CARBON DISCLOSURE, CARBON PERFORMANCE AND FINANCIAL PERFORMANCE: INTERNATIONAL EVIDENCE

A thesis submitted by

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ABSTRACT

This study examines the relationships and interrelationships between carbon disclosure and carbon performance, and between carbon performance and financial performance. It also examines the relationship between carbon disclosure and financial performance. Additionally, it investigates the relationship between agency cost and carbon disclosure, and between agency cost and carbon performance. Finally, this research investigates the trends in improvement of carbon disclosure and carbon performance of the companies, over the study period. The interrelationships between carbon disclosure and carbon performance, and between carbon performance and financial performance, have not been investigated by any study before. Similarly, no study has yet investigated the relationship between carbon disclosure and financial performance. The relationships between carbon disclosure/carbon performance and agency cost, have not been studied either by any previous research. Whilst a couple of studies have conducted trend analysis of carbon disclosure previously, no study has yet undertaken trend analysis of carbon performance. These examinations are performed by using a cross-sectional sample of the world's largest 500 firms, drawn from most major industry sectors, who participated in the Carbon Disclosure Project (CDP) questionnaire survey over the five-year period from 2011 to 2015. Both full sample and country-wise analysis have been done, to test the hypotheses of this study.

Carbon disclosure and carbon performance scores for the sample companies are taken from the CDP database. Data for financial performance indicators, agency costs and relevant control variables, are collected from Thomson Reuters Datastream database.

Findings of this study indicate that there is a significant positive relationship between a firm's carbon disclosure, and its carbon performance. They also indicate that carbon disclosure and carbon performance of business, influence each other positively. Country-wise analysis shows that carbon disclosure is significantly positively related to carbon performance in all of the four regions of this study - namely North America, EU, UK and Asia-Pacific. Both way positive interrelationship between carbon disclosure and carbon performance, holds true in all regions except the UK.

The study also finds that carbon performance of a business is significantly negatively related to both accounting-based measure as well as market-based measure of a firm's financial performance. It also finds that there is no significant interrelationship between carbon performance and accounting-based measure of a firm's financial performance. However, carbon performance and market-based measure of a firm's financial performance, influence each other negatively - this relationship might vary across industries. Carbon performance is negatively related to both accounting-based measure as well as market-based measure of a firm's financial performance, in all regions except the UK. There is no significant and consistent interrelationship between carbon performance and any of the measures of firm financial performance, in any region.

Results of this study indicate that there is a significant negative relationship between carbon disclosure and accounting-based measure of a firm's financial performance. However, there is no significant and consistent relationship between carbon disclosure and a firm's market-based financial performance. There is a significant negative relationship between carbon disclosure and accounting-based measure of a firm's financial performance, in all regions. However, there is no

significant relationship between carbon disclosure and market-based measure of a firm's financial performance in any region.

This study also finds out that there is a positive but insignificant relationship between carbon disclosure and agency cost, both when agency cost is measured by Expense Ratio or by Asset Utilization Ratio. Results also indicate that carbon performance does not significantly affect a firm's agency cost when agency cost is measured by Expense Ratio. However, when agency cost is measured by Asset Utilization Ratio, there is a significant negative relationship between carbon performance and agency cost. Carbon disclosure and carbon performance both significantly positively affect agency cost in North America, however there is no significant and consistent relationship between agency cost and both carbon disclosure and carbon performance, in any other region.

Results of this study show that the level of carbon disclosure for the sample companies, have significantly and consistently improved during the study period. On the other hand, carbon performance did not significantly improve towards the beginning of the study period. It started improving later, but these improvements were not always consistent. Country-wise analysis shows similar patterns in all regions.

This study contributes to the literature that deals with the relationships and interrelationships between carbon disclosure, carbon performance and financial performance, by producing a number of novel findings that suggest there is a positive interrelationship between carbon disclosure and carbon performance; carbon performance and market-based measure of financial performance influence each other negatively; carbon disclosure and accounting-based measure of financial performance are negatively related and carbon performance negatively affects agency cost.

CERTIFICATION OF THESIS

This Thesis is entirely the work of **Md Abubakar Siddique** except where otherwise acknowledged. The work is original and has not previously been submitted for any other award, except where acknowledged.

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CHAPTER 1 INTRODUCTION

1.1 Background

Greenhouse gas (GHG) emission has become one of the primary threats for the existence of life on earth. The excessive concentration of GHG in earth's atmosphere, causes adverse consequences in natural ecosystems and humankind, creating the phenomenon of global warming or climate change (United Nations, 1992; Liu et al., 2015; Stern, 2006). Companies have always played a pivotal role in facing the problems of climate change because they are one of the biggest emitters of GHG (Hoffmann & Busch, 2008). In recent times, stakeholders such as shareholders, consumers and regulatory authorities, have started exerting pressure on corporations to decrease their GHG emissions (Jeswani et al., 2008; Weinhofer & Hoffman, 2010; Liesen et al., 2015; Comyns, 2016). Consequently, corporations are now expected to play a vital role in reducing their GHG emissions and in contributing towards stabilizing climate change (Luo & Tang, 2014). Businesses nowadays face an ever-increasing demand to disseminate information about their climate change related activities, also referred to as carbon disclosures, to satisfy the concerns of relevant stakeholders (Meng et al., 2014). Carbon disclosure is attracting increasing attention from scholars, stakeholders and regulators (e.g., Stanny, 2013; Matsumura et al., 2013). This is due to the fact that through carbon disclosure, stakeholders such as government and the public can better monitor firms' carbon emissions, which are likely to contribute to improved corporate carbon performance. As a result, corporate carbon disclosures have been steadily increasing in both size and complexity in the past decade (Peng et al., 2015).

Recent years have seen intense societal and scientific debate about climate change, which often centres on corporations (Howard-Grenville et Al., 2014). Consequently, businesses have been increasingly asked to provide more information on their climate change strategies and plans for managing and reducing carbon emissions. For example, since 2002, Carbon Disclosure Project (CDP), a consortium of over 300 institutional investors with $41 trillion in assets, has asked the world's 500 largest firms every year to disclose their GHG emissions, risks, opportunities, and management strategies. On top of that, mandatory initiatives that aim at increased transparency or improved emissions management, have recently been introduced at the national level of many countries. For example, in the US, all facilities that emit a minimum of 25,000 metric tons of CO_2 equivalents, are now required to disclose their emissions (U.S. Environmental Protection Agency, 2012). In the UK, all stock-listed companies must report their GHG emissions (U.K. Government, 2013). Similar initiatives have been introduced in many other countries and jurisdictions.

In recent times, businesses have started viewing climate change as an opportunity rather than a burden (Margolick & Russell, 2004, The World Bank, 2018). The equity market has started to realize the magnitude of the impact that the transition to a low-carbon global economy is expected to have on firms' competitiveness and long-term valuation (Goldman Sachs Sustain, 2009). Financial markets have also started to reward companies that are moving ahead on climate change, while those lagging behind are assigned more risk (Cogan, 2006; Kolk et al., 2008). As a result, an increasing number of firms have allocated resources to the communication of information on their climate change activities to interested parties.

Existing literature has identified many benefits that businesses can achieve from recording and subsequent disclosure of their climate change-related activities. In a meta-analysis, Albertini (2013) confirms a positive relationship between environmental disclosure and corporate financial performance. Sullivan and Gouldson (2012) find that proactive climate-related measures and carbon disclosures, as well as the development of climate-friendly products, can improve a company's image. Additionally, the pressure to disclose emissions can lead to improved carbon management which in effect can reduce energy consumption and energy costs (Matisoff, 2013). Improved carbon management can also help companies deal with natural (e.g., drought, flood) and regulatory risks related to climate change. Carbon disclosure also helps investors estimate a company's regulatory and natural risks related to climate change (McLaughlin, 2011). According to Dhaliwal et al. (2011), nonfinancial disclosure, which includes carbon disclosure, is associated with improved stock performance and cost of capital. Companies who handle climate change risks and opportunities efficiently, can position themselves as attractive options for climate-conscious investors (Juravle and Lewis, 2009). Therefore, carbon disclosure can be used by businesses as a means to showcase their climate change activities. This chapter is structured as below:

Section 1.2 discusses the motivation for undertaking this research. Section 1.3 outlines the objectives of this research. Section 1.4 discusses the contributions of this study. Section 1.5 provides the structure of this research, and section 1.6 summarises the chapter.

1.2 Motivation of this study

The study of carbon disclosure is gaining increasing importance in recent years due to the fact that through carbon disclosure businesses can communicate their climate change activities to its stakeholders (Hahn et al., 2015). These disclosures can help stakeholders such as shareholders and creditors to make better investment decisions for a particular company. Carbon disclosure can also help stakeholders such as regulatory agencies, institutional investors and the public, to better monitor and regulate a business's carbon emissions which are likely to contribute to improved carbon performance of the business. Improved carbon performance can also affect the financial performance of the business. Therefore, it is evident that the study of carbon disclosure and carbon performance, which falls under the broad category of environmental disclosure and environmental performance, are very important areas of study that deserve to be well researched. The growing concerns about carbon emission by businesses, and the increased importance of the study of carbon disclosure and carbon performance, provide multiple motivations for this study.

Firstly, despite its importance, limited research has been done to investigate the relationship between carbon disclosure and carbon performance, and the findings of these research have been largely inconclusive. In addition, most of this research has been done for specific countries and industries. To address this research gap, this study would like to investigate the relationships between carbon disclosure, carbon performance and financial performance, for the top 500 global companies which includes most major industries.

Secondly, in current literature, some studies find that superior carbon performers make more carbon disclosure, whereas some other studies find that inferior carbon performers make more carbon disclosure. However, none of the current studies investigate the disclosure practices of average carbon performers (businesses who are neither superior carbon performers nor inferior carbon performers). Additionally, to the best of my knowledge, no study has yet investigated whether there is an interrelation between environmental disclosure/carbon disclosure and environmental performance/carbon performance. If an interrelationship between carbon disclosure and carbon performance can be established, it can help managers of businesses to make decisions regarding their carbon disclosure and carbon performance activities. Therefore, this study would like to investigate the carbon disclosure practices of average carbon performers and to determine if there is any interrelationship that exists between a business's carbon disclosure and its carbon performance.

Thirdly, most of the studies that have been done to investigate the relationship between carbon performance and financial performance, have produced conflicting results (Rahman et al., 2014). In addition, this study could not find any existing research that investigates the interrelationship between carbon performance and financial performance. If an interrelationship between carbon performance and financial performance can be established that shows the impact of carbon performance on corporate financial performance and vice versa, it would be very useful for business managers to assess the impact of any activity they would like to undertake to improve their carbon performance. This study could not also find any major research that investigates the relationship between carbon disclosure and financial performance. Also,

the relationship between environmental disclosure/corporate social performance disclosure, and financial performance, is not well researched. Findings of any research on the relationship between carbon disclosure and company financial performance, would help firm management to assess the potential benefit of disclosing carbon activities. This study therefore, intends to investigate the relationship and interrelationship between carbon performance and financial performance, as well as the relationship between carbon disclosure and financial performance.

Fourthly, this research could find only a few studies that investigate the relationship between corporate disclosure and agency cost. However, this study could not find any existing research that investigates the relationship between carbon disclosure and agency cost, and between carbon performance and agency cost. It is important to know whether agency cost is related to carbon disclosure and carbon performance. Presence or absence of a relationship between agency cost and carbon disclosure/carbon performance, can explain the motivation or lack of motivation of a firm manager to disclose their climate change activities and improve their carbon performance. This study would like to address this research gap by investigating the relationship between agency cost and carbon disclosure, and between agency cost and carbon performance.

Finally, there are only a few studies that analyse the trends in carbon disclosure over the years. The latest trend analysis available has been done until the year 2008. On the other hand, this study could not find any trend analysis for carbon performance. It is important for many interested parties to know the trends in improvement of both carbon disclosure and carbon performance. These facts motivated this study to undertake a trend

analysis of carbon disclosure and carbon performance by the 500 largest global firms, over the years 2011 to 2015.

1.3 Research objectives

Based on the research gap and/or research need identified in the previous section, this study would like to examine the relationships and interrelationships between carbon disclosure, carbon performance and financial performance. It also would like to examine the relationship between agency cost and carbon disclosure, and between agency cost and carbon performance. Additionally, this research intends to investigate the trends in improvement of carbon disclosure and carbon performance over the period of this study. These examinations would be performed by using a cross-sectional sample of the world's largest 500 firms that participated in the Carbon Disclosure Project (CDP) questionnaire survey over the five-year period 2011 to 2015.

The specific objectives of this study are:

1. To examine the relationship (one-way relationship) and interrelationship (both-way relationship) between carbon disclosure and carbon performance
2. To examine the relationship (one-way relationship) and interrelationship (both-way relationship) between carbon performance and financial performance
3. To examine the relationship between carbon disclosure and financial performance
4. To examine the relationship between agency cost and carbon disclosure, and between agency cost and carbon performance

5. To study the trends in improvement of carbon disclosure and carbon performance over the study period.

Based on the above objectives, the primary research question investigated in this study is:

How do carbon disclosure, carbon performance, financial performance, and agency cost influence each other, and what is the trend in carbon disclosure and carbon performance over the years.

As this study examines the relationship between carbon disclosures, carbon performance, financial performance and agency cost, these terms will be defined below:

Carbon disclosure: Carbon disclosure includes disclosure by an organisation of information such as GHG emissions intensity and energy use, participation in emissions trading schemes, corporate governance and strategy in relation to climate change, performance against GHG emissions reduction targets, and risks and opportunities related to the impacts of climate change. In other words, carbon disclosure can be defined as a set of quantitative and qualitative information that is related to a business's past and forecasted carbon emissions levels, its exposure to and financial implications of climate change associated risk and opportunities, and its past and future actions to manage these risks and opportunities. This information may be released via the firm's annual reports, stand-alone sustainability reports, via the firms' websites or through other dissemination channels such as the Carbon Disclosure Project (Cotter et al., 2011).

Carbon performance: According to Hoffmann and Busch (2008), corporate carbon performance is indicated by a firm's carbon intensity, carbon dependency, carbon exposure and carbon risk. These indicators are described below:

Carbon intensity: Carbon intensity relates to a company's physical carbon performance and describes the extent to which its business activities are based on carbon usage for a defined scope and fiscal year.

Carbon dependency: Carbon dependency describes the change in a company's physical carbon performance within a given time period. The indicator is measured as the company's relative performance change from the status quo to the predicted carbon intensity.

Carbon exposure: Carbon exposure relates to a company's monetary carbon performance, and describes the monetary implications of the business activities due to carbon usage for a defined scope and fiscal year.

Carbon risk: Carbon risk describes the change in a company's monetary carbon performance within a given period. The indicator is measured as the relative performance change from the status quo to the predicted carbon exposure.

Financial performance:

In a broader sense, financial performance refers to the degree to which financial objectives are being or have been accomplished. It is the process of measuring the results of a firm's policies and operations in monetary terms. It is used to measure firm's overall financial health over a given period. The financial performance indicators used in the study, are discussed in detail in subsequent chapters.

Agency cost:

According to Jensen and Meckling (1976), the divergence of action due to the incomplete alignment of the interests of agents and principals may lead to an agency problem. The sacrifice of wealth by the principal, and potential costs associated with monitoring the agents is known as the agency cost. It is also discussed in detail in later chapters.

1.4 Contribution of this study

This study is likely to contribute to the emerging area of research on carbon disclosure and carbon performance in a number of ways. This study would like to conduct a global study, consisting of a large sample drawn from most major industries covering most major regions of the world, to investigate a one-way as well as both-way relationship between carbon disclosure and carbon performance. No previous study has investigated the both-way relationship between carbon disclosure and carbon performance. Also, most of the previous studies on one-way relationship between carbon disclosure and carbon performance, have been done with a smaller sample covering specific countries and specific industries. This research also contributes by conducting a first-ever study that investigates the disclosure practices of average carbon performers.

Studies have been done in the past to investigate the relationship between carbon performance and financial performance (for example Matsumura et al., 2013 and Albertini, 2013). However, no research has yet investigated the interrelationship between carbon performance and financial performance. This study also contributes by taking a novel attempt to investigate the interrelationship between carbon performance

and financial performance. To the best of my knowledge, no study has yet assessed the relationship between carbon disclosure and financial performance. This study is the first ever research to investigate the relationship between carbon disclosure and financial performance.

By investigating the relationship between carbon disclosure and agency cost (measured by both Expense Ratio and Asset Utilization Ratio), this study adds to the scant literature that is currently available in this area. On the other hand, there is no existing research that has determined the relationship between carbon performance and agency cost. By taking a first-ever attempt to investigate the relationship between carbon performance and agency cost, this study contributes greatly to the literature.

While some existing research has done trend analysis of carbon disclosure by businesses over the years, no study has yet done so for carbon performance. This study contributes to the literature by investigating the trends in improvement of carbon disclosure and carbon performance, for the largest firms in the world over a relatively recent period.

1.5 Structure of the thesis

This thesis consists of eight chapters. The table below provides the chapter-wise structure of this research:

Chapter 1	This chapter discusses the background, motivation, objectives and contributions of this study.
Chapter 2	This chapter discusses carbon disclosure reporting frameworks available globally and regionally. This description provides a contextual framework

	for this study.
Chapter 3	This chapter discusses different theories that have the potential to explain the relationships and interrelationships between carbon disclosure, carbon performance, financial performance and agency cost. This study utilizes these theories to develop its hypotheses and explain its findings.
Chapter 4	This chapter provides an extensive review of existing literature that deals with the relationship and interrelationship between carbon disclosures, carbon performance, financial performance and agency cost. By doing so, this chapter identifies the research gap in existing literature.
Chapter 5	Based on the research gap identified in chapter 4, this chapter develops the hypotheses of this study, by utilising propositions of relevant theories and a number of conceptual frameworks developed in this study.
Chapter 6	This chapter outlines the methods used in this study to test the hypotheses developed in the previous chapter. This chapter explains the research sample selection process. It also shows the process of selecting and measuring the dependent, independent and control variables used in this study. This chapter also outlines the models used in this study to test its hypotheses.
Chapter 7	This chapter provides the results from the tests conducted to test the hypotheses of this study. This chapter also conducts diagnostic tests to validate the data and models used in this study. This chapter analyses and interprets the relationship between carbon disclosure and carbon performance; between carbon performance and financial performance;

	between carbon disclosure and financial performance; between carbon disclosure and agency cost and between carbon performance and agency cost. This chapter also investigates any trends in improvement of carbon disclosure and carbon performance during the study period.
Chapter 8	This chapter concludes this study with a discussion of this research's potential implications, limitations and suggestions for future research.

1.6 Chapter summary

This chapter provides a brief background for the study followed by motivations for this study. It then provides the objectives and research questions and contributions of this study. This chapter also provides definitions of certain terms that are integral to understanding this study. Finally, this chapter provides a structure of this thesis. The following chapter will discuss certain carbon disclosure reporting frameworks that are relevant to this study.

CHAPTER 2 CARBON DISCLOSURE REPORTING FRAMEWORKS

2.1 Introduction

As discussed in the previous chapter, one of the primary objectives of this study is to investigate carbon disclosure practices of Global 500 companies. To do so, it is important to have an idea about the carbon disclosure reporting frameworks available globally, regionally or country-wise. Therefore, this section describes carbon emissions and climate change disclosure practices and frameworks relevant to the sample companies. This description provides a contextual framework for this study. Most of the sample companies are from one of the four regions namely: North America, European Union, the UK and Asia-Pacific. There are only four companies who are outside these regions (two each from South America and Brazil). The following sections describe the carbon disclosure reporting frameworks available in these four regions and countries inside these regions, as applicable. It also describes global reporting frameworks that are relevant for carbon disclosure. This chapter is structured as below:

Section 2.2 discusses carbon disclosure frameworks available globally. Section 2.3 discusses regional/country-wise carbon disclosure reporting frameworks, and section 2.4 summarises the chapter.

2.2 Global carbon disclosure reporting frameworks

The Global Reporting Initiatives (hereafter GRI) and Climate Change Reporting Framework (hereafter CCRF) are the two most important global carbon disclosure reporting frameworks that are relevant for this study. They will be described in the following sections. However, before discussing them, it will be worthwhile to briefly describe the Kyoto Protocol, which although is not strictly a carbon disclosure framework, has far-reaching implications on all global, regional and country-wise carbon reporting frameworks.

The Kyoto Protocol is an international agreement linked to the United Nations Framework Convention on Climate Change, which commits participating countries by setting internationally binding emission reduction targets. Recognising that developed countries are principally responsible for the current high levels of GHG emissions in the atmosphere as a result of more than 150 years of industrial activity, the Protocol places a heavier burden on developed nations under the principle of "common but differentiated responsibilities". The Kyoto Protocol was adopted in Kyoto, Japan, on 11 December 1997, and entered into force on 16 February 2005. Both the Convention and its Protocol created a framework for the implementation of an array of national climate policies, and stimulated the creation of the carbon market and new institutional mechanisms that could provide the foundation for future mitigation efforts. The Protocol has put in place an accounting and compliance system with a set of rules and regulations. In particular, the Protocol lays down specific rules concerning the reporting of information by participating countries that have to demonstrate that they are meeting their commitments. (United Nations Framework Convention on Climate Change, 2018).

2.2.1 Global Reporting Initiatives (GRI)

The GRI is a voluntary disclosure framework that includes disclosure about climate change and its impact. This framework guides organisations on how they can report their sustainability performance. The guidelines of this reporting framework include Performance Indicators and Management Disclosures that companies can adopt voluntarily to disclose their performance in key sustainability areas, including GHG emissions and initiatives to reduce them, as well as energy consumption and reduction initiatives (Cotter et al., 2011).

The GRI has pioneered and developed a comprehensive *Sustainability Reporting Framework* that is widely used around the world. The Framework, which includes Sustainability Reporting Guidelines and Sector Guidance, guides organisations on how they can report their sustainability performance. The guidelines of this reporting framework include Performance Indicators and Management Disclosures that companies can adopt voluntarily to disclose their performance in key sustainability areas including GHG emissions and initiatives to reduce them, as well as energy consumption and reduction initiatives.

2.2.1.1 The Sustainability Reporting

The GRI Sustainability Reporting Guidelines assist in the preparation of sustainability reports by organisations, regardless of their size, sector or location. The Guidelines offer an international reference for all those interested in the disclosure of governance approach, and of the environmental, social and economic performance and impacts of organisations. The Guidelines are useful in the preparation of any type of

document which requires such disclosure. The most current generation of the GRI Guidelines are The G4 Guidelines.

The G4 Guidelines: The G4 guidelines include two different types of Standard Disclosures: General Standard Disclosures and Specific Standard Disclosures.

GENERAL STANDARD DISCLOSURES: They include disclosure about:

- Strategy and Analysis
- Organisational Profile
- Identified Material Aspects and Boundaries
- Stakeholder Engagement
- Report Profile
- Governance
- Ethics and Integrity

SPECIFIC STANDARD DISCLOSURES: These include

- Disclosures on Management Approach and
- Indicators

(Global Reporting Initiatives, 2013)

2.2.2 Climate Change Reporting Framework (CCRF)

The Climate Disclosure Standard Board's (hereafter CDSB) Climate Change Reporting Framework, is a voluntary reporting framework designed to elicit climate change-related information of value to investors. Created in line with the objectives of financial reporting and rules on non-financial reporting, the climate change reporting

framework seeks to filter out what is required to understand how climate change affects a company's financial performance.

The CDSB climate change reporting framework is designed for use by companies in making disclosures in, or linked to, their mainstream financial reports about the risks and opportunities that climate change presents to their strategy, financial performance, and condition. CDSB's intention is that disclosures that comply with the climate change reporting framework will be of value to investors. The climate change reporting framework adopts and relies on relevant provisions of existing standards and practices, including the Greenhouse Gas Protocol and International Financial Reporting Standards, as well as reflecting developments in regulatory and voluntary reporting, and carbon trading rules. The Framework is "standard-ready" for adoption by regulators contemplating the introduction or development of climate change disclosure practices.

2.2.2.1 Requirements of Climate Change Reporting Framework (CCRF)

The CCRF has specified certain requirements for organisations to follow. The main requirements are requirements on determination, requirements on preparation, requirements on presentation, and Requirements on disclosure content. All of the requirements are to be applied wholly and faithfully, and they shall be read and applied in conjunction with: Chapter 3, which describes the characteristics of decision useful information that shall be applied in determining, preparing and presenting disclosures in accordance with the requirements; Chapter 4, which sets out the type of information that is useful to investors and is therefore to be considered for disclosure and the guidance and explanatory material that accompany the requirements.

Following is a summary of the above requirements:

Requirements on determination: An organisation shall determine the disclosures to be made under the CCRF according to the categories of disclosure content that are of value to investors, and a process that involves a thorough assessment of how climate change has actually affected or has the potential to affect the organisation's strategic objectives. Following are the main requirements related to the determination:

- Disclosures shall take account of the content requirements in Chapter 4 of the CCRF.
- Disclosures shall focus on investors as the primary users of information
- Disclosures shall bring to bear management's view of the organisation's strategy and objectives.
- Disclosures shall comply with regulatory requirements for financial reporting or corporate disclosure of climate change-related information. Where there is a conflict between the requirements of CCRF and the regulatory requirements, the regulatory requirements shall be applied, and the nature and effect of the conflict disclosed.

Requirements on preparation: Disclosures shall be made on a consistent basis and shall include the information that is necessary to maximize its value to investors. Following are the main requirements related to preparation:

- Disclosures under the CCRF shall enable investors to assess the future prospects of the organisation as well as its past performance.

- Information shall be provided on an annual basis for the same period covered by the mainstream financial report, or for a period of twelve months ending in that period.
- Subject to the CCRF recommendations about organisational boundaries for greenhouse gas emissions reporting (described in Chapter 4), disclosures shall be made to the organization for which consolidated financial statements are prepared.
- Disclosures shall include a statement of conformance with the CCRF requirements. In cases where full conformance has not been possible because of the organisation's particular circumstances, the statement shall identify those requirements with which it has not been possible to conform, in whole or in part, together with an explanation of the relevant circumstances, information about the organisation's stage of conformance, and its plans for full application of the requirements.
- The statement of conformance shall include details of the standards, policies and organisational boundary used for preparing information under the CCRF, and confirmation that the standards, policies and organisational boundary, have been used consistently from one reporting period to the next.

Requirements on presentation: Disclosures shall be presented and communicated to make them useful for investors. Following are the main requirements related to presentation:

- Disclosures shall be clear and straightforward
- Information shall be reported in a place and in such a way as to explain the links between the organisation's strategy, operations and climate change impacts.

- Organisations shall disclose performance measures and indicators used by management to manage the business, and to track progress against climate change-related targets.
- Disclosures shall explain changes in approach and changes in results from year to year.
- Disclosures shall be consistent with the associated financial statements of the organisation. Therefore, if financial statements include segment information, disclosures about climate change shall also reflect that segmentation.

Requirements on disclosure content: The CCRF requirements seek to ensure that disclosures include information that is essential to an understanding of how climate change affects management's objectives, the strategies for meeting those objectives, and the performance of the organisation. Disclosure shall include the following information:

a) Strategic analysis, risk and governance: Disclosure about strategic analysis shall include a statement about the long-term and short-term impact climate change actually and potentially has on the organisation's strategic objectives.

b) Risks: Disclosure about risks shall include an explanation and qualitative assessment of the organisation's exposure to current and anticipated (long-term and short-term) significant risks associated with climate change.

c) Opportunities: Disclosure about opportunities shall include an explanation and qualitative assessment of current and anticipated (long-term and short-term) significant opportunities associated with climate change.

d) Management Actions: Disclosure shall include a description of the organisation's long-term and short-term strategy or plan to address climate change-related risks,

opportunities and impacts, including targets to reduce GHG emissions, and an analysis of performance against those targets.

e) Future outlook: Disclosures shall include information about the future outlook, long-term and short-term, including trends and factors related to climate change that are likely to affect management's view of the organisation's strategy or the timescales over which achievement of the strategy is typically planned.

f) Governance: Disclosures shall describe the governance processes and organisational resources that have been assigned to the identification, management and governing body oversight of climate change-related issues.

g) Greenhouse gas emissions:

Following are the main GHG emissions content requirements:

1. Gross absolute Part 1 and Part 2 GHG emissions shall be calculated by reference to one or more recognised GHG emissions reporting schemes, and disclosed in CO_2 equivalent metric tonnes.
2. Normalized GHG emissions shall be disclosed for the organisation.
3. GHG emissions results shall be accompanied by contextual disclosures that include:
    - the name or names of the recognised GHG emissions reporting scheme(s) used to calculate GHG emissions
    - the quantification methodology used for calculating GHG emissions
    - key assumptions made in the preparation of disclosures
    - emission factors and/or the source of emission factors used to calculate GHG emissions from activity data

- the global warming potentials used and their source
- in support of Scope 2 (indirect) GHG emissions results, disclose details (in KWh, MWh or GWh) of the purchased electricity the organization has consumed;
- a description of the main effects of uncertainty in the calculation of GHG emissions e.g., data gaps, assumptions, extrapolations, metering/measurement inaccuracies etc.
- a statement on whether and to what extent GHG emissions results have been verified or assured, internally or by an independent third party
- confirmation or otherwise, that Scope 1 and 2 GHG emissions results relate to activities and sources within the organizational boundaries
- GHG emissions results shall be categorised/disaggregated as appropriate in the circumstances
- Movements in GHG emissions results over time, shall be disclosed and explained

(Climate Disclosure Standard Board, 2013)

This study intends to investigate carbon disclosure practices of Fortune 500 companies. The majority of the firms of this sample are from the following regions: North America, European Union, UK and Asia-Pacific. The disclosure frameworks for all these regions are discussed below:

2.3 Regional/country-wise carbon disclosure reporting frameworks

The following sections describe regional and country-wise disclosure frameworks that are relevant and useful for businesses who intend to disclose their climate change activities:

2.3.1 North America

Carbon disclosure reporting frameworks of United States of America (USA) and Canada are describe briefly in the following sections:

The United States of America:

In the USA, The Greenhouse Gas Reporting Program (GHGRP) requires reporting of greenhouse gas data and other relevant information from large GHG emission sources, fuel and industrial gas suppliers, and CO_2 injection sites. This data can be used by businesses and others to track and compare facilities' greenhouse gas emissions and identify opportunities to cut pollution, minimise wasted energy, and save money. A total of 41 categories of reporters are covered by the GHGRP. Facilities determine whether they are required to report based on the types of industrial operations located at the facility, their emission levels, or other factors. Facilities are generally required to submit annual reports if:

- GHG emissions from covered sources exceed 25,000 metric tons CO_2 equivalent per year
- Supply of certain products would result in over 25,000 metric tons CO_2 equivalent of GHG emissions, if those products were released, combusted, or oxidized

- The facility receives 25,000 metric tons or more of CO_2 for underground injection

Approximately 8,000 facilities are required to report their emissions annually. Total reported emissions from these facilities are about 3 billion metric tons CO_2 equivalent, which is about 50 percent of total U.S. GHG emissions. Additional GHGs are accounted for by approximately 1,000 suppliers. In total, data covering 85-90 percent of U.S GHG emissions are reported (The United States Environmental Protection Agency 2017).

