-0.12	-0.48	1.55	1.35
Skewness	0.13	0.42	-0.69	0.03	0.73	-0.07	-0.73
Range	49.53	4.86	2.25	3.55	18.71	2.63	1.20
Minimum	3.00	2.78	3.58	3.26	0.23	2.83	0.90
Maximum	52.53	7.64	5.83	6.82	18.93	5.46	2.10
Sum	617.45	123.75	124.65	126.91	165.38	104.96	41.80
Count	25	25	25	25	25	25	25
Confidence Level (95.0%)	5.87	0.56	0.22	0.35	2.27	0.22	0.11

This table explains the descriptive statistics based on sectors with 25 observations with the data of all three scopes of carbon emission. With small sample size of 25 observations, these statistics may be more sensitive to outliers and may not accurately represent the overall population. Smaller sample size may have reduced the statistical power to detect significant effects.

The mean of CD is 24.70 which is still less than the 50% of the maximum (52.53) score of carbon disclosure, indicates that sample data have relatively lower level of carbon disclosure and confirming the results obtained by the descriptive analysis based on 237 observations. The kurtosis of Scope-1 is -0.65, the sample distribution is platykurtic. The skewness of Scope-2 (-0.69) again indicates the sample distribution is left skewed.

Furthermore, to measure the linear correlation of all the variables, we ran the correlation matrix sectors-wise. The purpose is to examine the associations between all the variables within different sectors. The following [Table 8](#) gives the Pearson correlation coefficients for our variables.

Table 8: Correlation matrix based on sector (Pearson correlation coefficients)

	CD	CP1	CP2	CP3	Average of ROA (%)	Average of Size (measure of sales log values)	Average of Age
CD	1						
CP1	0.04	1					

CP2	0.11	0.59	1				
CP3	0.48	0.49	0.45	1			
Average of ROA (%)	0.29	0.11	0.06	0.10	1		
Average of Size (measure of sales log values)	0.21	0.48	0.57	0.46	0.35	1	
Average of Age	0.04	0.35	0.37	0.11	0.15	0.26	1

The correlation matrix based on sector indicates carbon disclosure and carbon performance are not significantly correlated as the values are too low to predict strong and remarkable correlation. The above results indicate that all the variables are positively correlated with each other, but values are very low indicating insignificant correlation. The regression results report that there is inconsequential relationship between ROA and carbon performance in the panel data. In other words, insignificant relationship observed in between carbon disclosure and carbon performance. The carbon disclosure increases as the firm size increases (0.21), indicating that the larger firms communicate more comprehensive carbon disclosures. This finding is in accordance with the prior studies which explained that larger firms voluntarily disclose their carbon related information to legitimize their presence (Bansal & Roth, 2000; Cho & Patten, 2007; Deegan, 2002; Sethi, 1978). The results of OLS regression, descriptive statistics and the correlation metrics indicate that there is a neutral relationship between carbon disclosure and carbon performance which denies our first two hypotheses. However, to verify the impact of these variables deeply, we further conducted the random effects panel-data regression, and we are going to explain our methodology in detailed in the next section.

The OLS Regression results were contradicting our hypotheses so to study all the variables and their correlations in depth, we have estimated some statistics with STATA. We estimated a panel data model with more variables than our previous regression model. The only transformation in our data is that we have organized the sectors into four categories, like Energy=1, Finance=2, Industry=3, Services=4. By including random effects, our model can address correlation issues and heterogeneity within sectors and indicate more accurate estimates of the effects of independent variables. The following tables are showing the random effect panel-data regression results obtained in STATA. We will be interpreting the results in the empirical results' section.

The following [Table 9](#) shows random effects regression using xtreg, re. It is the random effect estimator. In STATA, the `xtreg,re` test command gives us the chi-square. The Chi-square analysis is used to assess the overall validity of the empirical model.

