Essays on Carbon Disclosure and Financial Consequences

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Abstract

In boardrooms around the world, climate change has recently emerged as a major issue, matching the level of public concern. This thesis is motivated by the growing interest in assessing the financial consequences of corporate involvement in climate change beyond regulatory compliance, as evidenced by firms' voluntary participation in the Carbon Disclosure Project (CDP). This thesis contributes to the ongoing literature by extending insights into three financial consequences of voluntary carbon disclosure, namely, financial performance, firm risk, and market reaction.

We empirically investigate these financial consequences by conducting three essays using a unique dataset containing firms listed on the London Stock Exchange's FTSE350 index for the period 2007 to 2015. In the first essay, we empirically conceptualise and investigate the impact of adopting proactive carbon strategies on financial performance, building on the resource-based view (RBV) of the firm as a theoretical framework. For this, we employ a panel data approach. The finding provides strong evidence that voluntary carbon disclosure and firm financial performance are positively associated. In the second essay, we build on the RBV theory and consider the potentially positive association between information asymmetry and firm risk, and subsequently the relationship between corporate carbon disclosure and firm risk, by appointing the panel data approach. We find that the adoption of carbon strategies significantly reduces the firm's total, systematic, and idiosyncratic risks. In the third essay, we examine the market reaction to carbon disclosure announcements by adopting an event study method. This is done by considering investors' perspective on the costs and benefits of carbon disclosure. The results show that the market reacts significantly negatively to carbon disclosure announcements via the CDP. Furthermore, additional tests are applied, including investigating the influence of the global financial crisis and industry status on the examined relationships. Our research findings offer fresh insights and updated policy implications for investors, management, regulators, and sustainability institutions.

Dedication

This thesis and my endeavours to complete it is dedicated to my late father, Mubarak Alsaifi, who sadly did not stay with us long enough to see his son gain his doctorate. It is also dedicated to my mother, Shaikhah Alomar, whose prayers sustained me throughout and whose support was a true blessing. I further dedicate this thesis to my dear wife, Dalal Alhamlan, and to my wonderful daughters Shaikhah and Hala and their future siblings. I also dedicate this thesis to my siblings and valued friends.

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List of Abbreviations

Abbreviation	Meaning
ARs	Abnormal Returns
CARs	Cumulative Abnormal Returns
CDP	Carbon Disclosure Project
CDS	Carbon Disclosure Score
COPs	Conferences of the Parties
CSR	Corporate Social Responsibility
DEFRA	Department for Environment, Food and Rural Affairs
EU	European Union
EUETS	European Union Emissions Trading System
FP	Financial Performance
FPI	Financial Performance Index
G7	Group of Seven
GFC	Global Financial Crisis
GHG	Greenhouse Gas
GICS	Global Industry Classification Standard
GLS	Generalised Least Squares
IV- 2SLS	Two- Stage Least Squares
MtCO2e	Metric tons of carbon dioxide equivalent
OLS	Ordinary Least Squares
RBV	Resource-Based View
UCS	Union of Concerned Scientists
UK	United Kingdom
UKCCC	UK Climate Change Committee
UNFCCC	United Nations Framework Convention on Climate Change

Chapter 1.Introduction

Global warming and related climate change are the most serious problems confronting the world today (World Economic Forum, 2016).[1] While it is not a new phenomenon, increased awareness and understanding of the scale of the threats in the 21st century have shed light on the need for greater corporate responsibility toward the environment (Laufer, 2003). This increased attention has prompted calls for businesses to prioritise the disclosure of reliable information, so that a firm's risk and opportunity related to climate change can be properly assessed, something now elevated to a strategic issue (Lewandowski, 2017). On their part, firms have realised that they face real consequences from climate change and are increasingly giving strategic consideration to reducing their carbon footprint (Busch and Hoffmann, 2011).

1.1 Research Motivation and Significance

The main cause of climate change is greenhouse gas (GHG) emissions (Luo *et al.,* 2018), and the leading source of such emissions is corporations (CDP, 2017).[2] Therefore, the need to recognise how corporate initiatives aimed at tackling climate change impact a firm's financial situation is a pressing one. At the most fundamental level this research is motivated by the alarming potential consequences of climate change. This is combined by an understanding of the degree to which GHGs are emitted by large corporations suggesting that any global success in tackling this issue would require corporate as well as government action. Furthermore, it is also understood that such concerns extend beyond the research domain and are expressed by investors, regulators and other stakeholders with increasing intensity which adds to the significance of the research. The motivation to examine the relationship between voluntary carbon disclosure and firm financial situation is derived from the uncertainty surrounding it. With a clearer understanding of this relationship, firms may be supported in their decision-making and strategy. Finally, undertaking the research at this time is supported by the growing pressure from investors, stakeholders and regulators for firms to go beyond

[1] The 1992 United Nations Framework Convention on Climate Change (UNFCCC) defines 'climate change' as 'a change of climate, which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods (UNFCCC, Article 1.2, 1992).

[2] GHG resulting from human activities have reached a historical peak (Okereke *et al.,* 2012). They contribute to the warming of the atmosphere and constitute a serious risk to the health and safety of our society, as well as having an impact on all life (CGU, 2009). The components of GHG are carbon dioxide, water vapor, methane, nitrous oxide, and chlorofluorocarbons (NASA, 2019). The term 'carbon emissions' is occasionally used instead of GHG emissions, because carbon dioxide is predominant among other GHGs, representing 81% of total GHG emissions in the UK (Department for Business, Energy and Industrial Strategy, 2018).

statutory requirements to make enhanced voluntary carbon disclosures. This pressure is evidenced by the rising prominence of organisations such as the UK-based Carbon Disclosure Project (CDP) which provide a framework and platform for such disclosure. While climate change is a global phenomenon, to examine the relationship between carbon disclosure and firm financial consequences it is appropriate to take as a research case an advanced high emissions economy with a recognised voluntary disclosure framework. Therefore, the United Kingdom has been selected as the research case.

1.2 The UK Context

This study takes the United Kingdom (UK) as a research sample in this examination on the consequences of carbon disclosure, in a business context. The UK represents an interesting case because it is a high-emitting country and at the forefront of tackling climate change and promoting mitigation measures and carbon reporting by the business sector. The UK is a part of the European Union (EU) that is one of the world's top three GHG-emitting economies (following China and the United States). Among EU member countries, the UK is one of the largest GHG emitters (Haque, 2017). According to the Union of Concerned Scientists (UCS) (2018), the country is among the top 20 emitters of GHGs. In 2013, emissions from the consumption of energy by the UK reached 568.3 million metric tons of carbon dioxide, ranking it 11th in the world (CIA Factbook, 2018).

1.3 The UK's Changing Climate Risk and Political Response

The UK's climate is changing; specifically, it is getting warmer. Nine of the ten warmest years, on record, have occurred since 2002 (Kendon *et al.,* 2018). The decade 2008–2017 witnessed temperature that was 0.8 degrees Celsius warmer than 1961–1990. Summers are becoming wetter, and a long-term trend of rising sea levels has been observed (Kendon *et al.,* 2018). A range of present and future risks have been identified for the UK. These risks include floods and coastal change affecting communities, businesses, and infrastructure; health and productivity risks from higher temperatures; increased pressures on water supply; and risks to ecosystems, soils, and biodiversity (UK Government, 2017).

Since the 1992 Earth Summit in Rio de Janeiro, the UK government has adopted and engaged a proactive stance towards climate change not least in efforts to encourage multilateral cooperation and to work with the business community through either voluntary guidelines or

statutory regulation. In June 2012, the then deputy prime minister, Nick Clegg, told the United Nations Conference on Sustainable Development in Rio de Janeiro:

> "Counting your business costs while hiding your greenhouse gas emissions is a false economy…British companies need to reduce their harmful emissions for the benefit of the planet, but many back our plans because being energy efficient makes good business sense too. It saves companies money on energy bills, improves their reputation with customers and helps them manage their long-term costs too." (DEFRA, 2012).[3]

From 2013, the UK became the first country in the world to make the reporting of GHG emissions a legal requirement for the quoted companies (DEFRA, 2012). In recent years, the UK prime minister restated the UK's commitment to tackling climate change at the G20 Summit in July 2017.

> "…The UK's own commitment to the Paris Agreement and tackling global climate change is as strong as ever. Not only will this protect the environment for future generations, it will keep energy affordable and maintain a secure and reliable supply in order to protect the interests of businesses and consumers. We play a leading role internationally and we are delivering on our commitments to create a safer, more prosperous future for us all". (Prime Minister's Office, 2017).

Successive UK governments have also put their statements into action in the form of both regulations and guidelines.

1.4 Regulatory Frameworks and Policy Guidelines

The regulatory environment currently in place in the UK is regulated by combination of national and international provisions and agreements. These will be described in the following sections of this chapter and are summarised in Table 1.1.

[3] DEFRA is an abbreviation of Department for Environment, Food and Rural Affairs. More details are explained in Section 1.4.2.1.

Panel A: National Regulatory Frameworks and Policy Guidelines
Companies Act 2006 and 2013 Revisions
Climate Change Act 2008
Department for Environment, Food and Rural affairs: Reporting Guidelines
Carbon Disclosure Project
The UK Emissions Trading Scheme
Panel B: International Provisions and Agreements
United Nations Framework Convention on Climate Change
Kyoto Protocol
The European Union Emissions Trading System
The Paris Agreement

Table 1.1 National and International Regulatory Frameworks and Agreements

1.4.1 Regulatory Frameworks in the UK

1.4.1.1 Companies Act 2006 and 2013 Revisions

The Companies Act 2006 is the main source of the UK's company law. Its comprehensive nature is reflected in it being, at the time of passing, the longest piece of legislation in the UK's history, with 1,300 sections. Its contribution to the legal framework on climate change is found in Section 417 (5) and (6), which states that the environment is one of the areas a listed company must report information about by using financial and/or non-financial key performance indicators. The Act suggests that companies should follow a "comply or explain" approach towards the reporting of non-financial indicators in their Business Review. The 2006 Act was amended by the Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013. These regulations removed the business review provision and replaced it with a legal requirement for quoted companies to disclose their annual GHG emissions and the methodologies used to calculate them in their annual directors' report. This came into force on 1 October 2013.

1.4.1.2 Climate Change Act 2008

The Climate Change Act 2008 put a legally binding framework in place to reduce the UK's GHG emissions and a framework for developing the UK's ability to adapt to climate change. Section 1 of the Act provides for a legally binding requirement for the government to reduce the UK's GHG emissions to 80% below 1990 levels by 2050. It also obliges the government to set five-yearly carbon budgets starting with the period 2008–2012 (first period). Table 1.2 presents the budgets that are already set.

Carbon budget Period	Carbon budget level	Reduction below 1990 levels
2008 to 2012	3,018 MtCO2e	25%
2013 to 2017	2,782 MtCO2e	31%
2018 to 2022	2,544 MtCO2e	37% by 2020
2023 to 2027	1,950 MtCO2e	51% by 2025
2028 to 2032	1,725 MtCO2e	57% by 2030

Table 1.2 The UK's Carbon Budgets 2008–2032
Source: The UKCCC (2018)

The UK's performance against these budgets has been positive. For example, in 2017 emissions were 43% lower than 1990 levels, ahead of target. In addition to target-setting, another important aspect of the Act was its provision for setting up the UK Climate Change Committee (UKCCC) as presented in Act's Section 32. The UKCCC is an independent statutory body, which was given the legal duty to advise the UK government on carbon budgets and report to Parliament on progress (UKCCC, 2017). Recently, the UKCCC has warned that still more policy intervention will be needed if the country is to obtain budgets for the fourth and fifth periods (UKCCC, 2018).

Overall, the Companies Act 2006 and the Climate Change Act 2008 determine the basic reporting requirements for the environmental dimension of a firm's corporate social responsibility. In the lack of mandatory standards about environmental responsibility measures/ indicators, this legislation sets out the legal minimum obligations. The minimum, however, increasingly falls short of the expectations of stakeholders. To fill this gap, voluntary guidelines and reporting frameworks that offer appropriate environmental indicators have become more widely used in the UK. These will be presented in the following section.

1.4.2 Other Frameworks and Policy Guidelines in the UK

1.4.2.1 Department for Environment, Food and Rural Affairs: Reporting Guidelines

Within the UK government it is the Department for Environment, Food and Rural Affairs (DEFRA), established in 2001, that has the responsibility for protecting the environment alongside rural communities, fishing and agriculture. In June 2013, DEFRA issued updated guidelines for reporting on the environment, including the mandatory reporting of GHG emissions. With the exception of the legal requirement to report GHG emissions for quoted companies, the guidelines issued by DEFRA are advisory. Furthermore, there is no universally agreed upon methodology for measuring these emissions, and they are not

required to be audited. The department does refer companies to the Carbon Disclosure Project (CDP) regarding methodologies, standards, and protocols (DEFRA, 2013).

1.4.2.2 Carbon Disclosure Project

One of the most significant non-statutory developments in the UK is the establishment of the CDP in 2000. The CDP is a non-profit charitable organisation, which has grown into a leading carbon disclosure initiative operating globally. It has developed several programmes covering GHG emissions, water, supply chain, forests, cities, and the Carbon Action Initiative (CDP, 2018a). Knox-Hayes and Levy (2011) attribute the success of the CDP to its "strategic skill in presenting the project in ways that appeal to multiple stakeholders and building broad legitimacy for reporting standards" (p. 1). In promoting disclosure and the sharing of information between companies, the CDP acts to reduce the perceived risks associated with this disclosure (Wilhelm, 2013).

The CDP issues an annual questionnaire containing items on how climate change is managed, including strategy, initiatives and targets, risks and opportunities related to climate change, data on emissions performance, and the methods used to gather data. The collated information is then published in an annual report that includes a firm-specific carbon disclosure score on a scale from 0 to 100. The report is publicly available via the CDP website (CDP, 2018a). Table 1.3 shows the numbers and percentages of FTSE350 firms participating in the CDP report over the sample period from 2007-2015.

FTSE350	2007	2008	2009	2010	2011	2012	2013	2014	2015	Average
Number	245	234	236	243	236	240	260	248	250	243.56
Per cent	70.00%	66.86%	67.43%	69.43%	67.43%	68.57%	74.29%	70.86%	71.43%	69.59%

Table 1.3 The Response Rate for FTSE350 Firms (2007-2015)
Source: CDP (2007-2015)

1.4.2.3 The UK Emissions Trading Scheme

The UK pioneered emissions trading with its UK Emissions Trading Scheme introduced in 2002, three years before the Kyoto Protocol had been ratified.[4] This multi-industry scheme encouraged major companies and organisations to reduce their emissions in return for payments from a fund exceeding £200 million (DEFRA, 2006). Subsequent reviews of the scheme concluded that its targets had been insufficiently ambitious. Therefore, the

[4] More details are explained about the Kyoto Protocol in Section 1.4.3.2.

administration of the scheme was transferred to the DEFRA in 2008. Nevertheless, this and other schemes established the concept of carbon pricing; it advocated that the price of goods and services should fully reflect the costs and benefits in social, economic, and environmental terms (Energy and Climate Change Committee, 2015).

1.4.3 International Frameworks

National regulatory frameworks and policy objectives in the UK are either determined or at least influenced by multinational agreements. The lead organisation on climate change is the United Nations; regionally, the EU also contributes towards the regulatory environment.

1.4.3.1 United Nations Framework Convention on Climate Change

The United Nations Framework Convention on Climate Change (UNFCCC) came into force on 21 March 1994 and currently has 165 signatories (United Nations, n.d.). The treaty had been prepared at the Earth Summit in Rio de Janeiro in June 1992. Although the main aim of the treaty was to promote international action to tackle man-made climate change by encouraging signatories to reduce GHG emissions, it did not introduce legally binding limits on emissions or enforcement mechanisms. However, it mandated annual conferences of the parties (COPs), and the consequential Kyoto Protocol was proposed at the 1997 conference.[5]

1.4.3.2 Kyoto Protocol

The third COP held under the UNFCCC took place in Kyoto, Japan, in December 1997. The conference adopted The Kyoto Protocol; however, it was not ratified until 2005.

The Kyoto Protocol is notable for establishing the principle of differentiated responsibilities, which implies countries at different levels of economic development have different capabilities and responsibilities to tackle climate change.

The geopolitical challenges to the operation of the Kyoto Protocol are exemplified by the sharp differences in country targets (Grubb *et al.,* 1999).

Relatedly, the Protocol gave rise to the concept and practice of emissions trading under which countries with excess allowances, likely to be developing countries given headroom to develop, can sell their allowances to other (more developed) countries.

[5] These conferences are known as the Conferences of the Parties. The first conference was held in 1996 at Berlin.

1.4.3.3 The European Union Emissions Trading System

The European Union Emissions Trading System (EUETS) was introduced in 2005 and governed the capping, pricing, and trading of carbon emissions in participating countries. Its coverage extended to major emitters including power stations, large factories, and industrial plants that exceed a certain level of emissions. In the early years of the scheme, carbon allowances were allocated without cost in order to stimulate the creation of the market; from 2013, these allowances were auctioned. The tactic of giving free allowances was highly significant. Firms could choose to sell these allowances or use them to emit carbon through production. Thus, an opportunity cost was attached to carbon emissions and the principle that goods and services are priced to include their environmental cost was reinforced (Oestreich and Tsiakas, 2015). Its success is reflected in its current coverage levels, which encompasses 11,000 installations across 31 countries, accounting for 45% of the total EU GHG emissions (European Commission, 2016). Installation operators, whether in the public or private sector, must purchase carbon credits in the open market should they intend to exceed their allocations.

1.4.3.4 The Paris Agreement

The Paris Agreement of 2015 came into force on 4th November 2016. The EU had ratified the agreement one month prior (United Nations, 2018). With its mitigation actions coming into effect from 2020, the overall aim of the agreement was to secure action by its signatories that would limit the surge in global temperature to 2 degrees Celsius above pre-industrial levels and attempt to go further in limiting the increase to 1.5 degrees Celsius (UNFCCC, 2018). Concerning the Kyoto Protocol, the central issue was uniting countries at different stages of development in the common cause of tackling global warming. Despite the non-prescriptive nature of the agreement, the period since November 2016 has seen the announcement of many ambitious carbon policy initiatives. One common area of these initiatives concerns vehicle emissions, with plans announced to ban petrol-powered cars at certain points in the future. For example, the UK government announced that by 2040 all cars sold in the UK would be zero-emission vehicles (Office for Low Emission Vehicles, 2018). It also confirmed its commitment to be a zero net emissions country by 2050. This target is a step further than the 80% reduction already mandated by the Climate Change Act 2008 (Carbon Brief, 2018). The Paris Agreement emphasised the environmental integrity, transparency, and robust accounting

by recognising the possibility of voluntary cooperation among parties to allow for achieving a higher ambition and setting out principles (e.g. Jayaraman and Kanitkar, 2016).

1.4.4 UK Policy Summary

Climate change is a global issue that not only requires nation states to take national initiatives, but also to engage in international cooperation and agreements. These sections have given an overview of the climate status and recent history of regulation and policy initiatives that form the framework of the UK's response to climate change challenges. Since the early 1990s, the UK has been a proactive participant in international cooperation, and it has simultaneously introduced its own national initiatives. As stated above, current policy discussions are centred on achieving a net zero emissions economy by 2050; this would make the UK one of the most ambitious countries among large emitters. In addition to legally binding national targets as mandated in the Climate Change Act 2008, the UK has also encouraged and legislated to promote carbon disclosure by large UK firms.

1.5 Research Overview, Aim, Objectives and Key Findings

The aim of this research is to examine the financial consequences of voluntary carbon disclosure on leading UK companies, specifically, those listed on the London Stock Exchange FTSE350 between 2007 and 2015. By contributing to a greater understanding of these consequences, the research may enhance the public perception of a firm's carbon disclosures and assist the firm in meeting continuing pressures from various stakeholders on carbon-related issues.

This research is delimited to the financial consequences of carbon disclosure and the non-financial consequences are not considered. Following this, three main objectives are set. The first is to investigate the relationship between voluntary carbon disclosure and firm financial performance (FP). The resource-based view (RBV) associated with carbon disclosure is applied as a theoretical framework. A thorough financial performance index, covering both market and accounting perspectives, is employed; a range of firm characteristics adjudged to potentially drive the examined relationship are controlled for; and sensitivity tests are applied. The findings offer clear evidence that a firm's voluntary carbon disclosure is a source of competitive advantage addressing firm risk and opportunity. Moreover, such disclosure enhances organisational legitimacy and reliability and ultimately improves firm FP. Furthermore, we capture the potential impact of the global financial crisis (GFC) on the

carbon disclosure and firm FP relationship. The results show that the carbon disclosure has no effect on FP during the crisis years. However, during the recovery period, reporting on carbon-related issues promotes higher firm FP. Additionally, the findings indicate that carbon disclosure has less association with market-based measures than do alternative indicators. Finally, we find that firms operating in carbon-intensive industries are not benefiting from disclosures on their carbon profile as much as firms in non-carbon-intensive sectors.

The second objective is the investigation of the impact of voluntary carbon disclosure on firm risk (FR), particularly, the potential for a positive relationship between information asymmetry and FR. The proposed RBV framework is applied to develop an understanding of the impacts of climate change mitigation activities on the FR. The study finds that adopting a carbon management strategy that includes enhanced carbon disclosure leads to a reduction in a firm's total, systematic, and idiosyncratic risks. Significantly, the relationship between carbon disclosure and FR only became noticeable after the GFC. Furthermore, the relationship between carbon disclosure and FR is more marked in carbon-intensive industries.

The third objective is to examine the market reaction to announcements of voluntary carbon disclosures, to reach a clear understanding about investors' interpretation of carbon disclosure initiatives based on the cost-benefit approach. Using an event study method, the results demonstrate that investors in the London Stock Exchange market elicit a significantly negative response to carbon disclosure announcements via the non-profit Carbon Disclosure Project (CDP). This negative reaction is more obvious for firms operating in carbon-intensive industries when compared to that of the main sample. This contrasts with the significantly positive investor reaction to carbon disclosure announcements during the GFC period.

While each objective is pursued in a separate empirical chapter, all three are important and equal components in pursuing the overall unified aim of the research. When combined, FP, FR and market reaction form a comprehensive picture of the financial consequences of voluntary carbon disclosure in a way that only examining one of these may not achieve. To achieve these objectives, data from well-established sources— Bloomberg, Datastream, and the CDP databases—are used in this research.

1.6 Potential Contributions

This thesis seeks to add novel contributions towards the knowledge of the way voluntary carbon disclosure, as part of a proactive carbon strategy, interacts with both the FP of the firm

and FR, and how investors and the market react to announcements of voluntary carbon disclosures.

The findings of this research make an important contribution to the literature examining the financial consequences of voluntary carbon disclosure. It will also offer significant implications for management, investors, regulators, and sustainability institutions. Moreover, our findings would be of significance to stakeholders who have considerable interests in evaluating the survival and sustainability of a firm and understanding the investors' reaction to carbon disclosures initiatives. In particular, investors can consider the findings when making investment decisions. The findings will enable regulators to enhance their evaluation of the willingness of firms to disclose their carbon emissions voluntarily and use this understanding when further developing the regulatory framework.

There are shared contributions across the three empirical chapters and unique contributions for each chapter. As there is relatively little known about the examined relationships within the UK context, the first of the shared contributions was to fill a considerable gap in the literature by providing evidence from the UK on the financial consequences of carbon disclosures. The second and third shared contributions provided evidence concerning industry type, specifically carbon-intensive vs non-carbon-intensive industries and the effect of the GFC on the relationships of interest. Turning to unique contributions, the first essay presented in Chapter 2 contributes to the literature in two ways. Firstly, we build on RBV theory to understand how the proactive carbon strategy through the voluntary carbon disclosure could affect the firm's FP. Secondly, it provided what is believed to be the first use of a financial index to quantify the financial impacts of carbon disclosure. Therefore, we add to the broad set of environmental accounting literature by identifying the impact of carbon disclosure on separate indicators, e.g. accounting vs market-based measures of firm FP. In the second essay presented in Chapter 3, we first devise a conceptual model based on RBV theory which considers the positive association between the information asymmetry and FR and which builds understanding how the voluntary carbon disclosure could affect FR. Secondly, to the best of our knowledge, it is the first study investigating the impact of carbon disclosure on FR. Alongside the contributions it shares with other chapters, the third study presented in Chapter 4 contributes a theoretical framework based on the cost-benefit approach to facilitate understanding of how investors and the market react to announcements of voluntary carbon disclosure.

1.7 Thesis Structure

The thesis is organised into five chapters. Following this introductory chapter, Chapters 2, 3, and 4 are the empirical chapters presented as three separate papers, each chapter contains its own introduction, literature review, hypothesis development, research design, results and analysis and conclusion sections. Finally, Chapter 5 concludes the thesis.