In January 2010, the U.S. Securities and Exchange Commission issued new guidance clarifying that publicly-traded companies need to disclose financially material impacts related to climate change. Material impacts may range from compliance costs related to emissions regulation to the physical impacts of changing weather patterns on operations.

Specifically, the SEC's interpretative guidance highlights the following areas as examples of where climate change may trigger disclosure requirements:

- **Impact of Legislation and Regulation:** When assessing potential disclosure obligations, a company should consider whether the impact of certain existing laws and regulations regarding climate change is material. In certain circumstances, a company should also evaluate the potential impact of pending legislation and regulation related to this topic.
- **Impact of International Accords:** A company should consider and disclose when material, the risks or effects on its business of international accords and treaties relating to climate change.
- **Indirect Consequences of Regulation or Business Trends:** Legal, technological, political and scientific developments regarding climate change, may create new opportunities or risks for companies. For instance, a company

may face decreased demand for goods that produce significant greenhouse gas emissions, or increased demand for goods that result in lower emissions than competing products. As such, a company should consider for disclosure purposes, the actual or potential indirect consequences it may face due to climate change related regulatory or business trends.

- **Physical Impacts of Climate Change:** Companies should also evaluate for disclosure purposes, the actual and potential material impacts of environmental matters on their business (US Securities & Exchange Commission, 2015).

Many states in the USA have separately mandated disclosure of GHG emission. The Global Warming Solutions Act of 2006, is a California State Law that fights global warming by establishing a comprehensive program to reduce greenhouse gas emissions from all sources, throughout the state (California Air Resources Board, 2006). In 2003, New York State proposed and obtained commitments from nine Northeast states, to form a cap and trade carbon dioxide emissions, under a program for power generators, called the Regional Greenhouse Gas Initiative (RGGI). This program was launched on January 1, 2009, with the aim being to reduce the carbon "budget" of each state's electricity generation sector, to 10 percent below their 2009 allowances, by 2018.

Canada:

The Greenhouse Gas Emissions Reporting Program (GHGRP), collects information on greenhouse gas emissions annually, from facilities across Canada. It is a mandatory program for those who meet the requirements. Facilities that emit 50

kilotonnes or more of GHGs in carbon dioxide (CO_2) equivalent units, per year, must report their emissions to Environment and Climate Change Canada. Emissions data is available by gas (in tonnes, and tonnes of CO_2 equivalent), for each facility and each year of data collected (2004-Present). The GHGs included are: carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFC), perfluorocarbons (PFC) and sulphur hexafluoride (SF6).

Several provincial governments have established substantial programs to reduce emissions in their respective territories. British Columbia, Manitoba, Ontario and Quebec, have joined the Western Climate Initiative, a group of 7 states of the Western United States, whose aim is to establish a common framework for a carbon credit market Government of Canada, 2017).

2.3.2 European Union

In compliance with the Kyoto protocol, the European Union (EU) pioneered the first carbon reduction scheme known as the European Union Emissions Trading Scheme (EU ETS), in 2005, which mandated carbon reduction targets for all European Union members. The EU ETS is a cornerstone of the EU's policy to combat climate change, and its key tool for reducing greenhouse gas emissions cost-effectively. It operates in 31 countries (all 28 EU countries plus Iceland, Liechtenstein, and Norway). It limits emissions from more than 11,000 heavy energy-using installations (power stations & industrial plants) and airlines operating between these countries, and it covers around 45% of the EU's greenhouse gas emissions. As per this scheme, all EU members are asked to report their emissions progress against the United Nations Framework Convention on Climate Change (UN FCCC) commitments, to the EU commission. The

Reporting formats and guidelines are issued under European commission decision 2007/589/EC. These guidelines require the largest EU companies to report about the six greenhouse gases controlled by the Kyoto protocol. On top of that, EU members should report their progress against the Kyoto targets every two years (Aguiar 2009). Additionally, some EU member countries have introduced regulations that require the disclosure of environmental issues as well as GHG emissions. For instance, the Grenelle II Act in France, requires firms to include in their annual reports, a section on social and environmental consequences of their activities (Najah, 2012).

The EU ETS works on the 'cap and trade' principle. A cap is set on the total amount of certain greenhouse gases that can be emitted by installations covered by the system. The cap is reduced over time, so that total emissions fall. Within the cap, companies receive or buy emission allowances which they can trade with one another as needed. They can also buy limited amounts of international credits from emission-saving projects around the world. The limit on the total number of allowances available, ensures that they have a value. After each year, a company must surrender enough allowances to cover all its emissions, otherwise heavy fines are imposed. If a company reduces its emissions, it can keep the spare allowances to cover its future needs, or else sell them to another company that is short of allowances. Trading brings flexibility, that ensures emissions are cut where it costs least to do so. A robust carbon price also promotes investment in clean, low-carbon technologies (European Commission, 2017).

2.3.3 The United Kingdom

The government of the United Kingdom (UK), enacted Climate Change Act 2008, to deal with climate change and carbon emissions. The Act attempts to ensure that

the net UK carbon account for all six Kyoto greenhouse gases for the year 2050, is at least 80% lower than the 1990 baseline. The Act aims to enable the United Kingdom to become a low-carbon economy, by achieving a range of greenhouse gas reduction targets. An independent Committee on Climate Change, has been created under the Act to provide advice to the UK Government on these targets. This act covers businesses that were not considered in the EU ETS. According to this scheme, firms are required to measure their energy use and emissions, and report them to the government. The Act requires the Government to set legally binding emissions targets, called carbon budgets, every five years. It also established an independent expert body, the Committee on Climate Change (the CCC), to advise Government on the level of those emissions targets. It also reports to Parliament on progress made on reducing emissions (Najah, 2012).

2.3.4 Asia-Pacific

In the Asian and Pacific regions, most of the sample companies belong to Australia and Japan. In 2007, Australia introduced a single national framework, for corporations to report on greenhouse gas emissions, energy use, and energy production. That framework, known as the National Greenhouse and Energy Reporting (NGER) Scheme, operates under the National Greenhouse and Energy Reporting Act 2007 (Cth).

Corporations that meet an NGER threshold must register and then report each year. Information collected through the NGER Scheme provides the basis for assessing liability under the carbon pricing mechanism. The Clean Energy Regulator administers the NGER Act. Participation in the NGER scheme has been summarised in seven steps to assist reporting corporations. The following are the steps:

Thresholds: There are two types of thresholds to determine which corporations are required to participate in the NGER scheme. These are facility thresholds and corporate group thresholds. As a guide, businesses emitting more than 25,000 tonnes of carbon dioxide equivalent, or consuming more than 25,000-megawatt hours of electricity, or 2.5 million litres of fuel in a financial year, can expect to be required to report.

Registration: Corporations that meet a threshold must apply for registration.

Data collection: Registered corporations must collect data and keep records about the greenhouse gas emissions and energy use and production of the members of their group, so they can report each year. In particular, each registered corporation must keep records of the activities of the members of its group, that allow it to report accurately under the NGER Act, and enable the Regulator to ascertain whether the corporation has complied with its obligations under the NGER Act. Under the NGER Act (section 22, Records to be kept), corporations are required to keep all records (this would include those that inform decisions, and the final decisions made relating to the NGER Act), for five years from the end of the year in which the activities take place.

Reporting: Once registered, corporations are required to report each year that they remain registered. NGER reports are due by 31 October, following the financial year reporting period.

Data publication: The Clean Energy Regulator is required to publish a summary of reported information, by 28 February each year. The Clean Energy Regulator only publishes information for registered corporations that exceed the publishing threshold. This snapshot of corporations' greenhouse gas emissions and energy use, is used to inform government policy development, assist government programs and activities, and meet Australia's international reporting obligations.

Monitoring and compliance: Participants are encouraged to voluntarily comply with legislative requirements. The NGER Act provides a range of monitoring and enforcement powers, where required (e.g., penalties).

Audits: The NGER Act provides for greenhouse and energy audits of reporting corporations registered under the Act. It also requires a Register of Greenhouse and Energy Auditors. Audits determine if registered corporations are complying with the NGER Act.

Penalties: Corporations that fail to register and report, or otherwise fail to comply with their obligations under the NGER Act, may be liable for penalties. The NGER Act allows for administrative, civil, and/or criminal responses, in relation to contraventions of the Act. Part 5 of the NGER Act sets out penalty provisions. These include fines of up to $340,000 (2,000 penalty units) for failure to apply for registration, and daily fines of up to $17,000 (100 penalty units) for each day of non-compliance. Obligations under the NGER Act continue, even if the period has expired or the due date has passed (National Greenhouse and Energy Reporting Act, 2007, Cth).

Japan introduced in 2005 (effective April 2006) the Mandatory Greenhouse Gas Accounting and Reporting System, based on the revised Act on Promotion of Global Warming Countermeasures (Act No. 117 of 1998). This system requires specified entities (which emit GHG emissions above a defined threshold) to calculate their GHG emissions and report the results to the Government. Industrial companies, commercial businesses, universities, freight carriers, etc. (as specified in the Law Promoting the Rational Use of Energy) who consume more than 1,500kl (crude oil equivalent) of energy per year, or emit more than 3,000t-CO_2 per year, must report their GHG emission levels.

The main objective of the system is to promote voluntary emissions-reduction efforts of emitters, through assessment of the current GHG emission levels. Under this system, "specified establishment emitters" are considered those that use more than 1,500 kl energy per year by crude oil equivalent for all establishments, and that satisfy the following requirements:

- Conduct business activities with each establishment emitting 3,000 tons or more CO_2 by type of greenhouse emission gas;
- Employ 21 or more staff in total, for all establishments

The other category "specified transportation emitters," are considered those that fall in the transportation sector, including specified freight carriers, specified consigners, specified passenger carriers, and specified air carriers, under the Act on the Rational Use of Energy (Industrial Efficiency Policy Database, 2007).

2.4 Chapter summary

This section provides a background for this study, by discussing relevant institutional frameworks in regards to the carbon disclosure frameworks available across the globe. Global carbon disclosure frameworks available currently, such as The Global Reporting Initiatives, that include The Sustainability Reporting guidelines and Climate Change Reporting Frameworks, are discussed in detail in the first part of this section. The next part of this section discusses regional/country-wise carbon disclosure reporting frameworks, available in North America, European Union, United Kingdom and Asia-Pacific. In North America and Asia-Pacific, relevant frameworks from only USA, Canada, Australia and Japan respectively, are discussed, as most other counties from

these regions do not have any substantial carbon disclosure frameworks. The next chapter will discuss the theories that are relevant for this study.

CHAPTER 3 THEORETICAL BACKGROUND

3.1 Introduction

The previous chapter provides a background and context for this study by discussing relevant institutional frameworks in regard to the carbon disclosure frameworks available across the globe. The objective of this chapter is to review different theories, that have the potential to explain the relationship and interrelationship between carbon disclosure, carbon performance, financial performance and agency cost. This study utilises these theories to develop its hypothesis and explain its findings. The theories discussed in this chapter are Legitimacy Theory, Stakeholder Theory, Voluntary Disclosure Theory, Signalling Theory, Proprietary Costs Theory, Instrumental Stakeholder Theory, and Agency Theory. This chapter is structured as below:

Section 3.2 discusses Legitimacy Theory. Section 3.3 discusses Stakeholder Theory. Section 3.4 discusses Voluntary Disclosure Theory. Section 3.5 discusses Signalling Theory. Section 3.6 discusses Proprietary Cost Theory. Section 3.7 discusses Instrumental Stakeholder Theory. Section 3.8 discusses Agency Theory and Section 3.9 summarises the chapter.

There are primarily two types of theories that have been used in prior research to explain the relationship between corporate performance and voluntary disclosure. They are categorised as socio-political theories, such as Legitimacy Theory and Stakeholder Theory, and economic-based theories, such as Signalling Theory and Voluntary Disclosure Theory.

3.2 Legitimacy Theory

As per Cormier and Gordon (2001), the concept of legitimacy originates from the social contract concept, where an organisation derives its legitimacy from the contract between it and society. Legitimacy is defined by Lindblom (1994) as a condition or status which exists when an entity's value system is congruent with the value system of the larger social system of which the entity is a part. When a disparity, actual or potential, exists between the two values systems, there is a threat to the entity's legitimacy. Suchman (1995) defines legitimacy as "a generalized perception or assumption that the actions of an entity are desirable, proper, or appropriate within some socially constructed system of norms, values, beliefs, and definitions".

As mentioned earlier, the concept of a social contract is related to Legitimacy Theory. Companies and other organisations exist at society's will and are beholden to some degree to society's wishes. Legitimacy is accomplished if society perceives that the company is operating in accordance with the existing norms and values of the society. Therefore, the organisation will always try to seek the legitimacy that is given by the society based on the social contract between them. When the organisation feels that its legitimacy is threatened, it will pursue several strategies to retain this legitimacy.

Therefore, organisations may use social and environmental disclosure as a tool to deal with society's demands and needs. By making social and environmental disclosures, firms attempt to convey a message to several types of stakeholders, highlighting that they are conforming to their expectations, and persuading them about their performance in order to maintain their legitimacy (Cotter et al., 2011).

As per Hannele (2010), if the organisation is not considered legitimate by the society, i.e. if a legitimacy gap exists, the organisation may use different strategies to bridge the gap. The actions taken in such a situation depend on management's perceptions of the threats to legitimacy.

As per Lindblom (1994), when management perceives that a legitimacy gap exists, they will implement different strategies such as:

- to correct the behaviour of their organisation realigning it with the desires of society
- to change the perception that society has of their behaviour, but not the Behaviour itself
- to transform the perception that society has of their behaviour, manipulating it, deceiving it, or simply distracting its attention, and/or
- to indoctrinate society with the aim of modifying its expectations and accommodate them to the organisation's ends

Legitimacy Theory assumes that businesses may disclose social and environmental information voluntarily, to legitimise their activities, so as to give the impression of being socially responsible to the society (Deegan, 2002; O'Donovan, 1999). Therefore, Legitimacy Theory has been used by many previous studies such as Deegan et al. (2000), Deegan (2002) and Gray et al. (1996), to explain the reasons for social and environmental disclosure.

When a business feels threatened as a result of its poor performance, it releases positive information to refine its image and bridge the legitimacy gap (Deegan & Rankin, 1996; O'Donovan, 2002). In this case, businesses use soft social and

environmental disclosure to deal with society's demands and needs (Freedman & Jaggi, 2005; Lindblom, 1994; Reverte, 2009). By making positive social and environmental disclosure, businesses indicate to several types of stakeholders, that they are meeting their expectations (Deegan & Gordon, 1996; Deegan & Rankin, 1996). These firms release positive social and environmental information, via annual reports (Cho & Patten, 2007; Deegan et al., 2000; O'Donovan, 2002) and corporate websites (Cho & Roberts, 2010), to maintain legitimacy in the eyes of stakeholders.

In summary, when businesses feel there is a lack of legitimacy due to breach of social contract, they would make positive social and environmental disclosure to retain legitimacy.

3.3 Stakeholder Theory

Stakeholders have been defined by Freeman and Reed (1983, p.91) as "any identifiable group or individual who can affect the achievement of an organisation's objectives, or is affected by the achievement of an organisation's objectives". According to this definition, many people or organisations can be classified as stakeholders such as shareholders, creditors, government, media, employees, local communities, local charities future generation etc. (Deegan & Unerman, 2006). Clarkson (1995, pp 106-107) divides stakeholders into primary and secondary stakeholders. Primary stakeholders are defined as "one without whose continuing support the corporation cannot survive as a going concern". While secondary stakeholders are defined as "those who influence or affect, or are influenced or affected by the corporation". However, these stakeholders are not engaged in transactions with the corporation, and are not

essential for its survival. O' Dwyer (2005) suggests that the broader ethical perspective that both primary and secondary stakeholders have particular minimum rights that should not be violated, can be extended to the notion that all stakeholders also have the right to be provided with information about how the organisation is affecting them by means of, for example, pollution, community sponsorship, provision of employment, safety initiatives etc., even if they choose not to use the information and even if they cannot directly have an impact on the survival of the organisation.

Stakeholder Theory has two branches: the ethical branch or normative branch, and the managerial branch or positive branch. Ethical branch argues that all stakeholders have the right to be treated fairly by an organisation. It also argues that issues of stakeholder power are not directly relevant. Therefore, the impact of the organisation on the life experience of a stakeholder should determine the organisation's responsibility to that stakeholder, rather than the extent of that stakeholder's economic power over the organisation (Deegan & Unerman, 2006). As per Hasnas (1998), the ethical branch of Stakeholder Theory, states that managers should manage the business for the benefit of all stakeholders", rather than for the stockholders only, regardless of whether stakeholder management leads to improved financial performance or not. According to the normative Stakeholder Theory, management must give equal consideration to the interests of all stakeholders, and, when these interests conflict, management should manage the business in a way so that it attains the optimal balance among them. Therefore, normative branch of Stakeholder Theory suggests that businesses have true social responsibilities.

The managerial branch of the Stakeholder Theory, assumes that expectations of various stakeholders will impact on an organisation's operating and disclosure policies.

However, the organisation will not respond to all stakeholders, rather it will respond to those that it deems to be powerful (Bailey et al., 2000; Buhr, 2002). Nasi et al. (1997) suggest that the most powerful stakeholder will be attended to first. This view is supported by Wallace (1995, p. 87) who argues that the higher the group in the stakeholder hierarchy, the more clout they have and the more complex their requirements will be.

According to Gray et al. (1996, p.45) this perspective tends to be more 'organisation-cantered'. Under this perspective, stakeholders are identified by the organisation of concern, by reference to the extent to which the organisation believes the interplay with each group needs to be managed in order to further the interests of the organisation. The more important the stakeholder to the organisation, the more effort will be exerted in managing the relationship. Information is a major element that can be employed by organisations to manage or manipulate the stakeholder in order to gain their support and approval or to distract their opposition and disapproval.

A stakeholder's power to influence corporate management is viewed as a function of the stakeholder's degree to control over resources required by the organisation. The more critical the stakeholder resources are to the continued viability and success of the organisation, the greater the expectation that stakeholder demand will be addressed. A successful organisation is considered to be one that satisfies the demands (sometimes conflicting) of various powerful stakeholder groups. Therefore, the organisations will undertake various activities such as public reporting, to meet the expectations of important stakeholders. Organisations will have incentives to disclose information about their activities to respective stakeholder groups, to indicate clearly that they are conforming with those stakeholder groups (Ullman, 1985).

Under ethical branch, firms focus on a broad range of stakeholders and their various information needs (Gray et al., 1996). However, under the managerial branch, firms' management uses disclosure as a tool to deal only with the informational needs of the various powerful stakeholder groups (Bailey et al., 2000; Reverte, 2009). Therefore, Stakeholder Theory suggests that businesses would use disclosure practices as an important tool to maintain their legitimacy, and to meet its stakeholders' expectations.

3.4 Voluntary Disclosure Theory

Meek et al. (1995, p.555), define voluntary disclosure as "free choices on the part of company management to provide accounting and other information deemed relevant to the decision needs of users of their annual reports". Voluntary disclosure tries to provide a clear view to stakeholders about the business's long-term sustainability and reducing information asymmetry and agency conflicts between managers and investors (Healy & Palepu, 2001; Boesso & Kumar, 2007).

According to Verrecchia (1983); Dye (1985) and Clarkson et al. (2008), Voluntary Disclosure Theory assumes that firms with superior environmental performance will be motivated to disclose information about their good performance practices, to differentiate themselves from firms with inferior environmental performance. To achieve these objectives, good performers will disclose verifiable or actual information about their environmental performance. This type of information is difficult to mimic by a firm's counterparts and competitors. Conversely, firms with poor environmental performance, will prefer to be silent about their performance if outsiders

are unable to identify whether the non-disclosure of performance information originates from poor performance or from high proprietary costs (Verrecchia, 1983).

On a similar note, Clarkson et al. (2008) predict a positive association between environmental performance and the level of discretionary environmental disclosure. The reason being, superior environmental performers, will convey their ‘‘type’’ by pointing to objective environmental performance indicators which are difficult to mimic by inferior type firms. On the other hand, inferior performers will choose to disclose less or to be ‘‘silent’’ on their environmental performance, thus being placed in a pool of firms where investors and other users ascribe the ‘‘average type’’ to that pool.

3.5 Signalling Theory

Signalling Theory can be used to explain the motivation of firms to voluntarily disclose company information (Bin Abdullah, 2008). Signalling Theory is concerned with the issue of information asymmetry problems (Akerlof 1970; Levin, 2001; Morris, 1987; Ross, 1977). This theory explains how information asymmetry problems (one party having more or better information than others) can be reduced by the party with more information signalling it to others. As part of signalling, companies communicate firm quality or value through voluntary disclosure, financial accounts and so on. In the case of voluntary corporate disclosure, managers provide additional information to investors, to help them make investment decisions (Cotter et al., 2011). Companies with good performance are likely to disclose more information, to signal their good quality to investors (Bin Abdullah, 2008).

Signalling Theory was originally developed to clarify the information asymmetry in the labour market (Spence, 1978). Subsequently, it has been used to explain voluntary

corporate disclosures (Ross, 1977). Signalling Theory discusses how to address problems caused by information asymmetry in any social setting. It suggests that information asymmetry should be reduced if the party possessing more information can send signals to interested parties (An et al., 2011). As a result of the information asymmetry problem, companies signal certain information to investors, to show that they are better than other companies in the market, for the purpose of attracting investments and enhancing a favourable reputation (Verrecchia, 1983).

A signal can be an observable action, or an observable structure, which is used to indicate the hidden characteristics (or quality) of the signaller. The sending of a signal is usually based on the assumption that it should be favourable to the signaller, e.g., indicating a higher quality of its products compared to its competitors (An et al., 2011).

By signalling companies, on the one hand, would make investors and other stakeholders reassess the value of the company, and then make decisions more favourable to the company (Whiting & Miller, 2008). On the other hand, the favour of various stakeholders would make a company obtain more investment, and therefore reduce the costs of raising capital. There are a number of means for companies to signal information about themselves. Among those, voluntary disclosure of positive accounting information is considered to be one of the most effective (Ross, 1979; Watson et al., 2002 and Xiao et al., 2004). Voluntary disclosure is used for signalling, where companies would disclose more information than required by mandatory laws and regulations, in order to signal that they are better (Campbell et al., 2001). To be effective, the signal must be difficult to be copied by another firm (Morris 1987). One of the ways, for example, a business can achieve this is to make hard disclosures (Clarkson

et al., 2008) regarding its superior environmental performance through discretionary disclosure channels, by using objective measure.

As signalling and voluntary disclosure theories predict a positive relationship between environmental performance and environmental disclosure, we can assume that superior carbon performers would try to distinguish themselves from poor carbon performers, by making verifiable and hard disclosures to signal their good carbon performance to various stakeholders.

Contrary to previous theories, Proprietary Costs Theory states that companies limit voluntary disclosure of relevant information to the financial market because of disclosure-related costs, such as preparation and competitive costs. (Verrecchia, 1983; Dye, 1986; Darrough & Stoughton, 1990; Wagenhofer, 1990). As proprietary cost theory provides a completely different perspective as to why some businesses do not like to disclose at all regardless of their performance, this theory is discussed below briefly.

3.6 Proprietary Costs Theory

According to Healy and Palepu (2001), firms' decisions to disclose information to investors, is influenced by concern that such disclosures can damage their competitive position in the markets. Studies such as Verrecchia (1983); Darrough and Stoughton (1990); Wagenhofer (1990); Feltham and Xie (1992); Newman and Sansing (1993); Darrough (1993); Gigler (1994), conclude that firms have an incentive not to disclose information that will reduce their competitive position, even if it makes it more costly to raise additional equity. Therefore, the managers may be unwilling to disclose more

information if they believe it contains proprietary information which can be harmful to their firm (Dye, 1985; Verrecchia, 1983, 1990).

As per Prencipe (2004), proprietary costs theory considers not only the benefits, but also the costs related to the release of information. Particularly, it states that companies limit voluntary disclosure when proprietary costs arise from it. These costs include not only the costs of preparing, disseminating and auditing information, but also the cost deriving from disclosing information which may be used by competitors and other parties in a way that is harmful for the reporting company.

Proprietary costs can be divided into two types: internal costs which include the costs of preparing and disclosing information, and external costs which result from a consequence of competitors' action to use the information disclosed for their own advantage (Prencipe, 2004). Hence, firms have an incentive to voluntarily disclose certain information if: a) they seek some benefits from this disclosure such as reduction in the cost of equity capital (Botosan, 1997; Botosan & Plumlee, 2002) or debt capital (Sengupta, 1998), and the benefits of this disclosure exceeds its costs; or b) the disclosure of this information does not harm the firm' share value, and in turn can facilitate a reduction in information asymmetry problems (Cotter et al, 2011).

3.7 Instrumental Stakeholder Theory

Instrumental Stakeholder Theory suggests that everything else being equal, firms that practice stakeholder management will perform better in profitability, stability, and growth etc. terms. It implies "certain" results can be obtained if "certain" behaviours are adopted (Pesqueux & Damak-Ayadi, 2005). Donaldson and Preston (1995, p. 71) claim

that Instrumental Stakeholder Theory can be “used to identify the connections, or lack of connections, between stakeholder management, and the achievement of traditional corporate objectives”. Therefore, Instrumental Stakeholder Theory could be interpreted as research into the positive or negative links between stakeholder management and financial performance, and into what would explain these links (Egels-Zandén & Sandberg, 2010). Donaldson and Preston (1995. p. 67) also describe instrumental Stakeholder Theory as “the proposition that corporations practicing stakeholder management will, other things being equal, be relatively successful in conventional performance terms.

3.8 Agency Theory

Agency theory describes the agency relationships between managers and shareholders, and between shareholders and debt holders (Jensen & Meckling, 1976 and Watts and Zimmerman, 1978, 1983). Jensen and Meckling (1976, p.308) define the agency relationship as “a contract under which one or more persons (the principals) engage another person (the agent) to perform some service on their behalf, which involves delegating some decision-making authority to the agent”. Agents correspond to managers, whereas principals correspond to shareholders, from a company’s perspective. Agency theory is based on the problems related to the separation of ownership and control. Agency problem may arise, when the management (agent) make decisions on behalf of the owners/shareholder (principals).

As per Cotter et al. (2011), providers of capital, such as shareholders and creditors, delegate strategic and operational decision making to managers. Managers

should therefore, act and make decisions that maximise shareholders' value, and ensure payment of debts to the creditors. However, as agency theory suggests, managers (the agents) make use of their position and power for their own benefit, rather than the benefit of shareholders and creditors (the principals). This agency problem occurs because of separation of firm ownership and control, and is worsened by information asymmetry problems between managers and debt holders. This information asymmetry happens as managers have better knowledge about firm's future value compared to shareholders and creditors. This can result in adverse selection and moral hazard problems, because capital providers are not sure whether managers are acting in their best interests. Managers, shareholders and creditors all have incentives to pursue their own interests. Monitoring and bonding devices are the most common tools used by capital providers to reduce agency and information asymmetry problems. Jensen and Meckling (1976) have identified three types of costs that arise due to an agency problem. These costs are Monitoring costs, Bonding cost, and Residual loss. These costs are briefly described below:

Monitoring Costs:

Monitoring costs are incurred when the shareholders/debt holders (principals) try to monitor the activities of the management (agents). Jensen and Meckling (1976) suggest that principal and agent are concerned in maximizing their own interest or wealth, while agents (decision makers) may not take actions in the best interest of the owners (principals). Therefore, the principal has to monitor the agents by setting up monitoring mechanisms. Examples of monitoring devices that are used by shareholders to ensure managers provide complete information, include the appointment of a board of

directors, the use of board committees, and hiring of external auditors who will audit the financial reports (Cotter et al., 2011). The cost of undertaking the audits and cost of having a board committee, can be referred to as monitoring costs.

Bonding Costs:

As agents are concerned with maximising their own wealth, a bonding device needs to be established that will align the interest of the managers (agent) of the firm, with those of the owners, the shareholders (Henderson et al., 1992). The bonding devices that could be used are contractual agreements such as debt contracts and compensation packages provided to managers, that bond managers' interest to those of the capital providers. On the other hand, managers have incentives to provide credible information to shareholders and debt holders, and they do this by preparing audited financial reports and other disclosures (Watson et al., 2002). Managers are required to bond themselves to prepare these financial statements, which are costly and referred to as bonding cost (Mamun et al., 2013). However, Jensen and Meckling (1976) argue that agents may take action by spending resources in assuring that it would not take actions which would not have a negative effect on the principal, which is considered as bonding costs.

Residual Loss:

Even after monitoring and bonding costs are incurred, there may still be a loss to the principals due to the agents making decisions that are different from those that could maximize principals' interest (Williamson, 1988). This loss is recognized as a residual loss.

In summary, the divergence of action due to the incomplete alignment of the interests of agents and principals, may lead to an agency problem. The sacrifice of wealth by the principal and potential costs associated with monitoring the agents, is known as the agency cost.

3.9 Chapter summary

In summary, The Legitimacy Theory suggests that when businesses feel there is a lack of legitimacy due to a breach of social contract, they would make positive social and environmental disclosure to retain their legitimacy. Stakeholder Theory suggests that businesses would use disclosure practices as an important tool to maintain their legitimacy and to meet its stakeholders' expectations. Voluntary Disclosure Theory and Signalling Theory, assume that firms with superior environmental performance will be motivated to disclose information about their good performance practices, to differentiate themselves from firms with inferior environmental performance, and to signal their superior performance to the investors. Instrumental Stakeholder Theory suggests that everything else being equal, firms that practice stakeholder management will perform better in profitability, stability, and growth, etc. terms. Agency Theory suggests managers (the agents) make use of their position and power for their own benefit, rather than the benefit of shareholders and creditors (the principals). The sacrifice of wealth by the principal and costs associated with monitoring the agents is known as the agency cost. These theories will be used in subsequent chapters, to analyse relevant literature, formulate hypotheses for this study, and interpret the findings of this study. The next chapter discusses existing literature relevant to this study.

CHAPTER 4 LITERATURE REVIEW

4.1 Introduction

The primary objective of this chapter is to provide an extensive review of existing literature that deal with relationship and interrelationship between carbon disclosures, carbon performance, financial performance and agency cost. As carbon disclosure and carbon performance are sub-sets of environmental disclosure and environmental performance, and there are limited research on carbon disclosure and carbon performance, this study will also shed light on existing studies that discuss the relationship between environmental disclosure and environmental performance. This chapter is structured as below:

Section 4.2 reviews existing research that investigates the relationship between environmental disclosure/carbon disclosure, and environmental performance/carbon performance. Section 4.3 provides a review of literature that deal with the relationship between environmental performance/carbon performance and financial performance. Section 4.4 discusses prior literature that investigates the interrelationship between carbon performance and financial performance. Section 4.5 reviews prior literature relevant to the relationship between carbon disclosure and financial performance. Section 4.6 deals with the relationship between carbon disclosure/carbon performance and agency cost. Prior studies that conducted trend analysis for improvement of carbon disclosure and carbon performance, are discussed in section 4.7. Section 4.8 provides a summary of the chapter.