Table 9: Random effects regression using xtreg, re

1. xtreg	roa	finalscore	scope1	scope2	scope3	sales	age	i.sector
Random-effects GLS regression			Number of obs		= 237			
Group variable: id			Number of groups		= 70			
R-squared:			Obs per group:					
Within	= 0.0414		min	= 1				
Between	= 0.2543		avg	= 3.4				
Overall	= 0.2845		max	= 6				
			Wald	chi2(9) = 29.22				
corr(u_i, X)	= 0 (assumed)		Prob > chi2	= 0.0006				

roa	Coefficient	Std. err.	z	P>z	[95% conf. interval]	
finalscore	.0082807	.0125629	0.66	0.510	-.0163421	.0329036
scope1	-.3346479	.4754289	-0.70	0.482	-1.266471	.5971756
scope2	-.169546	.7198031	-0.24	0.814	-1.580334	1.241242
scope3	-.3999178	.2691733	-1.49	0.137	-.9274878	.1276521
sales	4.012664	1.219503	3.29	0.001	1.622483	6.402846
age	-3.866846	2.990223	-1.29	0.196	-9.727575	1.993884
sector						
Finance	-3.363081	2.808064	-1.20	0.231	-8.866785	2.140623
Industry	4.577019	2.034052	2.25	0.024	.5903498	8.563687
Services	7.025069	2.459718	2.86	0.004	2.20411	11.84603
_cons	-2.381318	5.630354	-0.42	0.672	-13.41661	8.653974
sigma_u	5.5200487					
sigma_e	2.8097208					
rho	.79422821 (Fraction of variance due to u_i)					

In the section 2. of STATA, we analysed the sector variables independently. The following [Table 10](#) explains the descriptive statistics of our variables within the classified sectors.

Table 10: Random effects regression based on Energy, Finance, Industry and Services

3. by sector: sum roa finalscore scope1 scope2 scope3 sales age

→ sector = Energy

Variable	Obs	Mean	Std. dev.	Min	Max
roa	38	4.039868	4.104473	-3.03	17
finalscore	38	14.10526	15.08676	3	55
scope1	38	6.372493	1.580007	2.539396	8.483082
scope2	38	4.846033	.6486384	3.594503	6.143959
scope3	38	5.051258	1.377984	3.029789	7.380364
sales	38	4.379257	.594193	3.40637	5.540068
age	38	1.599516	.3488108	.90309	2.033424

→ sector = Finance

Variable	Obs	Mean	Std. dev.	Min	Max
roa	44	2.851295	4.925085	-6.37	19.67
finalscore	44	25.77273	19.65619	3	89
scope1	44	3.23107	.7624917	1.138934	4.319668
scope2	44	4.746847	.7150253	3.343014	6.067869
scope3	44	4.150163	.7864341	2.247581	6.298126
sales	44	4.501858	.4802207	3.484727	5.462358
age	44	1.455397	.2070034	.7781513	1.832509

→ sector = Industry

Variable	Obs	Mean	Std. dev.	Min	Max
roa	99	7.170444	6.611526	-9.38	25.3
finalscore	99	35.27273	19.64159	0	89
scope1	99	5.770555	1.472457	2.674402	7.878899
scope2	99	5.318749	.7022205	3.516139	6.929652
scope3	99	5.910932	1.188985	1.69897	8.65493
sales	99	4.328652	.5636419	2.569374	5.479918
age	99	1.765013	.1990623	1.361728	2.100371

→ sector = Services

Variable	Obs	Mean	Std. dev.	Min	Max
roa	56	12.46875	8.215206	-7.61	27.38
finalscore	56	42.07143	27.26027	0	89
scope1	56	3.840679	.9793147	1.490001	5.7889
scope2	56	4.758383	.7679351	2.464771	5.909457
scope3	56	4.902435	.9955792	2.625313	6.69696
sales	56	4.234557	.8333539	2.220108	5.282744
age	56	1.59448	.2707846	1.041393	2.093422

The [Table 11](#) provides the descriptive statistics of dependent and independent variables, the results are obtained from STATA, helping to understand the characteristics and distribution of variables.

Table 11: Descriptive Statistics from STATA

4. sum roa finalscore scope1 scope2 scope3 sales age

Variable	Obs	Mean	Std. dev.	Min	Max
roa	237	7.118549	7.256419	-9.38	27.38
finalscore	237	31.72152	22.95091	0	89
scope1	237	4.939598	1.752767	1.138934	8.483082
scope2	237	5.004372	.7573232	2.464771	6.929652
scope3	237	5.207905	1.292455	1.69897	8.65493
sales	237	4.346689	.6316039	2.220108	5.540068
age	237	1.640701	.2721954	.7781513	2.100371

Additionally, to explore the relationships between all the variables and identifying the prospective issues like multicollinearity, we run the correlation coefficient matrix again in STATA. So, [Table 12](#) explains the results of correlation coefficient matrix.