1.8 Chapter Summary

This chapter has introduced the research to be presented in this thesis. It has explained the motivation for the research and given a brief contextual summary of the UK in regard to climate change and its regulatory framework, including internnational agreemnts and provisions, designed to achieve reduced GHG emissions. Furthermore, the chapter described the overall aim of the research and the three objectives set to achieve this aim. These three objectives, each realised through empirical studies examining the relationship between voluntary carbon disclosure and three types of potential financial consequence, FP, FR and market reaction are presented in forthcoming chapters. They are linked by the aim of providing the fullest possible understanding of the financial consequences of voluntary carbon disclosure. As explained, non-financial consequences are not considered. Consideration was given to the potential contributions of the research and finally the structure of the thesis was briefly summarised.

Chapter 2.Does Corporate Carbon Disclosure Influence Financial Performance of UK Firms?

2.1 Introduction

A growing number of firms have made their global-warming strategy part of their core strategy as they recognise that going green could save money through improved energy efficiency and waste management, amongst other factors. Managers have private information about firms' carbon profile, including carbon strategy, carbon emissions, and carbon reduction activities, that is not directly accessible by outside stakeholders (Luo and Tang, 2014). In addressing the information asymmetry problem, managers strategically disclose relevant information to maximise the value of the firm as perceived by capital providers (Beyer *et al.,* 2010). Carbon disclosure can be among the various aspects of corporate reporting toward greater transparency in environmental reporting (Hahn *et al.,* 2015; Hummel and Schlick, 2016). Under the current regulatory reforms to meet growing environmental concerns from diverse stakeholders, climate change and energy transitions have become pressing financial and social issues. Green finance has recently emerged as a regular part of many investment decisions (Ward, 2017). Also, serious doubts have been raised about the business models of firms that operate in polluting industries. Many investors and other stakeholders have raised concerns about their firms' investments and strategic decisions on voluntarily disseminating carbon information. As such, investigating the impact of carbon disclosure on firm financial and operational performance is nowadays imperative.

The current emergence of investors' interests in climate-related financial risks calls for a specific type of global data about such risks to support rational investment decisions (The Economist, 2017). One attempt to respond to these needs was the initiation of the Carbon Disclosure Project (CDP), an environmental impact charity, which investigates the participating companies' practices and risks related to global warming.[6] The purpose is to promote more transparency that could guide investors away from shareholdings at risk of climate change impacts. CDP could also help drive investment toward a low-carbon and more sustainable economy. The objective of this paper is to investigate the relationship between voluntary carbon disclosure and firm financial performance (FP). Achieving this objective

[6] The scheme started out in the UK in 2000 but has grown to become the world's biggest register of corporate emissions. Each year, it administers a questionnaire on climate change-related issues to public companies on behalf of its signatories (e.g. banks, investors, wealth advisors, pension funds). It then makes public the results in an annual report.

could demonstrate how the impacts of climate change on business operations and responding to them, can simultaneously and positively affect both the environment and business.

Our study is motivated by an interest in understanding corporate engagement in climate change practices, beyond stringent requirements related to regulatory compliance, as evidenced by firms' voluntary participation in carbon disclosure through CDP. We contribute to the ongoing debate on the economic consequences of carbon disclosure by conceptualising and testing the impact of adopting proactive carbon management strategies on a firm's financial health. The resource-based view (RBV) theory is deemed appropriate to this study setting. The RBV emphasises that internally made decisions, based on a firm's ability to exploit the available productive resources, generate competitive advantage and, thereby, procure financial benefits. That is, there are possibly valuable and hard-to-duplicate resources that might provide strategic gains over competitors (Hasseldine *et al.,* 2005).

Our sample comprises 977 firm-year observations listed in the FTSE350 index from 2007 to 2015, a time characterised by high public awareness and extensive policy debate on climate change and greenhouse gas (GHG) emissions. FTSE350 companies are the largest companies by market capitalisation listed on the London Stock Exchange. Therefore, these companies represent a central projection for the UK's carbon profile and economic performance. We utilise carbon disclosure score (CDS), reported by the CDP – and construct a comprehensive financial index that captures different types of a firm's performance. This financial index comprises both accounting and market indicators. Findings in this study suggest that voluntary carbon disclosure tends to significantly improve a firm's FP. This finding is consistent with a "win-win" perspective of being 'green and competitive' (Porter and Van der Linde, 1995). Furthermore, we capture the potential impact of the global financial crisis (GFC) on the carbon disclosure and firm performance relationship. The results show that the carbon disclosure has no effect on performance during the crisis years. However, during the recovery period, high reporting on carbon-related issues promotes higher firm performance. We additionally re-assess the associations between carbon disclosure and each of the individual proxies for our financial index. Our findings show that market-based measures of firm performance are less related to carbon disclosure than other measures. Furthermore, we extend our analyses and cluster the full sample into two sub-samples, firms reporting high FP and low FP. The results show that firms which achieved high FP reported highly positive carbon disclosure compared to a modest disclosure for firms with low FP. Finally, conditional on the industry type (i.e. carbon-intensive vs non-carbon-intensive industries), we find that

firms operating in carbon-intensive industries are not benefiting from disclosing on their carbon profile as other firms that work in non-carbon-intensive sectors.

This study contributes to the emerging research area of climate-related activism and the broader corporate transparency debate in three ways. First, the limited debate within the prior literature on the financial consequences of carbon disclosure indicates a lack of consensus on the direction of this relationship. Moreover, relatively little is known about this association within the European context in general and in the UK context in particular. The UK represents an interesting setting for this type of research. While the European Union (EU) is marked as one of the world's top three GHG-emitting economies (after China and the United States), the UK, a member of the G7 (Group of Seven), represents one of the largest GHG emitters in the world (Haque, 2017).[7] The UK is also listed in the top twenty countries that emitted the most carbon dioxide (UCS, 2018).[8] It is also observed that climate change has fundamentally and adversely affected the UK weather.[9] Several government initiatives are launched accordingly.[10] The UK is currently leading and developing proactive mechanisms to mitigate the dangers of climate change. In December 2008, the Committee on Climate Change recommended that the UK government set a long-term target to reduce GHG emissions to at least 80% below 1990 levels by 2050. In September 2009, the Department for Environment, Food and Rural Affairs (DEFRA) issued voluntary guidance on measurement and reporting of GHG emissions to support UK organisations in reducing their contribution to climate change.[11] Moreover, the Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013 (SI 2013/1970) (Strategic Report Regulations, 2013) introduce

[7] The Group of Seven (G7) was a group of advanced industrialized countries – the United States, Germany, the United Kingdom, Japan, France, and Canada. This group holds an annual summit aimed at building a consensual approach to global issues including economic development, crisis management, energy, terrorism, and global security.

[8] According to the Central Intelligence Agency (CIA) Factbook, in 2013 the UK emitted approximately 568.3 million metric tons (MMT) of carbon dioxide, released by burning fossil fuels in the process of producing and consuming energy (CIA Factbook, 2018). Within the same year, France emitted 385.6 MMT of carbon dioxide; Italy emitted 362 MMT; Poland emitted 257.6 MMT; Belgium emitted 93.62 MMT (CIA Factbook, 2018).

[9] For example, on 10 August 2003, the UK recorded its highest ever temperature at 38.5°C (101.3°F)–which triggered thunderstorms and flash floods in northern England and Scotland and contributed to health problems among local communities led to the death of thousands. To make matters worse, December 2015 was the wettest and warmest month ever recorded in the Met Office's records dating back to 1910.

[10] In his recent speech in 2012 at the Accounting for Sustainability Annual Forums, The Prince of Wales was quoted as saying "…We are rapidly running out of time to adopt an approach that reduces our impact on the Earth's capacity to sustain us all. I am afraid the damage we are doing is now beginning to bite". He calls on the accountancy profession to increase efforts to promote corporate sustainability reporting, arguing that the measurement of a host of environmental metrics should become the norm for organisations around the world. For more details www.princeofwales.gov.uk/media/speeches.

[11] Tauringana and Chithambo (2015) find that these GHG guidelines have a significant positive effect on the level of GHG disclosures of FTSE350 firms.

requirements for quoted companies concerning disclosure of GHG emissions. The directors' report of such companies needs to disclose annual carbon dioxide emissions and the methodologies used to calculate them. Second, we build on the RBV theory (e.g. Hart, 1995; Russo and Fouts, 1997) to understand how proactive integration of climate change mitigations into a firm's business strategy could affect the bottom line performance through carbon disclosure to stakeholders. Thirdly, we test our RBV-based conceptual model against empirical reality by constructing a comprehensive index that captures FP. To our knowledge, this study is the first to use a financial index to quantify financial impacts of carbon disclosure. We take a step ahead to highlight how firms' engagement in high (low) carbon disclosure can lead to high (low) FP. Finally, findings in this study add to the broad set of environmental accounting literature identifying the impact of disclosing for carbon emissions on separate indicators, e.g. accounting vs market-based measures of firm performance. Our results also draw up insights provided by prior research related to carbon-intensive industries (e.g. Freedman and Jaggi, 2005; Hamilton, 1995) and introduce strong evidence related to carbon disclosure and implications on firm performance.

Findings in this paper provide updated insights and policy implications for managers, investors, and regulators. Managers should work towards improving the quality of carbon-related information by ensuring the relevance, credibility, and reliability of such information. In this regard, the CDP report, as a disclosure mechanism, fits the mission of both stakeholders and managers since it offers comparable and standardised information which make it difficult for poor performers to mimic high achievers (Luo and Tang, 2014). Our findings also guide regulators on how to promote and focus their efforts towards the implementation of sustainable carbon management practices in businesses. Although the DEFRA guidance on GHG disclosure and the new UK annual strategic report and requirements to disclose GHG emissions are essential steps in the right direction, regulators should consider framing climate change mitigation efforts and identify strategically relevant resources to which carbon disclosure quality contributes.

The next section reviews the literature and develops a hypothesis to answer the research question. The Section 2.3 presents sample data and model. Section 2.4 reviews the empirical results and additional analyses. The Section 2.5 concludes.

2.2 Literature Review and Hypothesis Development

2.2.1 Background

Many literature reviews exist on the determinants of corporate social/environmental/carbon responsibility or sustainability reporting (e.g. Berthelot *et al.,* 2003; Lee and Hutchison, 2005; Fifka, 2013; Hahn and Kühnen, 2013; Khlif *et al.,* 2015; Haque, 2017). The association between social/environmental responsibility and FP has also long been the centre of considerable research in many scholar disciplines (e.g Pava and Krausz, 1996; Griffin and Mahon, 1997; Margolis and Walsh, 2003; Orlitzky *et al.,* 2003; Qiu *et al.,* 2016). Stechemesser and Guenther (2012), Hartmann *et al.* (2013), Ascui (2014) and Haslam *et al.* (2014) provide extensive reviews of the literature on carbon accounting. Hahn *et al*. (2015) review the research addressing output and outcome of carbon disclosure and conclude that a considerable number of studies emphasise the empirical determinants and, to a lesser extent, the effects (outcome) of carbon disclosure, which has become a strategic decision-making issue for organisations within the current competitive scenarios (Kuo and Yi-Ju Chen, 2013). Accordingly, "the effects of carbon disclosure represent a major gap that should be filled by future research" (Hahn *et al.,* 2015, p. 97).

This view appears especially valid considering that the ongoing debate in the limited literature on the economic impact of reported GHG emissions or disclosed responses to climate change also shows no consensus and related empirical research provides inconclusive findings. Some studies find general support for a positive relationship (e.g. Hart and Ahuja, 1996; Ziegler *et al.,* 2011; Fujii *et al.,* 2013; Gallego-Álvarez *et al.,* 2015). Busch and Hoffmann (2011) find that carbon emissions as an outcome-based measurement have a positive relationship with FP, but they observe a negative link when using carbon management as a process-based measurement. Kim and Lyon (2011) analyse the conditions under which share prices are increased for the Financial Times Global 500 due to participation in the CDP and find no systematic evidence that CDP participation directly increased share prices.[12] However, they find that companies' CDP participation increased shareholder value when exogenous events caused the likelihood of climate change regulation to rise. Gallego-Álvarez *et al.* (2014) find that GHG emissions ratio does not have either a positive or negative influence on a company's FP. They conclude that "future research should consider the possibility of

[12] The Financial Times Global 500 provides an annual ranking of the world's largest firms according to their market capitalisation. It shows the changing performance of both individual companies and the sectors and countries they operate in.

including a broader time period, and thus the behaviour of firms before, during and after the period of economic crisis could be analyzed" (p. 371). Matsumura *et al.* (2014) find that the capital markets penalise all firms for their carbon emissions but impose a further penalty for non-disclosure. Misani and Pogutz (2015) study carbon-intensive industries, for which reduction of GHG emissions is a highly material issue, and find that firms achieve the highest FP when their disclosed GHG emissions are neither low nor high, but intermediate. These authors suggest that future research should also examine industries with lower average levels of emissions. Lewandowski (2017) find that carbon emission mitigation has a linear and significantly positive relationship to return on sales but is negatively related to Tobin's q. Empirical investigations of this relationship have used global or US-based samples and employed different measures of carbon disclosure (e.g. carbon intensity ratios, variation in the carbon dioxide emissions) while covering many time periods and not precisely a broader period after the GFC. Although accounting and market measures of performance have been widely used in previous literature, no consensus exists on the measurement of FP. Methodological and measurement issues thus seem to explain the inconsistent results (Hahn *et al.,* 2015). Moreover, Hahn *et al.* (2015) conclude that extant literature does not "explicitly refer to an underlying theoretical framework and, rather, rely on prior empirical evidence to develop their hypotheses" (p. 94). As such, it is not clear whether the understanding of this issue is much greater now than when it was first considered. With the growing interest and opaqueness of implications of carbon disclosure, it is necessary to develop a firm theoretical foundation highlighting the underlying cause-effect relationship between carbon disclosure and FP.

2.2.2 Carbon Management and Financial Performance: An RBV Conceptualisation

In a competitive business environment, the primary focus of a firm is to overcome intense competition and outperform other firms by creating competitive advantage (Kamasak, 2013), defined as superior FP (Winter, 1995). A firm has a competitive advantage "if it [can] create more economic value than the marginal (breakeven) competitor in its product market" (Peteraf and Barney, 2003, p. 314). Indeed, any firm is a bundle of resources (Penrose, 1959; Wernerfelt, 1984), defined as "the subset of its productive assets which are economically inalienable" (Wernerfelt, 2016, p. 102). Each firm has a unique (heterogeneous) resource endowment (Lockett *et al.,* 2008). These resources can only be a source of sustained competitive advantage when they are valuable (Barney and Clark, 2007). More precisely,

"bundles of strategically relevant resources" (Peteraf and Barney, 2003, p. 317) enable a firm to create viable business strategies and to develop a sustainable competitive advantage over its rivals (Collis, 1994; Kamasak, 2013).

The RBV of a firm, "an efficiency-based explanation of sustained superior firm performance" (Barney and Clark, 2007, p. V), is one of the leading theoretical paradigms to explain performance variation among competing firms (Newbert, 2007; Galbreath and Galvin, 2008) in relation to internal, idiosyncratic resources or firm-specific factors (Barney, 1991). According to this paradigm, if a firm is to earn superior profits and achieve sustained competitive advantage in the current economic climate (Hitt *et al.,* 2001), it must acquire and control valuable, rare, inimitable, and non-substitutable (VRIN) intangible resources (Barney, 1991) along with the dynamic capabilities that "integrate, build and reconfigure internal and external competencies to address rapidly changing environments" (Teece *et al.,*1997, p. 516). The RBV theoretical lens appears to have become the dominant theory in the debate on how environmental practices affects FP (e.g. Hart 1995; Hart and Ahuja, 1996; Russo and Fouts, 1997; Klassen and Whybark, 1999; Menguc and Ozanne, 2005; Sarkis *et al.,* 2010; Ramanathan, 2018). It offers a supportive framework for our study setting to analyse such relationship for two reasons (Russo and Fouts, 1997; Surroca *et al.,* 2010). First, it focuses on FP as the key outcome variable. Second, prior work adopting this view explicitly recognises the importance of the creation of intangible assets or resources, such as legitimacy and the broader reputational benefits of taking a proactive approach to the environment (Spicer, 1978; McGuire *et al.,* 1988; Fombrun and Shanley, 1990; Hamilton, 1995; Cohen *et al.,* 1995; Klassen and McLaughlin, 1996; Waddock and Graves, 1997; Toms, 2002; Hasseldine *et al.,* 2005; Cho *et al.,* 2012; Sullivan and Gouldson, 2012; Kuo and Yi-Ju Chen, 2013). Such advantage-creating resources can be generated, maintained or enhanced through disclosure practices (Chalmers and Godfrey, 2004).

Legitimacy, "a view closely tied to the RBV of the firm" (Tilling and Tilt, 2010; p. 58), serves as a resource (Hearit, 1995) that organisations use through various disclosure-related strategies (Deegan, 2014; Higgins and larrinaga, 2014) to construct their social conversations with stakeholders, and enhance reputation (Auger *et al.,* 2013; Beyer *et al.,* 2010; Busch and Hoffmann, 2011; De Villiers and Van Staden, 2006; Hasseldine *et al.,* 2005; Ullmann, 1985). Miles and Covin (2000) point out, "reputational advantage, as a function of credibility, reliability, responsibility and trustworthiness, is enhanced by superior environmental performance" (p. 300). After implementing more mitigating actions related to their ecological

impact and GHG effect, organisations will have greater motivations to voluntarily disclose high-quality information to stakeholders (Kuo and Yi-Ju Chen, 2013).

Accordingly, in the underlying proposition of the RBV is managing carbon effectively. This implies an organisational capability that should be communicated to corporate audiences in an appropriate, consistent, open, and accessible format to make a positive impact on competitive advantage. A proactive carbon strategy applied to processes, products, and services will often necessitate meeting the objectives of protecting human health and the quality of the environment as well as using natural resources prudently and rationally (Deegan and Gordon, 1996). Such strategy constitutes a part of the corporate environmental orientation and reflects a firm's contribution to climate change. When carbon management is poor, a firm's reputation for environmental responsibility and the legitimacy of its passive commitment to climate change issues are at risk (Misani and Pogutz, 2015). By contrast, a proactive carbon strategy tends to achieve maximum possible operational efficiency and reduce risks to humans and the environment (Hart and Ahuja, 1996; Fujii *et al.,* 2013). Improved environmental risk management practices in turn alleviate the societal pressure, mitigate the threat of government regulation, lower the market risk (Orlitzky and Benjamin, 2001; Salama *et al.,* 2011) and reduce cost of capital to the firm (Bansal and Clelland, 2004; Sharfman and Fernando, 2008; Dhaliwal, Li, Tsang, and Yang, 2011). Environmentally active firms are also expected to "enjoy several potential revenue-generating benefits: (a) reducing their exposure to potential carbon costs, (b) opening up new markets, (c) developing competencies that provide a competitive advantage, and (d) creating new revenue streams from excess credits" (Peloza, 2009, p. 1526).

Companies with such proactive carbon strategies attempt to improve their market and economic position (Grant, 1991; Hart, 1995; Russo and Fouts, 1997; Bansal and Roth, 2000; Miles and Covin, 2000; Galbreath, 2010; McLaughlin, 2011; Matisoff, 2013; Hahn *et al.,* 2015) by (1) investing in physical assets and corporate green R&D strategy of low-emission technologies; (2) attracting the skills required to use these assets and technologies to reduce the corporate impact on the natural environment; (3) minimising exposure to physical and regulatory risks associated with climate change and maximising opportunities from changing market forces and emerging controls; (4) improving organisational culture and inter-functional coordination as a means of promoting climate change mitigation action to prevent further accumulation of GHG in the atmosphere; (5) accomplishing a cost-based competitive advantage through reduced energy consumption; and (6) maximising value to stakeholders by

creating reputational capital. Therefore, the RBV plays a key role in understanding the proactive integration of climate change mitigation efforts into the business strategy. These efforts, if implemented and sustained, are unique and will be a source of both competitive and financial advantages to environmentally active firms (Russo and Fouts, 1997; Ramanathan, 2018).

2.2.3 The Decision to Disclose Carbon Information Voluntarily

For some time now, scholars have tried to answer the question of whether it pays to be green (e.g. Hart and Ahuja, 1996; Clarkson *et al.,* 2011; Barnett and Salomon, 2012). However, before answering this question, it is worth exploring another: How can we tell how green a firm is, or how green it is perceived to be? In other words, how can we identify a proactive carbon strategy, with boards of directors and executive committees having incorporated climate change policy considerations in their strategic planning and decision making (Galbreath, 2010)? This issue is important for managers and various other stakeholders because having a green strategy, if appropriately developed, implemented, and sustained, a firm's business operations can be distinguished from those of other competitors and hence, this strategy will be a source of both competitive and financial advantages.

In an area of financial reporting dominated by voluntarism, broad options are available to managers about how to report the impact of organisational activities on the environment (Hasseldine *et al.,* 2005; Delmas and Burbano, 2011; de Villiers and Van Staden, 2011). As Cairncross (1995) puts it: "Companies are free to publish whatever they wish (or whatever they think they can get away with" (p. 203). There is also a possibility that environmental responsibility can be used as an attempt to greenwash to deliberately manage stakeholders' perceptions by reporting biased/misleading positive information not matched by improved environmental impacts (see, for example, Ingram and Frazier, 1980; Wiseman, 1982; Deegan and Rankin, 1996; Al-Tuwaijri *et al.,* 2004; Lyon and Maxwell, 2011; Bowen, 2014), rather than as an authentic means to limit global climate change by measuring, managing, and reducing the GHG emissions (Haney *et al.,* 2009). Greenwashing can adversely affect investor confidence, eroding the environmentally responsible investing capital market (Delmas and Burbano, 2011), and could negatively affect firm performance (Lyon and Montgomery, 2015).

If these concerns are valid, managers need to improve the transparency and accountability of their corporate carbon profile and find innovative ways to cut emissions and associated waste

(Haslam *et al.,* 2014). Failure to communicate information on carbon profile to the market would result in the inability of investors to accurately estimate the risk associated with the investment. Carbon disclosure can then be regarded as a commitment to transparency, as efforts to address climate change risks and opportunities, and as a criterion for measuring an organisation's reliability and legitimacy. Once proactive carbon management strategies are adopted, firms will voluntarily report information about their mitigation actions (Connelly *et al.,* 2011), that is, their 'discharge of accountability' (Gray *et al.,* 1996, p. 39), through communication to stakeholders (Zéghal and Ahmed, 1990). High-quality voluntary carbon disclosure will then enable the organisation to develop a carbon competitive strategy (Schaltegger and Csutora, 2012), publicise stronger environmental records to stakeholders (Mahoney *et al.,* 2013), distinguish themselves from poor performers to avoid the problem of adverse selection (Luo and Tang, 2014), and eventually increase their market values (Hummel and Schlick, 2016). Therefore, within the context of the RBV, accountability through carbon disclosure, reconciled with sustainability, can be viewed as a resource that provides sustained competitive advantage (Haslam *et al.,* 2014).

Luo and Tang (2014) suggest carbon information is "a complex and multidimensional concept" (p. 196).[13] Managers must, therefore, come to appreciate the key elements in making disclosures on GHG pollution emissions and their detailed plans to deal with the global warming problem. These plans should include low-carbon initiatives, emissions reduction targets, energy/power consumption, and the determination of climate change risk and opportunities, resulting in a change in business operations, expenditures, and revenues. Ultimately, to be considered as valuable, unique resource, a credible carbon reporting system, by which to improve the perceived legitimacy and to gain reputational advantages, should cover questions of what sorts of carbon information is needed to be reported and relevant to use and what items reflect a proactive carbon management strategy.

Carbon disclosures conveying relevant information to stakeholders regarding advantage-creating resources would, therefore, imply integration of (a) climate change into business strategy, (b) an effective system of corporate governance, based on the values of transparency and accountability, that addresses climate change, and (c) external assurance/verification to enhance the credibility of firms' disclosures (e.g. Clarkson *et al.,* 2008). If carbon disclosures

[13] The main difference between this paper and the Luo and Tang (2014) study, is that we concentrate on financial consequences rather than non-financial ones. Luo and Tang (2014) examine the correlation between carbon performance measured by GHG intensity and carbon disclosure, and whether a good carbon performance could lead firms to distinguish themselves by focusing more on disclosing their carbon profile.

provide accurate information about actual performance and are successfully transmitted to a broader range of stakeholders, who increasingly require meaningful and transparent disclosures on GHG emissions and the management of related risks and opportunities regarding global warming, the carbon disclosure–FP relationship, in which strategic organisational resources required for competitiveness are combined, and environmental technologies are implemented, should exist (Klassen and Whybark, 1999). The relationships described above are summarised in Figure 3.1, which leads directly to the following hypothesis:

H_1 Carbon disclosure has a significant and positive association with the FP.