4.2 Relationship between environmental disclosure/carbon disclosure and environmental performance/carbon performance

There are vast amount of studies that examine the relationship between environmental performance and environmental disclosure, however, findings of these studies had been inconclusive. Some of these studies suggest a negative relationship between environmental performance and environmental disclosure, while others suggest a positive relationship. A few studies find no relationship between environmental performance and environmental disclosure. On the other hand, being a very recent area of research, there are not many studies that investigate the relationship between carbon disclosure and carbon performance. The following sections discuss previous studies that deal with the relationship between environmental performance/carbon performance and environmental disclosure/carbon disclosure:

4.2.1 Relationship between environmental disclosure and environmental performance

One of the most important studies that find positive relationship between environmental performance and environmental disclosure is the study by Clarkson et al. (2008). This study attempts to investigate a hitherto unresolved research issue in environmental accounting - the empirical association between the level of corporate environmental disclosures and corporate environmental performance. The authors revisit this relation by testing competing predictions from economics based and socio-political theories of voluntary disclosure, using a more rigorous research design than used in the previous research. They find that there is a positive association between environmental performance and the level of discretionary disclosures in environmental and social

reports or related web disclosures. In other words, they find superior environmental performers are more forthcoming in truly discretionary disclosure channels, as predicted by economics based voluntary disclosure theories. However, the results are inconsistent with the negative association predicted by socio-political theories.

Al-Tuwaijri et al. (2004) investigate the relationships between economic performance, environmental performance, and environmental disclosure, after explicitly considering that these three corporate functions are jointly determined. They find that good environmental performance is positively associated with good economic performance. They also suggest that good environmental performance is associated with more extensive quantifiable environmental disclosures of specific pollution measures and occurrences.

As mentioned earlier, the theory that explains a positive relationship between environmental performance and environmental disclosure is the Voluntary Disclosure Theory. This theory suggests that companies have incentives to disclose 'good news' to differentiate themselves from companies with 'bad news', to avoid the adverse selection problem (Dye, 1986; Verrecchia, 1983). According to Voluntary Disclosure Theory, businesses are likely to disclose their practices and performance when the perceived benefits exceed the associated costs; especially when they want to maximise their market value (Clarkson et al., 1992). There are benefits in disclosing positive information and costs in disclosing negative information, especially when stakeholders are not aware of the negative (Li et al., 1997). Voluntary Disclosure Theory, therefore predicts that companies will selectively disclose positive information, and will disclose more positive information if their environmental performance is good and they wish to distinguish themselves from bad or average performers. This, coupled with pressure from some

investors and consumers for good environmental performance, would lead to more positive perceptions of the firm and higher market value. They will also withhold negative information unless conditions force them to disclose it (Dye, 1985). Bewley and Li (2000) and Li et al. (1997), have argued that true environmental performance is not directly observable to investors; thus, companies with superior performance tend to make direct voluntary disclosures that cannot be easily matched by poor performers (Clarkson et al., 2008). Hence, this theory predicts a positive association between environmental performance and the level of discretionary environmental disclosure.

On the other hand, a high number of studies dealing with the relationship between environmental performance and environmental disclosure, find a negative relationship between performance and disclosure. These studies suggest companies with inferior environmental performance make more environmental disclosures.

Clarkson et al. (2011) examine how the environmental information voluntarily disclosed by a sample of Australian firms, relates to their underlying environmental performance. They focus on both the level and nature of environmental disclosures found in annual reports and stand-alone environmental or sustainability reports, and score the disclosures using an index developed by Clarkson et al. (2008) based on Global Reporting Initiative (GRI) Guidelines. The study, consistent with predictions of socio-political theories, finds that firms with greater emissions (a higher pollution propensity) make more environmental disclosures in total.

Freedman et al. (2004) and Freedman and Stagliano (2008) assess the association between environmental performance and environmental reporting of US electric utilities affected by the 1990 Clean Air Act (CAA). The emission of Sulphur Dioxide (SO_2) is used as the measure for environmental performance. From the examination of the annual

reports and 10Ks of 38 companies in 1990 and 1995, Freedman et al. (2004) find that companies with higher SO_2 emissions level, greater number of power plants targeted for SO_2 emissions reduction under the CAA and SO_2 emissions allowance shortfall, published greater SO_2 emissions disclosure. Freedman and Stagliano (2008), examine the SO_2 emissions disclosure of 32 electric utilities in 1999 and 2001. They consider all disclosure made in the annual reports, 10Ks and stand-alone reports and on the company websites. Companies with higher SO_2 emissions level that did not meet the SO_2 emissions standard and needed more SO_2 emissions allowance made extensive SO_2 emissions disclosure.

Berthelot et al. (2003) summarise the reasons for an organisation to increase its environmental disclosure. One of the reasons they find is poor environmental performance.

Cho and Patten (2007) and Patten (2002a, 2002b), observe that companies with poor environmental performance would be subject to greater exposure to the potential public and regulatory scrutiny, than companies with relatively better environmental performance. Their studies suggest that poor environmental performance leads to higher level of environmental disclosure.

Deegan and Rankin (1996) investigate the environmental reporting practices of a sample of 20 Australian companies which were successfully prosecuted by the New South Wales and Victorian Environmental Protection Authorities, during the period 1990-1993. This study finds that organisations (both prosecuted and non-prosecuted) are not very willing to provide any information within their annual reports about any negative environmental implications of their operations. This is consistent with findings of previous studies. The prosecuted firms provided significantly more positive

environmental disclosures than non-prosecuted firms. This implies that firms which have been prosecuted tend to counter the negative news of their prosecution with positive news about their environmental initiatives.

Some other prior empirical research such as Brammer and Pavelin (2006); De Villiers and Van Staden (2009); Gray et al. (1996); Hackston and Milne (1996), provide evidence on the predisposition of poor environmental performers, to disclose extensive environmental disclosure and/or highlight positive environmental actions while suppressing negative environmental effects.

The negative relationship between environmental performance and environmental disclosure could be explained by Legitimacy Theory and Stakeholder Theory. According to these theories, businesses with poor carbon performance would disclose positive but unverifiable information about their environmental performance to maintain legitimacy, positively influence perceptions of stakeholders, and avoid any possibility of litigation. Therefore, it can be assumed that companies with inferior environmental performance would make more environmental disclosure

In additon, there are few studies that find no relationship between environmental performance and environmental disclosure. By comparing the content analysis ratings of Environmental Information Disclosure (EID) in annual reports, with environmental performance ratings obtained from the Council on Economic Priorities (CEP), Ingram and Frazier (1980) show that there is no association between environmental performance and EID. After studying the 26 largest CEP-rated companies in the US, based on an EID index comprising 18 items across four categories, Wiseman (1982) obtains the same results. Freedman and Wasley (1990) examine 49 CEP-rated companies and found that

neither the annual report nor the 10-K environmental report, was indicative of a firm's actual environmental performance.

Sutantoputra et al. in their 2012 study, identify the level of environmental disclosure of 53 ASX200 Australian listed companies and test whether better-performing companies with either lower emissions or more positive Corporate Monitor environmental ratings, were likely to disclose more information on their environmental performance. This research finds no evidence that good performers disclose more as a way of promoting themselves and separating themselves from poor performers, or that poor environmental performers disclose more by relaying as much positive information as they can to try to improve their public image.

4.2.2 Relationship between carbon disclosure and carbon performance

As carbon disclosure is a very new area of research, there are not many studies that investigate the relationship between carbon disclosure and carbon performance. Some of the most relevant studies are discussed below:

Peng et al. (2015) use hand-collected data from the annual CSRs of listed companies in China during 2008–2010, to investigate two questions: (i) what factors cause the companies' decisions of whether or not to make carbon information disclosure and (ii) what forces influence the extent to which carbon emission information is disclosed. In this paper, they examine both external and internal factors, and they find that companies operating in high-emission sectors are more likely to make carbon information disclosure and tend to disclose more information. In addition, firms which have better performance are more willing to make the carbon information disclosure, but the content of their disclosure does not significantly differ from those with relatively

poorer performance. This study also shows that a company may be more likely to make carbon information disclosure when the number of industry competitors engaging in carbon information disclosure increases. Finally, the study results suggest that companies' decisions of whether to make carbon information disclosure may follow the moves of their industry peers.

Freedman and Jaggi (2004) examine the association between CO_2 emissions and environmental disclosure. They investigate the disclosure made in the annual reports and 10Ks of 66 US electric utilities. They find that only one-third of emitters made such disclosures. They observe that companies with a higher level of CO_2 emissions provide more disclosure, and company size (total assets), profitability (return on equity) and market risk (beta), does not influence the extent of the CO_2 emissions disclosure.

Sullivan and Kozak (2006) study the climate change disclosure of European electricity utilities. They observe that although many of the European electricity utilities reviewed provided a significant amount of information on their greenhouse gas emissions and related aspects of their business strategy, the majority did not provide sufficient information as needed by an institutional investor. Information provided by the companies did not explain how climate change issues were factored into business decision making or overall strategy, and most of the company reporting focused on historic performance rather than on the consideration of future trends in policy and company emissions.

Alrazi et al. (2010) examine the quality and the determinants of the environmental reporting published by 51 electric utilities from several countries. They find that the quality of the reporting was relatively high. The association between environmental performance and environmental reporting is only significant for CO_2

emission disclosures in the annual reports (not on websites). Companies from code law countries produce higher quality environmental information than companies from common law countries. Law enforcement and company size are positively associated with CO_2 emissions disclosure.

Cotter and Najah (2012) re-investigate the relationship between environmental performance and carbon and climate change related disclosure. They also examine the consequence of implementing carbon risk management and disclosure on both investors and non-investor stakeholders. The results of this study show that carbon risk management is significantly and positively associated with carbon disclosure quality that is made via CDP and sustainability reports, and thereby support the economics-based disclosure theories. Companies with good carbon risk management records disclose such information to separate themselves from inferior firms. These disclosures assist firms to reduce information asymmetry problems between the firm and external parties, especially its investors. This research also finds that while the firms' management has committed to reduce their carbon emission levels and adopted several strategies to mitigate climate change risks, these practices have neither reduced the ex-ante cost of equity capital nor increased the market value. In general, the results suggest that although investors are gradually becoming more interested in climate change information; the use of this data among mainstream investors is yet not very common. The last finding of this study shows that although carbon disclosure is not associated with non- investor stakeholders' perceptions, carbon risk management is positively and significantly associated. This could lead to a conclusion that instead of using disclosures, firms' management uses their carbon risk management activities to influence non-investor stakeholders' perceptions about these activities.

Cotter et al. (2011) investigate three important issues in climate change reporting in the Australian context. It explores (a) the gaps between regulatory requirements and authoritative guidance regarding climate disclosure in Australia, (b) reporting practices in this area, and (c) the demands for increased disclosure and standardization of that disclosure. The study result indicates that there seems to be a lack of sufficient disclosure in company reports and websites about several aspects of climate change impacts and their management. The results also show that the disclosures that are made tend to lack technical detail and are somewhat skewed towards the more positive aspects of climate change impacts and management.

Rankin et al. (2011) use institutional governance systems theory to examine hypothesized links between voluntary Australian corporate GHG disclosures, internal organizational systems, and private regulation, that guide GHG disclosures as evidence of reported corporate response to climate change. The study finds evidence of proactive corporate GHG disclosures within the "market governance system" in existence in Australia in 2007 where companies operated in a public policy vacuum in relation to climate change. Results of the two model analyses indicate that firms which disclose GHG emissions information are more likely to have also implemented an environmental management system (EMS), have stronger governance systems, make publicly available disclosures to the CDP, are larger, and operate in either the energy and mining or industrial sector. When the authors examine the extent and credibility of disclosures by the sub-sample of 80 firms that disclose GHG emissions data, they find that those firms are more likely to have an EMS that is ISO 14001-certified, use the Global Reporting Initiative (GRI) to guide sustainability disclosures, and disclose to the CDP, with those disclosures being publicly available. In addition, larger firms in the mining and energy

and industrial sectors are also more likely to disclose credible GHG emissions information guided by ISO 14064-1.

4.2.3 Summary of previous studies dealing with the relationship between environmental disclosure/carbon disclosure and environmental performance /carbon performance

In summary, findings of previous studies dealing with environmental disclosure/carbon disclosure and environmental performance/carbon performance, show inconclusive results. Studies such as Clarkson et al. (2011), Freedman et al. (2004), Freedman and Stagliano (2008), Berthelot et al. (2003), Cho and Patten (2007), Patten (2002a, 2002b), and Deegan and Rankin (1996), predict that poor environmental performance will lead businesses to make higher level of environmental disclosures. Freedman and Jaggi (2004) predict a negative association between carbon performance and carbon disclosure. On the other hand, studies such as Clarkson et al (2008), and Al-Tuwaijri et al. (2004), suggest that superior environmental performers will make more extensive quantifiable disclosure. Similar results are found from studies that examine relationship between carbon disclosure and carbon performance. Studies such as Peng et al. (2015), and Cotter and Najah (2012), predict positive association between carbon performance and carbon disclosure

4.3 Relationship between environmental performance/carbon performance and financial performance

As mentioned earlier, the study of carbon performance is a relatively new field of study which falls under the broad area of environmental performance. Therefore, before discussing the relationship between carbon performance and financial performance, the relationship between environmental performance and financial performance will be discussed first. A vast amount of research have been done to predict impact of firm's environmental performance on its financial performance. However, these studies largely produce conflicting findings. While the majority of the studies indicate a positive impact of firm's environmental performance on its financial performance, a good number of studies indicate negative impact and some even show no impact.

The following sections will review existing literature and theories in order to understand the relationship between environmental performance and financial performance, and carbon performance and financial performance.

4.3.1 Relationship between environmental performance and financial performance

Jaggi and Freedman (1992) evaluate the impact of pollution performance of pulp and paper firms in the United States, on their economic and market performance. Pollution performance measurement is based on a pollution index developed from pollution emission reports filed with the regional offices of the Environmental Protection Agency by pulp and paper firms for their individual plants. Economic performance is measured by Net Income, ROE, ROA, Cash flow/Equity and Cash flow/Assets; market performance is measured by the PE ratio and systematic risk. The association between

the pollution index and economic and market performance variables is tested by the Pearson Correlation Coefficients. The results of this study indicate that, in the short run, pollution performance is negatively associated with economic performance, and that the markets do not reward good pollution performance.

Cordeiro and Sarkis (1997) argue that studies that try to evaluate the relationship between corporate environmental pro-activism and financial performance by using historical corporate accounting performance and stock market measures of performance, do not yield any consistent pattern of relationship between firm's environmental pro-activism and financial performance. The authors revisit this relationship using a novel measure of firm performance: security analyst earnings forecasts. Their study demonstrates a significant, negative relationship between environmental pro-activism (using Toxic Release Inventory data) and industry analyst 1- and 5-year earnings-per-share performance forecasts for a sample of 523 US firms in 1992.

Filbeck and Gorman (2004) utilize data from the Investor Responsibility Research Centre as well as a proprietary database, to investigate the relationship between environmental performance and financial performance of electric utilities in the United States. They chose this sector because, as producers and distributors of energy, utilities produce substantial amounts of pollution. Their result differs from many of the earlier studies in that they do not find a positive relationship between holding period returns and an industry-adjusted measure of environmental performance. They in fact, find evidence of a negative relationship between financial return and a more pro-active measure of environmental performance.

Wagner et al. (2002) examine the relationship between the environmental and economic performance of firms in the European paper manufacturing industry. It

initially discusses possible functional relationships between environmental and economic performance rooted in different theoretical frameworks and links these to recent empirical and theoretical analyses of the Porter hypothesis. Following this, it reports the results of an empirical study carried out in the European paper industry. Findings of the study fit better with 'traditionalist' reasoning about the relationship between environmental and economic performance, which predicts the relationship to be uniformly negative.

Sarkis and Cordeiro (2001) investigate separately the differential relationships between pollution prevention and end-of-pipe efficiencies, with a short-run financial performance which is measured using return on sales (ROS). After controlling for both firm size and financial leverage, the authors find that for 482 US firms in 1992, pollution prevention and end-of-pipe efficiencies are both negatively related to ROS, and that this negative relationship is larger and more significant for pollution prevention efficiencies. These findings contradict studies that argue waste minimization, recycling, remanufacturing, and other environmental practices, will greatly enhance the "bottom-line" for organisations.

As mentioned earlier, the traditional view among scholars regarding environmental protection, is that it comes at an additional cost imposed on firms, which may weaken their global competitiveness. This traditional paradigm was challenged by Professor Michael Porter (Porter, 1991) and his co-author Claas van der Linde (Porter and van der Linde, 1995). Based on case studies, the authors suggest that pollution is often a waste of resources, and that a reduction in pollution may lead to an improvement in the productivity where the resources are used. More stringent but properly designed environmental regulations (in particular, market-based instruments such as taxes or cap-

and-trade emissions allowances) can “trigger innovation that may partially or more than fully offset the costs of complying with them” in some instances (Porter and van der Linde, 1995). This view is famously known as the Porter Hypothesis.

Albertini (2013) suggests that although the relationship between corporate environmental performance and financial performance has received a high degree of attention in research literature, the results of these studies are still contradictory. This article integrates prior research studying this relationship, and identifies the potential moderators that may have played a role in the apparent inconsistent results observed to date. They conduct a meta-analysis of 52 studies over a 35-year period that confirms a positive relationship between environmental performance and financial performance. Moderators’ analysis reveals that the relationship is significantly influenced by the environmental and financial performance measures, the regional differences, the activity sector, and the duration of the studies.

Song et al. (2017) examine the relationship between environmental management and financial performance of Chinese listed firms from 2007 to 2011. Results of the study indicate that environmental management is significantly positively related to financial performance in the following year, implying that environmental management can significantly improve future profitability. However, as environmental investment consumes capital and resources, results indicate that environmental management is not significantly related to improved financial performance in the current year – rather, it will improve the financial performance in the following year.

Salama (2005) argues that conventional estimates of the relationship between corporate environmental performance and corporate financial performance, are not very robust as they are typically based on simple ordinary least squares (OLS) regression. In

this paper, the author tests whether this relationship holds using median regression analysis that is more robust to the presence of outliers and unobserved firm heterogeneity. Based on panel data of 239 British companies, the study finds that the relationship between corporate environmental performance and corporate financial performance, is stronger when median regression is used.

Stefan and Paul (2008) aim to review empirical evidence of improvement in environmental performance causing improvement in economic or financial performance. Their findings suggest that improvement in environmental performance is likely to help businesses improve their financial performance, either by increasing revenue or by reducing costs.

Improvement in environmental performance may help increase in revenue by:

a) Providing firms, selling to the public sector and other businesses, better access to certain markets. b) Helping firms to differentiate their products given that credible information about the environmental features of the product is available, consumers are willing to pay, and there is barrier to imitation and c) helping firms to sell pollution control technologies when firms already have R&D facilities.

Improvement in environmental performance can help in cost reduction for

a) industries that are highly regulated and scrutinized by the public, such as chemical, energy, pulp and paper, metallurgy, etc. b) firms that have a flexible production process c) firms that are in highly competitive industries where optimization of resources is important d) firms that are in industries where market-based environmental policies are implemented and d) firms that already have R&D facilities.

Improvement in environmental performance can also help in reducing the cost of capital for firms with shares traded on stock markets. It can also help in reducing the

cost of labour for firms whose emissions may affect their workers' health, who seek to attract young, well-educated workers, and which are located in areas where sensitivity to environmental concerns is important.

Drawing on the resource-based view of the firm, Russo and Fouts (1997) posit that environmental performance and economic performance are positively linked, and that industry growth moderates the relationship, with the returns to environmental performance higher in high-growth industries. They test these hypotheses with an analysis of 243 firms over two years, using independently developed environmental ratings. Results indicate that "it pays to be green", and that this relationship strengthens with industry growth.

On the other hand, Elsayed and Paton (2005) conduct static and dynamic panel data analysis of the link between the environmental performance of 227 UK firms, and their financial performance. The results of the study imply that environmental performance has a neutral impact on firm performance. This finding is consistent with theoretical work suggesting that firms invest in environmental initiatives until the point where the marginal cost of such investments equals the marginal benefit.

Iwata and Okada (2011) examine the effects of environmental performance on financial performance using data from Japanese manufacturing firms from 2004 to 2008. The authors consider two different environmental issues of waste emission and greenhouse gas emissions, as proxies for environmental performance. In addition, to clarify how each financial performance responds to a firm's effort in dealing with different environmental issues, they utilise many financial performance indices reflecting various market evaluations. The estimation results of the study show different effects of each environmental performance on financial performance. Waste emissions

do not generally have significant effects on financial performance. On the other hand, greenhouse gas reduction leads to an increase in financial performance in the whole sample and in clean industries, although it does not have significant effects on financial performance in dirty industries. Furthermore, as the firm growth rate increases, the partial effects of waste emissions on financial performance decrease, whereas the partial effects of greenhouse gas emissions on financial performance increase.

4.3.2 Relationship between carbon performance and financial performance

Similar to the relationship between environmental performance and financial performance, existing literature have produced conflicting results regarding the relationship between carbon performance and financial performance. However, in the case of the relationship between carbon performance and financial performance, the majority of the studies predict a positive relationship while a few predict a negative and mixed or no relationship.

Ennis et al. (2012) analyses the relationship between emissions performance and financial performance of FTSE 350 companies over the period 2006-2009. They find a positive relationship between changes in emissions and changes in revenue. This means, if carbon emission increases and therefore carbon performance decreases, revenue will increase. They find that emissions levels are not presently drivers of stock prices. They also find that the financial market is not yet responsive to the carbon performance of companies.

Using carbon emissions data for 2006 to 2008 that S&P 500 firms disclosed voluntarily, Matsumura et al. (2013) predict and find a negative association between carbon emissions and firm value. They find that the capital markets integrate both

carbon emissions and the act of voluntary disclosure of this information into their firm valuations. The markets penalize all firms for their carbon emissions; firms that do not disclose their carbon emissions face a further penalty for non-disclosure.

The study by Wang et al. (2014) focuses on the relationship between GHG emissions and financial performance in Australia. Based on the 2010 GHG emission dataset from 69 Australian public firms listed on the ASX 200, the authors propose new linear regression models to investigate the relationship between GHG emissions and Tobin's Q. After carefully controlling for the effect of a number of variables on firm-level financial performance, they find that Tobin's Q is positively related to GHG emissions in Australia. Increase in GHG emission would decrease carbon performance. So, the findings of this study prove a negative relationship between financial performance and carbon performance. Such a positive relationship between corporate financial performance and GHG emissions advocates the win–lose reasoning argued in the literature, that money spent on GHG reductions would possibly harm firm competitiveness.

On the other hand, Boiral et al. in their 2012 study, aim to propose an integrated model of the determinants of corporate strategies to reduce GHG emissions and their impacts on environmental and economic performance, based on a survey of 319 Canadian manufacturing firms. They argue that the analysis of the relationship between carbon emissions and corporate performance is polarised around two main approaches: (i) the win-lose approach and (ii) the win-win approach. The first approach suggests that the efforts that companies make to reduce their carbon emissions lead to costs that are detrimental to their competitiveness. By contrast, the second approach suggests that reductions to carbon emissions increase firm competitiveness and thus sustainable

competitive advantage. The results of the study, show that, in Canada, the industrial firms most committed to tackling climate change tend to have better financial performance than other firms. This confirms, in broad terms, the hypothesis of a win-win relationship between the commitment to reduce GHG emissions and financial performance.

Gallego-Álvarez et al. (2015) analyse the impact of the variation in carbon dioxide emissions on financial and operational performance. By using international data consisting of 89 companies for the period 2006 to 2009, the findings show a reduction in emissions that generate a positive impact on financial performance. Overall, this research shows that companies promote greater environmental behavior in order to obtain higher financial performance.

Wang et al. (2016) in their study attempt to investigate the relation between carbon performance and financial performance. They use a sample of US S&P 500 corporations and use emissions reduction to measure carbon performance and Tobin's Q to measure financial performance. The results show a positive relation between carbon performance and financial performance. In addition, they find firms with better financial performance tend to be more transparent in carbon disclosure. The authors also argue a higher degree of correlation between carbon performance and financial performance indicates that managers who have financial and social obligations and who have chosen carbon projects have not only improved firm green image but have also generated tangible economic benefit for their organizations.

Nishitani et el. (2014) analyse how a firm's management of greenhouse gas emissions affects its economic performance. They use the theoretical model from Cobb–Douglas production and inverse demand functions, which predict that in conducting

GHG emissions management, a firm will enhance its economic performance because it promotes an increase in demand for its output and improves its productivity. The results of the study which uses panel data on Japanese manufacturing firms during the period 2007–2008, support the view that a firm's GHG emissions management enhances a firm's economic performance through an increase in demand and improvement in productivity - however, the latter effect is conditional. Although a firm's efforts to maintain lower GHG emissions improves productivity, efforts to reduce GHG emissions further, does not always improve it, especially for energy-intensive firms. Because firms attempting to maintain lower GHG emissions are more likely to improve their productivity, there is a possibility that firms with high GHG emissions can also enhance economic performance by reducing their emissions in the long term, even if additional costs are incurred. In addition, better GHG emissions management increases the demand of environmentally conscious customers because a product's life cycle GHG emissions in the upper stream of the supply chain influence those in the lower stream, and customers evaluate the suppliers' GHG emissions management in terms of green supply-chain management.

Nishitani and Kokubu (2012) examine the influence of firms' reductions of greenhouse gas emissions on firm value, measured by Tobin's Q. In this study, the authors argue that if the stockholders/investors regard the reduction of GHG emissions as a form of intangible value, the reduction of GHG emissions will enhance firm value. To prove this relation more precisely, they analyse not only the effect of the reduction of GHG emissions on firm value but also that of the market discipline imposed by the stockholders/investors in terms of the reduction of GHG emissions. Using data on 641 Japanese manufacturing firms in the period 2006-2008, the study finds that firms with

strong market discipline imposed by stockholders/investors, are more likely to reduce GHG emissions, and consequently, firms that reduce more GHG emissions are more likely to enhance firm value.

Griffin et al. (2012) analyse US and Canadian companies' disclosures of greenhouse gas emissions to the Carbon Disclosure Project (CDP) over a number of years. This study analyses the relationship between voluntary greenhouse gas emission disclosures and company stock price. The stock price analysis generates two key findings: one, that greenhouse gas emission levels associate negatively with stock price, although the valuation effects are more incrementally more pronounced for S&P 500 versus TSE 200 companies and, two, that the negative valuation effects are stronger for emission-intensive industries such as utilities, energy, and materials.

Delmas and Nairn-Birch (2011) conduct an empirical analysis based on a longitudinal database including over 1100 US firms across a range of industries for the period 2004-2008. This study investigates the impact of greenhouse gas emissions on corporate financial performance, and develops complementary hypotheses based on accounting and market based corporate performance measures, to represent a short-term and long-term perspective on financial performance. Their results reveal that increasing carbon emissions positively impact financial performance when using accounting-based measures such as ROA, while it has a negative impact on market-based measures of financial performance such as Tobin's Q. This implies that carbon performance is negatively related to financial performance when it is measured by ROA, while carbon performance is positively related to financial performance when it is measured by Tobin's Q.

Hart and Ahuja (1996) analyse the relationship between emission reductions and firm performance by using data from US firms obtained from Standard and Poor's 500 list for 1989 to 1992 and found no unanimity among emission reductions and operational and financial performance.

4.3.3 Summary of previous studies dealing with the relationship between environmental performance/carbon performance and financial performance

While the majority of the studies suggest a positive relationship between environmental performance/carbon performance and financial performance, a large number of studies predict a negative relationship as well. Jaggi and Freedman (1992) predict that in the short run, pollution performance is negatively associated with economic performance and that the markets do not reward good pollution performance. Cordeiro and Sarkis (1997) demonstrate a significant negative relationship between environmental pro-activism and industry analyst earnings-per-share. Filbeck and Gorman (2004) find evidence of a negative relationship between financial return and a more pro-active measure of environmental performance. Sarkis and Cordeiro (2001) find that pollution prevention and end-of-pipe efficiencies are both negatively related to ROS. Ennis et al. (2012) find if carbon emission increases and therefore carbon performance decreases, revenue will increase. They also find that emissions levels are not presently drivers of stock prices. According to them, the financial market is not yet responsive to the carbon performance of companies.

Matsumura et al. (2013) predict and find a negative association between carbon emissions and firm value. They observe that markets penalise all firms for their carbon

emissions. Wang et al. (2014) find that when measured by Tobin's Q, financial performance is negatively related to carbon performance.

On the other hand, Porter and van der Linde (1995) suggest that improvement in environmental performance may lead to an improvement in productivity and can trigger innovation that may partially or more than fully offset the costs of complying with them in some instances, and therefore, will improve the financial performance of the firm. Albertini (2013) and Salama (2005) confirm a positive relationship between environmental performance and financial performance. Stefan and Paul (2008) suggest that improvement in environmental performance is likely to help businesses improve their financial performance either by increasing revenue or by reducing costs. Russo and Fouts (1997) posit that environmental performance and economic performance are positively linked, and that industry growth moderates the relationship, with the returns to environmental performance higher in high-growth industries. Song et al. (2017) indicate that as environmental investment consumes capital and resources, environmental management is not significantly related to improved financial performance in the current year - rather it will improve the financial performance in the following year.

Boiral et al. (2012) predict two possible relationships between carbon performance and financial performance: the win-lose approach and win-win approach. Findings of their study confirm a win–win relationship between the commitment to reduce GHG emissions and financial performance. Gallego-Álvarez et al. (2015) show that reduction in emissions, which would improve carbon performance, generates a positive impact on financial performance of a company. Wang et al. (2016) show a positive relation between carbon performance and financial performance. Nishitani et el. (2014) support the view that a firm's GHG emissions management enhances a firm's

economic performance through an increase in demand and improvement in productivity. Nishitani and Kokubu (2012) suggest that if the stockholders/investors regard the reduction of GHG emissions as a form of intangible value, the reduction of GHG emissions will enhance firm value. Griffin et al. (2017) found that if carbon performance improves, stock price also increases and vice versa. Delmas and Nairn-Birch (2011) suggest that carbon performance is negatively related to financial performance when it is measured by ROA while carbon performance is positively related to financial performance when it is measured by Tobin's Q.

4.4 Interrelationship between carbon performance and financial performance

This study could not find any existing study that investigates the interrelationship between carbon performance and financial performance. However, it found two studies that deal with the interrelation between environmental performance and financial performance. Nakao et al. (2007) perform statistical analyses of five years' financial data from approximately 300 listed firms of Japan as well as the results of the Nikkei environmental management surveys. Nikkei environmental management survey is an annual survey that assesses the environmental management of Japanese companies and recognizes initiatives toward sustainability in terms of both environment and business management. The study finds that firm's environmental performance has a positive impact on its financial performance and vice versa. However, this tendency for positive two-way interactions appears to be only a relatively recent phenomenon. The tendency for realising the positive two-way interactions is not limited to the top-scoring firms in

terms of both financial and environmental performance. On the contrary, this is also a trend that can be observed fairly generally among the firms covered by the Nikkei environmental management surveys. Indices such as ROA, earnings per share and Tobin's Q are all useful in representing the financial performance of the firms. Earnhart and Lizal (2006) analyse the effects of ownership structure on corporate environmental performance, and examine the relationship between financial performance and environmental performance by using an unbalanced panel of Czech firms from 1993 to 1998. Their analysis provides evidence that greater profitability improves environmental performance by allowing a firm to generate internal financial resources that may be used for emission-reducing investments.