Table 12: Correlation Coefficient Matrix from STATA

5. pwcorr roa finalscore scope1 scope2 scope3 sales age, star (0.05)

	roa	finalscore	scope1	scope2	scope3	sales	age
roa	1.0000						
finalscore	0.2329*	1.0000					
scope1	-0.0162	-0.0320	1.0000				

scope2	0.0946	0.1627*	0.5156*	1.0000			
scope3	0.0695	0.3019*	0.4995*	0.5162*	1.0000		
sales	0.1520*	0.1697*	0.2650*	0.6090*	0.3641*	1.0000	
age	0.0354	0.0745	0.3589*	0.4000*	0.2943*	0.3059*	1.0000

SECTION 2: EMPIRICAL MODEL

We conducted necessary tests to determine which regression model to use for our panel data to analyze empirically the impact of carbon disclosure on both financial performance and carbon performance. Our model is inspired by the work of [Siddiqui et al. \(2021\)](#) who examined the relationship between carbon disclosure, carbon performance and financial performance. Following their steps, we also used Ordinary Least Squares (OLS) multiple regression model for our analysis (explained in previous [Table 3](#) & [Table 4](#)). However, individual specific effects of variables are experiences in our panel data, so we used “Random effects generalized least square (GLS) Regression” to study the impact of carbon disclosure on the corporate financial performance in depth. We used STATA, which is a multipurpose statistical software package for data visualization, manipulation, statistics, and computerized reporting. Many researchers use this software in different fields. Our empirical model to tests the respective hypotheses can be explain as follows:

Hypotheses 1 and 2:

Using OLS multiple regression model with panel data to test the interrelation that exists between carbon disclosure and carbon performance.

$$Y_{i,t} = \alpha_i + \beta X_{i,t} + \epsilon_{i,t}$$

Where, Y = ROA; X = CP₃: Scope3 data, α = Intercept, ϵ = Residuals, i=total number of observations, t=year, β = Beta/Slope coefficient, representing the expected change in Y for one-unit increase in X.

Hypothesis 3:

To test the impact of carbon disclosure on financial performance in the short-term using

$$ROA_{i,t} = \alpha_0 + \beta_1 CD_{i,t} + \beta_2 CP1_{i,t} + \beta_3 CP2_{i,t} + \beta_4 CP3_{i,t} + \beta_5 SIZE_{i,t} + \beta_5 AGE_{i,t} + \epsilon_{i,t}$$

Where, explanatory variable ROA is used as a proxy for firms' financial performance and carbon disclosure (final scores), carbon performance (carbon emission all scopes scores), size, age used as independent and control variables, all β values are the slope coefficients representing the expected change in ROA for one-unit increase in each respective variable.

SECTION 3: EMPIRICAL RESULTS

In this section, we highlight our empirical results related to each regression model, testing our three hypotheses. To begin with, we are presenting the relationship between carbon disclosure and carbon performance and reporting the impact of one on another. Then we show the empirical results for the relationship between carbon disclosure and financial performance in the short-term.

We interpreted the OLS Regression results in the previous section. The OLS Regression results were contradicting our hypotheses so to study all the variables and their correlations in depth, we have estimated some statistics with STATA. The [Table 9](#) random effects GLS regression results indicate that our model is suitably designed as the probability of Chi2 results (0.0006) are greater than 0.05 and it is significant at the 95% level. This indicates that there has been no effect of independent variables taken together on the dependent variables. Most of the variables' coefficients values are negative. If the coefficient's p-values are less than alpha, then they are statistically significant. But in the above results, the coefficient associated with scores are not significant. The p-value of carbon disclosure (final score) is $0.510 > 0.05$. Similarly, all the carbon emission scopes' coefficient are greater than 0.05. The p-value of Scope 1 is $0.482 > 0.05$, The p-value of Scope 2 is $0.814 > 0.05$ and the p-value of Scope 3 is $0.137 > 0.05$. Hence, the results are indicating that there is no relationship between carbon scores and performance. The p-values are similar for other control variables except size, industry, and services. Standard errors measure the variability in the coefficient estimates. The standard error values of carbon disclosure and carbon performance are less than one indicates more precise estimates. Furthermore, as we have organized the sectors into four categories (explained earlier), the [Table 9](#) results are derived from STATA (explained in Section 3). So, we tried to find out the correlation of all variables sector-wise in detailed. Energy sector has 38 observations, finance has 44, industry showed the 99 and the service sector has 56 in total of 237 observations.