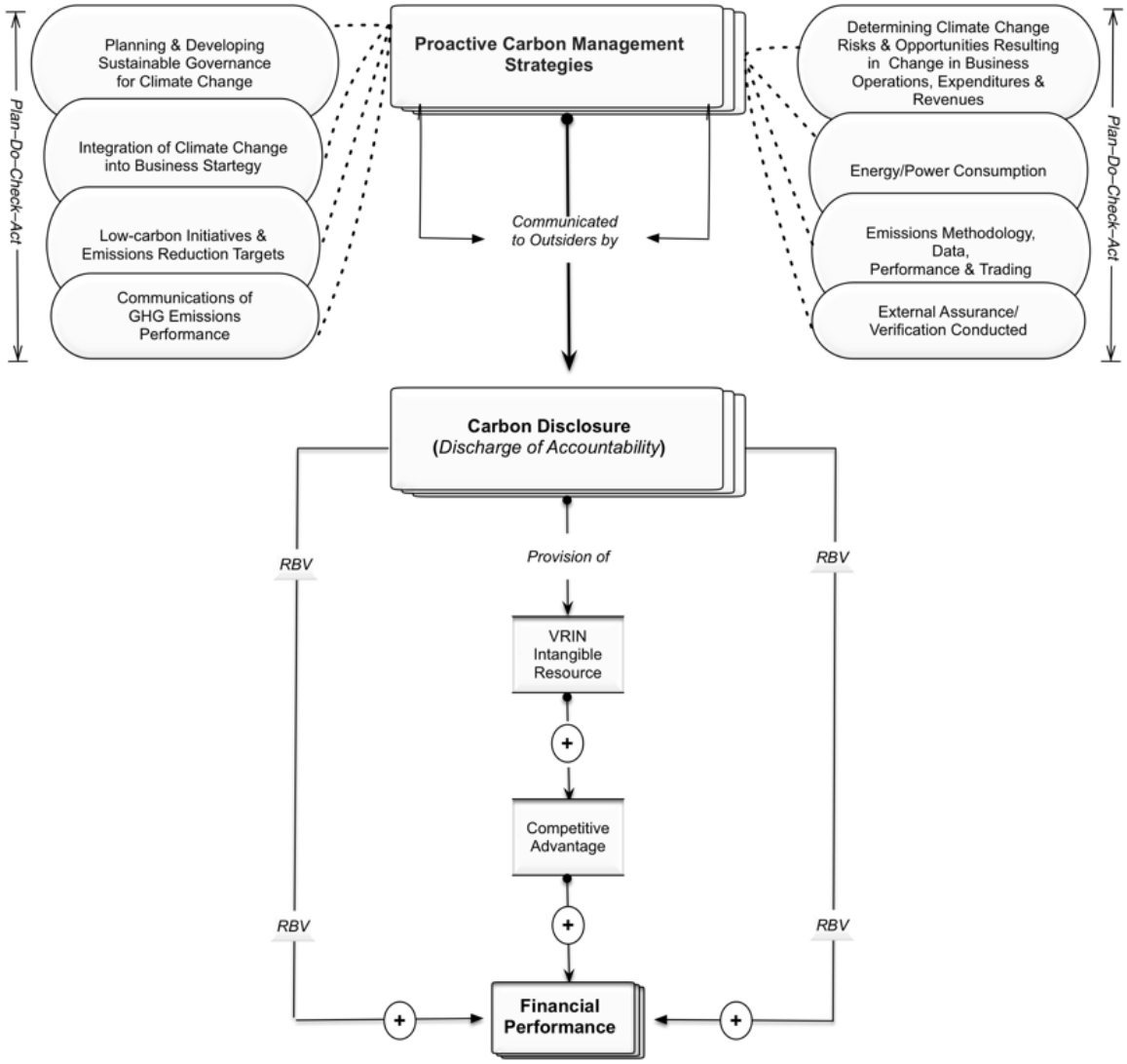

Figure 2.1 The Impact of Voluntary Carbon Disclosure on Financial Performance

2.3 Research Design and Data

2.3.1 Sample

Since it is the largest index in the UK that is annually assessed by the CDP, our sample includes all firms continuously listed on the FTSE350 index between the years 2007-2015. This period was characterised by high public awareness and extensive policy debate on GHG emissions, including national legal requirements (i.e. Regulation of 2013) and international climate provisions and agreements (i.e. Paris agreement). It is worth mentioning the FTSE350 companies were first invited to engage in and voluntarily report their carbon disclosure through the CDP online questionnaire in 2006. We exclude the year 2006 from the analysis for two reasons: (1) the modest participation level in CDS questionnaire in that year, and (2) to ensure the consistency of the companies' responses to the questionnaire items and analyses of the CDP data across time. The responses in 2006 were analysed and classified into four categories (qualitative): answered questionnaire (AQ), provided information (IN), declined to participate (DP), and no response (NR). In contrast, in the following years, the responses were classified based on the digital analysis (quantitative) and ranged from 0 to 100. The final sample consists of 977 firm-year observations, after dropping the financial institutions, as is common in this type of research, because of their unique accounting practices and the different set of environmental and social regulations such as the '*Equator Principles*' they follow (Macve *et al.,* 2010; Hussainey and Salama, 2010; Qiu *et al.,* 2016; Haque, 2017).[14] Table 2.1 summarises the distribution of the final sample by the Global Industry Classification Standard (GICS) classification, the same classification applied by the CDP.[15]

[14] The *Equator Principles* is a risk management framework, adopted by financial institutions, for determining, assessing and managing environmental and social risk in projects. See http://www.equator-principles.com.
[15] For the treatment of the outliers, our data are winsorised at the 2.5th and 97.5th percentiles.

Industry/Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	Per cent
Basic Materials	4	9	8	10	12	10	8	8	7	76	7.78
Consumer Goods	8	13	8	12	15	19	17	21	20	133	13.61
Consumer Services	24	29	24	28	33	32	35	35	40	280	28.66
Health Care	4	7	7	6	7	7	7	8	7	60	6.14
Industrials	26	32	28	31	37	39	37	39	37	306	31.32
Oil and Gas	5	6	5	4	5	6	8	6	1	46	4.71
Technology	2	1	2	2	2	2	3	1	2	17	1.74
Telecommunications	0	2	2	2	2	1	1	1	2	13	1.33
Utilities	5	7	6	5	4	5	4	6	4	46	4.71
N	78	106	90	100	117	121	120	125	120	977	100

Table 2.1 Sample Distributions based on Industry and Year

2.3.2 Measures

2.3.2.1 Financial Performance

The dependent variable in this study is firm financial performance (FP). Measurement of FP is a fundamental problem in the context of the prior literature hypothesising that corporate social and environmental responsibility is a predictor of FP (Margolis and Walsh, 2001). Accordingly, we take a step forward to overcome this concern by developing a composite financial performance index (FPI) incorporating the most common measures employed by previous studies examining the associations between corporate social/environmental responsibility and FP (e.g. Busch and Hoffmann, 2011; Jo and Na, 2012; Jayachandran *et al.,* 2013; Chang *et al.,* 2014; Koh *et al.,* 2014; Oikonomou *et al.,* 2014; Qiu *et al.,* 2016).

The FPI comprises ten financial variables which reflect accounting and market measures. These variables are classified according to their measure source, either accounting, market, or combined accounting and market-based measures. Accounting-based measures include return on assets (ROA), return on equity (ROE), asset turnover (AT), the debt-to-equity ratio (D/E) and interest coverage ratio (IC). Market-based measures include stock return volatility (RV), cost of equity (COE) and the price-earnings ratio (P/E). Altman Z-score (Z) and the market-to-book ratio (P/B), are categorised as combined measures. In constructing the FPI, we take the average industry value for each of these proxies at each time *t* and compare it with the firm *i* value of each proxy. We then create dummy variables for each of the ten variables. Each dummy variable gets a value of 1 if a firm's proxy has a score better than the industry average; 0 otherwise. Finally, we give a scale value for the FPI ranging from zero to ten, where a higher value reflects a better FP position. We use the scale value derived from the

dummy variables to get the overall financial health level. We require the availability of all FPI's proxies to have a value. We, therefore, remove any missing values along the FPI components. The data source is the Bloomberg database, and the definitions of variables are presented in Appendix 2.1

Although the idea of constructing an index to capture variables in regression equations has recently been emphasised by finance scholars on financial flexibility (e.g. Doidge *et al.,* 2009; Ferrando *et al.,* 2017) and corporate governance (Mollah *et al.,* 2017), to our knowledge, none of the previous studies in the context of environmental accounting has implemented an FPI to assess the relationship between corporate social/environmental/carbon practices and FP. Developing this index, to stipulate a firm's FP, can be justified from three perspectives. First, it offers simultaneous assessments of a firm's performance using multiple indicators. Given a rich variety of available proxies of financial measures that can be used independently in analysis, existing studies measure firms' FP by employing individual measures of the same category, such as accounting-based measures (see, for example, Harcourt, 1965; Watts and Zimmerman, 1978; Wright, 1978; Gonedes and Dopuch, 1979; Hagerman and Zmijewski, 1979; Dhaliwal *et al.,* 1982; Fisher and McGowan, 1983; Fisher, 1984; Benston, 1985; Salamon, 1985; Griner and Stark, 1991; Hay and Morris, 1991; Rees, 1995; Brealey *et al.,* 2012). However, despite their similarities, each of the measures captures different aspects of firm's FP. For example, return on assets (ROA), return on equity (ROE) and asset turnover (AT) reflect firms' profitability as well as their operational efficiency. Adding to these three measures, debt to equity (D/E) and interest cover (IC) provide the relative profitability of firms given their financial obligations. Furthermore, as important as accounting measurements which reflect the historical FP, market-based measures provide the perceptions and reactions of the market on the firms' future financial prospects. Moreover, it might be argued that accounting proxies are likely to be subject to managerial opportunism (i.e. earnings management) and influenced by differences in accounting practices. Hence, additional consideration of market-based measures can provide a more robust examination of a firm's financial health. Overall, it can be seen that different financial measures do not stand on their own but complement each other for a more comprehensive analysis of a firm's financial achievements. Therefore, those measures should be integratedly used by developing a composite measure that offers an overall assessment of the financial position/health of a firm that can be compared across several years.

Second, the FPI captures the relative FP of firms across industries rather than their absolute performance. It has been suggested that studying firm performance should be extended to reflect on other industry-specific characteristics (McGuire *et al.,* 1988). As for all previous studies, the comparison of absolute FP across firms can be misleading and biased. This property of the index is critical because it is more rational to compare firms with similar characteristics. Therefore, the index compares the individual financial aspects of each firm with the industry average benchmark.

Lastly, regarding the selection of the index's components, the study thoroughly evaluates the ten most well-acknowledged and important financial measures that have been used both in the literature and in practice. Furthermore, there were criteria that these measuring elements should provide unique value added to the firm's FP from different perspectives and that duplication should be avoided. For example, as there is significant duplication between EPS and P/EPS ratios, and Tobin's Q and P/EPS, EPS and Tobin's Q are excluded.

By computing the index, the correlations between measures are seen to be significant for around 90% of the measure pairs (the correlations results are not reported in this thesis). The associations between these ten measures justify the use of the FPI devised in this thesis. Particularly, many different aspects of firms' FP, good performance and bad performance can be inherent simultaneously through all measures. Consequently, it is useful to incorporate all aspects into one single measure for a complete picture of firms' financial health.

2.3.2.2 Carbon disclosure

Koh *et al.* (2014) suggest that future research may endeavour to measure corporate social and environmental practices using a survey methodology. We use the Carbon Disclosure Score (CDS), collected from the CDP database, as a proxy for a firm's carbon disclosure. The CDS is obtained via a survey and is based on a company's responses to questions in the CDS Online Response System. The score ranges from 0 to 100, representing the quality level of a firm's responses to an annual questionnaire issued by the CDP, an independent, not-for-profit organisation. The CDP works with institutional shareholders and corporations to run the global environmental disclosure system for business and disclose GHG emissions of thousands of major companies worldwide (e.g. S&P500 and FTSE350). The CDP "is working to reduce the risks associated with transparency by facilitating dialogue and information-sharing between companies" (Wilhelm, 2013, p. 159). It, therefore, demonstrates a strategic

competence that appeals to multiple stakeholders and builds broad legitimacy for carbon disclosure standards (Knox-Hayes and Levy, 2011).

The questionnaire assesses the information that companies disclose on CDS in terms of three broad topics: (1) climate change management: governance, strategy, targets and initiatives, and communications; (2) climate change-related risks and opportunities; and (3) climate change emissions methodology, emissions data, energy, emissions performance, and emissions trading.

It is worth mentioning, within the third category, which presents 48% of the CDS, the emissions performance (changes in carbon emissions volume) is one out of five topics in this category. Furthermore, the inclusion of emissions volume is critical. Similar to financial disclosure, firms should be aware of the likelihood of revealing negative as well as positive information on their emissions volume. Nevertheless, it is worthnoting, this component in the third category reflects the quality of the responses in terms of emissions volume reliability, honesty and fairness, regardless of carbon emissions volume emitted by firms. Specifically, increasing or decreasing of carbon emissions volume is not the standard but the quality of the information provided regarding this factor. Particularly, a disclosure of a high volume of carbon emissions does not necessarily reduce the CDS score. Therefore, there is no issue of compounding effects of carbon disclosure and emissions performance in this disclosure index.

Company responses to the CDP questionnaire, made publicly available on the CDP website, could have implications on investors' investment decisions (Kim and Lyon, 2011). According to Tang and Luo (2011), "a firm's reputation could be adversely affected if the firm refuses to participate in CDP, or participated but, disclosed poor carbon information" (p. 26).

The choice of the CDS measure of carbon disclosure is justified by the high number of organisations that voluntarily respond to the information request and by its popularity in previous studies of the determinants of disseminating relevant information on GHG (e.g. Prado-Lorenzo and Garcia-Sanchez, 2010; Luo *et al.,* 2012) and whether voluntary carbon disclosure reflects firms' true carbon performance (Luo and Tang, 2014).16 In a global economy, improving transparency and comparability of carbon information is regarded as imperative for information usefulness (Andrew and Cortese, 2011), which is perceived as integral to carbon markets and corporate carbon management (Knox-Hayes and Levy, 2011). Many companies provide their full CDP responses as a surrogate for disclosing climate

[16] The average number and percentage of FTSE350 companies participated in the CDS index over the sample period was 243.56 companies (69.59%).

change information in the annual or sustainability reports (Cotter and Najah, 2012) or in a form intended to complement annual reports and provide information relevant to investors relating to the financial risks that companies might experience due to their GHG emissions and opportunities from climate change (Kolk *et al.,* 2008; Kim and Lyon, 2011). Appendix 2.2 presents a summary of the questionnaire questions about the construct and their measurement items.

2.3.2.3 Controls

To control for the firm characteristics that may drive the examined relationship, we follow prior studies (see, for example, Toms, 2002; Freedman and Jaggi, 2005; Clarkson *et al.,* 2008; Dhaliwal *et al.,* 2011; Luo *et al.,* 2012) and include in our analysis firm size (SIZE), measured by the natural log of total assets, financial leverage (LEV), measured by the ratio of total debt to total capital and systematic risk measured by beta (BET) as control variables. Board size (BRS), measured by the natural log of total number of directors, and the percentage of non-executive directors on the board (NED) are included to control for the role, effectiveness, and independence of the board (Hermalin and Weisbach, 1991; Brickley *et al.,* 1994; Yermack, 1996; Dalton *et al.,* 1998; Chen and Jaggi, 2001; Balatbat *et al.,* 2004; Cornett *et al.,* 2007; Payne *et al.,* 2009; Brown *et al.,* 2011). In line with prior studies, we also include the percentage of shares held by executive directors to the total number of shares (MAN) and the total percentage of shares owned by substantial shareholders (5 per cent or more) (SUB) to control for ownership structure effects (Jensen and Meckling, 1976). Also, working in foreign markets requires firms to consider cross-national variances and comply with rules and regulations controlling trade between different countries. Given exposure to such hurdles, businesses are expected to be more socially responsible (Branco and Rodrigues, 2008). According to Stanny and Ely (2008), European companies with higher proportions of international trading are more strongly expected to disclose their carbon emissions. Therefore, consistent with Jackson and Apostolakou (2010), we control for the effects of foreign market activities (FMA) based on the ratio of foreign assets to total assets. This measure proxies for the degree of internationalisation of a firm that might influence the examined relationship. Further, the competitive business environment motivates firms to outperform the competitors by creating competitive advantage (Kamasak, 2013). We therefore control for the effects of product market competition (COM), measured by the number of competitors in the same industry in a given year (Bagnoli and Watts, 2003; Fernández-Kranz and Santaló, 2010). As

our sample firms are required to comply with the GHG reporting regulation (which came into force on 1 October 2013) and report on their GHG emissions as part of their annual Directors' Report based on the Companies Act 2006 'Amendment of Part 7' Regulations 2013 (Secretary of State, 2013), we include a dummy variable (REG) equal to one for years 2014-2015 and zero otherwise. Certain industries have high carbon emissions profiles and are therefore more heavily scrutinised by the public, media, and governmental regulations and legislation. Consequently, we include a dummy variable (IND) equal to one if a firm is part of a carbon-intensive industry and zero otherwise. In doing so, we divide the sample into ten subsamples by the industry's structure and definitions employed by the GICS. The standards of the FTSE All-Share Index are then applied to identify carbon-intensive industries within the sample, these being basic materials, utilities, industrials, oil and gas, and consumer services. Finally, we include yearly dummy variables to control for the possible influence of fluctuations in market trends that may affect firms' FP (Hui, 2005; Deng *et al.,* 2013; Al-Awadhi and Dempsey, 2017).

2.3.2.4 Model Tested

To test $\mathbf{H_1}$, our main empirical model is set out below:

$$\begin{aligned} FPI_{it} = {} & \beta_0 + \beta_1\, CDS_{it} + \beta_2\, SIZE_{it} + \beta_3\, LEV_{it} + \beta_4\, BET_{it} + \beta_5\, BRS_{it} + \beta_6\, NED_{it} + \\ & \beta_7\, MAN_{it} + \beta_8\, SUB_{it} + \beta_9\, FMA_{it} + \beta_{10}\, COM_{it} + \beta_{11}\, REG_{it} + \beta_{12}\, IND_{it} + \\ & \beta_{13}\, YEAR_{it} + \varepsilon_{it} \end{aligned} \quad (1)$$

where FPI is the financial performance index; CDS, Carbon Disclosure Score; SIZE, the natural log of total assets; LEV, the total debt to total capital ratio; BET, the systematic risk estimated by regressing the daily stock return on the daily market return over 12 months; BRS, the natural log of the number of board members; NED, the percentage of non-executive directors on the board; MAN, the percentage of shares held by executive directors to total number of shares; SUB, the total percentage of shares held by substantial shareholders (5 per cent or more); FMA, the ratio of foreign assets to total assets; COM, the number of competitors in the same industry; REG, a dummy variable takes the value of 1 for years 2014-2015 and 0 otherwise; IND, a dummy variable takes the value of 1 for a carbon-intensive industry and 0 otherwise; and YEAR, dummy variables.

2.4 Results and Analysis

2.4.1 Descriptive Statistics

Descriptive statistics are shown in Tables 2.2-2.4. In Table 2.2, the mean and distributional characteristics are reported for each variable. The response rate for our sample to the CDS information request is approximately 77% (752 out of 977). The mean value for CDS is 71.16, which is relatively high compared with prior studies that employed CDS as a dependent variable. Prado-Lorenzo and Garcia-Sanchez (2010), who examine the role of the board of directors in disseminating information related to GHG emissions, report 60% as the mean value for CDS based on CDS 2007 annual survey. Also, Luo and Tang (2014), who investigate whether the voluntary carbon disclosure reveals the actual carbon performance, report 65% as the mean value for CDS based on CDS 2010 annual survey. The differences in CDS mean values between our study and prior studies can be explained by the short period examined in those studies (only one year) and the time variation of the public pressure to disclose information related to climate change. The mean value for FPI is 4.9, with a minimum value of 0 and a maximum value of 10. The unreported average firm SIZE is £10.9 billion, which suggests that our sample comprises large firms. The mean and median values of SIZE, measured by the logarithm of total assets, are approximately 22, similar to the Clarkson et al. (2008) sample. The maximum value of SUB exceeds 100%. According to Asquith et al. (2005), this could happen when shares are owned by more than one party at the same time (the original lender plus the purchaser on the other side of the short sale).

Variable	N	Mean	Median	SD	Min	Max
FPI	977	4.9	5	2.1	0	10
CDS	752	71.16	73	20.41	4	100
SIZE	977	21.76	21.61	1.49	17.69	26.13
LEV	977	24.29	22.91	13.55	1.55	55.34
BET	977	0.87	0.82	0.34	0.05	2.69
BRS	966	9.31	9	2.42	4	20
NED	965	58.77	60	12.95	0	92.86
MAN	975	2.27	0.24	7.65	0	45.1
SUB	977	97.13	98.2	22.52	24.11	161.6
FMA	975	36.90	35.68	28.16	0	95.01
COM	977	23.90	28	12.67	1	40

Table 2.2 Descriptive Statistics of Chapter Variables
This descriptive statistics is based on our sample from 2007 to 2015.

Table 2.3 reports mean values of study variables by industry. Regarding the CDS mean, we find that utilities and basic materials outperform telecommunications, technology, and health care in terms of engaging in innovation to reduce their carbon footprint. Although voluntary environmental disclosures tend to be high for companies working in environmentally sensitive industries (Patten, 1991; Roberts, 1992; Hackston and Milne, 1996; Hasseldine *et al.,* 2005), the oil and gas industry was the sixth best sector behind health care and consumer services. According to KPMG Survey of Corporate Responsibility Reporting in Oil and Gas sector (2015), "The Oil and Gas sector has one of the highest rates of carbon reporting at 90 per cent. However, the quality of reporting is the lowest of all sectors at just 35 out of 100. The global average quality score is 51 out of 100. Less than one-third of large oil and gas companies (29 per cent) set targets to reduce carbon emissions" (p. 4). In general, and based on FTSE All-Share Index classification, this study indicates that the CDS mean for firms in carbon-intensive industries surmounts that for firms within low carbon industries (75.8 > 65.8).

Variable	N	FPI	CDS	SIZE	LEV	BET	BRS	NED	MAN	SUB	FMA	COM
Basic Materials	76	5.45	73.24	22.35	22.07	1.38	9.51	62.25	3.68	91.32	61.24	8.97
Consumer Goods	133	4.81	76.38	21.86	19.81	0.8	8.86	58.39	3.33	93.12	24.16	16.22
Consumer Services	280	4.60	72.52	21.66	28.71	0.79	9.6	57.48	3.1	96.82	26.59	31.93
Health Care	60	5.18	73.05	21.8	23.07	0.62	9.72	65.84	1.65	82.86	58.23	6.83
Industrials	306	4.82	66.22	21.2	21.81	0.91	8.65	57.11	1.4	101.66	41.50	34.62
Oil and Gas	46	5.54	70.95	23.5	13.91	1.05	12	61.96	1.37	98.89	64.65	5.74
Technology	17	4.24	58.53	20.92	19.7	0.84	8.18	64.78	0.25	102.75	52.94	2.06
Telecommunications	13	4.62	55.25	22.73	42.01	0.78	10.31	69.66	2.72	90.62	25.68	1.77
Utilities	46	5.04	81.13	23.1	39.11	0.61	9.98	54.99	0.1	106.8	7.41	5.30

Table 2.3 Mean Values of Chapter Variables
This table reports the variable mean values by industry from 2007 to 2015 for our sample.

Table 2.4 reports the Spearman (Pearson) correlations reported in the upper (lower) diagonal.[17] The correlation between CDS and other right-hand variables (e.g. SIZE and REG) is consistent with prior literature. As Cormier and Magnan (1999) conclude, "irrespective of their information costs and financial condition attributes, large firms disclose more environmental information than small firms" (p. 444). The significant positive correlation between CDS and REG indicates that the UK environmental reporting guidelines, including

[17] Unreported variance inflation factors (VIFs) are within levels of tolerance for multicollinearity.

mandatory GHG emissions reports requirements, motivate firms to be more accountable and transparent about their carbon profile. Consistent with RBV expectations, the significant positive correlation between FPI and CDS provides some primary findings suggesting that carbon disclosure tends to positively affect FP.