4.5 Relationship between carbon disclosure and financial performance

This study could not find any major existing research that investigates the relationship between carbon disclosure and financial performance. Even the relationship between environmental disclosure/corporate social performance disclosure, and financial performance are not well researched. The limited research that have been done in this area have produced conflicting results. Belkaoui (1976) examines the stock market reaction to pollution disclosure made in annual reports. The study finds that the stock market return of firms that disclosed environmental information yields higher returns than those firms that did not. Some researchers such as Berman et al., 1999; Brammer and Pavalin (2006); Weber et al. (2008) and Tang et al. (2012), argue that there should be a positive relationship between the disclosure of Corporate Social Responsibility (CSR) performances and company financial performances. The reasoning is that by

reporting and improving their CSR work, companies can receive the reputation as good company citizens, thus can attract investors as well as other stakeholders. The results of a study by Chen et al. (2015) show that improved corporate social performance as well as more transparent disclosures of corporate social performance would have a strong relationship with improving the internal utilisation of financial resources of the companies. But such corporate social performance and its disclosures, are not necessarily improving the company's external financial performances.

On the other hand Freedman and Jaggi (1988) examine the association between the extent of pollution disclosure and economic performance of firms belonging to four highly polluted industries - namely paper and pulp, oil refinery, chemical and steel. Ratios are used to measure economic performance. The results of the study indicate that there is no association between the extensive of pollution disclosure and economic performance.

4.6 Relationship between carbon disclosure/carbon performance and agency cost

There are only a few studies that investigate the relationship between disclosure and agency cost. Existing literature that deals with this relationship are discussed below: As explained before, the agency relationship between managers and owners lead to information asymmetry problem because managers can access information more than shareholders. According to Barako et al. (2006), voluntary disclosure is used by managers as a means of mitigating the agency problem, whereby they disclose more voluntary information to reduce the agency costs. Voluntary disclosure is also used as a

means to convince the external users that managers are acting in an optimal way (Watson et al., 2002). Borghei-Ghomi and Leung (2013), opine that GHG voluntary disclosure can be regarded as a means by which firms can reduce information asymmetry about GHG and the subsequent agency costs. Results of their study find a positive association between the level of GHG voluntary disclosure, firm size and corporate governance. In other words, it could be inferred that disclosing firms seek to reduce information asymmetry and the subsequent agency costs. According to Gray et al. (1995) management has superior information than outsiders, regarding the firms' operations. Investors demand information for monitoring contracts with companies and assessing companies' valuation. As a result, firms will be motivated to disclose information voluntarily as disclosure may help them to obtain resources on the best terms and conditions. Richardson and Welker (2011) argue that as per agency theory, the information asymmetry increases agency costs. Hence, companies may voluntarily choose to disclose information to reduce both information asymmetry and agency costs. This study could not find any existing research that investigates the relationship between carbon performance and agency cost.

4.7 Trends in the improvement of carbon disclosure and carbon performance

There is lack of research that studies the trends in improvement of carbon disclosure and carbon performance by businesses over the years. The available studies are discussed below:

Choi et al. (2013) analyse the corporate reaction of Australia's largest 100 companies over the period of 2006 to 2008 when the Australian government announced a series of regulations with regard to carbon emission disclosure. Over their study period, the percentage of Australian companies providing meaningful information on environmental factors including carbon emissions had increased substantially from 42% to 67%. In addition, the quality of that information had also improved in all areas including assessments of risks and opportunities provided by climate change, detailed disclosures of carbon emissions, quantification of energy consumption from different sources, strategies to reduce carbon emissions, and proper accountability for climate change strategies. The study also reveals that during the study period 1) the number of companies acknowledging and identifying the risk of climate change has doubled 2) firms disclosing strategies to achieve a reduction of future carbon emissions has almost doubled. 3) The number of companies reporting information of the change in carbon emissions almost trebled and 4) details of carbon emission accountability increased almost fivefold. Industries showing most significant changes in the disclosure quality, included Materials, Consumer Staples, Industrials, Financial, and Consumer Discretionary. The results also showed that larger firms with higher profitability tend to make more quality disclosures.

The study by Kolk et al. (2008) aims to study corporate responses towards climate change related to the development of reporting mechanisms for greenhouse gases, in particular, carbon disclosure. Analysis of responses of this study indicates that CDP has been successful in using institutional investors to ask firms to disclose extensive information about their climate change activities. The authors agree that response rates in terms of numbers of disclosing firms are impressive and growing.

However, neither the level of carbon disclosure that CDP promotes nor the more detailed carbon accounting, provide information that is particularly valuable for investors, NGOs or policy makers. They also argue that although carbon disclosure as a project of commensuration, has achieved some progress in technical terms, it has achieved very little in relation to the cognitive and value dimensions.

Stannay (2013) examines three disclosures (answering the questionnaire, disclosing emissions and accounting methodology) made to the CDP by S&P 500 firms, for the years 2006 through 2008. The frequencies of the three disclosures increased from 2006 to 2008. The disclosure patterns over the three years suggest that firms' disclosures are routine since once most firms begin to make a disclosure, they continue to do so. The estimations found that the most significant factor in a firm's subsequent disclosure (answering, emissions, and accounting) is its previous disclosure. For the two disclosures, answering the questionnaire and emissions, that have higher frequencies during the period, the regulatory proxy is not significant. The finding that the majority of firms answer the questionnaire, but do not disclose their emissions or how they account for these emissions, supports and contributes to the legitimacy literature, which predicts that a firm will answer the questionnaire, but not disclose its GHG emissions or how it accounts for them. By answering the questionnaire, a firm avoids scrutiny, a primary motivation for disclosing according to the Legitimacy Theory. In particular, when a firm answers the questionnaire, it deters the possibility of being targeted by a shareholder resolution. By making selective disclosures, that is answering the questionnaire, but not disclosing emissions or accounting methodology, firms circumvent the intent of voluntary reporting schemes such as the CDP. The ability to avoid potential costs from

voluntary schemes suggests a problem in relying on them to address climate change (King and Lenox, 2000).

Staney and Ely (2008) examine the factors associated with US S&P 500 firms' decision to disclose information requested by institutional investors through CDP about the current and projected effects of climate change. The results of the study support voluntary disclosure theories. It shows that firms subject to more scrutiny because of their size, previous disclosures, and foreign sales, are more likely to respond to the CDP questionnaire. During the study period, voluntary disclosure via the CDP questionnaire increased from 48 to 58% for S&P 500 firms. Out of the 42% firms who did not answer the questions posed by the CDP, 15% responded but declined to provide any information, and 22% did not respond all. This lack of response is surprising as the institutional investors who requested this information have a large ownership interest in these firms. The study does not find that firms in carbon-intensive industries are more likely to disclose. It also does not find any positive relation between disclosure and investment in new assets. This prompts the authors to believe that while companies may be investing in new assets, they might not be investing in assets that minimize carbon emissions, or else they would have disclosed this information to institutional investors.

4.7.1 Summary of previous studies dealing with trends in improvement of carbon disclosure and carbon performance

There are insufficient studies that analyse the trends in improvement of carbon disclosure over time. Choi et al. (2013) find that over the period of 2006 to 2008 when the Australian government announced a series of regulations with regard to carbon emission disclosure, the percentage of Australian companies providing meaningful

information on environmental factors including carbon emissions, had increased substantially from 42% to 67%. Kolk et al. (2008) find that response rates in terms of numbers of firms disclosing carbon information to CDP, are impressive and growing. Stannay (2013) examines three disclosures (answering the questionnaire, disclosing emissions and accounting methodology) made to the CDP by S&P 500 firms for the years 2006 through 2008. The study finds that frequencies of the three disclosures increased from 2006 to 2008. Staney and Ely (2008) find that during the study period, voluntary disclosure via the CDP questionnaire increased from 48 to 58% for S&P 500 firms.

4.8 Chapter summary

This chapter provides a background for this study by discussing existing literature that investigates the relationship and interrelationship between environmental disclosure/carbon disclosure and environmental performance/carbon performance; between environmental performance/carbon performance and financial performance; between carbon disclosure and financial performance; between carbon disclosure/carbon performance and agency cost and the trends in improvement of carbon disclosure and carbon performance. Finding of these studies will be useful in interpreting the results of this study. The next chapter will develop the hypotheses of this study.

CHAPTER 5 HYPOTHESIS DEVELOPMENT

5.1 Introduction

Based on the research gap identified in chapter 4, this chapter develops the hypotheses of this study by utilising relevant theories and a number of conceptual frameworks developed in this study. These hypotheses will be tested, and the findings of the tests will be interpreted in the next chapter. This chapter is structured as below:

Sections 5.2 to 5.4 develop the first three hypotheses of this study concerning the relationship and interrelationship between carbon disclosure and carbon performance. Sections 5.5 and 5.6 develop hypotheses that deal with the relationship and interrelationship between carbon performance and financial performance. Section 7.7 develops a hypothesis that predicts a relationship between carbon disclosure and financial performance. Sections 5.8 and 5.9 hypothesise relationship between carbon disclosure and agency cost and between carbon performance and agency cost. Section 5.9 hypothesises trends in improvement of carbon disclosure and carbon performance. Section 5.10 summarises the chapter.

5.2 Relationship between carbon disclosure and carbon performance

Limited research has been done to investigate the relationship between carbon disclosure and carbon performance and the findings of this research have been largely inconclusive. Most of this research has been done for specific countries and on specific industries. To address this research gap, this study investigates the relationship between

carbon disclosure and carbon performance for the top 500 global companies that include all industries except the financial services sector.

As discussed in the Theoretical Background chapter, socio-political theories such as Legitimacy Theory and Stakeholder Theory propose a negative relationship between carbon performance and carbon disclosure. These theories predict that business with poor environmental performance/carbon performance would make soft and unverifiable qualitative disclosure about their performance to maintain legitimacy and to satisfy expectations of various stakeholders. Firms must manage the interests of consumers and wider society, as well as continue to satisfy their shareholders, and must maintain their legitimacy to ensure survival. The greater the perceived importance of shareholders' information needs and community concerns to a business, the higher the level of environmental/carbon disclosures by the business. Therefore, it can be assumed that companies with inferior carbon performance would make more carbon disclosure to satisfy important stakeholders and retain their legitimacy as suggested by Stakeholder Theory and Legitimacy Theory. Based on these theoretical reasoning of Legitimacy Theory and Stakeholder Theory, we can hypothesize that the worse the carbon performance of a business, the more carbon disclosure it is likely to make. Therefore, the first hypothesis of this study is:

H1 – There is a negative relationship between carbon disclosure and carbon performance

In contrast to the theories discussed above, economic based Voluntary Disclosure Theory and Signalling Theory, propose a positive relationship between carbon disclosure and carbon performance. These theories suggest that companies with good

performance are likely to make hard and high-quality verifiable disclosure to signal their good quality to investors and to differentiate themselves from companies with 'bad news' to avoid the adverse selection problem. In the context of these predictions of Voluntary Disclosure Theory and Signalling Theory, we can hypothesize that better carbon performers will make more disclosure. This gives our second hypothesis as below:

H2- There is a positive relationship between carbon disclosure and carbon performance

5.3 Interrelationship between carbon disclosure and carbon performance

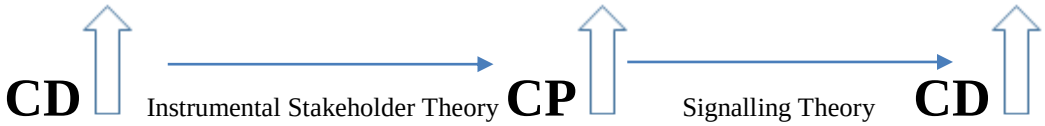
As discussed before, many studies have investigated the relationship between environmental disclosure/carbon disclosure and environmental performance/carbon performance. However, to the best of my knowledge, the interrelationship between environmental disclosure/carbon disclosure and environmental performance/carbon performance, have not been investigated by any prior research. In other words, no study so far has attempted to find out whether environmental disclosure/carbon disclosure affects environmental performance/carbon performance, and vice versa. For example, we know that improved environmental performance/carbon performance may lead to higher environmental disclosure/carbon disclosure, but we do not know whether higher environmental disclosure/carbon disclosure as a result of improved environmental performance/carbon performance in a period, will lead to better environmental performance/carbon performance in the next period. This study would like to address

this research gap by investigating whether there is a both-way relationship between carbon disclosure and carbon performance.

The theory that can explain a possible interrelation between carbon disclosure and carbon performance is Instrumental Stakeholder Theory. This theory suggests that everything else being equal, firms that practice stakeholder management will perform better in profitability, stability, growth and other conventional performance terms (Donaldson and Preston, 1995. p. 67).

In line with the propositions of Stakeholder Theory, we already know that companies would voluntarily make carbon disclosure to satisfy their stakeholders. As per the propositions of Instrumental Stakeholder Theory, this action by the companies (satisfying stakeholders by making voluntary carbon disclosure) consequently is likely to improve carbon performance of these companies. When carbon performance of these companies improve, they are likely to disclose these information to signal their good quality to investors as suggested by Signalling Theory. The following diagram shows the relationship:

Figure 5.1 Interrelationship between carbon disclosure and carbon performance



CD = Carbon disclosure CP = Carbon performance

Source: developed for this study

Based on the above arguments, we can predict a two-way positive relationship between carbon disclosure and carbon performance where an increase in carbon disclosure will improve carbon performance (as predicted by Instrumental Stakeholder Theory) and consequently, improved carbon performance will lead to more carbon disclosure (as predicted by Signalling Theory). This analysis leads to the next hypothesis of this study as below:

H3 - Carbon disclosure and carbon performance influence each other positively.

5.4 Disclosure practices of average carbon performers

As discussed in the literature review section, prior studies produce vastly conflicting findings regarding the relationship between environmental performance/carbon performance and environmental disclosure/carbon disclosure. Some studies find that superior environmental performers/carbon performers make more environmental disclosure/carbon disclosure whereas some other studies find that inferior environmental performers/carbon performers make more environmental disclosure/carbon disclosure. However, none of the existing studies predict anything about the disclosure practices of firms who are neither superior performers nor inferior performers, i.e., firms who can be considered as average carbon performers. This lack of previous studies opens up the potential for a new area of research. Therefore, this study would like to investigate carbon disclosure practices of average carbon performers.

As both superior carbon performers and inferior carbon performers make high carbon disclosure, we can assume that firms whose carbon performance are neither superior nor inferior do not make a high level of carbon disclosure. In other words,

businesses with superior carbon performance and inferior carbon performance would make significantly more carbon disclosure than businesses with average carbon performance. This argument gives rise to the next hypothesis of this study as below:

H4 - Both superior and inferior carbon performers make significantly more carbon disclosure than average carbon performers.

5.5 Relationship between carbon performance and financial performance

It is evident from the previous discussion in the literature review section, that the relationship between carbon performance and financial performance is a contentious issue. There are strong arguments and evidence to support a negative relationship as well as a positive relationship between corporate carbon performance and financial performance. However, in the recent past, the business environment has changed drastically due to the effects of climate change. Climate change and global warming have emerged to be one of the most important problems affecting the future of life on this planet, and it is by, and large agreed that GHG emissions including carbon dioxide (CO_2), are the main cause of climate change and global warming. Business which emits GHG is one of the major players that contribute to adverse climate change and global warming. There is immense pressure on businesses from different stakeholders, to reduce GHG emission and thereby improve their carbon performance. As discussed earlier, businesses would incur costs to improve their carbon performance. However, the benefit they would get from improvement in carbon performance, especially in the long

run, would outweigh the cost. Reductions in carbon emissions would increase firm competitiveness and thus sustainable competitive advantage. By GHG emissions management, a firm will enhance its economic performance as it promotes an increase in demand for its output and improves its productivity.

Stakeholders of business such as governments, non-governmental organisations, local communities, consumers, trading partners, employees, investors, financial agencies and stockholders, are conscious of corporate environmental management including GHG emission management, especially in developed countries. This would directly or indirectly influence the financial performance of business. For example, if a firm emits too much CO_2 it may have risk of paying for the extra emission in countries that would penalise too much CO_2 emission, especially in the future. The firm may also suffer from a loss of trust and reputation from carbon conscious consumers and other stakeholders. Such risks have negative effects on the evaluation of a firm's future profits. On the other hand, a firm that actively tries to manage their GHG emission might gain positive reputation among some stakeholders and may influence them to expect that the firm will succeed in reducing environmental risks and production costs in the long term, and thereby would be able to improve its financial performance. Therefore, firms have an incentive to address various environmental issues against the backdrop of various stakeholders' interests (Salama, 2004).

The positive relationship predicted between corporate carbon performance and financial performance can possibly be explained by the propositions of Stakeholder Theory. This theory, which have been discussed in detail before, argues that by matching and concentrating on the interests of various stakeholder groups, which will lead to their satisfaction, managers can increase the efficiency of their organisation’s

adaptation to external demands (Orlitzky et al., 2003). Corporate environmental performance is a kind of corporate investment (McWilliams and Siegel, 2001), and as a form of corporate investment, it creates opportunities to enhance organisational financial performance in the future (Jones, 1995).

Based on the above arguments coupled with the reasoning of Stakeholder Theory, we can predict that improvement of carbon performance of a firm will lead to improvement in its financial performance, especially in the long run.

Therefore, the next hypothesis of this study is as below:

H5: There is a positive relationship between carbon performance and financial performance

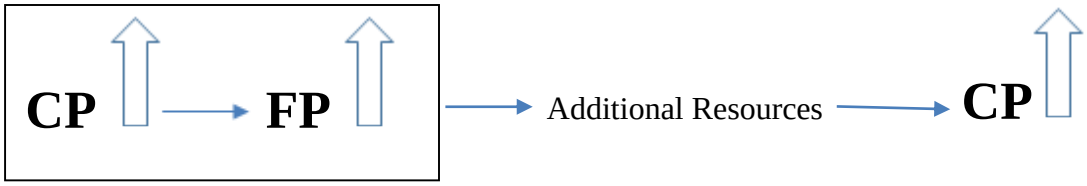
5.6 Interrelationship between carbon performance and financial performance

While many studies investigate the relationship between environmental performance/carbon performance and financial performance, there is no known research that investigates interrelation between carbon performance and financial performance.

This study has already explained and justified in the previous section that there is a positive relationship between carbon performance and financial performance, i.e. improved carbon performance of a business would improve its financial performance. Now, the study of Nakao et al. (2007) and Earnhart and Lizal (2006), suggest that when a firm's financial performance improves, it can generate additional internal financial resources to improve its environmental performance. In other words, improvement in

environmental performance of a business would improve its financial performance, and consequently, improved financial performance would help to improve its environmental performance. As there is no known study that investigates interrelationship between carbon performance and financial performance and as carbon performance is a subset of environmental performance, we can argue that improvement in carbon performance of a firm will lead to improvement in its financial performance, and this improvement in financial performance will allow the firm to invest in emission reduction technologies and activities which in turn will improve the firm's carbon performance. This relationship is shown in the diagram below:

Figure 5.2 Interrelationship between carbon performance and financial performance



CP = Carbon performance; FP = Financial performance

Source: developed for this study

The above argument leads to the next hypothesis of the study as below:

H6: Carbon performance and financial performance influence each other positively

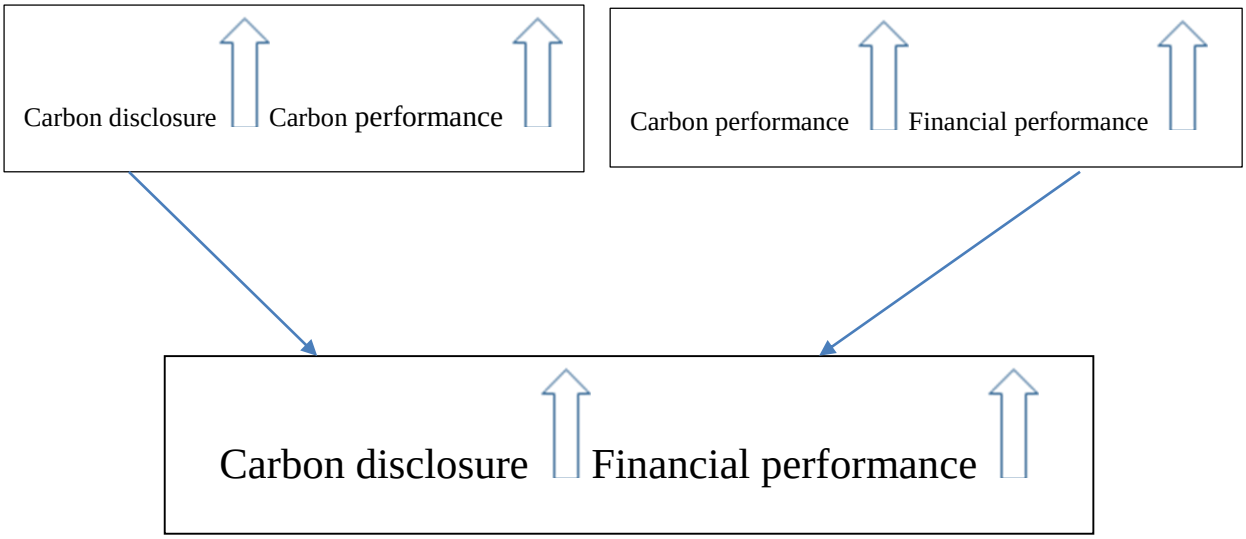
5.7 Relationship between carbon disclosure and financial performance

There are numerous studies that deal with the relationship between environmental disclosure/carbon disclosure and environmental performance/carbon performance. The majority of these studies find a positive relationship between them whilst a good number of studies find a negative relationship as well. Similarly, there are large number of studies that investigate the relationship between environmental performance/carbon performance and financial performance. In this case also, there are conflicting results. Whilst the majority of the studies find a positive relationship between environmental performance/carbon performance and financial performance, many studies propose a negative relationship. However, there is no known research that investigates if and how environmental disclosure/carbon disclosure affects the financial performance of a firm. It would be useful for stakeholders of businesses, if the relationship between environmental disclosure/carbon disclosure and carbon performance could be established. Therefore, this study would like address this research gap by finding out how carbon disclosure of a business affects its financial performance.

In Section 5.3, this study has already explained and justified that, as per the proposition of Instrumental Stakeholder Theory, if a firm performs stakeholder management, for example, by making voluntary carbon disclosure, carbon performance of the firm is likely to improve. On the other hand, section 5.5 of this study explained and justified that improved carbon performance of a firm is likely to improve its financial performance. Considering these two arguments, we can suggest that carbon disclosures will positively affect firms' future carbon performance. This improved carbon performance then, will positively affect the firm's financial performance. If

carbon disclosure of a firm positively affects its carbon performance, and carbon performance positively affects its financial performance, then we can argue that carbon disclosure of a business will positively affect its financial performance. This predicted relationship is show in the diagram below:

Figure 5.3 Relationship between carbon disclosure and financial performance



Source: developed for this study

The above arguments lead to the next hypothesis of the study as below:

H7: There is a positive relationship between carbon disclosure and financial Performance

5.8 Relationship between carbon disclosure and agency cost

As discussed before, Agency Theory suggests that businesses would use voluntary disclosure to reduce information asymmetry problems between owners and managers which subsequently would help them to reduce agency cost. Agency Theory has been used by several studies in the disclosure literature to explain voluntary reporting practices. They suggest that disclosure is a means by which companies can reduce the conflict between owners (principals) and managers (agents), and subsequently decrease the agency costs. If we apply this principles to explain the relationship between carbon disclosure and agency cost, we can suggest that if carbon disclosure of a firm increases, its agency cost will decrease. Therefore, we can hypothesis that:

H8: There is a negative relationship between carbon disclosure and agency cost

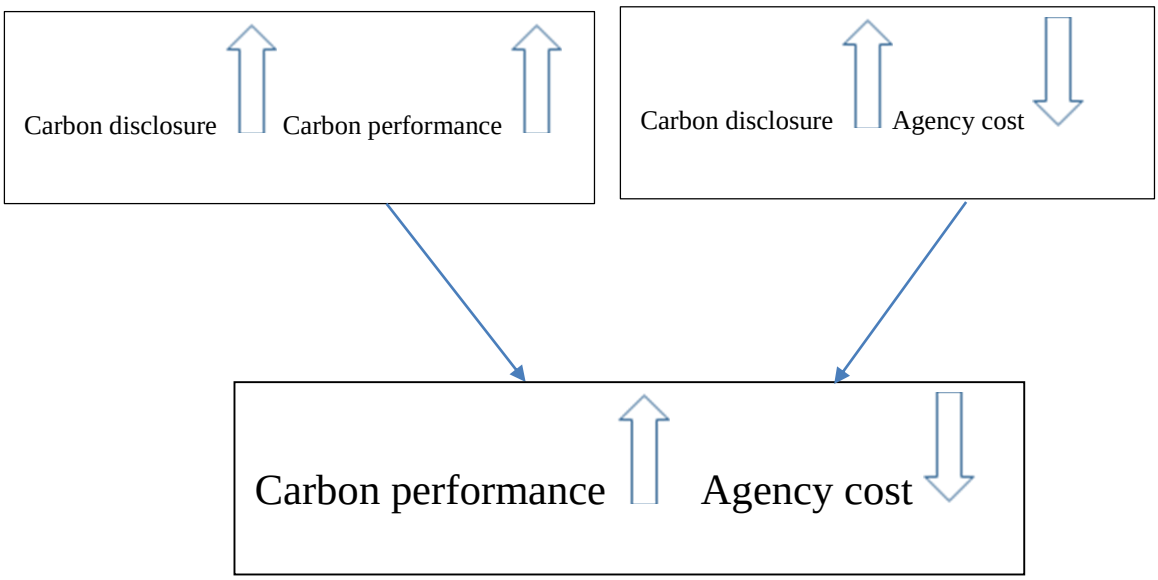
5.9 Relationship between carbon performance and agency cost

To the best of my knowledge, there is no known study that investigates the relationship between environmental performance/carbon performance and agency cost. It has already been mentioned before that the divergence of action due to incomplete alignment of the interests of agents and principals may lead to an agency problem. The sacrifice of wealth by the principal and potential costs associated with monitoring the agents is known as the agency cost. It has also been discussed and hypothesized in section 5.8 (hypothesis 8), that there is a negative relationship between carbon disclosure and agency cost i.e., if carbon disclosure of a firm increases, its agency cost will decrease. On the other hand, in section 5.3 of this study, it has been argued and

hypothesised (hypothesis 3) that carbon disclosure and carbon performance influence each other positively, i.e. better carbon performance will lead to higher carbon disclosure, and increased carbon disclosure will subsequently improve the firm's carbon performance.

From hypotheses 3 and 8, we can predict two sets of relations. 1) If carbon disclosure of a business improves, its carbon performance will subsequently improve and 2) On the other hand, if a business increases its carbon disclosure, its agency cost will decrease. Therefore, combining these two arguments, we can predict that if carbon performance of a business improves, its agency cost will decrease. The following diagram depicts these relationships:

Figure 5.4 Relationship between carbon performance and agency cost



Source: developed for this study

The above arguments give rise to the next hypothesis of this study as below:

H9: There is a negative relationship between carbon performance and agency cost

5.10 Trends in improvement of carbon disclosure and carbon performance over time

Due to increases in regulatory pressure, ever increasing voluntary disclosure channels and their desire to legitimise their operations, as per Legitimacy Theory, it can be assumed that carbon emission disclosure by business would increase overtime. On the other hand, there is no known research that studies the trends in improvement of carbon performance, i.e. there is a lack of empirical research that tries to find out whether carbon performance of business has improved over the years. Therefore, this study would like to find out if carbon disclosure and carbon performance of businesses has improved over the years. This gives our last hypothesis as below:

H10: There is an improvement of both carbon disclosure and carbon performance by businesses over time

5.11 Chapter summary

This chapter utilises the research gaps identified in chapter 4, the propositions of relevant theories, and several conceptual frameworks developed in this study to formulate hypothesis for this study. Firstly, Socio Political and Economic Based Theories are used to develop the first two hypotheses of this study, that propose relationships between carbon disclosure and carbon performance. The next section of this study uses relevant theories and a conceptual framework developed for this study, to develop a hypothesis that predicts interrelationship between carbon disclosure and carbon performance. This chapter then develops hypothesis related to disclosure

practices of average carbon performers. The next part of the chapter uses relevant theories and a conceptual framework developed for this study, to develop hypotheses that predict relationship and interrelationship between carbon performance and financial performance. The next section of this study hypothesise a relationship between carbon disclosure and financial performance based on a conceptual framework developed for this study. This study then utilises relevant theories to hypothesise a relationship between carbon disclosure and agency cost. Based on a conceptual framework developed for this study, the next section develops a hypothesis relating carbon performance and agency cost. The final section of this chapter proposes a hypothesis related to the trends of improvement in carbon disclosure and carbon performance over the study period. Hypotheses formulated in this chapter, will be tested by regression models that will be developed in the next chapter.

CHPATER 6 RESEARCH METHOD

6.1 Introduction

This chapter outlines the methods used in this study to test the hypotheses developed in previous chapter. This chapter is organized as below: Section 6.2 and 6.3 explain the research sample selection process. Section 6.4 shows the process of selecting and measuring the dependent and independent variables. Section 6.5 outlines the methods used to select the control variables for this study, which are used to control the regression results. Section 6.6 outlines the models used in this study to test its hypotheses. Finally, section 6.7 summarises the chapter.

6.2 Sample period

This study intends to examine the relationship among carbon disclosure, carbon performance, financial performance and agency cost, for the world's largest 500 firms that participated in the Carbon Disclosure Project (CDP) questionnaire survey over the years 2011 to 2015. It also intends to study the trends in improvement of carbon disclosure and carbon performance over the same period. There are multiple reasons for choosing this study period. The data related to carbon disclosure and carbon performance of the firms were collected from the CDP database. CDP scoring methodology was developed in 2008. Initially, it focused on disclosure scores only. CDP started reporting carbon performance scores from 2010. However, during 2010, the response rate from companies were not very high. Since 2011, for most of the companies whose disclosure scores were available, their performance scores were also

available. Therefore, the sample period for this study starts in 2011. When I started collecting data for this study, full data set was available until the end of 2015. Therefore, the duration of the study ends in 2015.

6.3 Sample selection

The targeted sample for this study are the largest 500 firms worldwide (referred to as Financial Times Global 500 firms) who participated in CDP during the period 2011 to 2015. These 500 firms are chosen from the FTSE Global Equity Index Series as of 31 December 2015. They are also referred to as G500. These firms were ranked as the biggest in terms of sales and have a market capitalisation of US $32,387 billion. The companies are ranked by market capitalisation. The greater the stock market value of a company, the higher it's ranking (Financial Times, 2015).