As we have organized the sectors into four categories, Energy, Finance, Industry and Services. The [Table 10](#) shows the sector wise regression results. In energy sector, the mean of ROA is 4.040% is even less than 50% of the maximum (17%) score of ROA. The mean of CD (final score) which is 14.11 less than 50% of the maximum (55) score of carbon disclosure. In finance sector, the standard deviation of ROA (4.925%) indicates a wide distribution of values around the mean. The minimum ROA is -6.67 suggests that some firms in this sector may have negative returns on assets on the other hand the maximum value (19.67) is indicating that some firms with proportionally high returns on assets. Similarly in the industry sector, the minimum ROA has negative value indicating negative returns on assets, even the service sector has the similar results. The standard deviation of sales suggests few variations in sales across the sectors. These results are like descriptive statistics' ([Table 3](#) & [Table 4](#)) results, confirming that data disclosed by sample firms are low quality.

The [Table 11](#), section 4 of the STATA results is explaining statistical values of all variables on the bases of 237 observations. The minimum ROA is -9.38 suggesting that some firms in these observations may have negative returns on assets. The [Table 12](#), section 5 of the STATA, explains the correlation of all variables. ROA is positively and statistically correlated with carbon disclosure (final score), the correlation coefficient is 0.23, which is negligible correlation. ROA is also positively and statistically correlated with firms' size but again the correlation coefficient is 0.17, which is negligible correlation. Similarly, the carbon disclosure is low positively and statistically correlated with carbon emission Scope 2 &3 but weak negative correlation with Scopel. Firm's age has a weak positive correlation with ROA and carbon disclosure, but it is positively and statistically correlated with carbon emission (all scopes) and with firm's size(sales). The coefficient of the firm's size is positively and statistically correlated with ROA. These results suggests that larger firms have superior ROA than smaller firms. Furthermore, the coefficient of Scope 1 is negatively related to ROA and carbon disclosure (final score) indicating there is negative correlation between carbon performance, carbon disclosure and ROA. Few variables are statistically correlated but with the correlation range from weak to moderate.

To conclude this section, we would like to consider each part such as descriptive statistics results, the skewness, the relationship of our variables and the statistical analysis. Our database includes observations for multiple sectors like, energy, finance, industry, and services. Each sector has different mean values for the dependent and independent variables. The ROA shows positive skewness, explaining concentration of values towards the lower end of the distribution.

This indicates the presence of few extreme values or outliers on the higher end. The independent variables show the negative skewness, indicating a concentration of values towards the higher end of the distribution, with a long tail on the left side. ROA has positive skewness suggesting that higher values of ROA are proportionally less common, while lower values are more frequent. The independent variables have negative skewness indicating that lower values are more frequent, certainly influencing the relationship with the ROA. All the correlation coefficients obtained from the correlation matrix are negligibly correlated.

DISCUSSION AND RESULTS

In this chapter, we focused to answer the research questions regarding the relationship between carbon disclosure and carbon performance, also aiming to answer the impact of carbon disclosure on corporate financial performance in the context of Indian firms:

- If carbon disclosure positively or negatively impacts carbon performance?
- Does carbon disclosure affect the firm's profitability?

To provide answers to these questions, we developed a comprehensive empirical model. After considering, the signalling theory which states that the market positively rewards firms that are transparent about their environmental disclosures which is translated by increased economic benefits, we considered company's profitability (ROA as a measure) to measure carbon disclosure and carbon performance to study the relationship between carbon disclosure and carbon performance. Our empirical findings suggest that the scores (global scores and carbon emission all scopes scores) have no impact on performance. We classified the primary firms into different sectors and applied the OLS multiple Regression model with panel data. The regression results report that there is inconsequential relationship between ROA and carbon performance in the panel data. In other words, insignificant relationship observed in between carbon disclosure and carbon performance. This also means that there is a neutral relationship between carbon disclosure and carbon performance which denies our first two hypotheses. The first hypothesis stated that the relationship between carbon disclosure and carbon performance is positive, and our second hypothesis was the relationship between carbon disclosure and carbon performance is negative. Furthermore, we carried out the descriptive statistics and correlation matrix to study the impact of carbon disclosure on firm's financial performance to test our third hypothesis. The regression results confirms that data disclosed by sample firms are low quality. This also suggests that voluntary carbon disclosure on the CDP during the sample period is not getting satisfying response from the sample firms.