Variables	FPI	CDS	SIZE	LEV	BET	BRS	NED	MAN	SUB	FMA	COM	REG	IND
FPI	1	0.071*	-0.088**	-0.184***	-0.218***	0.113***	0.007	-0.124***	-0.058	0.055	-0.151***	-0.037	-0.022
CDS	0.076**	1	0.326***	0.011	-0.087**	0.202***	0.298***	-0.209***	-0.248***	-0.132***	0.032	0.462***	-0.053
SIZE	-0.090***	0.311**	1	0.141***	0.043	0.606***	0.323***	-0.567***	-0.256***	0.098***	-0.252***	-0.042	-0.014
LEV	-0.209***	-0.001	0.136***	1	-0.216***	0.076**	-0.058	-0.056	-0.036	-0.010	-0.041	-0.096***	0.129***
BET	-0.213***	-0.084**	0.171***	-0.157***	1	-0.023	0.111***	-0.007	0.027	0.199***	0.081**	-0.004	0.167***
BRS	0.081**	0.188***	0.643***	0.092***	0.060*	1	0.124***	-0.346***	-0.283***	0.173***	-0.105***	.001	0.067*
NED	-0.045	0.298***	0.403***	-0.044	0.151***	0.164***	1	-0.212***	-0.222***	0.127***	-0.011	0.198	-0.116***
MAN	-0.084***	0.052	-0.189***	-0.028	0.052	-0.174***	-0.103***	1	0.118***	-0.112***	0.194***	0.092**	-0.061*
SUB	-0.013	-0.236***	-0.235***	0.049	-0.005	-0.243***	-0.169***	-0.303***	1	0.007	0.065*	-0.082**	0.126***
FMA	0.009	-0.136***	0.125***	-0.091***	0.246***	0.164***	0.116***	-0.100***	-0.018	1	-0.037	-0.073**	0.086**
COM	-0.135***	-0.006	-0.294***	-0.029	-0.042	-0.145***	-0.094***	0.012	0.087***	-0.155***	1	0.215***	0.483***
REG	-0.072**	0.397***	-0.030	-0.048	-0.097***	-0.010	0.185***	0.027	-0.064**	-0.104***	0.191***	1	-0.035
IND	0.001	-0.046***	-0.022	0.093***	0.189***	-0.043	-0.118***	-0.024	0.150***	0.025	0.521***	-0.034	1

Table 2.4 Spearman (Pearson) Correlation Analysis of Chapter Variables

*This table reports the pairwise coefficients for our sample from 2007 to 2015 of 977 firm-year observations. The upper (lower) triangle reports the Spearman (Pearson) correlations. *, ** and *** denote significance at the 10%, 5% and 1% respectively.*

2.4.2 Empirical Tests

2.4.2.1 Carbon Disclosure and Firm Performance

We employ alternative empirical assessments using several estimations to examine the impact of carbon disclosure on FP. Beside using Ordinary Least Squares (OLS) regression procedures (Column 1) as reported in Table 2.5, we employ a TOBIT formulation for our second regression (Column 2) to account for the censored nature of the dependent variable (FPI) (e.g. Clarkson *et al.,* 2008; Luo and Tang, 2014). We also re-estimate our model using the Random-Effects Generalised Least Squares (GLS) (Column 3), based on Hausman test results, to control for heteroscedasticity (Kennedy, 2003).18 Finally, we use the instrumental variable two- stage least squares (IV- 2SLS) estimator in Column four (applying firm age and CDS Lag: 1 year) to examine the endogenous relation of carbon disclosure and FPI (Larcker and Rusticus, 2010, Jo and Harjoto, 2011, 2012). Endogeneity, arising from omitted variables, measurement error, interdependence between variables or correlated unobserved effects, is an issue we cannot ignore (e.g. Semykina and Wooldridge, 2010). Furthermore, it is often challenging to ascertain the existence of reverse causality between dependent and independent variables, i.e. CDS drives FPI or otherwise (Wintoki *et al.,* 2012). To address these endogeneity concerns, the study employed the IV-2SLS model, which requires the use of instrumental variables which are both exogenous and relevant. This requires the selection of an instrument for correlating with the endogenous variable (i.e. CDS) but not with the dependent variable (i.e. FPI) (Schreck, 2011). In line with Harjoto and Jo (2011; 2012), we select the Firm Age as a first instrumental variable. This selection is based on the assumption that mature firms are likely to be in a stronger position to participate in carbon disclosure projects but also that improved firm performance from such participation is not automatic (Harjoto and Jo 2011; 2012). In line with Schreck (2011) and Surroca et al. (2010), we use a one-year time lag of CDS as the second instrumental variable. Both instrumental relevance and exogeneity criteria are satisfied by using the lagged term of CDS. Prior period CDS can be viewed as one of a firm's criteria for judging its current carbon disclosure and its current developing (declining) level.19

[18] The Hausman test reports 0.460 and confirms the presence of no systematic differences between the fixed and random effects (Prob > 0.05).

[19] In order to confirm the absence of residual endogeneity, we run the Durbin Wu-Hausman test which reports a *P*-value of 0.483. The IV-2SLS estimation uses a reduced sample because instruments (lagged values) are only available for 651 observations.

Results reported in Table 2.5 provide strong evidence for the positive impact of carbon disclosure on FP. CDS has a highly significant and positive association with FPI, consistently across all estimation methods. This result implies that firms continuously engaged with voluntary carbon disclosure on their carbon practices can attain the high FP and achieve a long-term competitive advantage in the marketplace. This finding confirms our main hypothesis (H1) and indicates that "it pays to be green" (e.g. Hart and Ahuja, 1996) which is generally supported by the RBV (Hart, 1995; Russo and Fouts, 1997). Indeed, investing in a proactive carbon strategy, and voluntarily disclosing information that supports successful carbon management, leads to developing company-specific competencies aligned with enhanced transparency and accountability and the creation of further market opportunities.

With regards to the control variables, SIZE reports a significant and negative association with FPI, contrary to our expectations. However, this finding is in line with prior research on RBV (e.g. Surroca *et al.,* 2010; Gallego-Álvarez *et al.,* 2015), highlighting the importance of recognising the mediating effect of intangible assets in determining FP (e.g. Penrose, 1959; Barney, 1991; Teece *et al.*, 1997). We reflect on this argument within the theoretical framework proposed in Section 2.2 (Figure 2.1), suggesting the possible creation of a new intangible resource, acquired through improved carbon management and subsequent voluntary disclosures. This resource takes the form of a reputational asset that offers a competitive advantage and hence, improves FP. Because intangible assets are assumed to have a mediating effect on the association between environmental responsibility and FP, and the FP is negatively related to tangible assets (e.g. Surroca *et al.,* 2010), the negative association between SIZE and FP seems to be driven by the tangible rather than intangible assets. We also find that the coefficient on LEV is highly significant and negative, in line with previous studies (e.g. Simerly and Li, 2000; Elsayed and Paton, 2005). This finding can be attributable to the high cost of loans determined by debtors who interpreted the firms' need for debt as an indication of a liquidity issue, in a manner which affects the FP negatively. Consistent with prior studies (e.g. Busch and Hoffmann, 2011), the coefficient on BET is highly significant and negative, suggesting that high-risk firms could encounter financial difficulties. Moreover, BRS reports a significant and positive association with FPI (Dalton *et al.,* 1998), which is consistent with the resource dependence theory (Hillman and Dalziel, 2003; Payne *et al.,* 2009). The coefficient on NED is positive and significant (except in GLS where the coefficient is positive and insignificant). A high percentage of non-executive

directors on the board is regarded as possibly having positive effects on firm FP (Brickley *et al.,* 1994; Shleifer and Vishny, 1997; Cornett *et al.,* 2007). MAN has a negative and significant association with FP. This result is supported by Short and Keasey (1999) who suggest that at certain ownership levels, managers consider it beneficial to enjoy perquisites (e.g. bonuses), particularly at times of falling share prices, and they do so with little fear of sanction from other shareholders. The association between SUB and FPI is negative and significant in OLS and IV-2SLS analyses, similar to the finding of Faccio and Lasfer (2000). This result implies that institutional holders tend to be short-term investors who act as "brokers", holding or selling the shares according to their portfolio and reallocating requirements in a way that affects FP negatively, as opposed to institutional investors that own shares with a long-term policy (Elyasiani and Jia, 2010). COM is negatively and significantly associated with FP, which is in line with Giroud and Mueller (2011) stating that a rise in product substitutability leads to reduced revenues for any assumed number of firms. REG coefficient is also negative and significant (except in GLS where the coefficient is negative and insignificant). This can be explained by the costs arising from compliance with environmental regulations which may be significantly detrimental to maximising shareholder wealth (Filbeck and Gorman, 2004). Moreover, IND reports a positive and significant association. Hart and Ahuja (1996) suggest that firms with intensive emissions can enhance their productivity and competence by reducing their industrial waste. This might lead to better employment of inputs, causing a reduction in raw materials and/or waste disposal expenses. FMA shows an insignificant relationship.

	OLS (1)	TOBIT (2)	GLS (RE) (3)	IV-2SLS (4)
CDS	0.018***	0.018***	0.013***	0.027***
	(0.004)	(0.004)	(0.004)	(0.008)
SIZE	-0.546***	-0.549***	-0.408***	-0.596***
	(0.074)	(0.071)	(0.107)	(0.089)
LEV	-0.040***	-0.041***	-0.044***	-0.040***
	(0.005)	(0.005)	(0.007)	(0.005)
BET	-1.671***	-1.682***	-1.086***	-1.683***
	(0.219)	(0.223)	(0.234)	(0.242)
BRS	1.727***	1.732***	0.766**	1.508***
	(0.339)	(0.359)	(0.383)	(0.366)
NED	0.014**	0.014**	0.003	0.014**
	(0.006)	(0.006)	(0.006)	(0.006)
MAN	-0.039***	-0.040***	-0.037**	-0.042***
	(0.008)	(0.010)	(0.018)	(0.009)
SUB	-0.006*	-0.002	-0.005	-0.007**
	(0.003)	(0.003)	(0.006)	(0.004)
FMA	0.002	0.002	0.002	0.004
	(0.003)	(0.003)	(0.003)	(0.003)
COM	-0.051***	-0.052***	-0.54***	-0.051***
	(0.007)	(0.007)	(0.011)	(0.007)
REG	-0.844**	-0.844**	-0.386	-1.045***
	(0.327)	(0.394)	(0.325)	(0.399)
IND	0.983***	0.997***	1.239***	0919***
	(0.209)	(0.192)	(0.347)	(0.216)
YEAR Effects	Yes	Yes	Yes	Yes
Constant	14.524***	14.600***	13.821***	15.717***
	(1.325)	(1.380)	(2.313)	(1.439)
Log- Likelihood		-1484.997		
Hausman test			0.460	
Durbin Wu-Hausman				0. 483
R^2/ Pseudo R^2	0.25	0.07	0.22	0.24
N	747	747	747	651

Table 2.5 The Impact of Carbon Disclosure on Financial Performance

*This table reports the results of four estimation methods: (1) OLS (2) TOBIT (3) Random-GLS (4) IV-2SLS. Heteroscedasticity-robust standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% respectively. (two-tailed test).*

Overall findings support our expectations and hypothesis, which suggest that implementing proactive carbon management strategies is likely to enhance FP. This path establishes the discharging of accountability through voluntary quality disclosure. The proactive strategies involve a set of plans, actions, and verifications all aimed at improving carbon disclosure. Significant changes in business operations are likely during this process which also involves target-setting elements and the alignment of carbon strategy with overall business strategy. Thus, prepared for voluntary disclosure (through CDP), the firm will subsequently be able to avail itself of the benefits driven by improved carbon disclosure. Therefore, in line with the RBV conceptual framework, carbon disclosure, which complements the capability resource to manage carbon effectively, and transmits accurate information about actual performance to a wide range of stakeholders, is an essential competitive resource that addresses climate change risks and opportunities and helps improve organisational reliability and legitimacy, which will eventually enhance the FP.

2.4.2.2 Additional Analyses

Considering the sample period of this study that includes the period of the GFC (2007-2008), we perform an additional analysis to capture the potential effect of the GFC on the examined relationship.[20] We split our sample into two sub-periods: 2007-2008 (financial crisis period) and 2009-2015 (recovery period). Table 2.6 shows that the relationship of CDS-FPI is insignificant during the GFC period, while it is highly significant during the recovery period. This finding emphasises that firms ought to adapt to times of GFC and reduce investment in carbon mitigation projects (e.g. Cheney and McMillan, 1990; Njoroge, 2009). However, after the crisis, corporate social and environmental responsibility tend to become more important in the public interest. As KPMG states: "Before the financial crisis, investors typically saw environmental due diligence as a risk management tick-box exercise to secure financial institution funding. However, post-this exogenous shock, there appears to be a greater focus on responsible investment. We are seeing an increased appetite for the potential upsides (e.g. cost savings, additional revenue streams) of the sustainability agenda, in a transactional context. Strategies to manage energy (buy better, use less

[20] Consistent with Erkens *et al.,* 2012, we specify the years of 2007-2008 as the GFC period.

and self-generate) and waste (convert waste to an asset) are transforming the environmental due diligence process" (KPMG, 2017).

Accordingly, findings suggest that the value of a firm was less dependent on intangible assets within the GFC period and that today's businesses are looking for confidence in the financial market to improve their reputations in competitive markets (Raithel *et al.,* 2010). Our finding, however, contradicts that of Gallego-Álvarez *et al.* (2014), who examine the impact of the crisis on the environmental performance of large international companies for the period 2006 to 2009. They find that in times of GFC, companies continue to invest in sustainable projects to enhance relations with their stakeholders that might result in higher economic profits. However, as they conclude, a limitation of their study is the period employed; future studies should examine longer time periods to enable analysis of the behaviour of firms during and after the period of GFC. Our study accounts for this possibility by comparing the GFC period and recovery period in examining the relationship between carbon disclsoure and FP.

	Financial Crisis Period (2007-2008)		Recovery Period (2009-2015)	
	OLS	**TOBIT**	**OLS**	**TOBIT**
CDS	0.013 (0.010)	0.013 (0.011)	0.019*** (0.004)	0.019*** (0.004)
SIZE	-0.450* (0.233)	-0.450* (0.233)	-0.552*** (0.078)	-0.556*** (0.075)
LEV	-0.060*** (0.011)	-0.060*** (0.012)	-0.037*** (0.005)	-0.037*** (0.006)
BET	-2.383*** (0.717)	-2.383 *** (0.790)	-1.603*** (0.230)	-1.615*** (0.236)
BRS	1.759* (0.981)	1.760* (1.058)	1.762*** (0.365)	1.766*** (0.383)
NED	0.032* (0.019)	0.032* (0.0187)	0.011** (0.006)	0.011* (0.006)
MAN	-0.029 (0.021)	-0.029 (0.027)	-0.040*** (0.010)	-0.040*** (0.011)
SUB	-0.010 (0.010)	-0.010 (0.010)	-0.005 (0.004)	-0.005 (0.004)
FMA	-0.004 (0.008)	-0.004 (0.007)	0.003 (0.003)	0.002 (0.003)
COM	-0.028 (0.026)	-0.028 (0.023)	-0.053*** (0.007)	-0.054*** (0.007)
REG			-1.029** (0.329)	-1.030*** (0.324)
IND	1.145* (0.591)	1.145** (0.532)	0.942*** (0.226)	0.958*** (0.206)
Constant	12.766*** (3.862)	12.766*** (4.132)	14.685*** (1.459)	14.765*** (1.487)
Log- Likelihood		-193.557		-1286.931
R^2/ Pseudo R^2	0.30	0.09	0.25	0.07
N	101	101	646	646

Table 2.6 The Impact of the Financial Crisis on the Relationship Examined

*OLS and TOBIT were applied. Heteroscedasticity-robust standard errors are in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively (two-tailed test).*

We perform an additional test to further examine the effect of carbon disclosure across the different set of continuous measures (i.e. accounting, market, combined accounting and market-based measures) and to check the robustness of our main findings. We re-assess the associations between carbon disclosure and each of the individual proxies for our FPI, as shown in Table 2.7 Across four out of five accounting measures, results report significant associations with carbon disclosure (i.e. ROA, ROE and AT in the expected direction and D/E in the inverse direction).[21] Among the three market measures, we only find a significant association between carbon disclosure and RV in the expected direction (i.e. negative). For the two combined measures, Z-score and P/B have a significant relationship in the expected direction (i.e. positive). Overall, the results indicate that the carbon disclosure quality is less related to market-based measures than other indicators.

Taken together, this finding suggests that accounting measures are more likely to be correlated with CDS than market measures. This finding is in line with Orlitzky *et al.* (2003), who state that the relationship of CSR-FP is robust when employing the accounting measures. Accounting measures reflect a firm's profitability, as a determinant of operating efficiency, and hence place more emphasis on the internal resource utilisation strategies than the market-based measures of performance. This interpretation is consistent with the RBV theory which explains performance variations among competing firms (Galbreath and Galvin, 2008) based on each firm's ability to exploit its internal resources (Barney, 1991). Beliveau *et al.* (1994) show that the different financial responses to CSR are based on the measures employed, with the accounting measures capturing the historical aspect and the market measures capturing the future aspect. This argument confirms the need to use a constructed index that captures several financial dimensions, particularly when considering the debate about the proper measure of a firm's FP (e.g., Cochran and Wood, 1984). The use of market measures along with accounting measures compensates for any potential measurement deficiency (Balabanis *et al.,* 1998).

[21] The expected direction for ROA, ROE and AT is positive, and the expected directions for D/E is negative.

DV	ROA	ROE	AT	D/E	IC	RV	COE	P/E	Z	P/B
Model	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS	OLS
CDS	0.026***	0.180***	0.004***	0.505***	0.006	-0.039**	0.000	-0.033	0.008***	0.030***
	(0.009)	(0.038)	(0.001)	(0.143)	(0.073)	(0.015)	(0.003)	(0.032)	(0.003)	(0.007)
SIZE	-1.453***	-6.300***	-0.050***	-13.674***	-5.435***	-1.889***	-0.151***	1.215**	-0.704***	-1.121***
	(0.178)	(0.756)	(0.017)	(2.452)	(1.270)	(0.213)	(0.057)	(0.577)	(0.052)	(0.136)
LEV	-0.067***	0.271***	-0.009***	6.176***	-0.604***	0.018	0.001	0.049	-0.052***	0.067***
	(0.011)	(0.058)	(0.001)	(0.234)	(0.077)	(0.014)	(0.004)	(0.038)	(0.003)	(0.010)
BET	-1.787***	-8.300***	-0.190***	-20.241***	7.291*	18.909***	4.671***	4.738**	-0.371**	-0.583**
	(0.533)	(2.001)	(0.048)	(6.946)	(3.822)	(0.890)	(0.226)	(2.177)	(0.160)	(0.281)
BRS	5.003***	23.892***	-0.193**	39.540***	10.785*	-0.983	0.017	3.714	1.348***	2.616***
	(0.812)	(3.913)	(0.081)	(13.822)	(6.257)	(1.161)	(0.297)	(3.369)	(0.260)	(0.687)
NED	0.053***	0.200***	0.002	0.165	-0.008	-0.051***	0.001	0.050	0.007	0.036***
	(0.015)	(0.056)	(0.001)	(0.211)	(0.101)	(0.018)	(0.005)	(0.044)	(0.005)	(0.010)
MAN	-0.038	-0.110	0.000	0.061	-0.181	0.146***	-0.003	0.093	-0.035***	-0.023
	(0.023)	(0.112)	(0.002)	(0.505)	(0.175)	(0.034)	(0.008)	(0.087)	(0.006)	(0.021)
SUBO	-0.001	-0.018	0.000	-0.107	0.003	-0.005	-0.004	0.082***	-0.003*	-0.020***
	(0.008)	(0.031)	(0.001)	(0.108)	(0.056)	(0.012)	(0.003)	(0.031)	(0.002)	(0.006)
FAR	-0.004	-0.063**	-0.002***	-0.370***	0.041	0.007	0.001	0.038*	0.009***	-0.004
	(0.006)	(0.026)	(0.001)	(0.111)	(0.044)	(0.008)	(0.002)	(0.023)	(0.002)	(0.004)
COM	-0.013	0.005	0.006***	-0.193	0.058	-0.035***	0.008**	-0.075**	-0.006**	0.004
	(0.010)	(0.035)	(0.001)	(0.125)	(0.060)	(0.013)	(0.003)	(0.037)	(0.002)	(0.005)
REG	-3.063***	-16.843***	-0.277***	-17.675	12.879***	3.181***	0.102	7.038***	0.137	-0.609
	(0.939)	(4.367)	(0.094)	(14.283)	(4.615)	(1.024)	(0.231)	(2.289)	(0.257)	(0.844)
IND	-0.008	0.763	0.092**	14.831**	-7.760**	0.216*	-0.107	-0.476**	-0.554***	-0.619**
	(0.466)	(1.829)	(0.042)	(6.480)	(3.924)	(0.605)	(0.154)	(1.677)	(0.136)	(0.290)
YEAR	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	28.271***	95.771***	2.364***	159.660***	127.070**	61.743***	9.412***	25.647**	17.294**	19.939***
	(3.677)	(13.292)	(0.281)	(47.308)	(22.840)	(4.387)	(1.116)	(10.184)	(0.936)	(2.670)
R^2	0.15	0.15	0.21	0.57	0.13	0.72	0.59	0.06	0.40	0.16
N	1,196	1,141	1,195	1,162	1,197	1,197	1,064	1,107	1,184	1,058

Table 2.7 The Impact of Carbon Disclosure on Variables of FPI

*This table reports the results of regressions for each variable of FPI as a continuous variable. where ROA is return on assets, ROE is return on equity, AT is asset turnover, D/E is debt to equity ratio, IC is interest coverage ratio, RV is stock return volatility, COE is cost of equity, P/E is price earnings ratio, Z is Altman z-score, and P/B is market to book ratio. The measurements of these variables as presented in Appendix 2.1. OLS was applied. Heteroscedasticity-robust standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% respectively. (two-tailed test).*

We further extend our analyses to cluster the full sample into two groups based on the mean value of FPI to examine whether there are structural differences for CDS across firms reporting high FPI and low FPI. Firms which grouped as having a low FPI report no significant evidence for this association. In Table 2.8 (Panel A), results confirm our main findings and show that firms with proactive carbon strategies promote better firm FP. This suggests additional benefits to stakeholders and might enhance investors' confidence that these firms tend to achieve maximum possible operational efficiency and are more likely to have superior FP (Porter and Van der Linde, 1995).

Furthermore, consistent with our main findings, firms within carbon-intensive industries tend to have better FP. Extending our further interest on this classification of firms operating in carbon-intensive industries, we perform an additional test which aims to provide the moderating effect of firms in carbon-intensive industries on the positive association between disclosure and FP. In this analysis, an interactive term between industry and carbon disclosure (IND*CDS) is constructed and is controlled for in Equation (1) using OLS estimation method.

Results in Table 2.8 (Panel B) show that the coefficient on CDS is consistently positive and highly significant, indicating that carbon disclosure promotes high firm performance. Conditional on the industry type (i.e. carbon-intensive vs non-carbon-intensive industries), we find the interaction term IND*CDS shows a negative and highly significant coefficient. This suggests that firms operating within the carbon-intensive industries and reporting on the carbon practices show significantly lower firm performance. The sum of the CDS and IND*CDS coefficients is positive and significant, which confirms that the positive association between CDS and FP is significantly lowered for this particular category of firms. In other words, firms operating in carbon-intensive industries are not benefiting from disclosing on their carbon profile when compared to other firms that work in non-carbon-intensive industries. This finding can be explained by the negative financial consequences resulting from the environment-related cost, which are more pronounced for firms in carbon-intensive industries (Ramiah *et al.,* 2013).