There are multiple reasons for choosing the G500 firms. An important reason is that these firms responded to CDP carbon disclosure and carbon performance questionnaire during the study period of 2011 to 2015. CDP is a non-profit organisation, which represents 534 institutional investors worldwide. CDP was launched in 2000. Since 2003, it started requesting information relevant to climate change from more than 3,700 firms across the world. This information includes the identification of carbon and climate change–associated risks and opportunities; the actions taken by firms to manage and adapt to these risks and opportunities; carbon and greenhouse gas emissions, actions, and strategies that have been and are taken to mitigate carbon emissions and finally governance strategies adopted by firms to deal with carbon and climate change matters. Hence, the CDP's database is the most comprehensive database of carbon and

climate change–related information that is publicly available (Griffin et al., 2017; Matsumura et al., 2013).

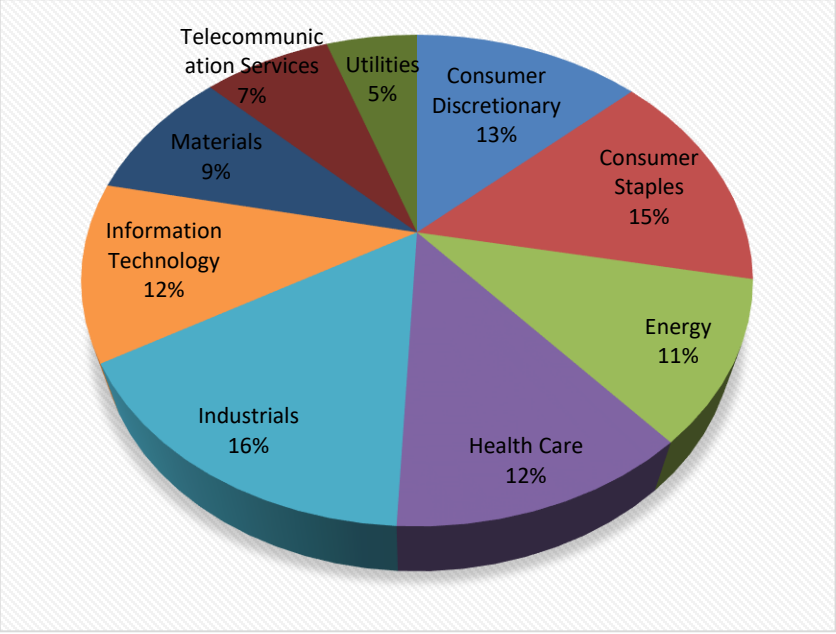
Another reason for choosing G500 firms, is their impact on the economies where they perform their operations (Jose and Lee, 2007). Some prior research such as Clarkson et al. (2008) and Patten (2002), have identified small sample size and the context as the reasons for their studies' mixed results. Therefore, a large sample like G500, which includes a wide range of industries and countries, may be able to overcome these limitations.

From G500 firms, financial firms have been excluded, as their business does not involve substantial carbon emission. To be included in the sample, firms should have both a carbon disclosure score and a carbon performance score available, for each of the years between 2011 and 2015. So, after excluding financial companies and companies whose carbon disclosure score and carbon performance scores are missing in any of the years between 2011 to 2015, the final sample constitutes 189 firms. Sample firms have been classified as per the Global Industry Classification Standard (GICS). The following table shows the distribution of sample firms based on the GICS as on 31 December 2015.

Table 6.1 Distribution of sample firms by sector

Sector	No of firms	Percentage
Consumer Discretionary	25	13.23
Consumer Staples	28	14.81
Energy	20	10.58
Health Care	23	12.17
Industrials	30	15.87
Information Technology	22	11.64
Materials	17	8.99
Telecommunication Services	14	7.41
Utilities	10	5.29
Total	189	100

Figure 6.1 Sector-wise distribution of sample firms



Out of 189 sample companies 91 belong to North America, 52 belong to the European Union, 22 belong to the United Kingdom, 22 are from the countries of Asia-Pacific, and from the remaining four, 2 are from Brazil and another 2 are from South Africa. The following table shows the breakdown:

Table 6.2 Distribution of sample firms by regions

Region	**No. of firms**	**Percentage**
North America	91	48
European Union	52	28
Asia-Pacific	22	12
United Kingdom	20	11
Others	4	2
Total	189	100

Data sources

The source of carbon disclosure and carbon performance scores is the CDP database. Financial performance in this study is measured by Return on Asset (ROA) and Tobin's Q, and agency cost is measured by Expense Ratio (ER) and Asset Utilisation Ratio. Data to measure financial performance, agency cost and control variables, are collected from Thomson Reuters Datastream database.

6.4 Measurement of dependent and independent variables

This study uses carbon disclosure, carbon performance, financial performance and agency cost, as dependent and independent variables. These variables are used sometimes as dependent variables and at other times as independent variables, depending on the requirement of the hypothesis being tested. This study uses CDP Carbon Disclosure Scores as the proxy for carbon disclosure, and CDP Carbon Performance Scores as the proxy for carbon performance for the sample companies. CDP prepares Carbon Disclosure Scores and Carbon Performance Scores based on its climate change scoring methodology. Scoring was developed in 2008 and initially focused on carbon disclosure. Carbon performance scores were started in 2011. CDP scoring is closely aligned with its mission to work with market forces to motivate companies to disclose their impacts on the environment and natural resources and take action to reduce negative impacts. CDP uses a scoring methodology that incentivise companies to measure and manage environmental impacts through participation in CDP's climate change, water, forests and supply chain programs. The scoring methodology is a means to assess the responder's progress towards environmental stewardship as communicated through the company's CDP response. The methodology ultimately yields a score based on the evaluation. The scoring methodology assess the level of detail and comprehensiveness in a response, as well as the company's awareness of environmental issues, and its management methods.

The scoring methodology provides a disclosure score, which assesses the level of detail and comprehensiveness in disclosure, and a performance score, which assesses the

level of action taken on climate change evidenced by the company's CDP response. The methodology for both the scores is presented below.

6.4.1 Measurement of CDP carbon disclosure scores

Disclosure scores are expressed as a number between 0 and 100. The disclosure score represents the potential quality in completeness of disclosure and hence it's likely usefulness to data users. The disclosure score is a matrix of comprehensiveness of the responses, good internal data management and understanding of climate change issues and is a measure of complete transparency on climate change. However, it is important to understand that disclosure score is not a measure of how green or sustainable a company is.

In general, the number of points allocated to each question asked in CDP questionnaire, which is filled in by the respondent companies on a voluntary basis, depends on the amount of data requested. Some questions have more than one point attached to a single piece of information where the information is of particularly high importance, e.g. the gross global Scope 1 emissions figure. Questions which allow text responses are usually judged according to how many of the required data points they achieve. At the end of scoring, the number of points a company has been awarded (the numerator) is divided by the maximum number that could have been awarded (the denominator). The fraction is then converted to a percentage by multiplying it by 100 and rounded to the nearest whole number as below:

(Points awarded / points attainable) x 100 = Disclosure Score

A low disclosure score is not necessarily an indicator of poor performance, but it suggests a company has insufficient information based on which a judgment of performance can be made.

6.4.2 Measurement of CDP carbon performance score

Performance points are awarded when a company highlights that it is undertaking or has undertaken a positive climate change action. Performance points are awarded for evidence provided in the CDP response of actions considered to contribute to climate change mitigation, adaptation and transparency. Actions considered to be more fundamental to progress on combating climate change, are awarded more points. External verification/assurance of emissions data is rewarded under the performance scoring, as it is considered that this potentially increases the usefulness of the information to decision makers, and can act as a pre-qualifier of the data submitted that should be recognized when evaluating performance. The performance score is solely based on activities and positions disclosed in CDP questionnaire, that is filled in by respondent companies on a voluntary basis. It therefore, does not consider actions not mentioned in CDP response. To receive a performance score, a company must achieve a minimum disclosure score of 50. This is to ensure that the judgment is based on sufficient information. Performance scores are converted to percentages in a similar way to the disclosure score percentage is generated. The percentages are then grouped into bands of A, A-, B, C, D, E, with A being the best. The numeric equivalent for A and A- is same. The difference between an A and A- band is whether the company has made to the A list for two years or not. Below are the numeric equivalents (score out of 100) of the performance bands for the years 2012-2015. The numeric equivalents for 2011 were

slightly different. However, for the sake of simplicity this study uses only 2012-15 scoring methodology.

Performance Band	Numeric Equivalents (score out of 100)
A and A-	86-100
B	61-85
C	41-60
D	21-40
E	0-20

As letter bands are difficult to use in statistical analysis, they have been converted to numeric values in this study. To find a numeric equivalent of a letter band, the upper and lower range of the scores of a letter band has been divided by 2 and then rounded to the nearest whole number. For example, the numeric equivalent of A and A- = (86+100) / 2 = 93. Similarly other letter bands B, C, D and E have been converted to numeric equivalents.

Several previous studies use CDP scores as a measure for carbon disclosure and carbon performance for their sample firms. Ennis et al. (2012) in their study, analyses the relationship between emissions performance and financial performance of FTSE 350 companies over the period 2006-2009, and uses CDP data to measure emission performance. In the study titled "Carbon disclosure, carbon performance, and cost of capital", He et al. (2013) use CDP scores in measuring carbon disclosure and carbon

performance for their sample firms. Luo and Tang (2014) also use CDP data to examine the relationship between voluntary carbon disclosure and carbon performance. Cotter and Najah (2012) in their study entitled “Institutional investor influence on global climate change disclosure practices”, use CDP scoring methodology to calculate disclosure scores.

6.4.3 Measurement of Financial performance

Return on Asset (ROA) and Tobin’s Q are used as proxies for financial performance in this study. Several previous studies use ROA and Tobin’s Q as measures for financial performance. ROA is calculated by dividing a company's annual earnings by its total assets. It is an indicator of how profitable a company is relative to its total assets. It gives an idea as to how efficient management is at using its assets to generate earnings. On the other hand, Tobin's Q or the Q ratio, is the ratio of the market value of a company's assets (as measured by the market value of its outstanding stock and debt) divided by the replacement cost of the company's assets (book value). ROA is an accounting based measures of a firm’s financial performance, while Tobin’s Q is a market based measures of a firm’s financial performance (Horváthová, 2010). Both ROA and Tobin’s Q have been chosen as proxies for financial performance in this study, so that we can examine the relationship between carbon performance and both accounting based measures of a firm’s financial performance, as well as its market based measure of financial performance.

Delmas and Nairn-Birch (2011) and Busch and Hoffmann (2011) use both ROA and Tobin’s Q to measure financial performance. They find that carbon performance is negatively related to financial performance when it is measured by ROA, whilst it is

positively related to financial performance when it is measured by Tobin's Q. Jaggi and Freedman (1992) use ROA to measure economic performance while evaluating the impact of pollution performance of pulp and paper firms in the United States on their economic and market performance. Hart and Ahuja (1996) use ROA as a measure of firm performance, in order to analyse the relationship between emission reductions and firm performance of US firms during the period 1989 to 1992. Russo and Fouts (1997) also use ROA as proxy for economic performance, in their study to examine relationship between environmental performance and economic performance. Nakao et al. (2007) uses ROA to measure financial performance while examining the relationship between environmental performance and financial performance of Japanese corporations. Gallego-Álvarez et al. (2015) in their study titled "Carbon emission reduction: the impact on the financial and operational performance of international companies", use ROA to measure financial performance.

On the other hand, several studies explore the relationship between environmental performance/carbon performance and financial performance, using Tobin's Q as an indicator for financial performance. For example, Nishitani and Kokubu (2012) use Tobin's Q to measure firm value while examining the relationship between the reduction of greenhouse gas emissions and firm value. Similarly, Wang et al. (2014) in their study to determine the relationship between GHG emissions and financial performance in Australia, use Tobin's Q to measure financial performance.

6.4.4 Measurement of agency cost

As mentioned earlier in literature review section, the sacrifice of wealth by the principal (owners of the business) and potential costs associated with monitoring the

agents (manager of the business), is known as the agency cost. Agency cost is measured by Expense Ratio (ER) and Asset Utilization Ratio (AUR) (Rashid, 2015). Expense Ratio (ER) is the ratio of operating expenses (selling, general, and administrative expenses, excluding financing expenses and any non-recurring expenses, such as losses on the sale of assets) to total annual sales (Ang et al., 2000). It measures how effectively a firm's management controls operating costs. According to Ang et al. (2000, p. 82), 'this measure captures excessive expenses including perk consumption'. The second measure of agency cost is the Asset Utilization Ratio (AUR), or the Asset Turnover Ratio. It is the 'proxy for the loss in revenues attributable to inefficient asset utilization' (Ang et al., 2000, p. 82). It is calculated as the ratio of annual sales to total assets. It is an efficiency ratio. It measures how effectively a firm's assets are employed (Ang et al. 2000). A low ER indicates that the management is controlling the operating expenses and vice versa, whereas a low AUR indicates that the management is using the assets in a non-cash flow generating venture and vice versa (Singh and Davidson III 2003).

6.5 Selection and measurement of control variables

A number of control variables are used in the hypotheses testing process because of their potential impact on the dependent variables. The following section explains these variables and justifies the reasons for their selection as control variables based on review of relevant literature.

Firm Size: Most voluntary disclosure studies control for a firm's size as a key determinant of disclosure level. There are two primary reasons that explain the

relationship between voluntary disclosure and firm size. Large firms have the resources to disseminate detailed information, and these firms are susceptible to a high degree of public scrutiny (Liu and Anbumozhi, 2009; Stanny and Ely, 2008). Studies such as Clarkson et al. (2008); Cormier et al. (2005); Freedman and Jaggi (2005); Liu and Anbumozhi (2009), and Stanny and Ely (2008), support the opinion that voluntary disclosure is positively associated with firm size. Recent studies such as Prado-Lorenzo et al. (2009), find that a firm's size positively influences its disclosure of GHG emissions information. Choi et al (2013) find in their study, that large firms will engage more actively in voluntary carbon reporting since they are more visible and also have more resources to prepare comprehensive disclosures. In this study, firm size is measured as a natural logarithm of total asset value measured as of the end of fiscal year. A number of previous studies such as Clarkson et al. (2008) and Sutantoputra et al. (2012) and King and Lenox (2001), use natural logarithm of total assets as a proxy for firm size.

Leverage: A number of studies use leverage to control for voluntary disclosures. Agency costs of debt are higher for firms with relatively more debt in their capital structure (Jensen and Meckling, 1976). The reason for using leverage to control disclosure, is that firms with high leverage adopt accounting policies that allow them to disclose detailed information about their financial, environmental or social performance. This behavior can be attributed to those fact that firms with high leverage would try to avoid agency costs which may be imposed by creditors (Clarkson et al., 2008), or they would try to keep particular stakeholders (investors, creditors) informed in order to avoid debt-covenants' breaches (Freedman and Jaggi, 2005). Therefore, firms with high

leverage are more likely to provide detailed information about their carbon emissions and climate change–related risks and opportunities. For this study, leverage is calculated as a percentage of total debt to total capital.

Firm age: Firm age has been used to control environmental performance by de Villiers et al (2011). According to Mohana-Neill, (1995) older firms are more likely to possess the necessary infrastructure to manage environmental issues at a lower cost. Similarly, Huergo and Jaumandreu (2004) argue that older firms are more likely to engage in environmental activities. Similar to previous studies such as Wagner and Schaltegger (2004), firm age, for this study, has been calculated as the natural logarithm of the age of the firm, starting from the year it was established until the end of 2015.

Growth opportunities: Growth opportunity has been used as a proxy for future growth. It is measured as ratio of market value of equity to book value of equity (Gaver and Gaver, 1993; Smith and Watts, 1992). Al-Tuwaijri et al. (2004) argue that as this ratio measures the difference between the market's appraisal of firm value and the estimate of value aggregated accounting transactions, growth opportunities should be positively related to economic performance. They also use growth as a proxy for intangible assets associated with innovation (Porter and van der Linde, 1995a), and therefore, argue that growth is positively related to environmental performance as well.

Capital intensity: Clarkson et al (2008) argue that firms with newer, cleaner technologies are likely to have a superior environmental performance measure, and it is reasonable to assume that they will want stakeholders to know about this superior

environmental performance in discretionary disclosure channels. For similar reasons, firms with higher sustaining capital expenditures are expected to have newer equipment and may want to signal their environmental type through more discretionary disclosures regarding their environmental performance. It is calculated by dividing total capital spending by total sales revenue of a company, for a particular year.

Carbon intensity: Carbon intensity is used as a control variable as firms operating in carbon-emission-intensive industry are subject to more climate change legislation and regulations, and their carbon disclosure tends to be more open. A binary code of '1' or '0', will be used to indicate industry classification. A firm will receive a score of '1' if it is considered to be operating in a carbon intensive industry such as materials, energy and utilities. Firms from other industries are not considered carbon intensive and hence awarded a score of '0' (Luo and Tang, 2014).

Dividend yield and dividend payout per share: Dividend yield and dividend payout per share have been used in this study to control for corporate financial performance and carbon performance. Numerous studies have shown relationship between dividend payment and corporate financial performance. Denis and Igor (2008) examine cross-sectional and time-series evidence on the propensity to pay dividends, in several developed financial markets over the period 1989–2002. Their study find that the likelihood of paying dividends is associated with firm size, growth opportunities, and profitability and the propensity to pay dividends is higher among larger, more profitable firms.

Myers and Frank (2004) empirically examine the data for a sample of 483 firms taken from the Multex Investor Database, to assess the impact of selected financial variables on the dividend decision. The study uses the firm's dividend payout ratio as the dependent variable to represent the dividend decision. The Price Earnings Ratio and sales growth related positively to the dividend payout ratio. Labhane and Mahakud (2016), examine the determinants of dividend payout ratio for Indian companies during the period 1994–1995 to 2012–2013. From the trend analysis carried out, the authors found that the larger and profitable firms have high dividend payout ratio. Petra et al. (2012) examine the determinants of corporate dividend policy of listed firms in Greece. The analysis is based on 945 firm year observations of 63 nonfinancial firms which paid dividends annually from 1993 to 2007. The authors find that size, profitability and liquidity factors increase the probability to pay dividends.

While firm profitability affects dividend distribution, profitability itself is affected by the business's environmental performance. For instance, Richardson et al. (1999) suggest that socially and environmentally responsible companies are more profitable. The reasons are (1) companies that voluntary engage in social and environmental behaviour may avoid the adverse effect of future regulatory costs on their future cashflows. Social and environmental projects undertaken by firms are seen as self-regulation acts undertaken (2) it is argued that customers accept more environmentally sensitive products. Consumers will vote with their money and choose to pay more for a product sold by firms that support a social and environmental cause for which they have an affinity. As dividend distribution is related to corporate financial performance and corporate financial performance is affected by the business's environmental performance, we can argue that there is a relationship between corporate

carbon performance and dividend distribution. The dividend yield expresses the dividend per share as a percentage of the share price. On the other hand, dividend payout per share = dividends per share / earnings per share * 100.

6.6 Models used in this study

All hypotheses that are developed in chapter 5 are tested using Ordinary Least Square (OLS) regressions. The following models are developed in this study:

Relationship between carbon disclosure and carbon performance:

To test hypotheses 1 and 2 which examines the relationship between carbon disclosure and carbon performance, this study uses the following model:

$$CD_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (1)$$

Interrelation between carbon disclosure and carbon performance:

To test hypothesis 4 which tries to determine the interrelationship between carbon disclosure and carbon performance, the following models are used:

$$CP_{i,t} = \alpha + \gamma_1 CD(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (2)$$

$$CD_{i,t} = \alpha + \gamma_1 CP(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (3)$$

Relationship between carbon performance and financial performance:

To test hypothesis 5, which examines the relationship between carbon performance and financial performance, the following regression models have been used:

When financial performance is measured by ROA, the below model is used:

$$ROA_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (4)$$

When financial performance is measured by Tobin's Q, the below model is used:

$$TOBINSQ_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (5)$$

Interrelation between carbon performance and financial performance:

To test hypothesis 6, which addresses the interrelation between carbon disclosure and carbon performance, the following regression models are used:

When financial performance is measured by ROA:

$$ROA_{i,t} = \alpha + \gamma_1 CP(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (6)$$

$$CP_{i,t} = \alpha + \gamma_1 ROA(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (7)$$

When financial performance is measured by Tobin's Q:

$$TOBINSQ_{i,t} = \alpha + \gamma_1 CP(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (8)$$

$$CP_{i,t} = \alpha + \gamma_1 TOBINSQ(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (9)$$

Relationship between carbon disclosure and financial performance:

To test hypothesis 7, which examines the relationship between carbon disclosure and financial performance, the following regression models are used:

When financial performance is measured by ROA:

$$ROA_{i,t} = \alpha + \beta_1 CD_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (10)$$

When financial performance is measured by Tobin's Q:

$$TOBINSQ_{i,t} = \alpha + \beta_1 CD_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (11)$$

Relationship between carbon disclosure and agency cost:

To test hypothesis 8, which addresses the relationship between carbon disclosure and agency cost, the following regression models are used:

When agency cost is measured by Expense Ratio:

$$ER_{i,t} = \alpha + \beta_1 CD_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (12)$$

When agency cost is measured by Asset Utilization Ratio:

$$AUR_{i,t} = \alpha + \beta_1 CD_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (13)$$

Relationship between carbon performance and agency cost:

To test hypothesis 9, which addresses the relationship between carbon performance and agency cost, the following regression models are used:

When agency cost is measured by Expense Ratio:

$$ER_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (14)$$

When agency cost is measured by Asset Utilisation Ratio:

$$AUR_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon_{i,t} \quad (15)$$

Trends in improvement of carbon disclosure and carbon performance overtime:

To test hypothesis 10, which intends to examine the trends in improvement of carbon disclosure and carbon performance over the study period, the following regression models are used:

To examine improvement of carbon disclosure over time:

$$CD_{i,t} = \alpha + \beta_1 T2_{i,t} + \beta_2 T3_{i,t} + \beta_3 T4_{i,t} + \beta_4 T5_{i,t} + \beta_5 SIZE_{i,t} + \beta_6 LEV_{i,t} + \beta_7 CAPIN_{i,t} + \beta_8 AGE_{i,t} + B_9 GROWTH_{i,t} + \beta_{10} CINT_{i,t} + \beta_{11} DIVYIELD_{i,t} + \beta_{12} DIVPAY_{i,t} + \varepsilon_{i,t} \quad (16)$$

To examine improvement of carbon performance over time:

$$CP_{i,t} = \alpha + \beta_1 T2_{i,t} + \beta_2 T3_{i,t} + \beta_3 T4_{i,t} + \beta_4 T5_{i,t} + \beta_5 SIZE_{i,t} + \beta_6 LEV_{i,t} + \beta_7 CAPIN_{i,t} + \beta_8 AGE_{i,t} + B_9 GROWTH_{i,t} + \beta_{10} CINT_{i,t} + \beta_{11} DIVYIELD_{i,t} + \beta_{12} DIVPAY_{i,t} + \varepsilon_{i,t} \quad (17)$$

Where:

$CD_{i,t}$ = CDP carbon disclosure score for firm *i* for year *t*

$CP_{i,t}$ = CDP carbon performance score for firm *i* for year *t*

$SIZE_{i,t}$ = Firm size for firm *i* for year *t*. It is measured as natural logarithm of total asset value

$LEV_{i,t}$ = Leverage for firm *i* for year *t*. It is measured as the ratio of total debt to total assets

$CAPIN_{i,t}$ = Capital intensity for firm *i* for year *t*. It is measured as the ratio of capital spending divided by total sales revenues

$AGE_{i,t}$ = Firm age for firm *i* for year *t*. It is measured as the natural log of total number of years since the firm was established.

$GROWTH_{i,t}$ = Growth opportunity for firm *i* for year *t*. It is measured as ratio of market value of equity to book value of equity as a proxy for future growth opportunities

$CINT_{i,t}$ = Carbon intensity for firm *i* for year *t*. Firms operating in a carbon-intensive industry (materials, energy or utilities) are assigned a value of 1 and other firms are assigned a value of 0.

$DIVYIELD_{i,t}$ = Dividend yield for firm *i* for year *t*. It is measured as the ratio of dividend per share to share price

$DIVPAY_{i,t}$ = Dividend payout for firm *i* for year *t*. It is measured as dividend payout per share. It is calculated as Dividends per share / Earnings per share * 100

$ROA_{i,t}$ = Return on Asset for firm *i* for year *t*. It is calculated by dividing a company's annual earnings by its total assets.

$TOBINSQ_{i,t}$ = Tobin's Q for firm *i* for year *t*. It is the ratio of the company stock market value to the total assets book value for the company.

$ER_{i,t}$ = Expense Ratio for firm *i* for year *t*. It is the ratio of operating expenses (selling, general, and administrative expenses, excluding financing expenses and any non-recurring expenses, such as losses on the sale of assets) to total annual sales.

$AUR_{i,t}$ = Asset Utilisation Ratio for firm *i* for year *t*. It is calculated as the ratio of annual sales to total assets

α = intercept

β/γ = Regression coefficient

ε = error term

T = current fiscal year

T-1 = previous fiscal year

T1 = fiscal year 2011

T2 = fiscal year 2012

T3 = fiscal year 2013

T4 = fiscal year 2014 and

T5 = fiscal year 2015

Dummy variables:

Industry sectors and time have been used as dummy variables to control for industry and time effects. The sample companies are divided into nine sectors such as: Consumer Discretionary, Consumer Staples, Energy, Health Care, Industrials, Information Technology, Materials, Telecommunication Services and Utilities.

6.7 Chapter Summary

This chapter outlines the methodologies used in this research and justifications for using them. Firstly, this chapter discusses the sample selection process followed by the data sources and justification for using these sources. Secondly, it discusses how this study measures its dependent, and independent variables. The dependent and independent variables are carbon disclosure, carbon performance, financial performance and agency cost. Thirdly, this chapter discusses the control variables, how these variables are measured and the theoretical reasoning for using them. Finally, the regression models which are used in this study to test its hypotheses are stated. The next chapter conducts data analysis and interprets the results.

CHAPTER 7 DATA ANALYSIS, RESULTS AND INTERPRETATION

7.1 Introduction

The objectives of this chapter are to analyse and interpret the relationship between carbon disclosure and carbon performance; between carbon performance and financial performance; between carbon disclosure and financial performance; between carbon disclosure and agency cost and between carbon performance and agency cost. This chapter also aims to investigate any trends in improvement of carbon disclosure and carbon performance during the study period. These analyses are done for both full sample and region wise. However, most of the similar research in this area (for example: Cotter & Najah, 2012) have termed region-wise analysis as country-wise analysis. To keep consistency with previous studies, the term country has been used to mean region in this study. This chapter provides the multiple regression results from the tests conducted to test the hypotheses of this study. This chapter also conducts normality, multicollinearity and heteroscedasticity tests to validate the data and the regression models used in this study. This chapter is organized as below:

Section 7.2 provides the descriptive statistics of this study. Section 7.3 provides the diagnostics test used to validate the data and regression models used in this research. Section 7.4 analyses and interprets relationship and interrelationship between carbon disclosure and carbon performance. Section 7.5 analyses and interprets the relationship and interrelationship between carbon performance and financial performance. Section 7.6 investigates the relationship between carbon disclosure and financial performance. The relationship between carbon disclosure and agency cost and between carbon

performance and agency cost is analysed and interpreted in Section 7.7. Section 7.8 conducts a trend analysis to investigate any improvement for carbon disclosure and carbon performance over the study period. Section 7.9 summarizes the chapter. All hypotheses in the study have been tested both for full sample and country-wise.

7.2 Descriptive statistics

The purpose of this section is to provide the descriptive statistics for the variables used in this study. It provides descriptive statistics for full sample as well as country-wise.

7.2.1 Descriptive statistics for dependent, independent and control variables

The following table displays the descriptive statistics for dependent, independent and control variables for the full sample, for the entire study period (years 2011–2015).

Table 7.1 Descriptive statistics for dependent, independent and control variables

	N	Minimum	Maximum	Mean	Std. Deviation
Carbon Disclosure	944	50.00	100.00	85.81	12.87
Carbon Performance	944	10.00	93.00	66.55	21.07
Return on Asset (%)	945	-148.37	51.24	10.42	9.78
Tobin's Q	945	0.00	8.13	1.57	1.05
Expense Ratio	945	0.00	0.82	0.25	0.17
Asset Utilisation ratio	945	0.11	4.49	0.78	0.51
Firm Size	945	8.72	12.86	10.68	0.77
Firm Age	945	0.00	5.86	3.96	8.51
Growth Opportunity	945	-7003.03	4139.18	35.40	351.07
Dividend Yield (%)	945	0.00	16.55	2.87	1.81
Dividend Payout per share	945	0.00	99.67	38.54	26.83
Capital Intensity	945	0.00	0.93	0.10	0.11
Carbon Intensity	945	0.00	1.00	0.25	0.43
Leverage	945	0.00	83.87	24.98	13.34

As per the above table, the mean of carbon disclosure score for the whole sample is 85.81 out of 100. As discussed in previous chapter, carbon disclosure score represents the potential quality in completeness of disclosure and hence it's likely usefulness to data users. The disclosure score is a matrix of comprehensiveness of the responses, good internal data management and understanding of climate change issues and is a measure of complete transparency on climate change. Therefore, an average score of 85.81 indicate that the data disclosed by sample companies are of high quality and are useful to the uses. It also indicates that the sample companies have good level of understanding

about climate change related issues and they are disclosing a good amount of data related to their climate change activities. Carbon disclosure score ranges from a minimum of 50 to a maximum of 100 among the sample companies. Only those companies who have a minimum of 50 in disclosure scores are selected in this study, as companies who get less than 50 are not awarded performance score. Therefore, the minimum disclosure score of 50 and maximum of 100 indicate huge variation in the extent of carbon disclosure made by the sample firms.

The mean of carbon performance score for the whole sample is 66.87 out of 100, which is less than the mean of carbon disclosure score. Carbon performance scores are awarded to companies for evidence provided in the CDP response of actions considered to contribute to climate change mitigation, adaptation and transparency. Therefore, the average score of 66.87 indicate above average carbon performance by the sample companies. The minimum carbon performance score is 10 and maximum is 93. This suggest a huge variation among sample companies in regards to their carbon performance. Return on asset has a mean of 10.42%. Minimum ROA from the sample companies is -148.37% and maximum is 31.24%. Tobin's Q has a mean of 1.57% with a minimum of 0.00% and a maximum of 8.13%. Minimum expense ratio for the sample firms is 0.00 while the maximum is 0.82. It has a mean of 0.25. Asset utilization ratio ranges from 0.11 to 4.49 with a mean of 0.78.

7.2.2 Country-wise descriptive statistics for major variables

The following table displays the country-wise descriptive statistics for major variables for the entire study period (years 2011-2015).