To solidify our results, we ran the random effect GLS regression in STATA. We estimated a panel data model with more variables than our previous regression model. The only transformation in our data is that we have organized the sectors into four categories, like Energy=1, Finance=2, Industry=3, Services=4. The results of our both the regressions are similar and showing the same output, indicating an insignificant or neutral impact of carbon disclosure on firm's profitability in short term. Such findings contradict our third hypothesis which assumes that the impact of carbon disclosure on company's financial performance is negative in the short- term. Our findings concerning the relationship between carbon disclosure, carbon performance and financial performance remain strong which supports our choice of variables and estimation method. Additionally, our findings are supported by few previous literatures, such as [Praveen Kumar et al. \(2018\)](#) examined the relationship between the climate change disclosures and 44 Indian companies' financial performance by considering the carbon disclosure scores from the CDP report during 2011-2015. It has been observed that ROE was the higher for firms with higher environmental disclosure scores than the firms with lower disclosure scores. [Praveen Kumar et al. \(2018\)](#) did not find any evidence that the climate change disclosure affects ROA. [Wenting, Lu et al. \(2021\)](#) also examined the impact of carbon disclosure on financial performance by considering 2011-2018 CDP report, taking the Fortune 500 companies as a sample, stated that companies must upgrade their accounting techniques in accordance with the current needs of the low carbon economy. Because carbon disclosure has shifted from a voluntary disclosure to an obligatory necessity in many jurisdictions. [Ullmann \(1985\)](#), who suggested that an asymmetry of the results and their irrelevance could indicate the impact of carbon disclosure on the firm's financial performance is limited and negligible in the short run for carbon-intensive sectors ([Lu et al., 2021](#)). Another evidence from previous literature explains that if market is unable to recognize the social performance accurately then relation is going to be neutral ([Arpita Ghosh, 2013](#)).

CONCLUSION

Carbon reporting is the latest research field, especially in the emerging countries, little research has been conducted on the relationship between carbon disclosure, carbon performance and corporate financial performance and the discoveries of the studies have been cryptical with conflicting results. Some scholars argue that the relationship is positive while others declare it's negative or neutral or even mixed. The complicated and vibrant nature of carbon disclosure and the limited research on this topic in emerging countries especially India, have been the main motivation of conducting this research paper. We chose to investigate further the impact of carbon disclosure on the firm's corporate financial performance in the short-term. We have also studied the both-ways relationship between carbon disclosure and carbon performance.

To conduct our study, we started collecting the CDP-India annual reports from 2017 to 2022 to collect the carbon related data for our sample firms. To create our own database, we used TSR and Screener online databases which covers financial information of many Indian companies. We eliminated financial details and firms with missing carbon related information to obtain reliable results. Then we defined our variables. Return-on-assets (ROA) which is a metrics for the firm's financial performance and act as dependent variables for the short-term effect. Carbon disclosure is measured by considering the "Final scores" allotted to the participating companies for their carbon disclosure in the CDP report. We converted the alphabetic ratings given by CDP to Indian companies into numeric values by considering the Fibonacci sequence. The carbon performance is measured by considering the carbon emission Scope 1,2 and 3 values. These variables act as dependent and independent variables to study the mutual relationship between carbon disclosure and carbon performance. Firm size measured by sales in the respective years and firm age represent our control variables. All these variables are used together to study the relationship and impact of carbon disclosure on firm's corporate financial performance.

Initially the primary database covers a comprehensive environmental data of 144 Indian companies over the period of 2017-2022 disclosed in CDP-India annual reports. We excluded the firms with missing carbon related information and financial ratios from our data set which shows the sample of 140 firms and 411 observations. For analysis purpose, we eliminated those firms lacking the complete information. Considering, the signalling theory which states that the market positively rewards firms that are transparent about their environmental disclosures

which is translated by increased economic benefits. Hence, we consider company's profitability and carbon performance to study the relationship between carbon disclosure and carbon performance. From our database, we examined the firms with only carbon emission Scope 3 data, giving us only 240 observations to study. So, we perform OLS multiple regression model with this panel data based on 240 observations. Then we examined all the three scopes values (237 observations) to carry out the descriptive statistics based on observations. Furthermore, we classified the primary firms into sectors, giving us 25 observations, to verify the creditability of results, we perform OLS multiple regression model and descriptive statistics based on the sectors. We proceed further with analysing the correlation matrix based on sectors for our variables. All the correlation coefficients obtained from this correlation matrix are negligibly correlated, hence it has been confirmed that there is insignificant relation between carbon disclosure and carbon performance and similarly carbon disclosure has neutral impact on corporate financial performance. These conclusions suggest that a more comprehensive approach may be essential to drive improvements in carbon reporting, carbon performance and financial performance.