	Panel A				Panel B
	High FPI		Low FPI		Interaction
	OLS	TOBIT	OLS	TOBIT	OLS
CDS	0.011***	0.012***	-0.004	-0.004	0.045***
	(0.004)	(0.004)	(0.003)	(0.003)	(0.007)
SIZE	-0.455***	-0.460***	0.120*	0.121*	-0.571***
	(0.068)	(0.067)	(0.065)	(0.063)	(0.0723)
LEV	-0.020***	-0.020***	-0.015***	-0.015***	-0.041***
	(0.005)	(0.005)	(0.004)	(0.004)	(0.005)
BET	-0.518**	-0.527**	-0.786***	-0.788***	-1.764***
	(0.210)	(0.234)	(0.166)	(0.167)	(0.214)
BRS	0.964***	0.971***	0.403	0.402	1.746***
	(0.334)	(0.352)	(0.279)	(0.276)	(0.338)
NED	0.015***	0.015**	0.004	0.004	0.015***
	(0.005)	(0.006)	(0.005)	(0.004)	(0.005)
MAN	-0.033***	-0.033***	-0.001	-0.001	-0.040***
	(0.008)	(0.011)	(0.007)	(0.006)	(0.008)
SUBO	0.002	0.002	0.001	0.001	-0.005
	(0.004)	(0.003)	(0.002)	(0.002)	(0.003)
FMA	-0.002	-0.002	-0.001	-0.001	0.002
	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)
COM	-0.036***	-0.036***	-0.001	-0.001	-0.056***
	(0.007)	(0.006)	(0.006)	(0.006)	(0.007)
REG	-0.021	-0.025	-0.917***	-0.917***	-0.853***
	(0.318)	(0.368)	(0.231)	(0.294)	(0.321)
IND	0.368**	0.380**	0.266	0.267	3.578***
	(0.186)	(0.172)	(0.187)	(0.1177)	(0.614)
IND*CDS					-0.035***
					(0.008)
YEAR Effects	Yes	Yes	Yes	Yes	Yes
Constant	13.508***	13.603***	1.158	1.136	13.139
	(1.291)	(1.222)	(1.215)	(1.216)	(1.326)
Log- Likelihood		-656.681		-433.8144	
CDS+IND*CDS					0.010**
					(0.004)
R^2/ Pseudo R^2	0.19	0.06	0.16	0.06	0.27
N	411	411	336	336	747

Table 2.8 The Impact of Carbon Disclosure on Sub-sample of FPI and the Industry Effect

*Panel A reports the results for clustering our sample into higher (lower) than the mean value (4.9) of FPI. Panel B reports the moderating effect of industry on the impact of carbon disclosure on FP. OLS and TOBIT were applied. Heteroscedasticity-robust standard errors are in parentheses. *, ** and *** denote significance at the 10%, 5% and 1% respectively. (two-tailed test).*

2.5 Conclusion

Motivated by the growing public concern about climate change and green finance, this study empirically assesses the economic consequences of carbon disclosure. We use the RBV as a conceptual foundation for analysis within carbon accountability research to understand companies' responsibility practices towards their constituents in the UK, one of the leading countries in Europe, that is rigorously developing regulations in carbon emissions. The current literature seems to be lacking such investigation, particularly within this specific setting.

The RBV is arguably one of the dominant strategic paradigms that can significantly advance our understanding of carbon management practices. It explicitly looks for the intangible assets or internal resources and dynamic capabilities of competitive advantage and aims to explain why competing firms might differ in performance (Barney,1991; Teece *et al.,* 1997; Peteraf and Barney 2003). In this paper, we hypothesised that it is not only resources that generate competitive advantage but also the managerial capabilities to put these resources into communication with stakeholders after implementing carbon mitigation actions to make a positive impact on market participants' expectations. If carbon disclosure provides accurate information about actual performance and is transmitted to a broader range of stakeholders, the carbon disclosure-FP relationship should exist. As such, carbon disclosure does not replace the capability resource to manage carbon effectively in the RBV stream; rather it complements it.

The RBV represents legitimacy and reputation as intangible resources (Miles and Covin, 2000; Tilling and Tilt, 2010; Kuo and Yi-Ju Chen, 2013) that are derived from combinations of internal investments required for carbon mitigation projects and external market assessment of carbon-related risks and opportunities. In such context, a firm may choose to voluntarily report high-quality information regarding their proactive carbon strategies applied to processes, products, and services to create, maintain or enhance its competitive advantage. Failure to communicate information on carbon profile to the market would result in the inability of investors to accurately estimate the risk associated with the investment. Carbon disclosure can then be regarded as a commitment to transparency, as efforts to address climate change risks and opportunities, and as a criterion for measuring an organisation's reliability and legitimacy.

The RBV's theoretical framework suggested in this study is expected to form a basis for understanding how incorporating climate change mitigation efforts into business strategies can

affect the bottom line of firms' performance through disclosure to the public. We tested this theoretical prediction through employing several empirical assessments. We utilised firms' voluntary carbon disclosure in the CDP, and developed a composite measure of FP for FTSE350 firms over the 2007–2015 period.

Our results show that enhanced carbon disclosure in the period examined positively influences FP. Findings suggest that if businesses are to put the RBV framework into practice to maximise cost savings and accelerate business benefits, they need both the proactive integration of climate change mitigation efforts into their business strategy and the high-quality carbon disclosure communications to signal their superior performance to the public realm. Furthermore, the results show no significant evidence for the impact of carbon disclosure on FP during the GFC years. This association is more pronounced after the crisis period (i.e. carbon disclosure became an important determinant of firm performance).

The study also shows evidence that market-based measures of firm performance are less related to carbon disclosure than other measures of performance. Moreover, results indicate that firms which achieved high FP reported highly positive carbon disclosure compared to a modest disclosure for firms with low FP. We also find that firms operating in carbon-intensive industries are not benefiting from disclosing on their carbon profile as other firms that work in non-carbon-intensive industries.

As an implication in an increasingly competitive world, and as the level of carbon disclosure and stakeholder demands for carbon-related information increase, it is becoming evident that managers should consider a company's carbon management and its subsequent quality reporting activities as strategic issues. Carbon-related decisions should be integrated into corporate transparency and disclosure requirements as well as broader organisational decision-making processes to support firms seeking to develop a competitive advantage.

A limitation of the study is that the sample firms are the largest 350 companies by capitalisation which have their primary listing on the London Stock Exchange. Therefore, caution should be taken in generalising the present study outcomes to other businesses.

Additionally, for two variables, advertising expenses and R&D expenditure, there are gaps in the data which could have impacted the analysis of the relationship of interest. Furthermore, this study did not examine whether developing an RBV competitive advantage from proactive carbon management strategy leads to better risk management. Therefore, future research could explore

the question of whether promoting sound carbon mitigation policies decreases a firm's market risk or is a cost burden and increases such risks. Furthermore, Brexit may open new research directions to investigate the carbon disclosure profile in the UK and its impact on firms' FP as well. This possibility is especially relevant given the current political climate in the UK as Brexit-related uncertainty implies that the UK may withdraw from the EU Emissions Trading System and establish its policy to combat climate change and mitigate GHG emissions cost-effectively.

Chapter 3.Does Improving Corporate Carbon Disclosure Reduce Firm Risk? Empirical Evidence from the UK

3.1 Introdution

Awareness of the environmental downsides of economic development is increasing worldwide. Climate change and energy transitions have become major social and financial issues, which is reflected in the prevailing regulatory reforms driven by the concerns of different stakeholder groups (Haque, 2017). In response, more responsibility is falling on firms to improve their environmental strategies. Firms have recognised their responsibility in this area and the opportunities that these new realities present, including tangible cost savings from waste management and energy efficiency to the intangible benefits of an enhanced reputation. That is, firms are increasingly prioritising their climate change strategy in their overall business strategy (Lewandowski, 2017). [22] Interest in firm risk arising from climate change, including that from regulatory and market influences, has exponentially increased among institutional investors and other stakeholders, exerting growing pressure on corporate managers to prioritise the evaluation and reporting of such risks and related opportunities (Matsumura *et al.,* 2014). Carbon reporting as a tool to tackle the climate risk is only one element of corporate reporting, but it is recognised as a vital and challenging undertaking (Graafland *et al.,* 2016).

There is growing evidence that managers share a common interest with increasingly demanding stakeholders and could potentially gain from carbon disclosure. There is evidence that voluntary carbon disclosure enables a firm to avoid the valuation penalty that capital markets impose based on the magnitude of carbon emissions and the failure to disclose carbon emission information (Matsumura *et al.,* 2014). As part of a superior overall corporate social responsibility (CSR) practices, carbon disclosure and engagement with stakeholders can lead to improved access to financing (Cheng *et al.,* 2014).

As an effort to report the carbon profile was establishing the Carbon Disclosure Project (CDP) which is a registered charity that aims to help organisations understand, report and, ultimately, reduce their carbon impacts. By promoting greater transparency, they could nudge investors away

[22] "The trend is clear; the world is moving towards a green economy. Governments and business increasingly understand that there is no trade-off between a healthy environment and a healthy economy" (António Guterres, United Nations, 2017).

from investment decisions that carry a risk from climate change impacts. In addition, the CDP could encourage investments that move the economy towards a more low-carbon sustainable future. The objective of this work is to investigate the relationship between voluntary carbon disclosure and firm risk (FR). Recognising the effects of climate change on the FR allows stakeholders to proactively respond in a manner that benefits the firm and the environment.

The motivation for the present study is derived from an interest in understanding corporate engagement in climate change beyond regulatory compliance by considering voluntary carbon disclosure through the CDP. We contribute to the debate on the economic outcomes of carbon disclosure through the conceptualisation of the impact of the adoption of proactive carbon management strategies on FR and investigation of any effects. Besides the potential positive association between information asymmetry and FR, the resource-based view (RBV) theory is considered appropriate to build our study's theoretical framework. RBV focuses on how internal decision making, determined by the availability of productive resources, generates a competitive advantage and results in financial benefits through a reduction in FR, which may include valuable and hard-to-duplicate resources that could offer strategic gains over competitors (Ramanathan, 2018).

Our study sample represents listed firms on the FTSE350 index and comprises 2089 year-observations from 2007 to 2015, a period of raised public awareness and intense policy debate on issues of greenhouse gas (GHG) emissions and climate change. The companies listed on the FTSE350 are the largest in the London Stock Exchange by market capitalisation, so they constitute a central projection for carbon and economic performance in the UK. We use climate change-related disclosure – the Carbon Disclosure Score (CDS) published by the CDP – and apply three FR measures: total, systematic, and idiosyncratic risks. In the first empirical study (Chapter 2), the measure of total risk used in the current study (i.e. stock return volatility) is an element of the financial performance index. Technically, the standard deviation of stock returns can be viewed as an indicator of both financial performance and risk. For the former, the links between profitability and stock prices were established based on the measure of asset prices (i.e. present value of future cash flow). Therefore, the fluctuations in stock price can indicate the stability of firms' financial performance, which is an important aspect of financial health. As a result, it is included as a measuring component of the financial performance index. On the other hand, the measure also indicates the total risk of firms and is analysed in isolation in this study.

This risk measure is examined in more detailed by studying its components. According to finance theory, the total risk is composed of systematic risk (market risk) - the portion of risk explained by changes in the average market portfolio returns - and idiosyncratic risk (firm-specific unique risk) - the residual risk that cannot be explained by changes in the average market portfolio returns (e.g. Luo and Bhattacharya, 2009; Jo and Na, 2012). This study finds that proactive responses to climate change involving voluntary carbon disclosure significantly improve the three aspects of FR. The findings are in line with the notion of 'win-win' outcomes from being both green and competitive (Porter and Van der Linde, 1995). The present study also captures the effect of the global financial crisis (GFC) on the carbon disclosure-FR relationship. The results indicate that carbon disclosure had no effect on risk during this GFC period. However, during the recovery period, reporting on carbon disclosure resulted in a lower FR. By distinguishing between intensive and non-intensive carbon industries, this study reveals that the relationship between carbon disclosure and FR is more marked in carbon-intensive industries.

This study contributes to the emergent field of climate-related activism and carbon disclosure by providing broader considerations of corporate transparency in three ways. First, our study builds on RBV theory (Hart, 1995; Russo and Fouts, 1997) by investigating how proactive carbon strategy may influence the FR. We test the conceptual model based on RBV theory and consider the positive association between the information asymmetry and FR by applying three variables that capture FR. Second, previous studies emphasised the broad measures of environmental responsibility, but our analysis focuses on carbon issues, allowing for an examination of one delimited aspect. To our knowledge, this is the first study investigating the impact of carbon disclosure on FR. Therefore, our study extends the emerging literature on carbon responsibility (e.g. Luo and Tang, 2014; Haque, 2017). Third, the debate in the literature on the economic effects of CSR verges on suggesting a negative direction for this relationship, but there is no evidence within the European or UK contexts on the direction and extent of the relationship between carbon disclosure and FR. As the UK, a member of the G7 (Group of Seven), is a major emitter of GHG in global terms (Haque, 2017), it is appropriate and interesting as a setting for this study. Moreover, the UK is presently taking a leadership role in the development of proactive

mechanisms aimed at the mitigation of climate change dangers.[23] In late 2008, the UK's Committee on Climate Change recommended that the government target a reduction in GHG emissions to a minimum of 80% below the 1990 levels by 2050. The Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013 (SI 2013/1970) (Secretary of State, 2013) created new obligations for listed companies with regard to GHG emissions disclosure. In their directors' report, such firms must publish their annual carbon dioxide emissions and the methodology used for their calculation. The present study fills an important gap in the literature by presenting evidence from the UK.

The findings presented in this paper provide updated insights and policy implications that are of interest to regulators, managers and investors. Management must work toward the improvement of carbon disclosure including its reliability, credibility and relevance. CDP reports appear to be a particularly appropriate mechanism, as they meet the needs of managers and stakeholders by offering standardised and readily comparable information that makes mimicking higher achievers problematic for lower-performing firms (Luo and Tang, 2014). The results of this study offer guidance to regulators seeking to encourage businesses to implement sustainable carbon management practices. The 2009 guidelines for GHG disclosure and the disclosure requirements issued by Department for Environment, Food and Rural Affairs, and the new annual strategic report are crucial steps in the right direction, but regulators should frame efforts to mitigate climate change in terms of strategically important resources that are enhanced by quality carbon disclosure.

The rest of this paper is presented as follows: Section 3.2 reviews the existing literature on the relationship between carbon disclosure and FR, which facilitated the creation of the hypothesis for this paper. Section 3.3 presents the research design, sample, study period and measurement of variables, followed by Section 3.4, which shows the research results and an analysis of the findings. Section 3.5 concludes.

[23] In electricity generation terms, 2017 was the UK's greenest year ever. Data from the National Grid shows that the UK reduced its electricity sector carbon emissions by half since 2012 and is the seventh-cleanest power system worldwide (BBC News, 2017).

3.2 Literature Review and Hypothesis Development

3.2.1 Background

Many literature examined sustainability reporting or corporate social/environmental/carbon responsibility (e.g. Bansal and Roth, 2000; Al-Tuwaijri *et al.,* 2004; Sun *et al.,* 2010; Qiu *et al.,* 2016). The association between social/environmental responsibility and FR has been the focus of substantial research across a range of academic disciplines (e.g. Orlitzky and Benjamin, 2001; Lee and Faff, 2009; Salama *et al.,* 2011; Jo and Na, 2012; Oikonomou *et al.,* 2012; Albuquerque *et al.,* 2013; Benlemlih *et al.,* 2018). Comprehensive literature reviews on carbon accounting have been performed (Stechemesser and Guenther, 2012; Hartmann *et al.,* 2013; Ascui, 2014; Haslam *et al.,* 2014;). Hahn *et al.* (2015) reviewed studies examining the output and outcome of carbon disclosure and concluded that studies primarily give prominence to the empirical determinants of carbon disclosure and secondarily, and to a much lesser degree, examine the outcomes (effects) of the disclosure. As a result, "the effects of carbon disclosure represent a major gap that should be filled by future research" (Hahn *et al.,* 2015, pp. 97).

This assertion appears particularly well-founded considering the ongoing debate on the economic impacts of carbon disclosure in the literature. In previous related empirical studies, CSR was measured by indices/scores that focus broadly on environmental/social aspects rather than on impacts of carbon profile on FR, as in our paper. Furthermore, related empirical research on the impact of CSR on FR provides virtually consensual and conclusive findings that report a negative association. Those who measured FR using the systematic risk by beta found a negative relationship between FR and CSR. Salama *et al.* (2011) provide evidence in the UK regarding the association between CSR measured by social and environmental responsibility rankings and systematic FR. Panel data from 1994 to 2006 across sectors for the UK's most admired firms (including the FTSE100) revealed a statistically significant negative relationship between CSR and FR. The same findings were repeated by Oikonomou *et al.* (2012) and Albuquerque *et al.* (2013) by observing US firms of the S&P500 index from 1991-2008 and US firms from MSCI's (former KLD's) database from 2003-2011, respectively.[24] A different set of studies employed the idiosyncratic risk as an FR proxy and the results showed a negative association between

[24] MSCI Research delivers detailed research, scoring, and scrutiny concerning the environmental, social, and governance-related corporate practices of thousands of global firms, providing primary and timely information (https://www.msci.com/esg-integration).

company-unique idiosyncratic risk and CSR, including Lee and Faff (2009) using the Dow Jones Global index from 1998–2002 as a research sample and Luo and Bhattacharya (2009), who relied on the America's Most Admired Companies list for a research sample from 2002-2003. Total risk was employed to measure the FR in a study by Jo and Na (2012), who analysed the relationship by observing American firms from the MSCI database. They found that the risk reduction effect from CSR engagement is economically and statistically significant in firms operating in controversial sectors compared to those in non-controversial industries. Orlitzky and Benjamin (2001) summarise this research area quantitatively through a meta-analysis of 18 studies examining the relationship between CSR and FR, representing 6,186 observations from 1978 to 1997. They found that CSR is negatively correlated with risk and that the negative correlation is highest with total risk. Benlemlih *et al.* (2018) applied three variables to measure FR, total risk, systematic risk and idiosyncratic risk and found significant and negative relationships between social and environmental disclosures and total and idiosyncratic risk for 2005-2013 for FTSE350 listed firms. According to the authors, future research should re-examine this relationship by applying different measures.[25]

Although environmental and social measures have been widely used in previous literature, no measure precisely reflects the carbon profile (e.g. CDS issued by CDP, changes in carbon dioxide emissions and carbon intensity ratios). Although it covers many time periods, the literature does not extensively cover an extended post-financial crisis period. Furthermore, as Hahn et al. (2015, pp. 94) note, previous studies do not "explicitly refer to an underlying theoretical framework and, rather, rely on prior empirical evidence to develop their hypotheses". It is unclear whether our understanding of the issue has advanced since it first received scholarly attention. As the field has matured, there is a need for a sound theoretical foundation and further empirical work on the relationship between carbon disclosure and FR.

3.2.2 Carbon Disclosure and FR: Rethinking the Relationship with an RBV Conceptualisation

The priority of all firms in a competitive business environment is to secure a sustainable competitive advantage to outperform and overcome other firms (Kamasak, 2013). This

[25] Benlemlih *et al.* (2018) employed an environmental disclosure score extracted from Bloomberg's database as a proxy for environmental disclosure. We cannot use this proxy as a measure for carbon disclosure in the relationship examined in this paper as the components of this measure are not all fully related to carbon (e.g. water consumption, wastewater, electricity consumption, paper consumption and phone recycling).

competitive advantage is achieved "if it is able to create more economic value than the marginal (breakeven) competitor in its product market" (Peteraf and Barney, 2003, pp. 314). A firm can be viewed as a bundle of resources (Penrose, 1959; Wernerfelt, 1984), defined as "the subset of its productive assets which are economically inalienable" (Wernerfelt, 2016, pp. 102), and every firm possesses a unique (heterogeneous) resource endowment (Lockett *et al.,* 2008). However, such resources may only be the basis of sustained competitive advantage if they are valuable (Barney and Clark, 2007), as "bundles of strategically relevant resources" (Peteraf and Barney, 2003, pp. 317) allow for a firm to generate accomplishable business strategies and build a sustainable competitive advantage over competitor firms (Collis, 1994; Kamasak, 2013).

The RBV of the firm, "an efficiency-based explanation of sustained superior firm performance" (Barney and Clark, 2007, pp. V), offers a theoretical approach to explain differences in performance among firms in the same market (Newbert, 2007; Galbreath and Galvin, 2008) related to internal, firm-specific factors and idiosyncratic resources (Barney, 1991). In the RBV approach, for a firm to generate superior profits and/or decrease costs and establish a sustainable competitive advantage in today's business climate (Hitt *et al.,* 2001), it has to acquire and control valuable, rare, inimitable, and non-substitutable (VRIN) intangible resources (Barney, 1991) and possess dynamic capabilities that "integrate, build and reconfigure internal and external competencies to address rapidly changing environments" (Teece *et al.,* 1997, pp. 516). There is a strong case for RBV theory as the predominant theory in the discourse on how firm performance is affected by environmental practices (e.g. Hart, 1995; Hart and Ahuja, 1996; Russo and Fouts, 1997; Klassen and Whybark, 1999; Menguc and Ozanne, 2005; Ramanathan, 2018).

Carbon disclosure is a reflection of a firm's contribution to climate change and thus constitutes an important part of the corporate environmental strategy. Adopting a proactive environmental strategy often leads to achievement of an optimal operational efficiency and a reduction of risks to humans and the environment (Hart and Ahuja, 1996; Fujii *et al.,* 2013). Enhanced environmental risk management practices relieve societal pressures, lower the threat of government regulation, and reduce market risk (Orlitzky and Benjamin, 2001; Salama *et al.,* 2011) and the firm's cost of capital (Bansal and Clelland, 2004; Sharfman and Fernando, 2008; Dhaliwal *et al.,* 2011). Firms that are environmentally proactive "enjoy several potential revenue-generating benefits: (a) reducing their exposure to potential carbon costs, (b) opening up new

markets, (c) developing competencies that provide a competitive advantage, and (d) creating new revenue streams from excess credits" (Peloza, 2009, pp. 1526).

Achieving competitive advantage through voluntary carbon disclosure as a vital aspect of overall CSR reporting will lead to an enhanced level of transparency (e.g. Wood, 1991; Clarkson *et al.,* 2008; Dhaliwal *et al.,* 2011). Superior openness regarding CSR can lead to improved access to finance and reduced idiosyncratic capital constraints (Cheng *et al.,* 2014). Considering these benefits, there is a strong case for presenting carbon information as part of overall CSR reporting in the same manner that financial information is presented in traditional annual reports (Cho *et al.,* 2013). As stated earlier, carbon disclosure as a competitive advantage and transparency are closely linked; we can use a firms' voluntary disclosures to evaluate their level of transparency. Existing literature indicates that the more transparent a firm is, the less the information asymmetry between that firm and its investors is (e.g. Diamond and Verrecchia, 1991; Lambert *et al.,* 2007). Dhaliwal *et al.* (2011, pp. 62) recognise, ''… some CSR projects have direct implications for positive cash flow even in the near future''. As an element of overall CSR, carbon disclosure projects can potentially influence equity valuation (Cho *et al.,* 2013) because carbon disclosure reduces uncertainties about the value consequences of CSR projects. Therefore, the promotion of carbon transparency allows for the firm and stakeholders to improve the quality of their economic decision making. The resulting transparency and reduction in information asymmetry are expected to affect the relationship examined in this paper.

3.2.3 Discharging Accountability: The Quality Role

Managers should seek creative ways to reduce their firm's carbon footprint in an accountable and transparent manner (Haslam *et al.,* 2014). Having adopted such strategies, firms with better carbon disclosure will voluntarily indicate information on their actions (Connelly *et al.,* 2011), that is, their "discharge of accountability" (Gray *et al.,* 1996, pp. 39), by communicating (Zeghal and Ahmed, 1990) intent to devise a carbon competitive strategy (Schaltegger and Csutora, 2012), publicising stronger environmental records to stakeholders (Mahoney *et al.,* 2013), and distinguishing their firm from poor performers, avoiding the problem of adverse selection (Luo and Tang, 2014) and leading to more informed economic decisions that reduce the probability of FR.

Managers need to appreciate the main components of disclosures on GHG pollution emissions and their detailed plans for addressing the issue of global warming. Such plans typically cover emissions reduction targets, low-carbon initiatives, and energy/power consumption and identify climate change risk and opportunities, which may result in changes in business operations, expenditures, and revenues. Consequently, an enhanced carbon disclosures imply the integration of three elements (1) climate change into business strategy, (2) an effective corporate governance system rooted in the values of accountability and transparency, which considers climate change, and (3) third-party verification/assurance to enhance the credibility of firms' disclosures (e.g. Clarkson *et al.,* 2008). Managers should appear of such a proactive carbon strategy to the full range of stakeholder groups, who increasingly insist on meaningful and transparent disclosure concerning GHG emissions and the management of associated risks.

Enhanced environmental disclosure promotes firm transparency, reduces information asymmetry and facilitates improved economic decision making in conditions of greater trust and confidence for both firms and investors (Benlemlih *et al.,* 2018). Cui *et al.,* (2016) found a positive association between information asymmetry and FR that was also supported by Stoll (2000), Chung *et al.,* (2010), and Cho *et al.* (2013). The carbon disclosure–FR relationship should be established, in which the strategic organisational resources required for competitiveness are combined and environmental technologies are implemented (Klassen and Whybark, 1999). These expectations lead to the following hypothesis:

H_1 Carbon disclosure and FR are negatively associated.