Table 7.2 Country-wise descriptive statistics for major variables

Panel A: Carbon disclosure score					
Region	**N**	**Minimum**	**Maximum**	**Mean**	**Std. Deviation**
North America	455	50	100	84.25	13.25
EU	259	50	100	88.15	13.01
UK	100	53	100	86.106	10.99
Asia-Pacific	110	54	100	85.48	12.32
Panel B: Carbon performance score					
North America	455	10	93	62.83	21.42
EU	259	10	93	72.34	20.72
UK	100	10	93	70.7	19
Asia-Pacific	110	10	93	66.13	19.39
Panel C: Financial Performance measured by ROA					
North America	455	-148.37	38	11.63	11.34
EU	259	-8.29	51.24	9.92	8.5
UK	100	-13.65	32.37	9.18	7.33
Asian-Pacific	110	-12.53	21.42	7.8	6.08
Panel D: Financial Performance measured by Tobin's Q					
North America	455	0	6.21	1.8	1
EU	259	0.23	8.13	1.49	1.32
UK	100	0.54	2.84	1.37	0.63
Asia-Pacific	110	0.15	2.47	1.07	0.5

Panel E: Agency cost measured by Expense Ratio					
North America	455	0	0.82	0.26	0.16
EU	259	0	0.55	0.26	0.15
UK	100	0	0.79	0.26	0.24
Asia-Pacific	110	0.01	0.76	0.21	0.14
Panel F: Agency cost measured by Asset Utilization Ratio					
North America	455	0.11	4.49	0.82	0.6
EU	259	0.3	2.17	0.76	0.37
UK	100	0.26	1.43	0.66	0.24
Asia-Pacific	110	0.17	2.71	0.81	0.52

The above table presents country wise descriptive statistics for major variables. Panel A shows that European Union firms have the highest scores in carbon disclosure with a mean of 88.15, followed by UK (88.15) and Asia-Pacific (85.48). North American firms have the lowest carbon disclosure score with an average score of 84.25. This is consistent with CERES (2007) and Doran and Quinn (2009) which suggest that US firms are behind their counterparts in reporting their exposure to climate change and carbon emissions.

Panel B shows that EU firms have the best carbon performance scores with an average score of 72.34 followed by UK (72.34) and Asia-Pacific (66.13). Similar to carbon disclosure scores, North American firms have the worst carbon performance scores with a mean of 62.83. Therefore, we can see that better carbon performers make more carbon disclosure. This is consistent with studies such as Peng et al. (2015) and

Cotter and Najah (2012), who predict a positive association between carbon performance and carbon disclosure.

Panel C and D indicate that North American firms have the best financial performance both in terms of ROA and Tobin's Q. Asia and Pacific has the worst financial performance. This suggests that carbon performance and financial performance are negatively associated. This is consistent with many studies such as Jaggi and Freedman (1992) and Wang et al. (2014).

Panel E shows average Expense Ratios of firms from different regions. Firms from North America, EU and UK have an average of 0.26 Expense Ratio, whilst Asia-Pacific has an average Operating Ratio of 0.21. As mentioned earlier, Expense Ratio (ER) is the ratio of operating expenses (selling, general, and administrative expenses, excluding financing expenses and any non-recurring expenses, such as losses on the sale of assets) to total annual sales. It measures how effectively a firm's management controls operating costs. Therefore, we can say that companies from Asia-Pacific region are more effective in controlling operating costs than companies from other regions.

Panel F illustrates the Asset Utilization Ratio (AUR) of companies from different regions. North American firms have the highest average AUR followed by Asia-Pacific, EU and UK. As discussed before, AUR is calculated as the ratio of annual sales to total assets. It measures how effectively a firm's assets are employed. Therefore, we can suggest that North American firms are most effective in utilizing their assets followed by Asia-Pacific, EU and UK.

7.3 Diagnostic tests

As explained before, the hypotheses of this study are primarily tested by using Ordinary Least Squares (OLS) multiple regression model. To perform statistical analysis, it is necessary that the regression models used in a study meet the assumptions of statistical analysis, such as:

1. Normality
2. Multicollinearity
3. Heteroscedasticity.

To validate the data and models used in this study Normality, Multicollinearity and Heteroscedasticity tests have been done. The results are discussed below:

7.3.1 Normality Test

The normality assumption requires that observations be normally distributed in the population. Although Coakes and Steed (2001) argue that violations of normality are of little concern when the sample size is large (greater than 30). The Residual Test/Histogram-Normality Test carried out for all the models used in this study produce bell-shaped curves which confirms that the data used in this study are normally distributed.

7.3.2 Multicollinearity test

Multicollinearity refers to high correlations among the independent (or explanatory) variables. In other words, multicollinearity is present in a data set when the explanatory variables are significantly correlated with one another. When a high degree

of correlation is found among explanatory variables, these variables must be removed. For all the models used in this study, the correlation coefficients among the independent (or explanatory) variables are very small (less than 0.50 or negative). Furthermore, the Variance Inflation Factors (VIFs) of all the variables are less than 2, while it is argued that VIFs of more than 10 are an indication of Multicollinearity (Dielman, 2001; Gujarati, 2003; Hills and Adkins, 2003). Therefore, we can conclude that there is no multicollinearity in any of the models used in this study.

7.3.3 Heteroscedasticity test

The heteroskedasticity assumption requires that the variance of the error be constant across observations (all levels of explanatory variables) or that the residuals of the dependent variables be approximately equal or constant. In other words, the data points will be spread uniformly across the regression line. If the plots of standardized residuals (ZRESID) against the standardized predicted value (ZPRED) of a model appear as a funnel or curve shape, it indicates evidence of heteroskedasticity in the model. The Chi squared statistics and corresponding p value of the Breusch–Pagan–Godfrey test can also find out whether there heteroskedasticity is present in a model. Presence of heteroskedasticity has been checked in all models of this study. Whenever heteroskedasticity has been found in any model it has been corrected by using the correction technique for unknown heteroskedasticity proposed by White (1980).

7.4 Empirical results for the relationship and interrelationship between carbon disclosure and carbon performance

There are three objectives of this section. Firstly, this section would like to analyse and interpret the relationship between carbon disclosure and carbon performance (H1 and H2). Secondly, it would like to analyse and interpret the interrelationship between carbon disclosure and carbon performance (H3), and thirdly, it would like to analyse carbon disclosure practices of average carbon performers (H4).

7.4.1 Regression results for the relationship between carbon disclosure and carbon performance for H1 and H2

This section analyses the relationship between carbon disclosure, carbon performance and control variables. Table 7.3 (panel A) shows the regression results between carbon disclosure and carbon performance and between carbon disclosure and the control variables. The t tests are presented in the parentheses in this table and in all subsequent relevant tables. The regression results from this table indicate that there is significant positive relations between carbon disclosure and carbon performance at 1% significance level. This means firms with better carbon performance would make more carbon disclosure. This result supports hypothesis 2 which proposes a positive relationship between carbon performance and carbon disclosure. This finding is in congruence with the economics-based theories (Voluntary Disclosure Theory and Signalling Theory) which suggest firms with good performance are likely to disclose more information to signal their good quality to investors, and to differentiate

themselves from companies with 'bad news' to avoid the adverse selection problem (Clarkson et al, 2008; Al-Tuwaijri et al., 2004; Peng et al., 2015; Cotter & Najah 2012).

After testing the control variables, the regression results show that carbon disclosure is significantly positively related to company size and growth opportunities (both at 5% significance level) and negatively related to dividend yield (at 1% significant level). Other explanatory variables such as leverage, capital intensity, firm age, carbon intensity and dividend payout, do not have any significant influence on firm carbon disclosure.

These results imply that larger firms would make more carbon disclosure than smaller firms. This finding is supported by numerous studies which suggest that large firms have the resources to disseminate detailed information, and these firms are more visible and are susceptible to a high degree of public scrutiny (Liu & Anbumozhi, 2009; Stanny & Ely, 2008; Clarkson et al., 2008; Cormier et al., 2005; Freedman & Jaggi 2005; Prado-Lorenzo et al., 2009; Choi et al, 2013). These results also imply that there is a significant positive relationship between firm's carbon disclosure and its growth opportunity, i.e. firms with higher growth opportunities would make more carbon disclosure. This finding is supported by Dhaliwal et al. (2011) and Wang (2017). In regards to the relationship between carbon disclosure and dividend yield, the results suggest that companies with higher dividend yield, i.e. those who pay more dividend per share, make less carbon disclosure and vice versa. This result contradicts previous studies such as Richardson et al. (1999) who suggest that socially and environmentally responsible companies are more profitable and therefore, are likely to pay more dividend. Needless to say, the analysis results from Table 7.3 do not support

hypothesis 1 which proposes a negative relationship between carbon disclosure and carbon performance.

Adjusted R–squared of 0.59 shows that carbon disclosure is explained by all the variables (carbon performance, firm size, leverage, capital intensity, firm age, firm growth opportunity, carbon intensity, dividend yield and dividend payout) to the extent of 58%. F test implies that the model appears to be good since the p value is less than 1%. Panel B of Table 7.3 shows the regression results between carbon disclosure and carbon performance and control variables, after controlling the regression equation for industry and time effects. The relationship between carbon disclosure and carbon performance remains significantly positive even after controlling for industry and time effect. However, in the industry and time adjusted regression results, relationship/significance of relationship between carbon disclosure and some of the control variables such as firm size, leverage, capital intensity, carbon intensity and dividend yield, seem to vary across industry and time periods.

Table 7.3 Regression results for the relationship between carbon disclosure and carbon performance

$$CD_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	46.944***	48.169***
	(12.509)	(15.639)
CP	0.460***	0.424***
	(35.724)	(35.911)
SIZE	0.699**	0.082
	(2.021)	(0.2774)
LEV	0.092	0.064***
	(4.224)	(3.354)
CAPIN	-2.998	-4.226*
	(-0.913)	(-1.656)
AGE	-0.075	-0.059
	(-0.226)	(-0.203)
GROWTH	0.000**	0.000***
	(2.219)	(2.413)
CINT	1.072	-0.567
	(1.555)	(-0.429)
DIVYIELD	-0.310***	-0.111
	(-1.949)	(-0.762)
DIVPAY	-0.007	-0.003
	(-0.667)	(-0.422)
Adjusted R-squared	0.5908	0.736
F-statistic	151.845***	121.071***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.4.2 Regression results for the interrelationship between carbon disclosure and carbon performance for H3

The purpose of this section is to analyse the interrelationship between carbon disclosure and carbon performance. To do so, two models have been used. The first model is used to analyse the relationship between previous year's carbon disclosure and current year's carbon performance and relevant control variables. The second model is used to analyse the relationship between previous year's carbon performance and current year's carbon disclosure and relevant control variables. The regression results of first and second models are shown in Tables 7.4 and Table 7.5 respectively.

Regression results from Table 7.4 (panel A), show that there is a significant positive relationship between last year's carbon disclosure and current year's carbon performance at 1% significance level. On the other hand, regression results from Table 7.5 (panel A) also show that there is a significant positive relationship (at 1% significance level) between last year's carbon performance and current year's carbon disclosure. These results indicate that if a firm's carbon disclosure improves in a year, its carbon performance is likely to improve next year which is supported by the propositions of Instrumental Stakeholder Theory. On the other hand, if the carbon performance of a firm improves in a year, its carbon disclosure is likely to improve next year which can be explained by the propositions of Signalling Theory. Both these results hold true when industry and time effects are also considered as shown is Panel B of Table 7.4 and 7.5. Combining these two results, we can argue that there is a two-way positive relationship between carbon disclosure and carbon performance, where increase in carbon disclosure of a firm in a period will improve its carbon performance for the next period (as predicted by Instrumental Stakeholder Theory), and consequently,

improved carbon performance will lead to more carbon disclosure by the firm in the subsequent period as predicted by Signalling Theory. Therefore, we can conclude that the above results support hypothesis 3 which proposes that carbon disclosure and carbon performance influence each other positively.

Table 7.4 (panel A) also shows that, from the control variables, firm size, firm age, dividend yield and dividend payout are significantly positively related to carbon performance, while capital intensity, and growth opportunity are significantly negatively related to carbon performance. This means larger and older firms and firms who pay more dividend per share would have better carbon performance. Numerous previous studies predict a positive relationship between firm size and environmental and carbon disclosure which have been mentioned in the previous section. However, this study could not find any previous study that predict a relationship between firm size and carbon performance. However, it can be assumed that larger firms would have more resources to improve their carbon performance. A number of previous studies support the positive relationship between firm age and environmental/carbon performance, for example, Mohana-Neill (1995) suggest that older firms are more likely to possess the necessary infrastructure to manage environmental issues at a lower cost. Similarly, Huergo and Jaumandreu (2004) argue that older firms are more likely to engage in environmental activities.

Many previous studies such as Denis and Igor (2008), Myers and Fr (2004), Labhane and Mahakud (2016) and Petra et al. (2012), find that dividend distribution is positively related to corporate financial performance. Richardson et al. (1999) find that corporate financial performance is positively affected by the business's environmental

performance. Therefore, we can argue that there is a positive relationship between corporate carbon performance and dividend distribution.

The negative relationship between carbon performance and capital intensity is contradicted by Clarkson et al. (2008) who argue that firms who would make more capital spending are likely to have newer, cleaner technologies and consequently, these firms are likely to have a superior environmental performance measure. The negative relationship between carbon performance and growth opportunity is also contradicted by previous studies. Al-Tuwaijri et al. (2004) use growth as a proxy for intangible assets associated with innovation (Porter & van der Linde, 1995a), and therefore argue that growth is positively related to environmental performance.

Panel B of Table 7.4 shows the regression results between carbon performance and control variables after controlling the regression equation for industry and time effects. Regression results and relationship/significance of relationship between carbon performance and some of the control variables such as firm leverage, capital intensity, growth opportunity and dividend payout, seem to vary across industry and time periods.

Table 7.5 shows a positive relationship of firm size and leverage with carbon disclosure while it shows a negative relationship between carbon disclosure and leverage. The positive relationship between firm size and carbon disclosure has already been discussed before. A number of studies such as Clarkson et al. (2008) and Freedman and Jaggi (2005) support the positive relationship between firm leverage and voluntary disclosure. However, the negative relationship between carbon disclosure and capital intensity is contradicted by previous studies such as Clarkson et al. (2008) who suggest firms with higher sustaining capital expenditures are expected to have newer equipment

and may want to signal their environmental type through more discretionary disclosures regarding their environmental performance.

In Table 7.4, p value of both the models used (before and after controlling for industry and time effects) are less than 1%. This implies that both these models are good. Similarly, both the models used in Table 7.5 also appear to be good models, as p value of their F test is less than 1%.

Table 7.4 Regression results for the relationship between previous year's carbon disclosure and current year's carbon performance

$CP_{i,t} = \alpha + \gamma_1 CD(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon i,t$

	Panel A	Panel B
	(Before controlling for industry and time)	(After controlling for industry and time)
Intercept	-33.343***	-70.549***
	(-3.681)	(-7.885)
CD(-1)	0.627***	0.883***
	(12.260)	(15.438)
SIZE	3.232***	3.488***
	(4.0523)	(4.486)
LEV	0.038	-0.007
	(0.786)	(-0.160)
CAPIN	-13.365**	-3.940
	(-2.162)	(-0.625)
AGE	1.712**	1.186*
	(2.347)	(1.665)
GROWTH	-0.001*	-0.001
	(-1.730)	(-1.585)
CINT	-2.105	-6.101
	(-1.337)	(-1.240)
DIVYIELD	1.371***	1.152***
	(3.447)	(2.857)
DIVPAY	0.047**	0.021
	(2.089)	(0.988)
Adjusted R-squared	0.223	0.361
F-statistic	31.081***	25.240***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.5 Regression results for the relationship between previous year's carbon performance and current year's carbon disclosure

$CD_{i,t} = \alpha + \gamma_1 CP(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon i,t$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	45.3537***	38.794***
	(8.688)	(8.732)
CP(-1)	0.268954***	0.246***
	(14.743)	(13.964)
SIZE	1.685975***	1.236
	(3.564)	(2.844)
LEV	0.10678***	0.074***
	(3.807)	(2.941)
CAPIN	-7.457043**	-5.801*
	(-2.024)	(-1.816)
AGE	0.557975	0.435
	(1.213)	(1.050)
GROWTH	-0.000243	-0.000
	(-0.623)	(-0.545)
CINT	0.417346	-3.589
	(0.427)	(-1.090)
DIVYIEL	0.144022	0.256
D	(0.650)	(1.211)
DIVPAY	-0.002014	-0.0031
	(-0.146)	(-0.263)
Adjusted R-squared	0.249599	0.472
F-statistic	35.777***	39.308***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.4.3 Country-wise analysis for the relationship between carbon disclosure and carbon performance

The sample companies of this study has been divided into five regions, namely: North America, European Union (EU), the United Kingdom (UK), Asia-Pacific and Others. Table 7.6 shows the relationship and interrelationship between carbon disclosure and carbon performance of the first four groups. Others group has been excluded from the country-wise analysis as this group consisted of only 4 companies. In all of the four regions, carbon disclosure is significantly positively related to carbon performance, all at 1% significance level. These results are congruent with full sample results. This implies that in all regions, firms with better carbon performance will make more carbon disclosure. These findings are supported by a number of previous studies which have been mentioned before. This finding supports H2.

The proposed relationship in H3 that carbon disclosure and carbon performance influence each other positively holds true in all regions with a significance level of 1% except in the UK. Even in the UK, carbon disclosure of the previous year is positively related to carbon performance of the current year, and carbon performance of the previous year is positively related to carbon disclosure of the current year. However, whilst the relationship between previous year's carbon performance and current year's carbon disclosure is statistically significant at 1% level, the relationship between previous year's carbon disclosure and current year's carbon performance is not statistically significant.

All the models used in Table 7.6 for country-wise analysis are good models as the p value of their F tests are less than 1%.

Table 7.6 Country wise regression results for the relationship and interrelationship between carbon disclosure and carbon performance

Variable	North America			European Union			United Kingdom			Asia-Pacific		
	CD	CP	CD	CD	CP	CD	CD	CP	CD	CD	CP	CD
CP	0.456***			0.486***			0.348***			0.434***		
	(24.235)			(18.671)			(5.930)			(11.417)		
CD(-1)		0.665***			0.410***			0.135			0.494***	
		(9.680)			(3.658)			(0.599)			(2.895)	
CP(-1)			0.290***			0.195***			0.220***			0.196***
			(10.802)			(5.086)			(3.9470			(3.077)
SIZE	1.176**	2.874**	1.884***	0.338	5.073***	2.476**	0.540	9.777***	1.447	0.313	4.356	1.608
	(2.511)	(2.577)	(3.055)	(0.451)	(93.188)	(2.364)	(0.365)	(3.116)	(0.797)	(0.264)	(1.418)	(0.921)
LEV	0.105***	0.086	0.128***	0.078	0.267**	0.207***	0.258***	0.395*	0.347***	0.096	-0.135	0.089
	(3.195)	(1.235)	(3.245)	(1.603)	(2.234)	(2.638)	(3.230)	(1.975)	(3.769)	(1.372)	(-0.912)	(0.957)
CAPIN	-1.939	-2.257	-2.347	-18.200*	-69.465**	-50.436***	6.432	-1.057	-9.408	-5.112	-11.530	-8.280
	(-0.485)	(-0.257)	(-0.451)	(-1.701)	(-2.565)	(-2.993)	(0.365)	(-0.026)	(-0.498)	(-0.446)	(-0.990)	(-0.858)
AGE	-0.650	0.052	-0.716	0.660	4.248***	2.418***	-0.070	-2.410	-0.469	-0.940	0.666	-0.595
	(-1.248)	(0.043)	(-0.944)	(1.112)	(3.712)	(2.936)	(-0.064)	(-0.840)	(-0.364)	(-0.763)	(0.294)	(-0.391)
GROWTH	0.000	-0.011	-0.010**	0.304	0.553	0.585	0.001***	-0.002***	0.000	1.989*	0.357	2.227
	(0.051)	(-0.671)	(-2.486)	(1.152)	(0.973)	(1.433)	(3.201)	(-4.488)	(0.287)	(1.849)	(0.167)	(1.580)
CINT	0.325	-3.267	-1.169	2.532**	1.208	3.553**	-1.571	-3.480	0.720	2.250	0.738	2.355
	(0.286)	(-1.273)	(-0.702)	(2.565)	(0.418)	(2.261)	(-0.413)	(-0.439)	(0.173)	(0.710)	(0.129)	(0.659)
DIVYIELD	-1.028***	1.149	-0.390	0.162	1.771**	0.854	-0.661	-3.928***	-1.428*	-0.884	0.672	-0.849
	(-3.288)	(1.272)	(-0.910)	(0.664)	(2.578)	(2.090)	(-1.0480	(-2.970)	(-1.957)	(-1.631)	(0.458)	(-0.972)
DIVPAY	0.015	0.068	0.013	0.014	0.063	0.033	-0.020	-0.066	-0.033	-0.074**	-0.044	-0.089**
	(0.721)	(1.570)	(0.485)	(0.803)	(1.142)	(1.168)	(-0.713)	(-1.010)	(-1.152)	(-2.3640	(-0.624)	(-2.338)
Adjusted R^2	0.578	0.235	0.274	0.686	0.252	0.290	0.468	0.175	0.283	0.517	0.059	0.134
F-statistic	69.996***	16.439***	20.036***	63.511***	10.581***	12.612***	10.692***	3.310***	5.307***	13.981***	1.756***	2.863***

7.4.4 Empirical results for disclosure practices of average carbon performers for H4

To test this hypothesis, a single factor ANOVA analysis is done where the average carbon disclosure scores of superior carbon performers, average carbon performers and inferior carbon performers, are compared for the full sample. Firms who got A in carbon performance are considered as superior carbon performers. Firms who got B and C are considered average carbon performers, and firms who got D and E are considered as inferior carbon performers. To substantiate the findings from ANOVA analysis, Tukey's post hoc multiple comparison tests is done. The following tables show the test outcomes:

ANOVA: Single Factor

SUMMARY

Groups	*Count*	*Sum*	*Average carbon disclosure score*	*Variance*
Superior Carbon performers (A)	214	20579	96.163	16.913
Average Carbon performers (B&C)	602	51889	86.194	113.724
Inferior Carbon performers (D&E)	127	8469	66.6857	115.582

ANOVA

Disclosure Score	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	69480.574	2	34740.287	377.555	0
Within Groups	86492.938	940	92.014		
Total	155973.512	942			

Tukey's post hoc multiple comparisons

Dependent Variable: Disclosure score

Tukey HSD

Carbon Performance	Carbon Performance	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Superior	Average	9.969*	0.763	0	8.18	11.76
	Poor	29.479*	1.074	0	26.11	32
Average	Superior	-9.969*	0.763	0	-11.76	-8.18
	Poor	19.509*	0.937	0	17.31	21.71
Poor	Superior	-29.479*	1.074	0	-32	-26.11
	Average	-19.509*	0.937	0	-21.71	-17.31

The mean difference is significant at the 0.05 level.

Superior (Superior carbon performers) = A

Average (Average carbon performers) = B & C

Poor (Poor carbon performers) = D & E

***, ** and * represent significance levels at 1%, 5% and 10% respectively.

Interpretation of the above tests:

From the descriptive analysis shown in the summary table above, the estimated average disclosure scores are 96.17, 86.20 and 66.69, for superior, average and poor carbon performers respectively. This means on average, superior carbon performers

make more carbon disclosure than average carbon performers, whereas average carbon performers make more carbon disclosure than inferior carbon performers. From the overall F test result from the next table above, we can conclude that there are significant (F test p- value = 0.000) differences among average disclosure scores of the three carbon performance group, namely superior, average and inferior performers. This result is backed by Tukey's Post hoc multiple comparison test shown in the next table. From this test, with 95% confidence, it can be concluded that the average disclosure score of superior performers, exceeds the average disclosure score of average performers by values between a minimum of 8.18 and a maximum of 11.76. Similarly, it can be also concluded that the average disclosure score of average performers exceeds that of the poor performers, by values between a minimum of 17.31 and a maximum of 21.71.

From the above findings of ANOVA and Tukey's Post hoc multiple comparison test, we can see a one directional change in the carbon disclosure scores, which implies that superior carbon performers make more carbon disclosure than average carbon performers, and average carbon performers make more carbon disclosure than inferior carbon performers. These findings contradict H4 which suggest that both superior and inferior carbon performers make significantly more carbon disclosure than average carbon performers. However, these findings are in congruence with H2 and a number of studies such as Clarkson et al. (2008); Al-Tuwaijri et al. (2004); Peng et al. (2015) and Cotter and Najah (2012), who suggest that better carbon performers would make more carbon disclosure than inferior carbon performers.

7.5 Empirical results for the relationship and interrelationship between carbon performance and financial performance

The purpose of this section is to analyse and interpret the relationship (one-way relationship) and interrelationship (both-way relationship) between carbon performance and financial performance. These relationships are hypothesized in H5 and H6.

7.5.1 Regression results for the relationship between carbon performance and financial performance for H5

This section analyses the relationship between carbon performance and financial performance. In this study, financial performance is alternatively measured by both ROA and Tobin's Q. Table 7.7 shows the regression results between carbon performance and financial performance when financial performance is measured by ROA, while Table 7.8 shows the relationship between carbon performance and financial performance when financial performance is measured by Tobin's Q.

Panel A of Table 7.7 shows that carbon performance is significantly negatively related to ROA at 1% significance level. When industry and time effects are considered (shown in Panel B), the relationship between carbon performance and financial performance still remains significantly negative (at 5% significance level). This implies that when carbon performance of a business improves, its financial performance in terms of return on asset, deteriorates. When financial performance is measured in terms of Tobin's Q (as shown in Table 7.8 panel A), there is a negative but insignificant relationship between carbon performance and Tobin's Q. However, when industry and time effects are considered (as shown in Table 7.8 panel B), carbon performance and

Tobin's Q shows a significant negative relationship (at 5% significance level). Therefore, we can assume that carbon performance affects Tobin's Q negatively, i.e. if a firm's carbon performance improves, the financial performance of that firm, measured in terms of its Tobin's Q, would decrease. Combining these two results, we can conclude that carbon performance and financial performance are not positively related, but rather they are negatively related, regardless of the way financial performance is measured. These findings are backed up by numerous previous studies. Jaggi and Freedman (1992) predict that in the short run, pollution performance is negatively associated with economic performance and that the markets do not reward good pollution performance. Cordeiro and Sarkis (1997) demonstrate a significant negative relationship between environmental proactivism and industry analyst earnings-per-share. Filbeck and Gorman (2004) find evidence of a negative relationship between financial return and a more pro-active measure of environmental performance. Sarkis and Cordeiro (2001) find that pollution prevention and end-of-pipe efficiencies are both negatively related to ROS. Ennis et al. (2012) find if carbon emission increases and therefore carbon performance decreases, revenue will increase. They also find that emissions levels are not presently drivers of stock prices. According to them, financial markets are not yet responsive to the carbon performance of companies. Matsumura et al. (2013) predict and find a negative association between carbon emissions and firm value. They observe that markets penalise all firms for their carbon emissions. Wang et al. (2014) find that when measured by Tobin's Q, financial performance is negatively related to carbon performance.

While testing the control variables of Table 7.7, and after considering industry and time effects, we find that firm size and dividend payout show a positive relationship

with ROA, while capital intensity and dividend yield show a negative relationship with ROA. When financial performance is measured by Tobin's Q (as shown in Table 7.8) and industry and time effects are considered, firm size and divided payout per share are positively related - and firm age and dividend yield are negatively related to Tobin's Q. Numerous previous studies such as Nehring et al. (2009); Adenauer and Heckelei (2011); Chaddad and Mondelli (2013), hypothesize a direct relationship between organisational size and financial performance. The arguments used to justify a direct and positive relationship between profitability and size, focus on the greater resources and market opportunities of large companies, which can enable economies of scale. Large companies also have greater negotiating power with customers and suppliers, as well as easier access to international markets. As mentioned earlier, many previous studies such as Denis and Igor (2008), Myers and Frank (2004), Labhane and Mahakud (2016) and Petra et al. (2012), find that dividend distribution is positively related to corporate financial performance

7.5.2 Country-wise regression results for the relationship between carbon performance and financial performance

From Table 7.9 we can see that, in all the regions except UK carbon performance is negatively related to both ROA and Tobin's Q. However, in North America, the relationship between carbon performance and Tobin's Q is significant, while the relationship between carbon performance and ROA is insignificant. Both in EU and Asia-Pacific, relationships between carbon performance and ROA are significant. However, in these regions, the relationships between carbon performance and Tobin's Q

are insignificant. The relationships of carbon performance with ROA and Tobin's Q from North America, EU and UK are to some extent similar to the full sample results, especially in the direction of the relationship. All these regions predict a negative relationship between carbon performance and ROA, and Tobin's Q. The UK is the only region where carbon performance is positively related to both ROA and Tobin's Q. However, only the relationship between carbon performance and Tobin's Q is significant in this region. All the models used in Table 7.7, Table 7.8 and Table 7.9, are good models, as the p value of their F tests are less than 1%.