The previous research indicated the contradictory results regarding the relationship between carbon performance and carbon disclosure. We reinvestigate these relationships using a recent sample of Indian firms. We evaluate these relationships by examining projections by socio-political and economic-based voluntary disclosure and signalling theories. Our results derived from the voluntary disclosure of Indian firms to CDP annual reports, express that carbon disclosure insignificantly affects carbon performance. The prior literature also highlighted a mixed relationship between carbon disclosure and financial performance. We had a neutral relationship between carbon disclosure and corporate financial performance in the short-term. Our findings are supported by few previous literatures (explained in prior section).

Although, our research is the first to our knowledge that examines the link between carbon disclosure, carbon performance, and the impact of carbon disclosure on financial performance together in one research process in the context of Indian firms, it presents few limitations. Because of missing carbon-related data, our sample is restricted to 140 firms and 411 observations. As our sample data included firms that had voluntarily participated to the CDP from 2017 to 2022, the sample may become biased or methodic. This can be "Self-Selection bias" which could show incorrect speculations. To address "Self-Selection bias" the [Heckman \(1979\)](#) two-stage model is very useful. Besides, our panel data is unbalanced due to missing

data, as we are unable to find all the financial information of few firms through online databases and affected by heteroscedasticity, autocorrelation, and outliers' problems that we tried to adjust through a reliable model selection.

From 2012, Indian companies started participating in CDP and successfully achieve 5th rank on the annual CDP report 2022. So, this is the challenging phase for emerging countries like India and many Indian corporate houses have set decarbonisation targets by 2035. Our research has several implications. It can be of great benefit to investors, academics, as well as regulators looking for the impact of carbon disclosure on financial performance of Indian companies. After the pandemic, in 2021, India became the world's third largest GHG emitter after China and USA. So, it is compulsive to study their carbon performance and their efforts in contributing to a low-carbon economy. Therefore, our study helps to bring new perspective or create awareness into firms' environmental practices and reporting behaviours in carbon emission. The academics and board of management could benefit from this research by improving their carbon performance and increasing their carbon disclosure since they are positively associated with the firm's profitability ratios. Firms that can develop successful carbon mitigation strategies can have competitive advantage in the corporate market. Additionally, firms can gain substantial financial benefits acquired from low cost of capital, increased firm value, and improved financial performance. Concerning governance, authorities, and regulators, they must motivate and administrate firm's carbon emission efforts by executing more obligatory carbon mitigation frameworks that could hold industries responsible for their climate change actions. The firm's actual carbon performance and disclosure could help investors with their investment decision process since some firms may be involved in greenwashing activities or impression management (Walker & Wan, 2012; Talbot & Boiral, 2018).

In our study we only consider the impact of carbon disclosure on financial performance in the short-term by using ROA as a measure of firm's financial performance, the future research could investigate the impact of carbon disclosure on financial performance in the long-term by using Tobin's Q. Furthermore, most research on carbon reporting focus mainly on financial performance, future research could analyze the link between carbon disclosure and other types of corporate performance including operational, market, customer, and product. The emerging countries like India need more research on carbon reporting for the sustainable economy so future research should consider other factors and measures, enlarge the sample size to analyse the impact of carbon disclosure on corporate financial performance as well as on carbon

performance. The conflicting results have been reported by previous literature, such irregularity might be due to the policies and regulations of the country. Future research could investigate the impact of obligatory regulations on the quality of carbon disclosure.

The environmental changes have become a questionable and concerning issue at national and international level. The corporate houses also started acknowledging the phenomenon, resultant, they started voluntarily disclosing more on the social and environmental aspects to legitimise their operations (Gray et al., 1995; Deegan and Rankin, 1996; Deegan 2002; Campbell 2004) and additionally to maintain transparency to avoid prospective risk of information asymmetry for all their investors (Easley and O'Hara, 2004). Hence, financial implication of the voluntary environmental disclosure is acquiring more public attention and it is also essential in the value creation procedure of the firms, but reporting standards are silent in this regard, especially in the emerging countries. Therefore, stakeholders are dependable on voluntary climate change disclosure on the CDP to evaluate the environmental connections of the firm's operations (Bauer and Hann, 2010; Orens et al., 2010; Chaklader and Gulati, 2015). Hence, it is the regulators' responsibility to simplify the procedure of information disclosure by the firms without compromising the need of various stakeholders, such as investors.