3.3 Research Design and Data

3.3.1 Sample

Since it is the largest index in the UK that is annually assessed by the CDP, our sample includes all firms continuously listed on the FTSE350 index between the years 2007-2015. This period was characterised by high public awareness and extensive policy debate on GHG emissions, including national legal requirements (i.e. Regulation of 2013) and international climate provisions and agreements (i.e. Paris agreement). Noteably, the FTSE350 were initially invited to engage in and voluntarily report their carbon disclosure through the CDP online survey in 2006. However, 2006 was excluded from our analysis for two reasons: (1) there was only modest

participation in the CDP survey that year; (2) the 2006 responses were qualitatively analysed using 4 categories: Answered Questionnaire (AQ), Provided Information (IN), Declined to Participate (DP), and No Response (NR). In contrast, the quantitative analysis classified the responses of all subsequent years with scores from 0 to 100. The final sample consists of 2089 firm-year observations, after an exclusion was made for financial institutions as is standard practice for this type of research, due to the different set of environmental and social regulations such as the '*Equator Principles*' they adhere to and their unique accounting practices (Hussainey and Salama, 2010; Macve, *et al.,* 2010; Qiu *et al.,* 2016; Haque, 2017).[26] Table 3.1 gives a summary of the distribution of the final sample by the Global Industry Classification Standard (GICS) classification, the same classification applied by the CDP.[27]

Industry/Year	2007	2008	2009	2010	2011	2012	2013	2014	2015	Total	Per cent
Basic Materials	18	21	21	26	32	31	25	22	18	214	10.24
Consumer Goods	25	25	28	25	24	25	29	29	29	239	11.44
Consumer Services	63	66	66	60	57	57	61	67	67	564	27.00
Health Care	5	9	9	8	8	10	12	14	13	88	4.21
Industrials	65	65	66	59	62	60	64	64	58	563	26.95
Oil and Gas	18	21	20	21	21	19	17	15	11	163	7.80
Technology	13	13	17	17	15	14	13	10	8	120	5.74
Telecommunications	5	6	5	7	9	8	8	7	6	61	2.92
Utilities	11	11	10	9	8	7	7	7	7	77	3.69
N	223	237	242	232	236	231	236	235	217	2089	100

Table 3.1 Sample Distributions based on Industry and Year

3.3.2 Measures

3.3.2.1 Firm Risk

In line with previous literature, we apply the firm's total risk as measured by the standard deviation of the firm's daily stock return (e.g. Luo and Bhattacharya, 2009; Jo and Na, 2012), as in the following equation:

[26] The *Equator Principles* is a risk management framework used by financial institutions to determine, assess and manage environmental and social risk in projects. See: [http://www.equator-principles.com].
[27] To handle outliers, the data are winsorised at the 2.5th and 97.5th percentiles.

$$Standard\ Deviation\ of\ Return_{it} = \sqrt{\frac{1}{n}\sum_{t}^{n}(R_{it} - R_{mean})^2} \quad (1)$$

where R_{it} is the return on security *i* for day *t* and R_{mean} is the mean of the daily market return over 12 months. We use the CAPM beta to measure a firm's systematic risk (Jo and Na, 2012; Benlemlih *et al.,* 2018) and estimate it using a regression of the daily stock return on the daily market return of the FTSE350 over 12 months:

$$R_{it} = a_i + \beta_i R_{mt} + e_i \quad (2)$$

where R_{it} is the return on security *i* for day *t*, a_i is the intercept term, B_i is the systematic risk of security *i* (BETA), R_{mt} is the return on market *m* for day *t*, and e_i is an error term. Finally, we employ the idiosyncratic risk, i.e. the unique business risk, as measured by the standard deviation of residuals from the CAPM on the basis of daily stock returns (e.g. Amit and Wernerfelt, 1990; Lee and Faff, 2009; Bouslah *et al.,* 2013).

3.3.2.2 Carbon Disclosure

Koh et al. (2014) posit that future studies may attempt to measure corporate social and environmental responsibility by applying survey methodology. As a proxy for a firm's carbon disclosure, the carbon disclosure score – CDS from the CDP database is used. The CDP uses a survey to calculate the CDS based on a firm's responses to questions in the CDP's Online Response System. The score ranges from 0 to 100 and represents the quality of a firm's responses to the annual CDP questionnaire. The CDP "is working to reduce the risks associated with transparency by facilitating dialogue and information-sharing between companies" (Wilhelm and Willard, 2013, pp.159). In doing so, it has demonstrated a strategic competency that appeals to different stakeholders and created a broadly based legitimacy for carbon disclosure standards (Knox-Hayes and Levy, 2011).

The survey evaluates the information that firms disclose in the CDS under three broad headings: (1) climate change management: governance, strategy, targets and initiatives and communications; (2) climate change-related risks and opportunities; and (3) climate change emissions methodology, emissions data, energy, emissions performance and emissions trading. Appendix 3.1 presents a summary of the questionnaire questions about the construct and their measurement items.

It is worth mentioning, within the third category, which presents 48% of the CDS, the emissions performance (changes in carbon emissions volume) is one out of five topics in this category. Furthermore, the inclusion of emissions volume is critical. Similar to financial disclosure, firms should be aware of the likelihood of revealing negative as well as positive information on their emissions volume. Nevertheless, it is worthnoting, this component in the third category reflects the quality of the responses in terms of emissions volume reliability, honesty and fairness, regardless of carbon emissions volume emitted by firms. Specifically, increasing or decreasing of carbon emissions volume is not the standard but the quality of the information provided regarding this factor. Particularly, a disclosure of a high volume of carbon emissions does not necessarily reduce the CDS score. Therefore, there is no issue of compounding effects of carbon disclosure and emissions performance in this disclosure index.

Firms' responses to the CDP survey, available publicly on the CDP website, could have implications on investors' investment decisions (Kim and Lyon, 2011). Tang and Luo (2011, pp. 26) note that "a firm's reputation could be adversely affected if the firm refuses to participate in CDP, or participated but, disclosed poor carbon information".

Selection of the CDS as a measure of carbon disclosure is justified by the large number of organisations that voluntarily respond to CDP's information request and its use in previous studies on whether voluntary carbon disclosure is a true reflection of a firms' actual carbon performance (Luo and Tang, 2014) and on the determinants of disseminating relevant information on GHG (e.g. Prado-Lorenzo and Garcia-Sanchez, 2010; Luo *et al.,* 2012).[28] Information usefulness is dependent on the transparency and comparability of carbon information (Andrew and Cortese, 2011), and useful information is required for carbon markets and corporate carbon management (Knox-Hayes and Levy, 2011). For some firms, provision of full CDP responses substitutes for the disclosure of such information in their annual or sustainability reports (Cotter and Najah, 2012). For others, it is intended to complement the annual reports by providing investors with information that is relevant to the financial risks the firm may be

[28] Over the sample period, the average number of participating firms in the CDS was 243.56, which represents an average 69.59% rate of participation of FTSE350 companies.

exposed to due to their GHG emissions and opportunities from climate change (Kolk *et al.,* 2008; Kim and Lyon, 2011).

3.3.2.3 Controls

In controlling for firm characteristics that may affect the examined relationship, we follow the approach of earlier studies (e.g. Toms, 2002; Clarkson *et al.,* 2008; Luo *et al.,* 2012) and include firm size (SIZE) measured by the natural log of total assets and financial leverage (LEV) measured by the ratio of total debt to total capital. It is frequently asserted that firms with lower payout ratios carry greater risk. Therefore, the dividend payout (POUT), calculated by the ratio of the dividend per share to the stock price per share, can have a signalling effect concerning management's perception of future earnings uncertainties (Salama *et al.,* 2011; Oikonomou *et al.,* 2012). Earlier studies found that more profitable firms carried less risk (e.g. Jo and Na, 2012; Benlemlih *et al.,* 2018). Therefore, profitability (PROF) measured by return on assets (ROA) is included as a control. Corporate liquidity is an additional variable that is frequently applied to test the association and prediction of FR (e.g. Ferris *et al.,* 1989; Salama *et al.,* 2011; Oikonomou *et al.,* 2012). The lower the liquidity, the higher the firm's liquidity risk, which may be reflected in increased stock price fluctuations. The current ratio is widely viewed as the classic measure of liquidity. We control for liquidity (LIQ) using the current ratio, measured by the total current assets/total current liabilities. Most empirical studies examining this relationship controlled for the firm's growth (e.g. Oikonomou *et al.,* 2012). To control for growth (GROW) effects, we use the market-to-book (MTB) ratio because analysts regard companies with weak growth prospects (low MTB ratio) as more exposed to market volatility (e.g. Lewellen, 1999). Following Galbreath's (2010) suggestion that the structure of the board of directors and the deployment of organisational resources to manage the risk and opportunity arising from climate change influence climate change governance practices, we control for the influence of corporate board composition by calculating a composite index with the components of board composition as dummy industry-adjusted variables. Similar to Zaman, Hudaib, and Haniffa (2011) and Bui *et al.,* (2017), we incorporate six variables, as shown in Appendix 3.2, to construct an index for the board composition (BC). The competition in the business environment motivates firms to outperform their competitors by creating competitive advantage (Kamasak, 2013). Therefore, the effects of product market competition (COM) are controlled for, measured by the number of

competitors in the same industry in a given year (Bagnoli and Watts, 2003; Fernández-Kranz and Santaló, 2010). Working in foreign markets necessitates companies to consider cross-border differences and comply with policies and regulations governing commerce between different countries. Given exposure to such barriers, businesses are likely to be more socially responsible (Branco and Rodrigues, 2008). According to Stanny and Ely (2008), European firms with higher percentages of international commerce disclose their carbon emissions more. Consistent with Jackson and Apostolakou (2010), we control for the effects of foreign market activities (FMA) based on the ratio of foreign assets to total assets. As the firms in our sample must comply with the GHG reporting regulation (which came into effect on 1 October 2013), including reporting on their GHG emissions as part of their annual Directors' Report based on the Companies Act 2006 'Amendment of Part 7' Regulations 2013 (Secretary of State, 2013), a dummy variable (REG) set to one for 2014-2015 and zero otherwise is included. Lastly, to control for the potential influence of fluctuations in market trends that may affect the FR, we include yearly dummy variables (e.g. Deng *et al.,* 2013; Al-Awadhi and Dempsey, 2017).

3.3.2.4 Model Tested

To test the main hypothesis, our main empirical model is as follows:

$$FR_{it} = \beta_0 + \beta_1 CDS_{it} + \beta_2 SIZE_{it} + \beta_3 LEV_{it} + \beta_4 POUT_{it} + \beta_5 PROF_{it} + \beta_6 LIQ_{it} + \beta_7 GROW_{it} + \beta_8 BC_{it} + \beta_9 COM_{it} + \beta_{10} FMA_{it} + \beta_{11} REG_{it} + \beta_{12} YEAR_{it} + \varepsilon_{it} \quad (3)$$

where FR is one of the risk proxies, such as the total risk (i.e. stock volatility), systematic risk (i.e. beta), or idiosyncratic risk (i.e. unsystematic risk); CDS is the Carbon Disclosure Score; SIZE is the natural log of total assets; LEV is the total debt to total capital ratio; POUT is the dividend payout; PROF is the return on assets (i.e. ROA); LIQ is the current ratio; GROW is the MTB ratio; BC is the board composition index; COM is the number of competitors in the same industry in a given year; FMA is the ratio of foreign assets to total assets; REG is a dummy variable set to "1" for 2014-2015 and "0" otherwise; and YEAR are dummy variables.

A pair of empirical assessments is employed to investigate the impact of carbon disclosure on FR. First, we use the Ordinary Least Squares (OLS) regression. Second, we apply a specific estimator model, the instrumental variable-two-Stage Least Squares (IV-2SLS) model (using

Firm Age and CDS "$lag_{-1\ year}$"), to address the endogeneity problem between CDS and FR proxies (Jo and Harjoto, 2011, 2012; Schreck, 2011).[29]

3.4 Results and Analysis

3.4.1 Descriptive Statistics

Descriptive statistics are presented in Tables 3.2 and 3.3. The mean and distributional characteristics for each variable are reported in Table 3.2. The response rate to the CDP questionnaire for our sample was approximately 64% (1330 of 2089). The mean of the CDS is 69.12, which is somewhat higher than in previous studies employing CDS as a dependent variable. Prado-Lorenzo and Garcia-Sanchez (2010), examined the role of the Board of Directors in disseminating information related to GHG emissions and reported a mean CDS of 60% based on the CDP's 2007 annual survey. Luo and Tang (2014) investigated whether voluntary carbon disclosure reveals the actual carbon performance and reported a mean CDS of 65% based on the CDP's 2010 annual survey. The variance in the mean CDS between these earlier studies and our study may be justified by the shortened period applied by these studies (just one year) and the timing of public pressure on the disclosure of information relating to climate change. The mean total risk is 35.66, within the range established in prior studies, (e.g. Benlemlih *et al.,* 2018). The mean of the systematic risk is almost 1, (the same as the market beta), in line with prior literature employing BETA as the left-side variable (e.g. Salama *et al.,* 2011; Oikonomou *et al.,* 2012), and the average firm-specific risk (idiosyncratic) is 0.017, similar to previous studies (e.g. Amit and Wernerfelt, 1990). The unreported average firm SIZE is £8.12 billion, suggesting the sample comprises large firms. The logarithm of total assets was used to measure SIZE, and the mean and median result were 21, in line with that of the Clarkson *et al.* (2008) sample.

[29]See Section 2.4.2.1 (p.36) in Chapter 2 for more details about the instrumental variables.To confirm the absence of residual endogeneity, a Durbin Wu-Hausman test was performed, which reported P-values of 0.729, 0.246 and 0.956 for total, systematic and unsystematic risks, respectively. The IV-2SLS estimate utilises a reduced sample as instruments (lagged values) were only available for 817, 810 and 786 observations of the abovementioned FR proxies, respectively.

Variable	N	Mean	Median	SD	Min	Max
TR	2040	35.664	31.517	14.493	17.535	76.930
SR	2056	1.008	0.957	0.481	-0.042	2.479
IDR	1521	0.017	0.015	0.008	0.007	0.071
CDS	1330	69.12	72.000	21.022	4.000	100.000
SIZE	2076	21.365	21.214	1.534	16.909	26.147
LEV	2037	25.492	19.809	20.234	4.625	83.081
POUT	1777	0.032	0.030	0.017	0.001	0.180
PROF	2067	7.655	6.522	7.128	-6.828	28.573
LIQ	2077	1.558	1.285	1.131	0.306	7.015
GROW	1982	3.904	2.754	4.021	0.608	21.943
BC	1797	2.874	3.000	1.337	0.000	6.000
COM	2089	42.698	57.000	22.500	5.000	67.000
FMA	2089	37.504	34.990	27.684	0.000	95.010

Table 3.2 Descriptive Statistics of Chapter Variables
This descriptive statistics is based on our sample from 2007 to 2015.

Variables	TR	SR	IDR	CDS	SIZE	LEV	POUT	PROF	LIQ	GROW	BC	COM	FMA	REG
TR	1	0.45***	0.92***	-0.34***	-0.20***	0.10***	-0.01	-0.03	0.20***	-0.12***	-0.24***	-0.04*	0.17***	-0.27***
SR	0.44***	1	0.29***	-0.21***	-0.04	0.09***	-0.17***	-0.09***	0.15***	-0.23***	-0.03	0.14***	0.33**	-0.06*
IDR	0.93***	0.32***	1	-0.33***	-0.28***	0.11***	0.01	-0.01	0.22***	-0.11***	-0.25***	0.01	0.04	-0.20***
CDS	-0.41***	-0.17***	-0.40***	1	0.38***	-0.01	0.14***	-0.03	-0.03	0.09**	0.30***	-0.14***	-0.13***	-0.46***
SIZE	-0.23***	0.08***	-0.36	0.37***	1	0.21***	0.26***	-0.29***	-0.30***	-0.26***	0.35***	-0.26***	0.12***	0.01
LEV	0.12***	0.08***	0.11***	0.04	0.15***	1	0.33***	-0.39***	-0.30***	-0.41***	0.14***	0.09***	-0.03	-0.15***
POUT	-0.14	-0.10***	0.11***	0.04	0.17***	0.30***	1	-0.24***	-0.25***	-0.23***	0.09***	-0.14***	-0.12***	-0.16***
PROF	-0.05***	-0.07***	-0.07**	-0.06	-0.28***	-0.30***	-0.16***	1	0.17***	0.54***	0.02	0.01	0.01	-0.02
LIQ	0.16***	0.16***	0.15***	-0.04	-0.21***	-0.25***	-0.20***	0.15***	1	-0.05	-0.12***	-0.12***	0.09***	0.09***
GROW	-0.20***	-0.16***	-0.18***	0.06	-0.24***	-0.21***	-0.10***	0.42***	-0.09***	1	0.03	0.01	-0.04	-0.10***
BC	-0.20***	-0.08***	-0.28***	0.30***	0.41***	0.13***	0.10***	-0.05*	-0.17***	0.02	1	-0.03	0.01	0.12***
COM	0.12***	-0.01	0.14***	-0.07**	-0.17***	0.16***	0.04*	-0.01	-0.25***	0.12***	0.01	1	-0.04	0.05
FMA	0.17***	0.31***	-0.15***	-0.15***	0.13***	-0.07***	-0.14***	-0.05**	0.04*	-0.13***	-0.05*	-0.15***	1	-0.07**
REG	-0.21***	-0.13***	-0.20***	0.43***	0.07***	-0.11***	-0.09***	-0.03	-0.01	0.06**	0.12***	-0.04	-0.12***	1

Table 3.3 Spearman (Pearson) Correlation Analysis of Chapter Variables

This table reports the pairwise coefficients for our sample from 2007 to 2015 of 2089 firm-year observations. The upper (lower) triangle reports the Spearman (Pearson) correlations, ** and *** denote significance at the 10%, 5% and 1% respectively.*

Table 3.3 shows the Spearman (Pearson) correlations in the upper (lower) diagonal.[30] In line with RBV expectations, the significant negative correlation between all FR measures and CDS indicates that the carbon disclosure act to increase the carbon transparency that decreases the impact of FR. Moreover, the correlations between CDS and other right-hand variables (e.g. SIZE, REG and BC) are aligned with those in existing studies. Cormier and Magnan (1999, pp. 444) note that "irrespective of their information costs and financial condition attributes, large firms disclose more environmental information than small firms". The significant positive correlation between CDS and REG suggests that environmental reporting under UK guidelines, which includes mandatory GHG emissions reporting, motivates firms to act more accountably and transparently regarding their voluntary carbon disclosure. Furthermore, the significantly positive correlation between CDS and BC suggests corporate boards prioritise climate change on their agenda, consistent with Ben-Amar and McIlkenny's (2014) results indicating a positive association between board effectiveness and the firm's decision to respond to the CDP questionnaire and its carbon disclosure quality.

3.4.2 Empirical Tests

3.4.2.1 Carbon Disclosure and Firm Risk

Table 3.4 reports the results obtained using Equation (3) to investigate our hypothesis, primarily evaluating the impact of carbon disclosure on FR. Model 1 presents results from regressing total risk on the carbon disclosure and control variables. The coefficient of the CDS is negative and statistically significant across the two estimations, OLS and IV-2SLS. This indicates that improvement of carbon disclosure increases firm transparency, reducing information asymmetry. This builds trust and confidence between the company and stakeholders concerned about the environment. This results in demand control on the firm's stock that decreases price fluctuation and reduces its volatility risk (e.g. Jo and Na, 2012).

[30] Unreported variance inflation factors (VIFs) are within the levels of tolerance for multicollinearity.

Dependent Variable	Total Risk		Systematic Risk		Idiosyncratic Risk	
Model	**OLS(1)**	**IV-2SLS(1)**	**OLS(2)**	**IV-2SLS(2)**	**OLS(3)**	**IV-2SLS(3)**
CDS	-0.058*** (0.018)	-0.046* (0.026)	-0.002*** (0.001)	-0.004*** (0.001)	-0.003** (0.001)	-0.003* (0.001)
SIZE	-1.154*** (0.238)	-1.007*** (0.270)	0.024** (0.010)	0.028** (0.012)	-0.120*** 90.014)	-0.109*** (0.015)
LEV	0.085*** (0.016)	0.082*** (0.018)	0.003*** (0.001)	0.004*** (0.001)	0.005*** (0.001)	0.005*** (0.001)
POUT	3.077 (25.47)	-6.476 (19.36)	-2.976*** (0.947)	-2.860*** (0.882)	2.131 (1.551)	1.681 (1.073)
PROF	-0.205*** (0.062)	-0.199*** (0.058)	-0.003 (0.003)	-0.001 (0.003)	-0.016*** (0.004)	-0.015*** (0.003)
LIQ	2.485*** (0.318)	2.130*** (0.324)	0.083*** (0.017)	0.073*** (0.015)	0.120*** (0.020)	0.109*** (0.018)
GROW	-0.079 (0.058)	-0.065 (0.074)	-0.006* (0.003)	-0.005 (0.003)	-0.004 (0.003)	-0.002 (0.004)
BC	-0.27 (0.242)	0.118 (0.237)	-0.022** (0.011)	-0.018 (0.011)	-0.017 (0.015)	-0.017 (0.013)
COM	-0.017 (0.013)	-0.008 (0.014)	0.003*** (0.001)	0.003*** (0.001)	-0.001 (0.001)	-0.001 (0.001)
FMA	0.062*** (0.011)	0.063*** (0.011)	0.005*** (0.001)	0.004*** (0.001)	0.002*** (0.001)	0.003*** (0.001)
REG	-2.129* (1.284)	-2.516 (1.893)	0.015 (0.072)	0.033 (0.087)	-0.008 (0.071)	-0.022 (0.104)
YEAR Effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	56.380*** (5.169)	52.130*** (5.819)	0.277 (0.233)	0.319 (0.265)	4.133*** (0.313)	3.885*** (0.320)
Durbin Wu-Hausman		0.729		0.246		0.956
R^2	0.55	0.49	0.21	0.22	0.53	0.49
N	1104	817	1091	810	931	786

Table 3.4 The Impact of Carbon Disclosure on Firm Risk

*This table reports the results of two estimation methods OLS and IV- 2SLS. Heteroscedasticity-robust standard errors are in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively. (two-tailed test).*

The same estimation methods are used substituting total risk with systematic risk (Model 2) and idiosyncratic risk measures (Model 3). Regarding the systematic risk, OLS and IV-2SLS estimation models confirm that there is a significantly negative effect from CDS on BETA at 99% confidence level ($p < 1\%$). Environmentally engaged organisations, including those who continually aim to improve their carbon disclosure, will have lower anticipated variability of cash flows from implicit and explicit environmental-based stakeholder claims and experience a decrease in their market risk. This result is consistent with previous studies (e.g. Salama *et al.,* 2011; Jo and Na, 2012; Oikonomou *et al.,* 2012).

Additionally, when FR is measured by the idiosyncratic risk, the coefficient of the CDS is negative and statistically significant using both OLS and IV-2SLS. It appears that the reduced total risk among high-disclosure firms is predominantly a result of a reduction in the firm's idiosyncratic risk. (e.g. Benlemlih *et al.,* 2018).

Regarding the control variables, SIZE is significantly negatively associated with total and idiosyncratic risk, consistent with our expectation, whereas it is significantly positively associated with systematic risk, counter to expectation. Notably, this finding aligns with previous RBV research (e.g. Benlemlih *et al.,* 2018). One explanation could be that SIZE is controlling for leveraging effects that arise from the larger firms are better able to the debt market exposing them to increased market risk (Gyourko and Nelling, 1996). Lee and Jang (2007) reported the same finding, stating that the positive association of firm SIZE to market risk is paradoxical as it opposed the relevant finance theory and earlier studies. Furthermore, LEV is positively significant at the 1% level regarding each of the risk measures, in alignment with earlier research (e.g. Salama *et al.,* 2011; Jo and Na, 2012). This may result from the high cost of loans and the high percentage of debt determined by the market risk. In line with previous research (e.g. Beaver *et al.,* 1970; Oikonomou *et al.,* 2012), POUT is significantly negatively associated with systematic risk at the 1% level. It is commonly suggested that firms with low payout ratios have more risk, although it's statistically insignificant compared to other risk measures (i.e. total and idiosyncratic risk). Moreover, PROF is highly negatively associated with total and idiosyncratic risk, confirming that more profitable firms are associated with lower risk (e.g. Salama *et al.,* 2011; Jo and Na, 2012). The statistical relationship between PROF and the systematic risk is insignificant.

The results demonstrate that LIQ is significantly positively associated with all risk variables. This may be because high levels of liquidity could reflect an unwise investment of available resources; thus, higher levels of liquidity may indicate an increase in agency costs related to "free cash flow," which could also increase risk (Jensen, 1986). GROW is as negatively significantly associated with systematic risk at the 10% level in the OLS model, as firms with lower growth opportunities may have lower share prices, lower market-to-book ratios, and be vulnerable to market volatility (e.g. Lewellen, 1999). GROW is insignificant in the IV-2SLS model; this inconsistency may result from the decrease in observations when applied to the instrumental variables. Moreover, the growth effects are insignificant for the total and idiosyncratic risk. BC is significantly negatively associated with systematic risk at the 5% level in the OLS model whereas BC is insignificant in the IV-2SLS model, which could be caused by the decrease in observations when applied to the instrumental variables. The impact of BC is not noticeable for the total and idiosyncratic risk. This finding is in line with Rhoades *et al.* (2000), who concluded that there was a weak relationship between board composition and firm performance, part of a general lack of convincing evidence for a significant relationship (Barnhart *et al.,*1994; Johnson *et al.,* 1996; Dalton *et al.,* 1998; Dalton *et al.,* 1999). In relation to systematic risk, COM is positively significant at the 1% level. This result is consistent with Giroud and Mueller (2011), who found that increased product substitutability is followed by a reduction in revenues, which persuades affected firms to exit. Conversely, the impact of COM is not evident for the total and idiosyncratic risk. The FMA, the measure of the degree of internationalisation of a firm that might impact the examined relationship, is significantly positively associated with all risk variables. Reeb *et al.* (1998) explained this association, suggesting that FMA may result in increased risk related to exposure to several risk factors such as political risk, exchange rate risk, asymmetric information, and agency issues. Moreover, when a business invests in a less-developed market, FR is may increase (Kwok and Reeb, 2000). The REG results indicate no meaningful relationship.