Table 7.7 Regression results for the relationship between carbon performance and financial performance measured by ROA

$ROA_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	-5.291	-9.787
	(-1.504)	(-2.767)
CP	-0.033***	-0.025**
	(-2.616)	(-1.975)
SIZE	2.215***	2.379***
	(7.241)	(6.408)
LEV	-0.051	-0.046
		(-1.236)
CAPIN	-20.038**	-18.192*
	(-1.442)	(-1.818)
AGE	-0.850***	-0.736
	(-2.993)	(-2.636)
GROWTH	0.000	0.000
	(0.244)	(0.554)
CINT	-1.098	0.625
	(-1.329)	(0.731)
DIVYIELD	-0.725***	-0.663***
	(-3.980)	(-3.772)
DIVPAY	0.083***	0.085***
	(8.111)	(8.349)
Adjusted R-squared	0.173	0.206
F-statistic	22.848***	12.113***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.8 Regression results for the relationship between carbon performance and financial performance measured by Tobin's Q

$$TOBINSQ_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	-0.280	-0.299
	(-0.698)	(-0.737)
CP	-0.002	-0.003**
	(-1.525)	(-2.107)
SIZE	0.252***	0.179***
	(7.525)	(5.042)
LEV	0.003	0.001
	(0.687)	(0.276)
CAPIN	-0.805***	-0.164
	(-3.758)	(-0.863)
AGE	-0.099***	-0.101***
	(-2.768)	(-2.851)
GROWTH	0.000	0.000
	(1.601)	(0.375)
CINT	-0.301***	0.075
	(-5.304)	(0.932)
DIVYIEL	-0.172***	-0.116***
D	(-8.862)	(-5.865)
DIVPAY	0.007***	0.007***
	(5.413)	(5.370)
Adjusted R-squared	0.174	0.238
F-statistic	23.054***	14.398***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.9 Country wise regression results for the relationship between carbon performance and financial performance

Variable	North America		European Union		United Kingdom		Asia-Pacific	
	ROA	Tobin's Q	ROA	Tobin's Q	ROA	Tobin's Q	ROA	Tobin's Q
CP	-0.019	-0.004**	-0.039*	-0.000	0.039	0.006**	-0.041*	-0.001
	(-.968)	(-2.026)	(-1.794)	(0.1822)	(1.383)	(2.367)	(-2.005)	(-0.695)
SIZE	1.126***	0.181***	1.194**	-0.015	2.693**	0.358***	3.396***	0.158***
	(2.9420	(4.182)	(2.364)	(-0.285)	(2.1920	(4.488)	(5.053)	(5.264)
LEV	-0.028	0.020***	-0.122***	-0.020***	0.073	0.014***	-0.099**	-0.009***
	(-.489)	(5.026)	(-.3.803)	(-.4.245)	(1.156)	(2.629)	(-0.2600)	(-4.281)
CAPIN	-34.494**	-1.509***	24.928***	1.847***	-14.262	0.364	4.992	0.705***
	(-2.212)	(-5.967)	(4.045)	(2.788)	(-0.982)	(0.344)	(0.834)	(3.163)
AGE	-1.309***	-0.215***	0.895**	0.114**	-0.617	-0.021	-0.604	-0.019
	(.3.510)	(4.464)	(2.244)	(2.3620	(-0.812)	(-0.335)	(-0.971)	(-0.801)
GROWTH	0.011*	0.000	2.396***	0.441***	0.000	0.000***	3.138***	0.395***
	(1.720)	(0.327)	(9.491)	(11.511)	(0.370)	(2.773)	(5.721)	(12.151)
CINT	-0.984	-0.327***	1.134*	-0.033	0.080	-0.430*	0.742	0.104*
	(-.5870	(-0.401)	(1.655)	(-0.6280	(0.264)	(-1.837)	(0.514)	(1.747)
DIVYIELD	-1.102***	-0.333***	-0.099	0.023	-1.168**	-0.129***	0.261	0.000
	(-4.127)	(-11.010)	(-.525)	(1.248)	(-2.316)	(-3.673)	(0.893)	(0.0240
DIVPAY	0.101	0.009***	0.027**	0.004***	0.112***	0.006***	0.015	0.002**
	(5.739)***	(4.433)***	(2.079)	(2.810)	(4.715)	(3.367)	(0.937)	(2.414)
Adjusted R^2	0.229	0.318	0.620	0.793	0.307	0.495	0.507	0.810
F-statistic	15.944***	24.515	47.860***	110.880***	5.879***	11.792***	13.452***	52.720***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.5.3 Regression results for the interrelationship between financial performance (measured by ROA) and carbon performance for H6

From Table 7.10, we find that previous year's carbon performance significantly negatively affects current year's ROA at 1% significance level. This relationship remains valid after controlling for industry and time effects. On the other hand, Table 7.11 shows that although there is a negative relationship between last year's ROA and current year's carbon performance, this relationship is not significant. This relationship between last year's ROA and current year's carbon performance remains the same, even after controlling for industry and time effects. When these two results are put together, we can suggest that when financial performance is measured by Return on Asset, there seems to be no significant interrelationship between carbon performance and financial performance. These findings negate hypothesis 6. Regression results of Table 7.10 and 7.11, indicate that after controlling for industry and time effects, size and dividend payout show positive relationship with ROA, while capital intensity, firm age and dividend yield show negative relationships with ROA. On the other hand, firm size, firm age, dividend yield, and dividend payout are positively related to carbon performance, while carbon intensity and capital intensity are negatively related to carbon performance. Studies related to the positive relationship of firm size, firm age, dividend yield and dividend payout with carbon performance, have already been discussed before. The negative relationship between capital intensity and carbon performance is contradicted by studies such as Clarkson et al. (2008), who argue that firms who would make more capital spending are likely to have newer, cleaner technologies. Consequently, these firms are likely to have a superior environmental performance measure. The negative

relationship between carbon intensity and carbon performance is supported by Luo et al. (2014), who suggest that firms from carbon intensive industries inherently emit more carbon, and therefore carbon intensity would negatively affect firm carbon performance.

Table 7.10 Regression results for the relationship between financial performance measured by ROA of current year and carbon performance of previous year

$ROA_{i,t} = \alpha + \gamma_1 CP(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon i,t$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	-4.694	-8.496**
	(-1.344)	(-2.438)
CP(-1)	-0.045***	-0.035***
	(-3.813)	(-2.932)
SIZE	2.247***	2.414***
	(7.143)	(6.228)
LEV	-0.051	-0.046
	(-1.461)	(-1.264)
CAPIN	-20.510**	-18.435*
	(-2.064)	(-1.828)
AGE	-0.878***	-0.772***
	(-3.116)	(-2.752)
GROWTH	0.000	0.000
	(0.396)	(0.578)
CINT	-0.937	0.859
	(-1.134)	(0.989)
DIVYIEL	-0.770***	-0.672***
D	(-4.122)	(-3.758)
DIVPAY	0.085***	0.086***
	(8.094)	(8.371)
Adjusted R-squared	0.178	0.209
F-statistic	23.597***	12.303***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.11 Regression results for the relationship between financial performance measured by ROA of previous year and carbon performance of current year

$$CP_{i,t} = \alpha + \gamma_1 ROA(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	8.306	-0.503
	(0.863)	(-0.051)
ROA(-1)	-0.005	-0.020
	(-0.067)	(-0.298)
SIZE	4.216***	5.014***
	(4.755)	(5.290)
LEV	0.088*	0.048
	(1.690)	(0.874)
CAPIN	-22.359***	-11.823*
	(-3.463)	(-1.754)
AGE	1.919**	1.506*
	(2.476)	(1.867)
GROWTH	-0.002	-0.001
	(-1.055)	(-0.864)
CINT	-1.492	-9.952*
	(-0.858)	(-1.684)
DIVYIEL	1.211***	1.605***
D	(2.943)	(3.722)
DIVPAY	0.069***	0.046*
	(2.787)	(1.812)
Adjusted R-squared	0.081	0.158
F-statistic	10.171***	9.062***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.5.4 Regression results for the interrelationship between financial performance (measured by Tobin's Q) and carbon performance for H6

Table 7.12 shows that there is a negative but insignificant relationship between carbon performance of last year and financial performance of current year when financial performance is measured by Tobin's Q. However, when the results are controlled by industry and time, this relationship becomes significant. This finding implies that there is a possibility of a negative relationship between carbon performance of last year and financial performance of current year when financial performance is measured by Tobin's Q. However, this relationship might vary across industries. The negative relationship between carbon performance and financial performance (measured by Tobin's Q), is supported by Wang et al. (2014). On the other hand, Table 7.13 shows that last year's financial performance significantly negatively affect current year's carbon performance, when financial performance is measured by Tobin's Q. However, when industry and time effects are considered, this relationship still remains negative but becomes insignificant. This again indicates that the relationship between last year's financial performance (measured by Tobin's Q) and current year's carbon performance, may vary across industries. The negative relationship between carbon performance and financial (measured by Tobin's Q), is supported by Wang et al. (2014), as mentioned before.

Putting these two findings together, we can see an interrelationship between carbon performance and financial performance (measured by Tobin's Q), where carbon performance and financial performance seem to be affecting each other negatively rather than positively, as predicted in H6.

Table 7.12 Regression results for the relationship between financial performance measured by Tobin's Q, of current year and carbon performance of previous year

$$TOBINSQ_{i,t} = \alpha + \gamma_1 CP(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	-0.257	-0.184
	(-0.639)	(-0.450)
CP(-1)	-0.002	-0.003**
	(-1.381)	(-2.049)
SIZE	0.250	0.175***
	(7.438)	(4.962)
LEV	0.003	0.001
	(0.654)	(0.260)
CAPIN	-0.811***	-0.156
	(-3.765)	(-0.826)
AGE	-0.099***	-0.103***
	(-2.769)	(-2.885)
GROWTH	0.000*	0.000
	(1.734)	(0.494)
CINT	-0.290***	0.107
	(-5.073)	(1.380)
DIVYIEL	-0.176***	-0.120***
D	(-8.867)	(-5.933)
DIVPAY	0.007***	0.007***
	(5.372)	(5.373)
Adjusted R-squared	0.173	0.238
F-statistic	22.915***	14.367***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.13 Regression results for the relationship between financial performances measured by Tobin's Q, of previous year and carbon performance of current year

$CP_{i,t} = \alpha + \gamma_1 TOBINSQ(-1)_{i,t} + \gamma_2 SIZE_{i,t} + \gamma_3 LEV_{i,t} + \gamma_4 CAPIN_{i,t} + \gamma_5 AGE_{i,t} + \gamma_6 GROWTH_{i,t} + \gamma_7 CINT_{i,t} + \gamma_8 DIVYIELD_{i,t} + \gamma_9 DIVPAY_{i,t} + \varepsilon i,t$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	8.798	-0.202
	(0.919)	(-0.021)
TOBINSQ(-1)	-1.478**	-0.906
	(-2.185)	(-1.377)
SIZE	4.441***	5.085***
	(5.052)	(5.401)
LEV	0.091*	0.051
	(1.748)	(0.921)
CAPIN	-23.165***	-11.939*
	(-3.595)	(-1.777)
AGE	1.840**	1.483*
	(2.374)	(1.843)
GROWTH	-0.001	-0.001
	(-0.988)	(-0.846)
CINT	-1.846	-9.979*
	(-1.066)	(-1.696
DIVYIELD	1.038**	1.549***
	(2.457)	(3.535)
DIVPAY	0.076***	0.050*
	(3.035)	(1.960)
Adjusted R-squared	0.0856	0.160
F-statistic	10.793***	9.165***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.5.5 Country-wise regression results for the interrelationship between carbon performance and financial performance

From Table 7.14, we can see that there is no significant relationship between last year's carbon performance and current year's ROA, in any region except in North America. Similarly, last year's ROA does not have any significant relationship with current year's carbon performance, in any of the regions. Last year's carbon performance does not have any significant relationship with current year's Tobin's Q in any region either. However, last year's Tobin's Q is significantly related to current year's carbon performance, in both North America and Asia-Pacific. This relationship does not exist in the EU and UK. In summary, the country wise regression results from Table 7.14 do not consistently and significantly indicate any interrelationship between carbon performance and financial performance (measured by both ROA and Tobin's Q), in any of the four regions. All the models used in Tables 7.10, 7.11, 7.12, 7.113 and 7.14, are good models as the p value of their F tests are less than 1%.

Table 7.14 Country wise regression results for the interrelationship between carbon performance and financial performance

Variable	North America				European Union				United Kingdom				Asia-Pacific			
	ROA	CP	Tobin's Q	CP	ROA	CP	Tobin's Q	CP	ROA	CP	Tobin's Q	CP	ROA	CP	Tobin's Q	CP
CP(-1)	-0.039**				-0.027				-0.061				-0.023			
	(-2.250)				(-1.574)				(-1.226)				(-1.241)			
ROA(-1)		0.005				0.203				0.372				-0.375		
		(0.056)				(1.223)				(1.189)				(0.998)		
CP(-1)			-0.003				-0.001				0.001				0.000	
			(-1.326)				(-0.695)				(0.389)				(0.374)	
Tobin's Q(-1)				-2.901***				1.148				2.066				10.231**
				(-2.852)				(1.019)				(0.621)				(-2.524)
SIZE	1.184**	3.564***	0.176***	3.664***	1.108***	6.000***	-0.013	6.321***	3.748**	9.371***	0.403***	9.571***	3.290***	5.777	0.153***	5.648*
	(2.968)	(2.870)	(4.101)	(2.977)	(2.212)	(3.650)	(-0.256)	(3.881)	(2.434)	(3.334)	(4.570)	(2.934)	(5.117)	(1.651)	(5.030)	(1.783)
LEV	-0.027	0.107	0.020***	0.142*	-0.131***	0.384***	-0.020***	0.384***	0.109*	0.401**	0.016***	0.421**	-0.102***	-0.121	0.009***	-0.115
	(-0.479)	(1.393)	(5.004)	(1.800)	(-4.157)	(3.319)	(-4.314)	(3.3040	(1.7970	(2.497)	(3.122)	(2.415)	(-2.661)	(0.757)	(-4.057)	(-0.744)
CAPIN	-34.736**	-8.071	-1.505***	-12.010	25.690***	-96.943***	1.803***	94.038***	-10.594	-4.591	0.268	-6.077	5.430	-6.221	0.713***	-2.691
	(-2.217)	(-0.901)	(-5.837)	(-1.356)	(4.301)	(-3.583)	(2.767)	(-3.4550	(-0.647)	(-0.116)	(0.236)	(-0.146)	(0.860)	(0.571)	(3.224)	(-0.251)
AGE	-1.298***	-0.241	-0.214***	-0.476	0.766*	4.972***	0.118**	4.961***	-0.807	-2.520	-0.033	-2.496	-0.596	0.241	-0.020	0.282
	(-3.516)	(-0.187)	(-4.444)	(-0.368)	(1.955)	(4.033)	(2.518)	(4.036)	(-1.037)	(-0.861)	(-0.529)	(-0.877)	(-0.9330	(0.110)	(-0.806)	(0.132)
GROWTH	0.012*	-0.009	0.000	-0.011	2.377	0.287***	0.442***	0.295	0.000	-0.002***	0.000**	0.002***	3.124***	2.482	0.393***	4.643*
	(1.910)	(0.455)	(0.4730	(-0.627)	(9.449)	(0.383)	(11.577)	(0.380)	(0.225)	(-4.689)	(2.355)	(-4.149)	(5.606)	(1.1930	(12.027)	(1.842)
CINT	-0.996	-4.174	-0.316***	-4.947*	1.199	2.419*	-0.031	2.756	-1.335	-2.741	-0.429*	(-2.483)	0.828	1.499	0.102*	2.381
	(-0.612)	(-1.455)	(-3.853)	(-1.732)	(1.752)	(0.846)	(-0.589)	(0.972)	(-0.431)	(-0.348)	(-1.786)	-0.293	(0.570)	(0.261)	(1.730)	(0.425)
DIVYIELD	-1.179***	0.446	-0.338***	-0.162	-0.122	1.819***	0.024	1.777***	-1.435**	-4.137***	-0.150***	4.109***	0.154	-0.413	0.002	-0.769
	(-4.437)	(0.441)	(-10.910)	(-0.162)	(-0.6410	(2.777)	(1.3800	(2.7150	(-2.533)	(-4.099)	(-3.891)	(-3.659)	(0.417)	(0.299)	(0.125)	(-0.593)
DIVPAY	0.107***	0.127***	0.009***	0.141***	0.024	0.078*	0.004***	0.074	0.108***	-0.078	0.005***	-0.079	0.020	-0.074	0.002***	-0.054
	(5.499)	(2.674)	(4.326)	(3.057)	(1.790)	(1.398)	(2.859)	(1.331)	(4.597)	(-1.142)	(3.161)	(-1.214)	(1.132)	(0.970)	(2.359)	(-0.761)
Adjusted R^2	0.233	0.070***	0.314	0.086	0.617	0.197	0.793	0.196	0.323	0.190	0.470	0.173	0.492	-0.027	0.809	0.006
F-statistics	16.248***	4.789***	24.056***	5.737***	47.022***	8.019***	110.531	7.961***	6.205***	3.549	10.658***	3.277***	12.626***	0.687	51.933***	1.074***

7.6 Empirical results for the relationship between carbon disclosure and financial performance

The purpose of this section is to analyse and interpret the relationship between carbon disclosure and financial performance, which is hypothesized in H7

7.6.1 Regression results for the relationship between carbon disclosure and financial performance for H7

From Table 7.15, we can see that when financial performance is measured by ROA, there is a significant negative relationship between carbon disclosure and financial performance at 1% significance level. This relationship remains the same when industry and time effects are considered. As mentioned earlier, there is no existing study that investigates the relationship between carbon disclosure and financial performance. However, research in related areas such as studies by Belkaoui (1976); Berman et al. (1999); Brammer and Pavalin (2006); Weber et al. (20080 and Tang et al. (2012), who investigate the relationship between pollution disclosure/CSR performance disclosure and financial performance, suggest that there should be a positive relationship between these variables.

On the other hand, from Table 7.16, we do not find any significant or consistent relationship between carbon disclosure and financial performance, when financial performance is measured by Tobin's Q. This finding is supported by a similar study by Freedman and Jaggi (1988), who find that there is no association between the extensiveness of pollution disclosure and economic performance.

Therefore, we can conclude that there is a negative relationship between carbon disclosure and financial performance when financial performance is measured by ROA. However, there seems to be no significant relationship between carbon disclosure and financial performance when financial performance is measured by Tobin's Q.

7.6.2 Country-wise regression results for the relationship between carbon disclosure and financial performance

From Table 7.17, we can see that there is significant negative relationship between carbon disclosure and financial performance when financial performance is measured by ROA in all four regions. This finding is consistent with the full sample results, which also find significant negative relationship between carbon disclosure and ROA. However, as in the full sample results, country-wise analysis does not find any significant relationship between carbon disclosure and financial performance when financial performance is measured by Tobin's Q, in any of the four regions.

All the models used in Table 7.15, Table 7.16 and Table 7.17 are good models, as the p value of their F tests are less than 1%.

Table 7.15 Regression results for the relationship between carbon disclosure and financial performance, measured by ROA

$ROA_{i,t} = \alpha + \beta_1 CD_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$

	Panel A	Panel B
	(Before controlling for industry and time)	(After controlling for industry and time)
Intercept	-0.337	-7.049**
	(-0.094)	(-2.001)
CD	-0.103***	-0.056***
	(-5.016)	(-2.617)
SIZE	2.349***	2.378***
	(7.392)	(6.185)
LEV	-0.039	-0.042
	(-1.157)	(-1.140)
CAPIN	-20.676***	-18.419*
	(-2.086)	(-1.833)
AGE	-0.829***	-0.741***
	(-2.960)	(-2.637)
GROWTH	0.000	0.000
	(0.323)	(0.604)
CINT	-1.007	0.603
	(-1.239)	(0.695)
DIVYIELD	-0.741***	-0.670***
	(-4.033)	(-3.788)
DIVPAY	0.083***	0.084***
	(8.093)	(8.261)
Adjusted R-squared	0.185	0.207
F-statistic	24.805***	12.198***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.16 Regression results for the relationship between carbon disclosure and financial performance, measured by Tobin's Q

$$TOBINSQ_{i,t} = \alpha + \beta_1 CD_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	-0.449	-0.194
	(-1.048)	(-0.4640
CD	0.002	-0.002
	(1.215)	(-0.790)
SIZE	0.234***	0.168***
	(7.122)	(4.733)
LEV	0.002	0.001
	(0.532)	(0.283)
CAPIN	-0.715***	-0.147
	(-3.373)	(-0.783)
AGE	-0.105***	-0.104***
	(-2.942)	(-2.925)
GROWTH	0.000*	0.000
	(1.770)	(0.519)
CINT	-0.299***	0.094
	(-5.213)	(1.139)
DIVYIELD	-0.174***	-0.119***
	(-8.994)	(-5.953)
DIVPAY	0.006***	0.006***
	(5.215)	(5.253)
Adjusted R-squared	0.173	0.235
F-statistic	22.957***	14.190***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.17 Country wise regression results for the relationship between carbon disclosure and financial performance

Variable	North America		European Union		United Kingdom		Asia-Pacific	
	ROA	Tobin's Q	ROA	Tobin's Q	ROA	Tobin's Q	ROA	Tobin's Q
CD	-0.116***	0.002	-0.093***	-0.002	-0.146**	0.005	-0.082**	0.000
	(-4.080)	(0.913)	(-3.236)	(-0.3620	(-2.2100	(1.086)	(-2.3900	(-0.222)
SIZE	1.384***	0.161***	1.268**	-0.012	3.670***	0.395***	3.395***	0.156***
	(3.310)	(3.734)	(2.550)	(-0.233)	(2.8460	(4.860)	(5.349)	(5.216)
LEV	-0.012	0.019***	-0.112***	-0.020***	0.151**	0.014**	-0.091**	-0.009***
	(-0.224)	(4.840)	(-3.5000	(-4.0610	(2.5540	(2.627)	(-2.4650	(-4.1280
CAPIN	-34.988**	-1.465***	22.607***	1.789***	-13.617	0.317	4.618	0.708***
	(-2.245)	(-5.556)	(3.790)	(2.7140	(-0.8830	(0.285)	(0.742)	(3.222)
AGE	-1.391***	-0.212***	0.991**	0.117**	-0.849	-0.030	-0.686	-0.020
	(-3.723)	(-4.394)	(2.5160	(2.2810	(-1.1200	(-0.487)	(-1.142)	(-0.834)
GROWTH	0.011*	0.000	2.429***	0.442***	0.000	0.000**	3.293***	0.395***
	(1.763)	(0.388)	(9.360)	(11.4100	(0.227)	(2.366)	(6.120)	(12.286)
CINT	-1.093	-0.307***	1.388**	-0.028	-0.561	-0.440*	0.916	0.104*
	(-0.684)	(-3.714)	(2.0500	(-0.5160	(-0.181)	(-1.832)	(0.6180	(1.772)
DIVYIELD	-1.208***	-0.332***	-0.071	0.024	-1.618***	-0.141***	0.197	0.001
	(-4.649)	(-10.615)	(-0.3930	(1.2460	(-3.030)	(-4.0190	(0.642)	(0.062)
DIVPAY	0.107***	0.008***	0.029**	0.004***	0.104***	0.005***	0.009	0.002**
	(5.681)	(4.117)	(2.2480	(2.760)	(4.560)	(3.319)	(0.627)	(2.415)
Adjusted R^2	0.244	0.313	0.630	0.793	0.339	0.477	0.516	0.810
F-statistic	17.317***	23.977***	49.718***	110.976	6.645***	11.017	13.916***	52.525

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.7 Empirical results for the relationship of agency cost with carbon disclosure and carbon performance

The purpose of this section is to analyse and interpret the relationship between carbon disclosure and agency cost (H8), and between carbon performance and agency cost (H9)

7.7.1 Regression results for the relationship between carbon disclosure and agency cost for H8

Table 7.18 shows a positive but insignificant relationship between carbon disclosure and agency cost when agency cost is measured by Expense Ratio (ER). Table 7.19 also shows a positive but insignificant relationship between carbon disclosure and agency cost, when agency cost is measured by Asset Utilization Ratio (AUR). These two findings together suggest that there is a positive but insignificant relationship between carbon disclosure and agency cost. These findings contradict H8. Firm size, growth opportunity, and dividend payout, seem to positively affect ER. On the other hand, capital intensity, firm age, and carbon intensity, seems to negatively affect ER. However, after moderating for industry and time effects, it seems that the relationship of ER to firm size, capital intensity, and dividend payout, vary across industries and time periods. On the other hand, firm size, leverage, and capital intensity and growth opportunity, seem to have a negative relationship with AUR. The positive relationship between firm size and agency cost is supported by Rashid (2015), who argue that larger firms are likely to achieve economies of scale that may influence their agency cost. As a firm's size increases, there is a greater need for monitoring by independent outside

directors, and therefore an increase in firm's size may lead to increased agency cost. The relationship between growth opportunity and agency cost is supported by McConnell and Servaes (1990) and Florackis (2008). They argue that the effectiveness of governance mechanisms in reducing agency problems, is dependent on the firm's growth opportunities

Table 7.18 Regression results for the relationship between carbon disclosure and agency cost measured by ER

$$ER_{i,t} = \alpha + \beta_1 CD_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	0.169**	0.185***
	(2.221)	(2.465)
CD	0.001	0.000
	(1.297)	(0.562)
SIZE	0.018***	0.005
	(3.054)	(0.761)
LEV	-0.001	0.000
	(-1.443)	(-1.070)
CAPIN	-0.218***	-0.069
	(-4.697)	(-1.351)
AGE	-0.026***	-0.022***
	(-4.249)	(-3.902)
GROWTH	0.000*	0.000*
	(2.001)	(1.789)
CINT	-0.08***	-0.079**
	(-6.743)	(-2.240)
DIVYIELD	-0.005	-0.003
	(-1.585)	(-0.742)
DIVPAY	0.000*	0.000
	(1.798)	(1.450)
Adjusted R-squared	0.149	0.283
F-statistic	19.279***	17.946***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.19 Regression results for the relationship between carbon disclosure and agency cost measured by AUR

$AUR_{i,t} = \alpha + \beta_1 CD_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	1.775***	1.641***
	(6.545)	(5.482)
CD	0.000	0.002
	(0.319)	(1.344)
SIZE	-0.071***	-0.061***
	(-3.279)	(-2.357)
LEV	-0.006***	-0.008***
	(-4.949)	(-6.182)
CAPIN	-1.674***	-1.622***
	(-10.588)	(-10.990)
AGE	0.022	-0.002
	(1.360)	(-0.113)
GROWTH	0.000**	0.000**
	(-2.252)	(-2.385)
CINT	-0.013	0.165***
	(-0.446)	(3.326)
DIVYIELD	-0.017**	-0.002
	(-2.405)	(-0.256)
DIVPAY	0.001	0.000
	(1.107)	(0.334)
Adjusted R-squared	0.185	0.240
F-statistic	24.729***	14.554***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.7.2 Regression results for the relationship between carbon performance and agency cost for H9

Regression results from Table 7.20, show that there is a positive relationship between carbon performance and agency cost, when agency cost is measured by Expense Ratio. However, this relationship is not statistically significant. The relationship remains the same when the regression equation is controlled for industry and time effect. These results indicate that carbon performance does not significantly affect a firm's agency cost, when agency cost is measured by Expense Ratio. This finding does not support H 9.

On the other hand, Table 7.21 shows a significantly negative relationship between carbon performance and agency cost when agency cost is measured by Asset Utilization Ratio. These results hold when the results are controlled for industry and time effect. Therefore, we can conclude from these results that carbon performance of a business would negatively affect its agency cost when agency cost is measured by Asset Utilization ratio. In other words, when agency cost is measured by Asset Utilization ratio, if a firm's carbon performance improves, its agency cost would decrease and vice versa. This finding is supported by H9.

Table 7.20 Regression results for the relationship between carbon performance and agency cost measured by ER

$$ER_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	0.194	0.197***
	(2.647)	(2.817)
CP	0.000	0.000
	(0.593)	(0.417)
SIZE	0.019***	0.005
	(3.192)	(0.778)
LEV	0.000	0.000
	(-1.277)	(-1.010)
CAPIN	-0.222***	-0.070
	(-4.792)	(-1.376)
AGE	-0.026***	-0.022***
	(-4.239)	(-3.927)
GROWTH	0.000**	0.000*
	(2.029)	(1.795)
CINT	-0.083***	-0.079**
	(-6.708)	(-2.242)
DIVYIELD	-0.005	-0.003
	(-1.595)	(-0.744)
DIVPAY	0.000*	0.000
	(1.804)	(1.440)
Adjusted R-squared	0.147	0.283
F-statistic	19.100***	17.937***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.21 Regression results for the relationship between carbon performance and agency cost measured by AUR

$$AUR_{i,t} = \alpha + \beta_1 CP_{i,t} + \beta_2 SIZE_{i,t} + \beta_3 LEV_{i,t} + \beta_4 CAPIN_{i,t} + \beta_5 AGE_{i,t} + \beta_6 GROWTH_{i,t} + \beta_7 CINT_{i,t} + \beta_8 DIVYIELD_{i,t} + \beta_9 DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	1.805***	1.718***
	(7.001)	(6.109)
CP	-0.002*	-0.001*
	(-1.913)	(-1.734)
SIZE	-0.064***	-0.050**
	(-3.046)	(-2.049)
LEV	-0.006***	-0.008***
	(-4.877)	(-6.193)
CAPIN	-1.714***	-1.654**
	(-10.583)	(-11.017)
AGE	0.026	0.001
	(1.577)	(0.070)
GROWTH	0.000**	0.000**
	(-2.411)	(-2.426)
CINT	-0.015	0.144***
	(-0.519)	(3.391)
DIVYIELD	-0.015**	0.001
	(-2.127)	(0.171)
DIVPAY	0.001	0.000
	(1.353)	(0.524)
Adjusted R-squared	0.189	0.242
F-statistic	25.362***	14.697***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.22 Country wise regression results for the relationship of agency cost with carbon disclosure and carbon performance

Variable	North America				European Union				United Kingdom				Asia-Pacific			
	ER	AUR	ER	AUR	ER	AUR	ER	AUR	ER	AUR	ER	AUR	ER	AUR	ER	AUR
CD	0.001**	0.000			0.001	0.001			0.001	-0.002			-0.001	0.003		
	(2.127)	(0.114)			(0.830)	(0.723)			(-0.370)	(-0.659)			(-1.231)	(0.922)		
CP			0.001*	-0.003**			0.000	0.001			-0.001	0.000			0.000	0.003
			(1.692)	(-2.225)			(0.127)	(1.186)			(-0.925)	(0.271)			(-0.851)	(1.636)
SIZE	0.013*	-0.115***	0.015*	-0.104***	0.036***	-0.110***	0.038***	-0.112***	0.006	0.038	0.013	0.027	-0.005	-0.040	-0.005	-0.046
	(1.697)	(-3.149)	(1.876)	(-2.948)	(3.183)	(-4.485)	(3.274)	(-4.645)	(0.148)	(1.009)	(0.343)	(0.715)	(-0.601)	(-0.890)	(-0.629)	(-1.042)
LEV	0.001	-0.004*	0.001*	-0.003	-0.001	-0.014***	-0.001	-0.014***	-0.003	-0.009***	-0.003	-0.010***	-0.004***	-0.001	-0.005***	-0.001
	(1.443)	(-1.754)	(1.695)	(-1.613)	(-1.010)	(-8.102)	(-0.815)	(-8.387)	(-1.208)	(-3.041)	(-1.201)	(-3.607)	(-5.504)	(-0.416)	(-5.514)	(-0.270)
CAPIN	-0.095*	-1.751***	-0.097*	-1.777***	-0.018	-1.015***	-0.053	-0.989***	-0.424	-1.773***	-0.433	-1.781***	-0.491***	-1.872***	-0.486***	-1.873***
	(-1.864)	(-7.616)	(-1.895)	(-7.907)	(-0.100)	(-4.460)	(-0.285)	(-4.276)	(-0.809)	(-3.455)	(-0.817)	(-3.385)	(-5.227)	(-6.475)	(-4.774)	(-6.573)
AGE	-0.031***	-0.005	-0.032***	-0.006	-0.021**	0.063***	-0.019*	0.061***	-0.058*	0.171***	-0.060*	0.173***	-0.005	0.001	-0.004	-0.003
	(-3.696)	(-0.177)	(-3.727)	(-0.2070	(-2.011)	(3.363)	(-1.868)	(3.380)	(-1.837)	(4.141)	(-1.903)	(4.336)	(-0.309)	(0.022)	(-0.255)	(-0.057)
GROWTH	0.000	0.001***	0.000	0.001***	0.010***	0.069****	0.011***	0.069***	0.000**	0.000	0.000*	0.000	0.017	0.252***	0.015	0.255***
	(-1.337)	(3.596)	(-1.286)	(3.244)	(3.029)	(6.348)	(3.115)	(6.448)	(2.105)	(-1.045)	(1.890)	(-1.012)	(1.468)	(2.982)	(1.282)	(2.958)
CINT	-0.090***	-0.051	-0.089***	-0.065	-0.088***	0.077**	-0.086***	0.078**	-0.033	-0.089	-0.035	-0.081	-0.089***	-0.053	-0.091***	-0.050
	(-5.173)	(-1.0410	(-5.156)	(-1.326)	(-3.744)	(2.205)	(-3.622)	(2.295)	(-0.357)	(-0.764)	(-0.380)	(-0.701)	(-3.183)	(-0.524)	(-3.143)	(-0.507)
DIVYIELD	-0.015***	-0.048***	-0.017***	-0.047***	-0.004	0.040***	-0.004	0.040***	0.022	0.021	0.020	0.027	0.026***	-0.034	0.027***	-0.034
	(-2.825)	(-3.145)	(-3.055)	(-2.911)	(-0.8280	(4.592)	(-0.733)	(4.518)	(1.168)	(1.130)	(1.016)	(1.413)	(3.230)	(-1.488)	(3.376)	(-1.467)
DIVPAY	0.000	0.001	0.000	0.001	0.001*	0.000	0.001*	0.000	0.001*	0.000	0.001	0.000	-0.001*	0.001	-0.001	0.001
	(0.509)	(1.124)	(0.547)	(1.502)	(1.673)	(0.293)	(1.781)	(0.256)	(1.685)	(0.064)	(1.639)	(0.163)	(-1.6780)	(0.703)	(-1.521)	(0.642)
Adjusted R^2	0.140	0.185	0.136	0.197	0.207	0.542	0.205	0.543	0.149	0.352	0.154	0.350	0.503	0.346	0.499	0.352
F-statistic	9.202***	12.468***	8.963***	13.360***	8.502***	34.894***	8.395***	35.095***	2.928***	6.981***	3.009***	6.915***	13.265***	7.401***	13.084***	7.591***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.7.3 Country-wise regression results for the relationship of agency cost with carbon disclosure and carbon performance

From Table 7.22, we can see that, in North America, carbon disclosure significantly positively affects agency cost, when agency cost is measured by Expense Ratio. However, carbon disclosure does not have any significant relationship with agency cost in any other region regardless of whether agency cost is measured by Expense Ratio or Asset Utilization Ratio. On the other hand, carbon performance significantly positively affect agency cost in North America, both when agency cost is measured by Expense Ratio or Asset Utilization Ratio. Carbon performance also does not have any significant relationship with agency cost in all other regions, whether agency cost is measured by Expense Ratio or by Asset Utilization Ratio. In summary, both carbon disclosure and carbon performance significantly positive affect agency cost only in North America, which contradicts the full sample results.