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APPENDICES

STATA OUTPUT

❖ Random effects regression using xtreg, re

```

1 . xtreg roa finalscore scope1 scope2 scope3 sales age i.sector

Random-effects GLS regression           Number of obs   =       237
Group variable: id                     Number of groups =        70

R-squared:                               Obs per group:
    Within = 0.0414                       min =           1
    Between = 0.2543                      avg =           3.4
    Overall = 0.2845                      max =           6

Wald chi2(9) =       29.22
Prob > chi2   =       0.0006

corr(u_i, X) = 0 (assumed)

```

roa	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
finalscore	.0082807	.0125629	0.66	0.510	-.0163421	.0329036
scope1	-.3346479	.4754289	-0.70	0.482	-1.266471	.5971756
scope2	-.169546	.7198031	-0.24	0.814	-1.580334	1.241242
scope3	-.3999178	.2691733	-1.49	0.137	-.9274878	.1276521
sales	4.012664	1.219503	3.29	0.001	1.622483	6.402846
age	-3.866846	2.990223	-1.29	0.196	-9.727575	1.993884
sector						
Finance	-3.363081	2.808064	-1.20	0.231	-8.866785	2.140623
Industry	4.577019	2.034052	2.25	0.024	.5903498	8.563687
Services	7.025069	2.459718	2.86	0.004	2.20411	11.84603
_cons	-2.381318	5.630354	-0.42	0.672	-13.41661	8.653974
sigma_u	5.5200487					
sigma_e	2.8097208					
rho	.79422821	(fraction of variance due to u_i)				

❖ Random effects regression based on Energy, Finance, Industry and Services

```

2 . sort sector
3 . by sector: sum roa finalscore scope1 scope2 scope3 sales age

```

-> sector = Energy

Variable	Obs	Mean	Std. dev.	Min	Max
roa	38	4.039868	4.104473	-3.03	17
finalscore	38	14.10526	15.08676	3	55
scope1	38	6.372493	1.580007	2.539396	8.483082
scope2	38	4.846033	.6486384	3.594503	6.143959
scope3	38	5.051258	1.377984	3.029789	7.380364
sales	38	4.379257	.594193	3.40637	5.540068
age	38	1.599516	.3488108	.90309	2.033424

-> sector = Finance

Variable	Obs	Mean	Std. dev.	Min	Max
roa	44	2.851295	4.925085	-6.37	19.67
finalscore	44	25.77273	19.65619	3	89
scope1	44	3.23107	.7624917	1.138934	4.319668
scope2	44	4.746847	.7150253	3.343014	6.067869
scope3	44	4.150163	.7864341	2.247581	6.298126

sales	44	4.501858	.4802207	3.484727	5.462358
age	44	1.455397	.2070034	.7781513	1.832509

-> sector = Industry

Variable	Obs	Mean	Std. dev.	Min	Max
roa	99	7.170444	6.611526	-9.38	25.3
finalscore	99	35.27273	19.64159	0	89
scope1	99	5.770555	1.472457	2.674402	7.878899
scope2	99	5.318749	.7022205	3.516139	6.929652
scope3	99	5.910932	1.188985	1.69897	8.65493
sales	99	4.328652	.5636419	2.569374	5.479918
age	99	1.765013	.1990623	1.361728	2.100371

-> sector = Services

Variable	Obs	Mean	Std. dev.	Min	Max
roa	56	12.46875	8.215206	-7.61	27.38
finalscore	56	42.07143	27.26027	0	89
scope1	56	3.840679	.9793147	1.490001	5.7889
scope2	56	4.758383	.7679351	2.464771	5.909457
scope3	56	4.902435	.9955792	2.625313	6.69696
sales	56	4.234557	.8333539	2.220108	5.282744
age	56	1.59448	.2707846	1.041393	2.093422

❖ Descriptive Statistics and Correlation matrix

4 . sum roa finalscore scope1 scope2 scope3 sales age

Variable	Obs	Mean	Std. dev.	Min	Max
roa	237	7.118549	7.256419	-9.38	27.38
finalscore	237	31.72152	22.95091	0	89
scope1	237	4.939598	1.752767	1.138934	8.483082
scope2	237	5.004372	.7573232	2.464771	6.929652
scope3	237	5.207905	1.292455	1.69897	8.65493
sales	237	4.346689	.6316039	2.220108	5.540068
age	237	1.640701	.2721954	.7781513	2.100371