3.4.3.2 Additional Analyses

As the sample period in this study includes the GFC period (2007-2008), we perform an additional test to isolate the potential effect of the GFC on the relationship being examined.[31] Our sample was divided into two sub-periods: 2007-2008 (GFC period) and 2009-2015 (recovery period). Table 3.5 indicates that the relationship of CDS-all risk measures is not significant for the GFC period but is highly significant during the recovery period. This finding shows that firms should adapt during times of crises by reducing investment in carbon mitigation projects (e.g. Cheney and McMillan, 1990; Njoroge, 2009). After the crisis, corporate social and environmental responsibility tends to increase the public agenda. As KPMG states: "Before the financial crisis, investors typically saw environmental due diligence as a risk management tick-box exercise to secure financial institution funding. However, post-this exogenous shock, there appears to be a greater focus on responsible investment. We are seeing an increased appetite for the potential upsides (e.g. cost savings, additional revenue streams) of the sustainability agenda, in a transactional context. Strategies to manage energy (buy better, use less and self-generate) and waste (convert waste to an asset) are transforming the environmental due diligence process" (KPMG, 2017).

This indicates that a firm's value depended less on intangible assets during the GFC period and that, today, firms seek investor confidence in the financial market to improve their reputations in competitive markets (Raithel, *et al.,* 2010). There is a contradiction between our findings and those of Gallego-Álvarez *et al.* (2014). They found that, in crisis periods, firms continue investing in sustainability projects to enhance stakeholder confidence, which may lead to higher profitability.[32] They note that future research should extend the sample period to encompass firm behaviour both before and after the GFC to allow for a complete analysis. The present study accounts for this possibility with a comparison of the GFC and recovery periods in the examination of the relationship between carbon disclosure and FR.

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[31] Consistent with Erkens *et al.,* 2012, we specify the years of 2007-2008 as the GFC period.

[32] Gallego-Álvarez *et al.* (2014) investigated the impact of the global financial crisis on the environmental performance of large multinationals from 2006 to 2009. They state that the relatively short sample period is an important limitation of their study.

Variable	Total Risk		Systematic Risk		Idiosyncratic Risk	
Period	**Crisis**	**Recovery**	**Crisis**	**Recovery**	**Crisis**	**Recovery**
CDS	-0.063 (0.056)	-0.055*** (0.018)	-0.001 (0.002)	-0.002*** (0.001)	-0.001 (0.004)	-0.002*** (0.001)
SIZE	-0.530 (0.908)	-1.242*** (0.241)	-0.022 (0.033)	0.028*** (0.011)	-0.127** (0.061)	-0.115*** (0.014)
LEV	0.057 (0.069)	0.089*** (0.016)	0.002 (0.002)	0.003*** (0.001)	0.004 (0.005)	0.005*** (0.001)
POUT	-37.532 (79.261)	9.037 (26.720)	-4.509* (2.554)	-2.713*** (1.003)	2.363 (6.222)	2.111 (1.606)
PROF	0.164 (0.192)	-0.254*** (0.062)	-0.005 (0.007)	-0.003 (0.003)	-0.018* (0.011)	-0.015*** (0.004)
LIQ	2.267* (1.236)	2.535*** (0.338)	0.016 (0.043)	0.091*** (0.018)	0.166 (0.115)	0.115*** (0.019)
GROW	-0.362* (0.190)	-0.015 (0.055)	0.003 (0.008)	-0.008** (0.004)	-0.005 (0.014)	-0.003 (0.003)
BC	0.068 (0.923)	-0.298 (0.243)	0.006 (0.034)	-0.026** (0.012)	0.002 (0.058)	-0.021 (0.015)
COM	0.101** (0.041)	-0.034*** (0.013)	0.001 (0.002)	0.003*** (0.001)	0.005* (0.003)	-0.002*** (0.001)
FMA	0.053 (0.039)	0.067*** (0.010)	0.005*** (0.001)	0.004*** (0.001)	(0.001) (0.003)	0.003*** (0.001)
REG		-8.949*** -1.652		-0.024 (0.057)		-0.486*** -0.093
Constant	37.276* (20.244)	65.228*** (5.435)	1.349* (0.731)	0.209 (0.238)	3.957*** (1.308)	4.550*** (0.328)
N	156	948	151	940	129	802
R^2	0.54	0.37	0.16	0.23	0.49	0.40

Table 3.5 The Impact of the Financial Crisis on the Relationship Examined
*OLS was applied. Heteroscedasticity-robust standard errors are in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively (two-tailed test).*

We further extend our analysis to investigate the potential effect of industry in the examined relationship. Industries with higher carbon emissions profiles are subject to more public and media scrutiny and governmental regulations and legislation. The sample in the present study is diverse and includes both intensive and non-intensive industries. The sample contains ten industries (nine after excluding the financial industry) according to the industry's structure and definitions applied by the industry GICS. FTSE All-Share Index standards are applied to identify carbon-intensive industries based on the level and nature of GHG emissions. These were industrials, basic materials, utilities, consumer services and oil and gas. The sample was divided into two sub-samples: intensive and non-intensive. An OLS regression test was performed to identify the possible impact of the industry on the examined relationship. Table 3.6 indicates that the relationship of CDS-all risk measures is significant for firms in intensive industries but not significant for those operating in non-intensive industries. This result confirms the notion that voluntary environmental disclosures predominate among firms in environmentally sensitive sectors (Patten, 1991; Roberts, 1992; Hackston and Milne, 1996; Hasseldine *et al.,* 2005). This is consistent with the argument proposed by Hart and Ahuja (1996) that companies with intensive carbon emissions can improve productivity and competence through a reduction in their industrial waste. One likely outcome is enhanced employment of inputs, leading to a reduction in the costs of raw material and waste disposal in a manner that also reduces the default risk and cost of capital.

Variable	Total Risk		Systematic Risk		Idiosyncratic Risk	
Industry	**Intensive**	**Non-Intensive**	**Intensive**	**Non-Intensive**	**Intensive**	**Non-Intensive**
CDS	-0.060*** (0.020)	-0.036 (0.033)	-0.003*** (0.001)	-0.001 (0.001)	-0.003** (0.001)	0.001 (0.002)
SIZE	-0.847*** (0.300)	-2.136*** (0.352)	0.014 (0.012)	0.004 (0.015)	-0.104*** (0.018)	-0.197*** (0.022)
LEV	0.077*** (0.018)	0.116*** (0.042)	0.003*** (0.001)	0.008*** (0.001)	0.004*** (0.001)	0.005** (0.002)
POUT	3.514 (30.300)	17.513 (36.341)	-2.241** (1.073)	-6.187*** (1.491)	1.042 (1.824)	7.324** (3.395)
PROF	-0.241*** (0.073)	-0.011 (0.111)	0.003 (0.003)	0.001 (0.004)	-0.020*** (0.004)	0.002 (0.007)
LIQ	2.578*** (0.371)	1.800*** (0.632)	0.066*** (0.022)	0.043** (0.019)	0.140*** (0.022)	0.107** (0.047)
GROW	-0.066 (0.072)	0.062 (0.100)	0.010** (0.004)	0.006 (0.005)	-0.002 (0.005)	-0.004 (0.006)
BC	-0.330 (0.271)	-0.279 (0.504)	-0.026** (0.012)	0.007 (0.020)	-0.022 (0.016)	-0.004 (0.030)
COM	-0.033* (0.018)	-0.088 (0.055)	0.001 (0.001)	0.003 (0.002)	-0.001 (0.001)	-0.010** (0.004)
FMA	0.081*** (0.013)	-0.001 (0.015)	0.006*** (0.001)	0.001 (0.001)	0.003*** (0.001)	-0.001 (0.001)
REG	-3.408** (1.488)	1.011 (1.824)	0.038 (0.080)	-0.165 (0.142)	-0.041 (0.082)	0.038 (0.110)
YEAR Effects	Yes	Yes	Yes	Yes	Yes	Yes
Constant	51.783*** (6.733)	73.260*** (7.391)	0.595** (0.292)	0.774** (0.324)	3.903*** (0.397)	5.349*** (0.485)
N	839	265	826	265	713	218
R^2	0.57	0.59	0.25	0.23	0.53	0.63

Table 3.6 The Impact of the Industry Type on the Relationship Examined
*OLS was applied. Heteroscedasticity-robust standard errors are in parentheses. *, ** and *** denote significance at 10%, 5% and 1%, respectively (two-tailed test).*

3.5 Conclusion

This study was motivated by the increasing public concern about climate change and provides an empirical assessment of the economic consequences of carbon disclosure, with a focus on FR. The RBV was our conceptual framework for analyses of carbon accountability and firms' responsibility practices toward stakeholders in the UK context, in which regulators are actively pursuing the regulation of carbon emissions. There appears to be a lack in the literature of this type of investigation, especially in this specific setting. Considering the possible positive association between information asymmetry and FR, the RBV theoretical framework proposed in this study facilitates understanding the effects of integrating climate change mitigation endeavours into an overall business strategy in terms of the bottom-line performance and risk. To test this hypothesis, we conducted econometric analyses involving the measurement of carbon disclosure using voluntary carbon disclosure score and three FR measures, the total, systematic, and idiosyncratic risks for FTSE350 firms for 2007–2015.

The results show that during this period, there was a negative influence from enhanced carbon disclosure on FR. These findings indicate that firms should aim to put the RBV framework into practice to maximise cost savings and accelerate business benefits to proactively integrate climate change mitigation efforts into their business strategy and deploy a high-quality carbon disclosure mechanism. The additional tests show no significant evidence for any effect from carbon disclosure during the GFC period. However, carbon disclosure became a more important determinant of FR after the GFC. By distinguishing between intensive and non-intensive carbon industries, this study finds that the examined relationship strengthens in the more intensive carbon industries.

In a world of ever-increasing competition with increasing stakeholder demand for carbon disclosure, management must consider the firm's carbon disclosure and the reporting of strategic issues, which means integrating carbon-related decisions into the overall corporate disclosure requirements and transparency efforts as well as the broad sweep of organisational decision making to achieve a competitive advantage.

The study has a limitation as the sample was restricted to the 350 largest UK companies (by market capitalisation) of the FTSE350. As a result, caution should be exercised when generalising the current study's findings beyond these companies. The present study did not examine whether a proactive carbon management strategy extends to a company's stock reaction. Hence, further research could investigate whether the impact of carbon disclosure announcements

on a company's stock reaction is positive or a cost burden that affects company's stock response negatively. Moreover, the UK's withdrawal from the European Union may create new research opportunities to investigate the country's carbon profile and its impact on FR. Such an opportunity is particularly pertinent given the UK's current political landscape, which includes Brexit-related uncertainties, such as the potential withdrawal from the European Union Emissions Trading System and establishment of a new policy to manage climate change and GHG emissions in a cost-effective manner.

Chapter 4.Market Responses to Firms' Voluntary Carbon Disclosure: Empirical Evidence from the UK

4.1 Introduction

Climate change has emerged as a significant business consideration over the last two decades. Firms have increasingly included the consideration of global warming as part of their strategic management decision making (e.g. Matsumura *et al.,* 2014; Haque, 2017). In recent years, businesses have experienced increasing pressure to disclose more information about their plans to lower their greenhouse gas (GHG) emissions and their overall climate change strategy. Globally, stakeholders, and public interest groups have called for greater disclosure, increased transparency, and a consistent approach to GHG emissions (e.g. Black, 2013; Flammer, 2013; Qian and Schaltegger, 2017). Meanwhile, firms and their insurers have expressed concerns over the cost of these disclosures from the viewpoint of liability exposure and competitive disadvantage (Allen *et al.,* 2009; Weigand, 2010). Additionally, there are individuals who urge balancing the approach by considering both costs and benefits (e.g. Li *et al.,* 1997). Therefore, today's firms face the challenging task of determining the appropriate level of disclosure of the risks and costs associated with GHG emissions. It is no surprise that the question of whether being green receives consistently close scrutiny by both the media (Hart, 1995; Lam *et al.,* 2016) and scholarly journals. The event study methodology is widely adopted to address this question. It does so by quantitatively examining stock market reactions to company announcements related to environmental initiatives (e.g. Klassen and McLaughlin, 1996; Jacobs *et al.,* 2010).

The objective of this study is to demonstrate how investors and the market reacts to firms' environmental initiatives to disclose their carbon profile. This objective will be achieved by examining and extending the extant literature on whether investors see voluntary disclosure of carbon emissions information as being relevant to stock valuation.

One initiative to meet the need for consistency and transparency is the Carbon Disclosure Project (CDP).[33] The CDP is a charitable organisation concerned with environmental impact and pursues the goal of spreading environmental risk management and reporting throughout the business

[33] Currently the world's largest register of corporate carbon disclosures, the CDP was established in 2000 in the UK. Its central activity is administrating an annual survey on behalf of investor signatories. The CDP survey collects information from public companies on climate change-related issues. Its breadth of coverage has also led it to become an important data source for academic research. The CDP has highlighted the fact that its data was used in 70 peer-reviewed studies published between 2005 and 2015.

community. Its strategy aims to facilitate investors to move away from shareholdings bearing risk arising from climate change impacts. The CDP sends companies listed on major stock indices such as the FTSE350 and S&P500 an annual survey. The survey gathers information under the following three headings: (a) climate change management: strategy, initiatives, target, communications, and governance; (b) climate change-related risks and opportunities; and (c) climate change emissions methodology, emissions performance, emissions data, and energy and emissions trading. The collected information is made available to the public via the CDP website. The present study is motivated by a desire to understand the nature and consequences of businesses' approach to climate change outside of regulatory compliance, viewed from the perspective of participation in the CDP to make voluntary carbon disclosures. To meet our objective, we apply the event study method and select three days around the event dates as the event window (i.e one day before the event, the event day itself and one day after the event). Applying this procedure helps us account for potential pre-event information leaks and the scenario where announcements are made after the stock market has closed. Any further expansion of the window would open up the likelihood in which market movements are not attributable to the specific event (Fisher-Vanden and Thorburn, 2011). The sample comprises 1,564 firm-year observations of firms listed on the FTSE350 index for the period 2009–2015. This period witnessed heightened public engagement in climate change issues and the associated policy debate. The firms listed on the FTSE350 are the UK's largest public companies by market capitalisation, and hence they offer a core representation of the UK's economic performance and its carbon strategy. The findings of this study show that investors react significantly negatively to firms disclosing their carbon profile through participation in the CDP, regardless of disclosure level or score. These findings indicate that investors' perceptions are in line with a win-lose logic of being green, but with economically disadvantageous consequences (Freedman, 1970). Moreover, concerning robustness checks, the market reaction is significantly negative for businesses that make disclosures to the CDP but operate in carbon-intensive industries. With CDP participation seen as an indication that environmental costs will rise, the cost implication is acute, particularly for companies operating in carbon-intensive industries (Ramiah *et al.,* 2013). Moreover, we examine the impact of the global financial crisis (GFC) on the market reaction for those firms responded to the CDP survey as an additional analysis, by creating a sub-sample for the period of 2007-2008. The results demonstrate a significantly positive market reaction. Investors interpret firms' participation in CDP during the GFC as a signal of financial strength

that allows for the allocation of financial resources to environmental initiatives. Earlier studies of market reactions to carbon disclosure have been conducted in the US context (e.g. Jacobs *et al.,* 2010; Fisher-Vanden and Thorburn, 2011; Kim and Lyon, 2011; Hsu and Wang, 2013). A smaller number of studies have examined carbon disclosures in developing countries, typically Asian contexts (e.g. Lee *et al.,* 2015; Lam *et al.,* 2016). European contexts have received very limited attention regarding market reaction to carbon disclosures, including the UK. It is worth mentioning that we already examined the voluntary carbon disclosure impacts on some of the market variables in Chapter 2 by applying regression methodologies, however, that test does not clearly consider the immediate market reaction towards the announcements of voluntary carbon disclosure. In Chapter 2, the regressions capture the carbon disclosure effects on market variables based on long term period (i.e. 9 years), while in this chapter we seek to capture the immediate market reaction from such announcements by using very short event window through event study methodology. Indeed, to the best of our knowledge, this is the first study examining the market responses of the London Stock Exchange to announcements related to carbon disclosure by applying the event study approach.

The UK, as a G7 (Group of Seven) member, is one of the world's biggest emitters of GHG (Haque, 2017) making it a pertinent setting for studies of this kind. Moreover, the UK is currently at the forefront of the development of mechanisms to proactively mitigate the negative consequences of climate change. Notably, the UK has the greatest proportion of firms making Scope 1 and 2 emissions disclosures (>97%) and the greatest proportion of board-level oversight of climate change risk (96%) (CDP, 2018b).[34] In 2008, The UK's Committee on Climate Change gave the government a recommendation to put in place a GHG reduction target that would see emissions fall to a minimum of 80% of the 1990 levels by 2050. The following year, the government published voluntary guidelines for measuring and reporting of GHG emissions to encourage firms in the UK to reduce their climate change impact. Furthermore, the Companies Act 2006 (Strategic Report and Directors' Report) Regulations 2013 (SI 2013/1970) brought in statutory requirements for listed companies regarding GHG emission disclosure. Since 1st October 2013, the firms have been obligated to publish a directors' report of GHG emissions and

[34]Scope 1 emissions are those directly emitted by sources owned or controlled by the reporting firm. Scope 2 emissions are indirect and represent emissions arising from the generation of energy purchased.

the methodology applied in calculating them. The UK is, therefore, a highly significant country in terms of both emissions and emissions disclosure terms. Hence, it is important to address the gap noticed in the case of the country, which is addressed in the present study.

Furthermore, we contribute to the continuing literature by constructing the cost-benefit approach as a conceptual model, to understand market reaction to voluntarily corporate engagement in climate change initiatives. One proposes that voluntary moves aimed at improving corporate environmental strategy decrease profits and, therefore, runs counter to the maximization of shareholder value, a "win-lose" perspective (e.g. Freedman, 1970). On the other hand, there is another perspective which emphasises that shareholder value and corporate environmental strategy are not mutually exclusive. Instead, under this view it is proposed that tackling emissions and achieving profitability can be pursued together, in a "win-win" approach (e.g. Porter and Van der Linde, 1995).

Our study's findings offer fresh insights and updated policy implications for investors, management, and sustainability institutions (e.g. CDP). The London Stock Exchange placed a negative value on voluntary carbon disclosures announcements due to the interpretation that any costs incurred beyond regulatory compliance is against the interests of shareholders and would generate disadvantages economic consequences. We conclude that voluntary carbon disclosures should include statements justifying environmental strategy and accompanying initiatives. Justifications may include, for example, ensuring readiness for forthcoming legislation, carbon trading intentions, or competitive lobbying. Statements should be clear on the anticipated value of these efforts.

In the next section, we review existing literature and explain the hypothesis development. The research design and methodology are explained in the Section 4.3. The Section 4.4 presents the empirical results. Concluding remarks are made in the Section 4.5.

4.2 Literature Review and Hypothesis Development

4.2.1 Background

Researchers have shown considerable interest in the economic consequences of a firm's social responsibility (e.g. Hart and Ahuja, 1996; Russo and Fouts, 1997; Orlitzky and Benjamin, 2001; Lee and Faff, 2009; Luo and Bhattacharya, 2009; Hussainey and Salama, 2010; Salama *et al.,* 2011; Jo and Na, 2012; Benlemlih *et al.,* 2018). Some of the early literature followed the approach of Freedman's proposition that the "social responsibility of business is to increase its

profits" (Freedman, 1970, p. 122) and firmly positioned corporate social responsibility (CSR) in the cost column. As a cost of doing business, CSR would inevitably mean low profits and directly conflict with management's obligation to shareholders. For example, a firm contemplating to install a new clean energy machine and to train staff would require new capital, both of which would come at a significant cost. Conversely, another stream of literature challenges Freedman's approach by arguing that the twin pursuits of pollution control and profitability are not necessarily mutually exclusive (Porter and Van der Linde, 1995). This approach sees pollution as a wasteful use of energy and material resources; furthermore, efforts to control pollution, for example, through improved processes or products, can bring the double benefit of reducing the firm's carbon footprint while strengthening its competitiveness. Empirical studies have produced mixed results when examining the CSR and firm financial performance. These studies can be put into one of the following three groups based on their analytical approach: (a) portfolio analysis, (b) regression analysis, and (c) event studies.

Studies using the portfolio analysis method aim to examine whether returns for a portfolio comprising firms with a positive environmental responsibility outperform the market as a whole. The results have been negative especially for old studies, finding that mutual funds made up of environmentally or socially responsible firms perform less well in terms of risk-adjusted returns (White, 1996; Geczy, *et al.,* 2005). Similarly, Ziegler *et al.* (2009) reported a negative abnormal return for investment strategies that involve buying stocks of companies that are proactively aiming to reduce GHG emissions and divesting stocks where the firms invest no significant environamntal efforts. However, a more recent study finds that investors could gain abnormal risk-adjusted revenues of around 13% annually when investing in portfolios entirely comprised of firms which disclose their carbon profile (Liesen *et al.,* 2017).

Studies using regression analysis focus mainly on the relationship between environmental responsibility and financial performance over the long term. Several studies have found a positive relationship. Others, however, reported either mixed findings or a negative relationship (e.g. Jaggi and Freedman, 1992; Molloy *et al.,* 2002; Clarkson, *et al.,* 2004). Generally, it appears that a positive relationship is found when the environmental measures involve compliance, regulatory risk, and liability (Fisher-Vanden and Thorburn, 2011). Furthermore, Matsumura *et al.* (2014) reported a significantly negative relationship between GHG emissions and the value of equity. Their suggestion is attributed to the "uncertainty surrounding physical climate parameters" as well as to the costs associated with "measuring, monitoring, and reducing carbon emissions"

(Matsumura *et al.,* 2014, p. 701). The implication of the empirical evidence from these regression studies is that a negative impact on financial performance should be anticipated from environmental investments (Fisher-Vanden and Thorburn, 2011). It should be noted, however, that the long-term nature of these studies exposes firm performance to an array of explanatory factors that are beyond environmental responsibility.

The event studies investigate how markets react to environmental initiatives/disclosures/activities. Although the event study methodology has been proven to be a productive approach, the findings have not been consistent, with some results indicating a positive reaction to environment-related announcements, others a negative reaction, and some even reporting the absence of any effect. In one of the earlier studies, Shane and Spicer (1983) reported that the stock market reaction to announcements of improved pollution performance is more positive than it is for announcements of poor performance. Likewise, Klassen and McLaughlin (1996) found that positive abnormal stock returns are normally triggered by positive firm events such as the winning of an environmental award. Additionally, Griffin and Sun (2013) found that capital markets give a positive response when firms voluntarily disclose GHG emissions. Contrary to this evidence, other studies found a different negative reaction to events. For example, when Finnish forestry firms announce environmental investments, the stock market's reaction is found to be negative (Halme and Niskanan, 2001). In the same vein, when studying investor perceptions, Molloy *et al.* (2002) found that the perception of environmental investment is that it increases costs, not reduces them. Moreover, Beatty and Shimshack (2010) reported that stock markets react to negative environmental disclosures but not to positive ones. Basing his study on the toxic release inventory's data releases, Hamilton (1995) found that the public disclosure of these data and the press coverage thereof leads to significantly negative abnormal returns in cases where the toxic release was high. Furthermore, Stevens (1984) found that companies whose pollution control costs are low are more likely to experience positive abnormal stock market returns when compared to firms incurring high costs. The interpretation of investors is that the new information increases firm liability or compliance risk, thereby leading to higher costs. Another event study on ISO 14001 certification announcements reported that the shares of firms that are relatively less polluting drop the post-announcement (Cañón-de-Francia and Garcés-Ayerbe, 2009). The interpretation of the authors is that investors see no significant benefit with such certification, but associate it with high costs. In recent studies, both Chapple *et al.* (2013) and Griffin *et al.* (2017) found that there is a negative relationship between GHG

emissions disclosures to the CDP and shareholder value. They concluded that shareholders treat carbon emissions as a hidden off-balance sheet liability. In a study most closely related to the present one, Lee *et al.* (2015) proposed that the stock market would react negatively to a company's CDP carbon disclosure based on the fact that such announcements are viewed as bad news that potentially involves costly mitigation measures. Finally, as mentioned, there are studies reporting no effect. An examination of environmental conscientiousness scores covered in the press revealed no significant abnormal stock market returns in response (Yamashita *et al.,* 1999). Similarly, Gilley *et al.* (2000) reported that the stock market did not react in any significant way to company announcements on environmental initiatives. This aligns with Jacobs *et al*. (2010) who found, among their other findings, that environmental initiative announcements fail to provoke significant stock market reactions. Kim and Lyon (2011) also showed a lack of evidence for increases in company value arising from carbon disclosure.