All the models used in Tables 7.18 to 7.22, are good models as the p value of their F tests are less than 1%.

7.8 Empirical results for the trends in improvement of carbon disclosure and carbon performance

The purpose of this section is to conduct a trend analysis to assess whether level of carbon disclosure and carbon performance improved over the study period, which is hypothesized in H10.

7.8.1 Regression results for the trends in improvement of carbon disclosure and carbon performance for H10

Table 7.23 shows that level of carbon disclosure has consistently improved from year 1 to year 5. These improvements are statistically highly significant as all the p values are less than 1%. When the regression results are controlled for industry effects, improvement of level of carbon disclosure over the years still remains consistently positive and statistically highly significant.

On the other hand, Table 7.24 shows that carbon performance does not significantly improve from year 1 to year 2. Compared to year 1, carbon performance improves significantly in years 3, 4 and 5. However, while carbon performance increases from year 1 to year 3 and from year 3 to year 4, it decreases from year 4 to year 5. All these results are statistically highly significant at 1% significance level. These results remain the same when they are controlled for industry effect.

In summary, level of carbon disclosure consistently and significantly improved during the study period. On the other hand, compared to 2011, carbon performance did not significantly improve in 2012. However, it improved significantly in years 2013, 2014 and 2015, but these improvements were not always consistent.

7.8.2 Country-wise trend analysis for improvement of carbon disclosure and carbon performance

From Table 7.25, we can see that compared to year 1, level of carbon disclosure keeps improving consistently and significantly over years 2, 3, 4 and 5 in all the regions. These results are similar to full sample results. On the other hand, similar to full sample results, carbon performance does not significantly improve in year 2 in comparison to year 1 in any of the regions. In North America, carbon performance increases from year 1 to year 3 but then keeps decreasing in year 4 and 5. In EU, carbon performance keeps improving in year 3 and year 4 before decreasing in year 5. In UK, carbon performance improves in year 3 and then keeps decreasing in year 4 and 5. In Asia-Pacific, carbon performance keeps improving in years 3 and 4 before decreasing in year 5. All the models used to assess trends in improvements of carbon disclosure and carbon performance are good models, as p values of their F test are less than 1.

Table 7.23 Regression results for improvement of carbon disclosure from year 1 to 5

$$CD_{i,t} = \alpha + \beta_1 T2_{i,t} + \beta_2 T3_{i,t} + \beta_3 T4_{i,t} + \beta_4 T5_{i,t} + \beta_5 SIZE_{i,t} + \beta_6 LEV_{i,t} + \beta_7 CAPIN_{i,t} + \beta_8 AGE_{i,t} + B_9 GROWTH_{i,t} + \beta_{10} CINT_{i,t} + \beta_{11} DIVYIELD_{i,t} + \beta_{12} DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A	Panel B
	(Before controlling for industry and time)	(After controlling for industry and time)
Intercept	53.864***	47.852***
	(10.302)	(9.091)
T2	6.173***	6.037***
	(4.888)	(4.877)
T3	11.292***	11.098***
	(9.369)	(9.311)
T4	13.109***	12.943***
	(10.907)	(10.908)
T5	18.955***	18.729***
	(17.909)	(17.804)
SIZE	1.589***	2.211***
	(3.386)	(4.382)
LEV	0.086***	0.085***
	(3.255)	(2.932)
CAPIN	-14.431***	-9.176***
	(-4.288)	(-2.646)
AGE	0.664	0.578
	(1.555)	(1.246)
GROWTH	0.000	0.000
	(-0.104)	(-0.143)
CINT	0.426	-4.693
	(0.444)	(-1.580)
DIVYIELD	0.294	0.535**
	(1.462)	(2.337)
DIVPAY	0.020	0.017
	(1.560)	(1.287)
Adjusted R-squared	0.309	0.331
F-statistic	36.170***	23.171***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.24 Regression results for improvement of carbon performance year 1 to 5

$$CP_{i,t} = \alpha + \beta_1 T2_{i,t} + \beta_2 T3_{i,t} + \beta_3 T4_{i,t} + \beta_4 T5_{i,t} + \beta_5 SIZE_{i,t} + \beta_6 LEV_{i,t} + \beta_7 CAPIN_{i,t} + \beta_8 AGE_{i,t} + B_9 GROWTH_{i,t} + \beta_{10} CINT_{i,t} + \beta_{11} DIVYIELD_{i,t} + \beta_{12} DIVPAY_{i,t} + \varepsilon i,t$$

	Panel A (Before controlling for industry and time)	Panel B (After controlling for industry and time)
Intercept	9.434	-0.748
	(0.997)	(-0.076)
T2	3.093	2.880
	(1.379)	(1.317)
T3	11.128***	10.812***
	(5.139)	(5.081)
T4	12.408***	12.125***
	(5.666)	(5.633)
T5	8.108***	7.739***
	(3.673)	(3.575)
SIZE	3.560***	5.010***
	(4.146)	(5.346)
LEV	0.071	0.048
	(1.392)	(0.870)
CAPIN	-22.499***	-11.651*
	(-3.417)	(-1.733)
AGE	1.837**	1.499*
	(2.434)	(1.865)
GROWTH	-0.001	-0.001
	(-0.778)	(-0.851)
CINT	-1.428	-9.710
	(-0.826)	(-1.636)
DIVYIELD	1.107***	1.521***
	(2.748)	(3.522)
DIVPAY	0.066***	0.048
	(2.725)	(1.905)
Adjusted R squared	0.127	0.159
F-statistic	12.381***	9.501***

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

Table 7.25 Country wise trend analysis for improvement of carbon disclosure and carbon performance

Variable	North America		European Union		United Kingdom		Asia-Pacific	
	CD	CP	CD	CP	CD	CP	CD	CP
T2	7.138***	4.225	5.771**	0.487	4.569	6.791	7.512**	5.177
	(3.946)	(1.347)	(2.357)	(0.112)	(1.517)	(1.004)	(2.144)	(0.759)
T3	11.925***	12.095***	10.274***	9.483**	11.516***	11.871*	13.492***	13.911**
	(6.824)	(3.923)	(4.384)	(2.250)	(4.072)	(1.983)	(4.368)	(2.117)
T4	12.439***	9.470***	14.088***	14.688***	11.769***	10.967*	16.187***	19.308***
	(6.837)	(2.888)	(6.311)	(3.812)	(4.334)	(1.864)	(5.175)	(3.033)
T5	19.608***	6.863**	18.016***	9.570**	19.275***	6.767	20.651***	11.454*
	(12.384)	(2.032)	(8.367)	(2.346)	(7.732)	(1.028)	(7.201)	(1.754)
SIZE	1.132*	3.003**	3.053***	5.710***	3.983***	9.753***	1.491***	4.018
	(1.703)	(2.363)	(3.409)	(3.684)	(3.190)	(3.458)	(0.959)	(1.375)
LEV	0.058	0.088	0.262***	0.363***	0.357***	0.441**	0.087	-0.100
	(1.494)	(1.138)	(3.869)	(3.367	(5.171)	(2.484)	(1.078)	(-0.652)
CAPIN	-7.455	-8.804	-75.380***	-99.908***	2.572	-8.880	-3.146	-2.000
	(-1.594)	(-1.019)	(-5.239)	(-3.975)	(0.166)	(-0.213)	(-0.484)	(-0.150)
AGE	-0.479	-0.147	2.557***	4.673***	-1.706	-2.915	-0.749	0.771
	(-0.674)	(-0.118)	(3.206)	(3.633)	(-1.406)	(-0.994)	(-0.751)	(0.380)
GROWTH	0.001	-0.008	0.386	0.477	0.000	-0.002***	1.892*	1.257
	(0.099)	(-0.364)	(1.036)	(0.882)	(-0.694)	(-2.820)	(1.740)	(0.585)
CINT	-1.933	-4.411	3.699***	2.470	-1.378	-2.856	1.276	0.177
	(-1.158)	(-1.552)	(2.890)	(0.906)	(-0.426)	(-0.342)	(0.419)	(0.028)
DIVYIELD	-0.090	0.571	0.997***	1.825***	-2.487***	-4.345***	-1.509***	-1.442
	(-0.198)	(0.613)	(2.968)	(2.621)	(-4.890)	(-3.888)	(-2.952)	(-1.197)
DIVPAY	0.046*	0.113**	0.036	0.067	-0.009	-0.050	-0.081***	-0.059
	(1.839)	(2.520)	(1.363)	(1.259)	(-0.358)	(-0.713)	(-2.684)	(-0.763)
Adjusted R^2	0.289	0.102	0.431	0.262	0.535	0.182	0.387	0.076
F-statistic	16.382***	5.294***	17.310***	8.615***	10.504***	2.836***	6.730***	1.749*

***, ** and * represent significance levels at 1%, 5% and 10% respectively. t-statistics are provided in parentheses.

7.9 Chapter summary

This chapter provides the empirical results obtained from testing the hypotheses of this study. Result of this chapter indicate that carbon disclosure and carbon performance are significantly positively related, which supports H2 but negates H1. This finding is in congruence with the economics-based theories, Voluntary Disclosure Theory, and Signalling Theory. This finding supports studies such as Clarkson et al., 2008; Al-Tuwaijri et al., 2004; Peng et al., 2015 and Cotter and Najah 2012. In country-wise analysis also, carbon disclosure is significantly positively related to carbon performance in all of the four regions. This implies that in all regions, firms with better carbon performance make more carbon disclosure.

Results of this chapter also indicate that there is a two-way positive relationship between carbon disclosure and carbon performance, where increase in carbon disclosure of a firm will improve its carbon performance (as predicted by Instrumental Stakeholder Theory), and consequently, improved carbon performance will lead to more carbon disclosure by the firm in the subsequent period, as predicted by Signalling Theory. These results support hypothesis 3 which proposes that carbon disclosure and carbon performance influence each other positively. The both-way positive relationship between carbon disclosure and carbon performance, holds true in all regions. However, while the relationship is significant in North America, EU and Asia-Pacific, it is insignificant in the UK.

Results found from investigating disclosure practices of average carbon performers conducted in this study, indicate that superior carbon performers make more carbon disclosure than average carbon performers, and average carbon performers make

more carbon disclosure than inferior carbon performers. These findings contradict H4 which suggest that both superior and inferior carbon performers make significantly more carbon disclosure than average carbon performers.

Results of this study also show that when financial performance is measured by Return on Asset, it has a negative relationship with the firm's carbon performance. When financial performance is measured by Tobin's Q, it also has a negative relationship with the firm's carbon performance. Therefore, we can conclude from these results that carbon performance and financial performance influence each other negatively regardless of the way financial performance is measured. These findings negate H5. This finding is backed by numerous previous studies such as Jaggi and Freedman (1992), Cordeiro and Sarkis (1997), Filbeck and Gorman (2004), Sarkis and Cordeiro (2001), and Wang et al. (2014). In country-wise analysis, we find that carbon performance is negatively related to both ROA and Tobin's Q in all regions except the UK.

Results also suggest that, when financial performance is measured by Return on Asset, there seems to be no significant interrelationship between carbon performance and financial performance. However, there is a significant negative interrelationship between carbon performance and financial performance when financial performance is measured by Tobin's Q. However, this relationship might vary across industries. The country-wise regression results do not consistently and significantly indicate any interrelationship between carbon performance and financial performance, regardless of the way it is measured in any of the four regions.

Results from this study also indicate that when financial performance is measured by ROA, there is a significant negative relationship between carbon disclosure

and financial performance. This finding is contradicted by studies by Belkaoui (1976); Berman et al. (1999); Brammer and Pavalin (2006); Weber et al. (20080 and Tang et al. (2012). Results also indicate that there is no significant or consistent relationship between carbon disclosure and financial performance when financial performance is measured by Tobin's Q. This finding is supported by Freedman and Jaggi (1988). In country-wise analysis, this study finds that there is significant negative relationship between carbon disclosure and financial performance when financial performance is measured by ROA in all four regions. However, there is no significant relationship between carbon disclosure and financial performance, when financial performance is measured by Tobin's Q, in any region.

The next set of results of this study indicate that there is a positive but insignificant relationship between carbon disclosure and agency cost when agency cost is measured by Expense Ratio. When agency cost is measured by Asset Utilization Ratio, there is still a positive but insignificant relationship between carbon disclosure and agency cost. Results also indicate that there is a positive relationship between carbon performance and agency cost when agency cost is measured by Expense Ratio. However, this relationship is not statistically significant. When agency cost is measured by Asset Utilization Ratio, we find a significantly negative relationship between carbon performance and agency cost. Therefore, we can conclude that carbon performance of a business would negatively affect its agency cost when agency cost is measured by Asset Utilization ratio. In other words, when agency cost is measured by Asset Utilization ratio, if a firm's carbon performance improves, its agency cost would decrease. Country-wise analysis shows that both carbon disclosure and carbon performance significantly positive affect agency cost, only in North America. We don't find any significant and

consistent relationship between agency cost and carbon disclosure/carbon performance, in any other region.

Results of this study also show that level of carbon disclosure for the sample companies have significantly and consistently improved during the study period. On the other hand, compared to 2011, carbon performance did not significantly improve in 2012. However, it improved significantly in years 2013, 2014 and 2015 but these improvements were not always consistent. In country-wise analysis, we can see that compared to year 1, level of carbon disclosure keeps improving consistently and significantly over years 2, 3, 4 and 5 in all the regions. However, the study could not find any consistent and significant trend in increase or decrease of carbon performance of the sample companies, in any of the regions during the study period.

CHAPTER 8 CONCLUSIONS AND IMPLICATIONS

8.1 Introduction

This chapter concludes the thesis and summarises the major findings from Chapter 7. Section 8.2 outlines the conclusions about the research objectives/questions developed in chapter 1. Section 8.3 discusses several implications of this study on theory and practice. Section 8.4 discusses the limitations of this study, and finally section 8.5 identifies a number of areas for future research.

8.2 Conclusions about research objectives

As mentioned in chapter 1, the specific objectives of this study are:

1. To examine the relationship and interrelationship between carbon disclosure and carbon performance
2. To examine the relationship and interrelationship between carbon performance and financial performance
3. To examine the relationship between carbon disclosure and financial performance
4. To examine the relationship between agency cost and carbon disclosure and between agency cost and carbon performance
5. To study the trends in improvement of carbon disclosure and carbon performance over the study period.

Sections 8.2.1 to 8.2.6 discuss the conclusions about the above research objectives based on the analysis conducted in previous chapter.

8.2.1 Relationship and interrelationship between carbon disclosure and carbon performance

Results obtained from testing the hypotheses regarding the relationship between carbon disclosure and carbon performance indicate that carbon disclosure and carbon performance are significantly positively related. This finding is supported by the economics-based theories (Voluntary Disclosure Theory and Signalling Theory) which suggest that firms with good performance are likely to disclose more information to signal their good quality to investors, and to differentiate themselves from companies with 'bad news' to avoid the adverse selection problem (Clarkson et al, 2008; Al-Tuwaijri et al., 2004; Peng et al., 2015; Cotter & Najah 2012). Naturally, this finding contradicts many studies that suggest a negative relationship between environmental/carbon disclosure and carbon performance as predicted by Stakeholder and Legitimacy Theories. This positive relationship between carbon disclosure and carbon performance, remains significantly positive, even after controlling the regression results for industry and time effect. This indicates that these findings are robust.

In country-wise analysis also, carbon disclosure is significantly positively related to carbon performance in all of the four regions, namely: North America, EU, UK and Asia-Pacific. This implies that in all regions, firms with better carbon performance make more carbon disclosure.

Many studies have investigated the relationship between environmental disclosure/carbon disclosure and environmental performance/carbon performance. However, to the best of my knowledge, no study has yet investigated whether there is an interrelation between environmental disclosure/carbon disclosure, and environmental performance/carbon performance. This study tests a hypothesis that

proposes a both-way relationship between carbon disclosure and carbon performance. Results from testing this hypothesis indicate that there is a two-way positive relationship between carbon disclosure and carbon performance, whereby increase in carbon disclosure of a firm in a period will improve its carbon performance (supported by Instrumental Stakeholder Theory), and consequently, improved carbon performance will lead to more carbon disclosure by the firm in the subsequent period (supported by Signalling Theory). These results are robust as the findings remain the same even after controlling them for industry, time and dummy variables. The both-way positive interrelationship between carbon disclosure and carbon performance holds true in all regions except UK.

The empirical results for disclosure practices of average carbon performers conducted in this study indicate that superior carbon performers make more carbon disclosure than average carbon performers, and average carbon performers make more carbon disclosure than inferior carbon performers.

8.2.2. Relationship and interrelationship between carbon performance and financial performance

Results of this study indicate that carbon performance is negatively related to both accounting based measure (ROA) as well as market based measure (Tobin's Q), of a firm's financial performance. This finding is backed by some of the studies such as Jaggi and Freedman (1992), Cordeiro and Sarkis (1997), Filbeck and Gorman (2004), Sarkis and Cordeiro (2001) and Wang et al. (2014). However, this finding contradicts a large number of existing studies such as Porter and van der Linde (1995), Albertini (2013), Salama (2005), Stefan and Paul (2008), Russo and Fouts (1997), Song et al.

(2017), Boiral et al. (2012), Gallego-Álvarez et al. (2015), Wang et al. (2016), Nishitani et el. (2014), Nishitani and Kokubu (2012) and Griffin et al. (2017).

In country-wise analysis, this study finds that carbon performance is negatively related to both accounting based measure as well as market based measure of a firm's financial performance, in all regions except the UK. These results can be considered robust as they have been controlled for industry and time effect.

While many studies investigate the relationship between environmental performance/carbon performance and financial performance, there is no known research that investigates interrelation between carbon performance and financial performance. This study proposes a positive both-way relationship between carbon performance and financial performance whereby improvement in carbon performance of a firm will lead to improvement in its financial performance, and this improvement in financial performance will allow the firm to invest in emission reduction technologies and activities, which in turn will improve the firm's future carbon performance.

Results from this study suggest that accounting based measure of firm financial performance does not have any significant interrelationship with its carbon performance. However, market based measure of firm financial performance and carbon performance influence each other negatively. However, this relationship might vary across industries. There is no significant interrelationship between carbon performance and any of the measures of firm financial performance, in any of the four regions.

8.2.3 Relationship between carbon disclosure and financial performance

There is no existing research that investigates the relationship between carbon disclosure and financial performance. Even the relationship between environmental disclosure/corporate social performance disclosure, and financial performance are not well researched. The limited research that has been done in this area has produced conflicting results. The results of this study indicate that there is a significant negative relationship between carbon disclosure and accounting based measure of firm financial performance. This finding is contradicted by studies such as Belkaoui (1976); Berman et al. (1999); Brammer and Pavalin (2006); Weber et al. (2008) and Tang et al. (2012), who suggest that relationship between pollution disclosure/CSR performance disclosure and financial performance should be positive. Findings of the study also indicate that there is no significant or consistent relationship between carbon disclosure and market measure of financial performance. This finding is supported by Freedman and Jaggi (1988), who find that there is no association between the extensiveness of pollution disclosure and economic performance. Therefore, we can conclude that there is a negative relationship between carbon disclosure and accounting based measure of a firm's financial performance. However, there seems to be no significant relationship between carbon disclosure and market based measure of a firm's financial performance. In country-wise analysis, this study finds that there is significant negative relationship between carbon disclosure and accounting measure of firm financial performance in all four regions. However, there is no significant relationship between carbon disclosure and market measure of firm financial performance in any of the four regions.

8.2.4 Relationship of agency cost with carbon disclosure and carbon performance

Results of this study indicate that there is a positive but insignificant relationship between carbon disclosure and agency cost both when agency cost is measured by Expense Ratio or by Asset Utilization Ratio. Results also indicate that carbon performance does not significantly affect a firm's agency cost when agency cost is measured by Expense Ratio. However, when agency cost is measured by Asset Utilization Ratio, we find a significantly negative relationship between carbon performance and agency cost. Therefore, we can conclude from these results that carbon performance of a business would negatively affect its agency cost when agency cost is measured by Asset Utilization ratio. In other words, when agency cost is measured by Asset Utilization ratio, if a firm's carbon performance improves, its agency cost would decrease. Country-wise analysis shows that both carbon disclosure and carbon performance significantly positive affect agency cost only in North America. We don't find any significant and consistent relationship between agency cost and carbon disclosure/carbon performance in any other region.

8.2.5 Trends in improvement of carbon disclosure and carbon performance over time

Results of this study show that the level of carbon disclosure for the sample companies have significantly and consistently improved during the study period. On the other hand, compared to 2011, carbon performance did not significantly improve in 2012. However, it improved significantly in years 2013, 2014 and 2015, but these improvements were not always consistent. In country-wise analysis, we can see that compared to year 1, level of carbon disclosure keeps improving consistently and

significantly over years 2, 3, 4 and 5 in all the regions. However, the study could not find any consistent and significant trend in increase or decrease of carbon performance of the sample companies, in any of the regions during the study period.

8.3 Implications of this study

This study investigates many aspects of the relationship and interrelationships between carbon disclosure, carbon performance and financial performance which have never been investigated before. Unlike most previous studies, this study investigates the above relationships globally by taking a sample of 500 largest global companies across most major industry sectors and from all major regions of the world. Additionally, country-wise analysis has been done to test the above mentioned relationships. By doing so, this study produces a number of first ever findings that make a valuable contribution to the literature. These findings also have several implications for future policy and practice in this area.

8.3.1 Implications for literature

Most of the studies that investigate the relationship between carbon disclosure and carbon performance have been done for specific countries and on specific industries. This study investigates this relationship on a global scale covering all major industries except financial services. This study also investigates interrelationship between carbon disclosure and carbon performance and disclosure practices of average carbon performers, which have not been done by any previous research. Findings of this study indicate that there is significant positive relationship between carbon disclosure and

carbon performance. This means firms with better carbon performance would make more carbon disclosure. This finding supports economics-based theories (Voluntary Disclosure Theory and Signalling Theory) which suggest firms with good performance are likely to disclose more information. However, this finding contradicts the assumptions of Stakeholder Theory and Legitimacy Theory, which suggest that companies with inferior carbon performance would make more carbon disclosure, to satisfy important stakeholders and retain their legitimacy. These findings supplement and add to the body of limited literature in this area.

Confirming the predictions of Instrumental Stakeholder Theory and Signalling Theory, findings of this study also suggest that carbon disclosure and carbon performance influence each other positively, i.e., there is a positive two-way relationship between carbon disclosure and carbon performance. As a first ever finding, this result is likely to be of great value to future researchers in this area.

This research investigates the relationship between carbon performance and both accounting based measure of financial performance, as well as market based measure of financial performance. Results suggest that carbon performance and financial performance are negatively related to each other regardless of the way financial performance is measured. Future researchers would find this result interesting as it contradicts most of the previous research which proposed a positive relationship between environmental disclosure/carbon disclosure and environmental performance/carbon performance.

As a novel attempt, this study investigates a both-way relationship between carbon performance and financial performance. Results indicate that accounting based measure of firm financial performance does not have any significant interrelationship

with its carbon performance. However, market based measure of firm financial performance and carbon performance, influence each other negatively. These new findings open up possibilities for new research in this under researched area.

Although a handful of previous studies investigate the relationship between environmental disclosure and economic performance, no study has yet assessed the relationship between carbon disclosure and financial performance. As another novel attempt, this study investigates the relationship between carbon disclosure and financial performance. Results indicate that there is a significant negative relationship between carbon disclosure and accounting based measure of financial performance. However, there is no significant or consistent relationship between carbon disclosure and market based measure of financial performance. These new findings would add great value to the scant literature that deal with the relationship between environmental disclosure/carbon disclosure and financial performance.

The relationship between carbon disclosure and agency cost has not been studied by any previous research. Similarly, there is no existing research that investigates the relationship between carbon performance and agency cost. As another novel attempt, this study comprehensively investigates both these relationships by using both measures of agency cost namely, Expense Ratio and Asset Utilization Ratio. Results indicate that there is no significant relationship between carbon disclosure and agency cost, regardless of whether agency cost is measured by Expense Ratio or by Asset Utilization Ratio. Carbon performance also does not have any relationship with agency cost when it is measured by Expense Ratio. However, when measured by Asset Utilization Ratio, there is a significant positive relationship between Agency cost and carbon performance.

Therefore, we can suggest that if carbon performance of a business improves, its agency cost will decrease. These new findings should be valuable to future researchers as well.

While a few studies have conducted trend analysis of carbon disclosure for certain companies, no study has yet conducted a trend analysis for carbon performance. This study also adds to the existing literature by conducting a trend analysis for both carbon disclosure and carbon performance for a global sample over a recent period.

Finally, unlike most previous studies, this study conducts country-wise analysis for all of its hypotheses which produces many interesting and novel findings. Many of these findings are likely to add much value to the literature.

8.3.2 Implications for policy and practice

In addition to the above mentioned contributions, findings of this research are likely to have important implications for policy makers and practitioners. Stakeholders of businesses such as managers, shareholders, institutional investors, regulators and so on, can use results of this study to better understand the relationship and interrelationship between carbon disclosure and carbon performance, between carbon performance and financial performance, between carbon disclosure and financial performance, and between agency cost and carbon disclosure/carbon performance. This understanding will help them to make better business decisions.

As mentioned earlier, as a novel attempt, this study finds that carbon disclosure and carbon performance influence each other positively. This implies that increase in carbon disclosure of a firm will improve its carbon performance, and consequently, improved carbon performance will lead to more carbon disclosure by the firm in the

subsequent period. This finding can be very useful to business managers to make decisions regarding their carbon disclosure and carbon performance activities. This finding will encourage managers to increase carbon disclosure of their businesses as increased carbon disclosure is likely to improve the carbon performance of their business. Improved carbon performance is likely to make the business more attractive to potential investors. It would also improve the image of the business to stakeholders such as customers and the general public.

This study also comes up with a first ever finding that carbon performance and financial performance influence each other negatively. This means, if a firm improves its carbon performance it will negatively affect its financial performance which consequently will negatively affect its future carbon performance. This finding can help business managers to assess the impact of any carbon performance activities they would like to undertake.

This study also finds that there is a negative relationship between carbon disclosure and financial performance, i.e. if a business improves its carbon disclosure, its financial performance will worsen. This finding will help firms' management assess the potential benefit of disclosing carbon activities.

The findings of the study also indicate that there is no relationship between agency cost and carbon disclosure. However, it finds that carbon performance positively affects agency cost, i.e. if a firm improves its carbon performance, its agency cost would decrease. These findings should be of great interest to several stakeholders of businesses, particularly the shareholders, institutional investors and creditors, who can decrease agency cost by compelling the managers to improve carbon performance of the business.

8.4 Research limitations

Despite the fact that this study is one of the first and the most comprehensive study to investigate the relationship and interrelationship between carbon disclosure, carbon performance and financial performance, it still has some limitations. Firstly, the carbon performance scores used in this study, which are taken from CDP, originally were in letter bands such as A, A-, B, C, D and E. As letter bands are difficult to use in statistical analysis, they have been converted to numeric values in this study. To find a numeric equivalent of a letter band, the upper and lower range of the scores of a letter band have been divided by 2 and then rounded to the nearest whole number. For example, the numeric equivalent of A or A- = (86+100) / 2 = 93. Due to this conversion, for example, all the companies who had a CDP performance score of A or A-, are assigned carbon performance score of 93 in this study. The same has been done to convert other letter bands. Due to the approximate conversions of letter bands to numeric scores, carbon performance scores used in this study may not be arithmetically 100% accurate.

This study has been done for multiple years, and country-wise analysis has been done for all the research questions. However, one of the limitations is that no industry-wise or sector-wise analysis has been done in this study.

8.5 Suggestions for future research

There are several opportunities for future research that can enhance the findings of this study. Firstly, further research can be done by conducting an industry-wise

analysis regarding the relationship and interrelationship between carbon disclosure, carbon performance, financial performance and agency cost.

Secondly, while investigating the relationship between carbon disclosure and carbon performance, future researchers can go into more depth by analysing the carbon disclosure practices of businesses in terms of hard disclosure and soft disclosure as done by Clarkson et al. (2008) for environmental disclosure. Previous research has indicated that both inferior and superior environmental performers make extensive carbon disclosure. However, superior performers make verifiable hard disclosure so that others cannot mimic their performance, as suggested by Voluntary Disclosure and Signalling Theory. On the other hand, poor environmental performers make soft unverifiable disclosure to satisfy various stakeholders and maintain legitimacy as supported by Stakeholder and Legitimacy Theory. Therefore, a new study of carbon disclosure practices in terms of hard and soft disclosure is likely to add great value to the existing literature.

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