5 . pwcorr roa finalscore scope1 scope2 scope3 sales age, star(0.05)

	roa	finalscore	scope1	scope2	scope3	sales	age
roa	1.0000						
finalscore	0.2329*	1.0000					
scope1	-0.0162	-0.0320	1.0000				
scope2	0.0946	0.1627*	0.5156*	1.0000			
scope3	0.0695	0.3019*	0.4995*	0.5162*	1.0000		
sales	0.1520*	0.1697*	0.2650*	0.6090*	0.3641*	1.0000	
age	0.0354	0.0745	0.3589*	0.4000*	0.2943*	0.3059*	1.0000

❖ Variables in different percentiles

6 . sum roa finalscore scope1 scope2 scope3 sales age, detail

roa				
	Percentiles	Smallest		
1%	-6.37	-9.38		
5%	-1.28	-7.61		
10%	.62	-6.37	Obs	237
25%	1.71	-6.25	Sum of wgt.	237
50%	4.43		Mean	7.118549
		Largest	Std. dev.	7.256419
75%	11.96	25.46		
90%	18.71	26.75	Variance	52.65561
95%	21.17	27.08	Skewness	.7813686
99%	26.75	27.38	Kurtosis	3.00796
finalscore				
	Percentiles	Smallest		
1%	3	0		
5%	3	0		
10%	3	3	Obs	237
25%	8	3	Sum of wgt.	237
50%	34		Mean	31.72152
		Largest	Std. dev.	22.95091
75%	34	89		
90%	55	89	Variance	526.7442
95%	89	89	Skewness	.7192105
99%	89	89	Kurtosis	3.196639
scope1				
	Percentiles	Smallest		
1%	1.61183	1.138934		
5%	2.246794	1.490001		
10%	2.651249	1.61183	Obs	237
25%	3.745153	1.846275	Sum of wgt.	237
50%	4.554404		Mean	4.939598
		Largest	Std. dev.	1.752767
75%	6.649972	7.878899		
90%	7.552953	8.402253	Variance	3.072194
95%	7.709869	8.421439	Skewness	.2007366
99%	8.402253	8.483082	Kurtosis	1.97561

scope2

	Percentiles	Smallest		
1%	3.343014	2.464771		
5%	3.516139	3.04359		
10%	4.031408	3.343014	Obs	237
25%	4.522346	3.385427	Sum of wgt.	237
50%	5.085076		Mean	5.004372
		Largest	Std. dev.	.7573232
75%	5.543082	6.616746		
90%	5.808798	6.654913	Variance	.5735384
95%	6.143959	6.75496	Skewness	-.2828901
99%	6.654913	6.929652	Kurtosis	3.159081

scope3

	Percentiles	Smallest		
1%	2.247581	1.69897		
5%	3.029789	2.149219		
10%	3.411451	2.247581	Obs	237
25%	4.23036	2.350616	Sum of wgt.	237
50%	5.334669		Mean	5.207905
		Largest	Std. dev.	1.292455
75%	6.135182	7.804032		

90%	6.730488	7.818418	Variance	1.67044
95%	7.219603	7.821313	Skewness	-.1407062
99%	7.818418	8.65493	Kurtosis	2.521642

sales

	Percentiles	Smallest		
1%	2.569374	2.220108		
5%	3.387568	2.49693		
10%	3.649627	2.569374	Obs	237
25%	3.960851	2.595496	Sum of wgt.	237
50%	4.301876		Mean	4.346689
		Largest	Std. dev.	.6316039
75%	4.837879	5.464713		
90%	5.165455	5.474545	Variance	.3989234
95%	5.403673	5.479918	Skewness	-.4245022
99%	5.474545	5.540068	Kurtosis	3.393946

age

	Percentiles	Smallest		
1%	.90309	.7781513		
5%	1.041393	.90309		
10%	1.342423	.90309	Obs	237
25%	1.477121	.90309	Sum of wgt.	237
50%	1.612784		Mean	1.640701
		Largest	Std. dev.	.2721954
75%	1.892095	2.100371		
90%	1.963788	2.100371	Variance	.0740903
95%	2.064458	2.100371	Skewness	-.4924221
99%	2.100371	2.100371	Kurtosis	3.282999