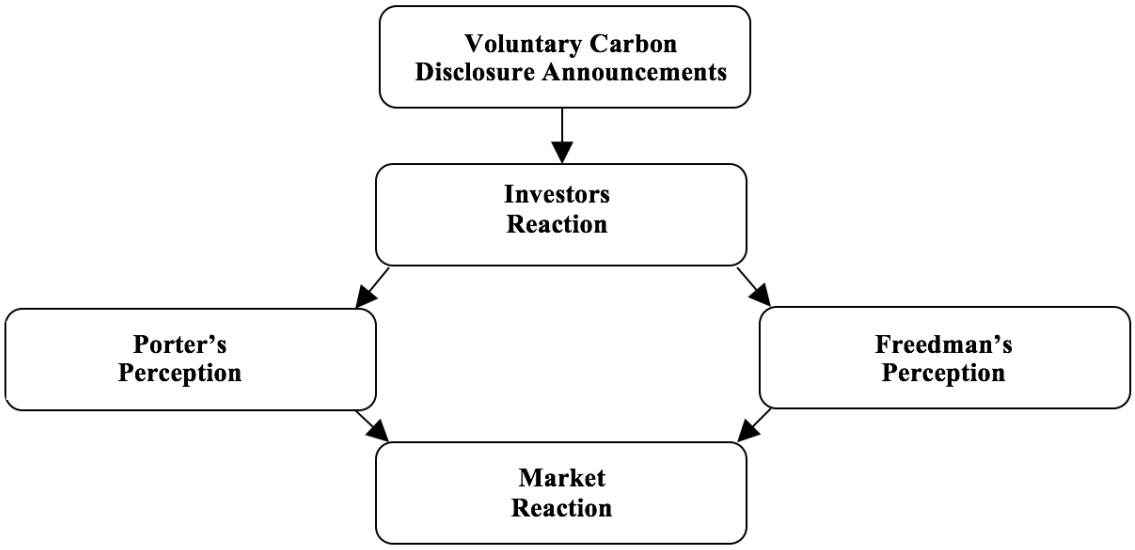

Figure 4.1 Conceptual Model Linking Voluntary Carbon Disclosure to Market Reaction

4.2.2 Hypothesis Development

The stakeholder theory is a popular approach among CSR researchers (Lee *et al.,* 2015). It emphasises the influence of various stakeholder groups, including investors, employees, customers, government, and the community, on firm decision making (Freeman, 1984). Since the market reaction is a consequence of investor reaction, our hypothesis is formulated based on how investors will react to voluntary carbon disclosure announcements initiated by the CDP. Two

main mechanisms have been proposed to examine how CSR either increases revenues or costs (Freedman, 1970; Porter, and Van der Linde, 1995). A review of these mechanisms reveals the way voluntary carbon disclosure may impact market reaction.

The framework shown in Figure 5.1 was used to develop the hypothesised impact of carbon disclosure announcements on markets. Figure 5.1 indicates that it is possible that investors' perception of the voluntary efforts for carbon disclosure will match Freedman's perception. Freedman (1970) proposed that if a firm incurs environmental expenses beyond those required for regulatory compliance, then they would be acting against the interests of shareholders and would see a negative effect on firm value and performance. In line with this, investors may view firms asked to make disclosures to the CDP as having potentially high GHG emissions and with them high mitigation costs. Furthermore, where carbon information is disclosed, there may be no benefit to investors (Kolk *et al.,* 2008). By agreeing to participate in the CDP, firms are committing to disclosing their existing GHG emission levels, reduction targets, initiatives to achieve these targets, and associated risks and opportunities arising from global warming (Lee *et al.,* 2015). Mitigation initiatives tend to be related to costs. To exemplify, the decision to deploy green technologies is associated with an investment that would not be required if the firm decides not to act as a green firm (Wegener, 2010). Jacobs *et al.* (2010) suggested that markets react negatively to voluntary initiatives to reduce emissions because the associated costs are evident, while the revenue benefits are hard to define. Consistent with this and other studies, Fisher-Vanden and Thorburn (2011) found that participation in the Environmental Protection Agency Climate Leaders programme, as a resource for reducing GHG emissions voluntarily, is linked to a negative market reaction.[35] Palmer *et al.* (1995) argued that shareholders' wealth is reduced by efforts to mitigate climate change because such efforts can mean diverting the investment from more productive activities, and can hence mean that the full potential earnings of its assets are not realised. As a result, the firm finds itself disadvantaged economically. In line with this argument, Hsu and Wang (2013) reported that positive wealth effects are associated with firms receiving negative news coverage regarding climate change. Lee *et al.* (2015) suggested that investors have concerns that measures to combat global warming may not bring sufficient benefits to justify the costs. Indeed, this concern also has a political dimension. According to Hsu and Wang (2013),

[35] The Environmental Protection Agency Climate Leaders programme is an American governmental initiative aimed at tackling climate change threats and mitigating GHG emissions.

the deadlock in the run-up to the Paris climate treaty was partly due to the issue of additional firm costs and the threat to the competitiveness of some industries.

Alternatively, as shown in Figure 5.1, it is also possible for investors to view carbon disclosures through Porter's lens. This sees pollution as wasted resources and, therefore, views mitigation measures and the enhancement of carbon profile as strengthening firm competitiveness in a win-win situation (Porter and Van der Linde, 1995). Furthermore, a participation in voluntary carbon disclosure will enable a firm to attract and retain high quality staff (Turban and Greening, 1997), encourage innovation (Surroca *et al.,* 2010), and improve decision making as well as overall organisational culture (Sharma and Vredenburg, 1998; Hillman and Keim, 2001).

In line with the stakeholder theory (Freeman, 1984), it has been argued that companies engaged in enhancing their environmental responsibility are acquiring both stakeholder support and necessary resources, which mitigates against legislative, regulatory, or fiscal actions (Buysse and Verbeke, 2003; Flammer, 2013). In turn, such activities can enhance firm reputation (Hart, 1995), may manage firm legitimacy (Porter and Kramer, 2006), and reduce financial risks (Peloza, 2009). It may also attract investment from the growing number of environmentally conscious investors (Heal, 2005; Consolandi *et al.,* 2009; Dowell and Hart, 2011). The increased demand from environmentally conscious consumers can lead to a growth in share prices. Klassen and McLaughlin (1996) and Dowell *et al.* (2000) suggested that important reputational benefits emerging from positive environmental actions can be associated with revenue growth, therefore maximising shareholder wealth by creating reputational capital. Turning to costs, participation in CDP as an environmental initiative may help companies achieve cost reductions by reducing pollution and other forms of waste (Porter and Van der Linde, 1995). Costs may also be lowered by improving energy efficiency and operational and supply chain business processes (Hart and Ahuja, 1996; Christmann, 2000; Sroufe, 2003; Rao and Holt, 2005). This might lead to better employment of inputs, causing a reduction in raw materials and/or waste disposal expenses. In the long term, costs related to future environmental crises, regulatory compliance, and liabilities may be avoided (Reinhardt, 1999; Karpoff *et al.,* 2005).

It is clear from this discussion that the views of Freedman (1970) and Porter and Van der Linde (1995) represent two expected outcomes from voluntary carbon disclosure, in terms of stock market reaction. The former is a negative reaction, and the latter is a positive one. Therefore, we formulate the following reference hypothesis:

H_1: There is a significant market reaction following the announcement of CDP survey.

4.3 Research Design and Data

4.3.1 Sample

Since the FTSE350 is the largest index in the UK that is annually assessed by the CDP, all firms continually listed on the FTSE350 between 2009 and 2015 were included in the sample. It is noteworthy that the FTSE350 firms were originally asked in 2006 to engage with and report their carbon footprint voluntarily via the CDP online survey.36 This first year, however, was not used for our analysis because (1) there was only a low level of participation in the CDP, and (2) the qualitative analysis only extended to assigning responses to one of the following four categories: Answered Questionnaire (AQ), Provided Information (IN), Declined to Participate (DP), and No Response (NR). From the following year, a 0 to 100 scoring scale was introduced. Notwithstanding this change, we also decided to exclude the period 2007-2008 to isolate our analysis from the effects of the global financial crisis (GFC). However, we will consider this impact in the additional analysis section. Following standard practice for research of this kind, financial institutions were also excluded because of their unique accounting principles and the different social and environmental guidelines they apply, such as the 'Equator Principles' (Hussainey and Salama, 2010; Macve *et al.,* 2010; Haque, 2017; Qiu *et al.,* 2016).37 Ultimately, the sample comprised of 1,564 firm-year observations crossing nine industries. The Global Industry Classification Standard (GICS) used for the CDP sector categories is also applied to this study. A summary of the final sample distribution by industry and year is given in Table 4.1 Panel A indicates 2014 as the highest year for response rate (79%) and 2009 as the lowest (57%) in the sampled period. Despite the surprising drop in 2015, it is clear that the annual increase in the response rate is consistent with the public concern related to climate change. Panel B shows that the utilities industry has the highest overall response rate (93%), while the technology industry has the lowest (52%). Based on the FTSE All-Share Index classification, this study

[36] The CDP reporting year is set to match the fiscal year of each participating firm. Subsequently, the summary of survey data is generally published in September or October of the reporting year.

[37] The *Equator Principles* offer financial institutions a risk management framework aimed at providing a minimum standard for determining, assessing, and managing environmental and social risks in projects. See: http://www.equator-principles.com.

indicates that the response rate for firms operating in carbon-intensive industries (72%) is almost equal to the response rate for the firms in non-intensive industries (71.25%). 38

	Participated Firms	Non-Participated Firms	Total	Response Rate %
Panel A: Sample Structure and Response Rates by Year				
2009	130	100	230	57%
2010	137	87	224	61%
2011	156	74	230	68%
2012	163	47	210	78%
2013	176	53	229	77%
2014	171	45	216	79%
2015	167	58	225	74%
N	1,100	464	1,564	
Panel B: Sample Structure and Response Rates by Industry				
Basic Materials	102	61	163	63%
Consumer Goods	155	33	188	82%
Consumer Services	266	145	411	65%
Health Care	54	20	74	73%
Industrials	311	107	418	74%
Oil and Gas	79	43	122	65%
Technology	45	41	86	52%
Telecommunications	36	10	46	78%
Utilities	52	4	56	93%
N	1,100	464	1,564	

Table 4.1 Sample Distributions of Chapter Observations based on Participating in CDP
This table reports the distribution of our sample from 2009 to 2015 by industry and year.

4.3.2 Event Study

The market reaction following announcements in the CDP report is estimated by using event study method, thereby testing the hypothesis. This method provide the means (medians) to estimate event-related market returns and, at the same time, control for more general market influences on stock prices (MacKinlay, 1997; Jacobs *et al.,* 2010). The underlying assumption is that, in conditions of market efficiency, an event's effect is reflected immediately in the stock

[38] FTSE All-Share Index standards are applied to identify carbon-intensive industries based on the level and nature of GHG emissions. These were industrials, basic materials, utilities, consumer services, and oil and gas.

price of the concerned firm. Consequently, by observing the stock price for a short time span, event effects on a firm's value can be recorded (Fisher-Vanden and Thorburn, 2011).

The initial task when implementing the event study is to determine the event period, this being the period for estimating abnormal returns. To encompass the possibility of pre-announcement information leakage, the day prior to the announcement is included in addition to the announcement day itself (Lam *et al.,* 2016). For this reason, and to align with previous event studies (Ba *et al.,* 2013; Wassmer *et al.,* 2014; Lam *et al.,* 2016), we selected three days around the event dates as our main event window (i.e. days -1 to +1). This procedure would help us to account for the possibility of pre-event information leakages and the possibility of announcements being made after stock market closures. Further extension of the window would open up the possibility in which market movements are not attributable to the particular event (Fisher-Vanden and Thorburn, 2011). Calendar days are converted to event days by designating the announcement day as Day 0. If the announcement is made on a non-trading day or later than 4.30 pm London time of a trading day, then Day 0 would become the following day. All other trading days are recorded as relative to Day 0; hence, the trading day prior to Day 0 (announcement day) is recorded as Day -1. Likewise, the trading day immediately after the announcement day is designated Day 1. Additionally, aligning with previous studies, the estimation of abnormal returns is conducted using the market model (e.g. Jacobs *et al.,* 2010; Fisher-Vanden and Thorburn, 2011; Wassmer *et al.,* 2014).

Under this model, a linear relationship is posited between a given stock's return and the market return (the return on the market portfolio) over a specified period of time:

$$ER_{it} = a_i + \beta_i R_{mt} + \varepsilon_{it} \qquad (1)$$

whereby ER_{it} represents the expected return of stock *i* on Day *t*, R_{mt} represents the market return on Day *t*, a_i is the intercept of the relationship for stock *i*, and β_i is the slope of the relationship for stock *i* regarding the market return, with ε_{it} being the error term for stock *i* on Day *t*. The term $\beta_i R_{mt}$ represents the sensitivity of stock *i*'s returns to market return. This portion of the return for which market movements provide no explanation is represented by the error term ε_{it}, which captures the effects of the firm-specific information released. The computation of expected return for each firm in the sample is estimated in accordance with Equation (1), where a_i and β_i are estimated by applying the ordinary least squares regression across the 200-trading-day estimation

period. The commencement of the estimation period was designated, with Day -200 being the first trading day of the year, and terminated on Day -21. The reason for terminating the estimation period 21 days before the event day is to protect the estimates from contamination due to the impacts of the announcement and to render any stationarity inconsequential. In cases where a firm does not have data available for the entire estimation period, a qualifying minimum of 40 stock returns during the 200-day period was applied to the estimates in Equation (1).
Next, the computation of the abnormal return for firm *i* on Day *t*, which is the difference between the actual and the expected return, goes as follows:

$$AR_{it} = R_{it} - ER_{it} \quad (2)$$

whereby AR_{it} is equal to the abnormal return on security *i* on date *t*, R_{it} represents the actual return of stock *i* on Day *t*, and ER_{it} represents the expected return of stock *i* on Day *t*.
After this, aligning with previous event studies (e.g. Gilley *et al.,* 2000; Jacobs *et al.,* 2010; Lam *et al.,* 2016), the data is both parametrically and non-parametrically tested. First, for testing the data parametrically, we use the t-test to determine the statistical significance of the mean of cumulative abnormal returns (CARs). Second, for testing the data non-parametrically, we control for the effect of outliers using the Wilcoxon signed-rank test, which determines the statistical significance of the median of CARs.[39]
Finally, the CARs are computed by cumulating ARs over the announcement period.

$$AR\ [t_1, t_2] = \sum_{t=t_1}^{t_2} AR_{it} \quad (3)$$

whereby CAR is the cumulative abnormal return, *t* is the selected day related to the announcement event and AR_{it} is the abnormal return on security *i* on date *t*.

[39] Since the study's observations are not normally distributed on the basis of a Sapiro-Francia normality test, the Wilcoxon signed-rank non-parametric statistical test is prioritised for explaining the results (McDonald, 2009). Therefore, if the results of these two tests (t-test and Wilcoxon signed-rank test) are inconsistent, we consider the Wilcoxon signed-rank results.

4.4 Results and Analysis

4.4.1 Descriptive Statistics

Descriptive statistics of the sample use data from the fiscal year immediately prior to the most recent announcement, and are shown in Table 4.2. The averages of firms' market value and total assets are £9.7 and £8.8 billion, respectively, which suggests that our sample comprises large firms. While there is broad variation in firm characteristics found in the sample, there is an overall weighting towards the London Stock Exchange's largest firms by market capitalisation.

	Market Value (£M)	Total Assets (£M)	Sales (£M)	Net Income (£M)	Employees
Mean	9,776.55	8,835.48	7,875.15	593.31	26,643.69
Median	1,961.40	1,660.80	1,425.33	108.58	8,354.50
SD	23,582.01	26,594.06	28,930.35	1,789.27	61,447.96
Max	143,951.20	226,632.40	298,487.50	17,374.88	648,254
Min	242.63	38.54	0.29	-274.56	8

Table 4.2 Descriptive Statistics of Chapter Observations
This table is based on our sample for the period 2009 to 2015, comprising 1,564 firm-year observations.

4.4.2 Market Reaction to CDP Announcements

Table 4.3 (Panel A) shows how markets reacted to announcements from companies participating in the CDP report; additionally, the t-test and Wilcoxon signed-rank test results of ARs and CARs are presented. The ARs on Day -1 are not statistically significant for both the t-test and Wilcoxon signed-rank test, indicating an absence of evidence of information leakage prior to CDP announcements. Furthermore, the median of ARs on day 0 is significantly negative on the Wilcoxon signed-rank test. A subsequent checking of CARs periods reveals evidence that responses from capital markets had a significantly negative relationship with the voluntary carbon information disclosure for various lengths of the event window. Notably, the mean (median) of CARs over the two-day window (0 to +1) and for the key three-day event window (-1 to +1) are statistically negatively significant at the 5% and 10% levels, respectively, for the Wilcoxon signed-rank test, which indicates that investors respond negatively to the CDP announcements of FTSE350 firms. This could be ascribed to the fact that investors interpret climate-related environmental initiatives as an investment/cost to the company without an offsetting benefit, that reduces competitive advantage, which aligns with the conclusions of Cañón-de-Francia and Garcés-Ayerbe (2009). It would also align with Hsu and Wang's (2013) findings that, generally, investors hold the belief that when firms tackle climate change, it can

increase costs and place firms at an economic disadvantage. In other words, voluntary carbon disclosure requires additional costs that reduce the attractiveness of investment in the firm, which may lead investors to abandon the firm's stock even at low prices. Therefore, **H**1 is supported, and London Stock Exchange investors' reaction is consistent with Freedman's (1970) view that expenses incurred for environmental purposes, which fall outside of regulatory compliance run, counter to the best interests of shareholders and degrade firm value. Conversely, market reactions to CDP's non-participants, shown in Panel B of Table 4.3, were not significant, particularly for the key event window (-1 to +1), with the exception of Day 0 that is negatively significant in the Wilcoxon signed-rank test.

Panel A: Participated Firms					
Day	N	Mean	Median	t-Test	Wilcoxon signed-rank test
Abnormal Return (ARs)					
-1	1100	-0.018%	-0.018%	-0.378	-0.755
0	1100	-0.054%	-0.095%	-1.030	-2.483**
+1	1100	-0.045%	-0.061%	-0.804	-0.948
Cumulative Abnormal Return (CARs)					
-1, 0	1100	-0.072%	-0.115%	-1.103	-2.092**
0, +1	1100	-0.098%	-0.144%	-1.326*	-2.156**
-1, +1	1100	-0.122%	-0.202%	-1.351*	-1.798*
Panel B: Non-Participated Firms					
Day	N	Mean	Median	t-Test	Wilcoxon signed-rank test
Abnormal Return (ARs)					
-1	464	0.120%	-0.142%	1.301	-0.636
0	464	-0.178%	0.109%	-1.867	-2.195**
+1	464	0.096%	0.062%	1.060	1.334
Cumulative Abnormal Return (CARs)					
-1, 0	464	-0.072%	-0.115%	-0.453	-0.782
0, +1	464	-0.058%	-0.221%	-0.634	-0.583
-1, +1	464	-0.050%	0.154%	-0.295	-0.632

Table 4.3 Market Reaction for Participated and Non-Participated Firms in CDP Report
*This table is based on our sample for the period 2009 to 2015, comprising 1,564 firm-year observations. * p<10% (one-tailed tests), ** p<5% (one-tailed tests), and *** p<1% (one-tailed tests).*

The explanation of our findings is that participation in the CDP survey is perceived as leading to extra costs from investors' perspective. The robustness of the main results presented in Table 4.3

are inducted on firms participating in CDP and working in carbon-intensive industries. For such firms, there is a greater likelihood of significant costs being incurred in relation to environmental protection, including risk management, clean-up costs, and reporting and compliance costs (Nguyen, 2018). For this, we divide the firms participating in the CDP survey into ten industries (nine after excluding the financial industry) based on GICS classification.

We then apply FTSE All-Share Index standards to identify carbon-intensive industries within the subsample of firms that participated in the CDP survey (1,100 observations). These were found to be consumer services, basic materials, industrials, utilities, and oil and gas. Panel A in Table 4.4 indicates that investors react to CDP announcements for firms working in carbon-intensive industries in a significantly negative way at the 5% level. This response occurs in almost all window periods, particularly in the key event window (-1 to +1) and on the announcement day itself (Day 0). The mean and median results of ARs and CARs for these and other periods support the notion that investors' impressions of participation in measure to tackle climate change and voluntary carbon disclosure initiatives are a cost on firms. This finding is aligned with Chapple *et al.* (2013) who also found that the market evaluates the most carbon-intensive firms in the sample more negatively than other firms. These investors' reactions reflect the expectation that environment-related costs will increase, creating negative financial consequences; an expectation that is even more pronounced for firms in carbon-intensive industries (Ramiah *et al.,* 2013). These cost consequences may be carbon-related management and accounting costs, clean-up costs, litigation and compliance costs or reputational damage costs. For firms working in non-intensive industries (Panel B), although there are significant positive reactions thru t-test on the announcement day (day 0) and for the event window of (-1 to 0), we were unable to confirm these results since the test of Wilcoxon signed-rank has insignificant signs.

Panel A: Intensive Industries					
Day	N	Mean	Median	t-Test	Wilcoxon signed-rank test
Abnormal Return (ARs)					
-1	810	-0.023%	-0.036%	-0.4258	-1.099
0	810	-0.136%	-0.129%	-2.313**	-3.169***
1	810	-0.041%	-0.053%	-0.581	-0.268
Cumulative Abnormal Return (CARs)					
-1, 0	810	-0.159%	-0.171%	-2.116**	-2.116**
0, +1	810	-0.176%	-0.161%	-2.001**	-2.347**
-1, +1	810	-0.198%	-0.266%	-1.812**	-2.089**
Panel B: Non-Intensive Industries					
Day	N	Mean	Median	t-Test	Wilcoxon signed-rank test
Abnormal Return (ARs)					
-1	290	-0.003%	0.022%	-0.033	0.384
0	290	0.175%	0.019%	1.575*	0.431
1	290	-0.056%	-0.118%	-0.702	-1.458
Cumulative Abnormal Return (CARs)					
-1, 0	290	0.171%	0.082%	1.322*	1.065
0, +1	290	0.119%	-0.079%	0.869	-0.239
-1, +1	290	0.089%	-0.038%	0.562	0.009

Table 4.4 Market Reaction for Participated Firms in Intensive and Non-Intensive Industries
*This table is based on firms participated in CDP from our sample for the period of 2009 to 2015, comprising 1,100 firm-year observations. * p<10% (one-tailed tests), ** p<5% (one-tailed tests), and *** p<1% (one-tailed tests).*

4.4.3 Additional Analyses

To examine the impact of the GFC period, we apply the same criteria as for the main sample, but change the period from 2009-2015 to 2007-2008, and the total observations for the new sample becomes 455.[40] Table 4.5 (Panel A) shows the market responses for companies participating in CDP announcements during the crisis period. The results through the two tests (i.e. t-test and Wilcoxon signed-rank test) over several event window periods, including the key period (i.e. -1, +1), show a significant positive market reaction. This finding can be explained as an investor perception of the CDP announcement as a signal of the financial strength of the participating firms. This perception is based on the view that firms that participated in CDP during the GFC are confident of their financial situation. This is demonstrated by their allocation of financial

[40] Consistent with Erkens *et al.,* 2012, we specify the years of 2007-2008 as the GFC period.

resources to non-profit social initiatives, such as voluntarily disclosure of their carbon profile through the CDP report. This finding is supportive of Mohr *et al.,* (2001) who argue that investment in CSR should be maintained during economic crises as it exerts a positive influence on stakeholder behaviour. Similarly, Gallego-Álvarez *et al.,* (2014) stated that CSR is required in times of financial crises to induce greater trust in the business. The results of non-CDP participants for the 2007-2008 period, as presented in Panel B of Table 4.5, shows that while market responses are inconsistent through ARs and CARs periods, for the key period (i.e. -1, +1), reactions are insignificant. Having said that, the market would not react positively or negatively for firms that do not disclose their carbon profile during the GFC period but will reward firms that disclose their carbon profile during the GFC period.

Panel A: Participated Firms					
Day	N	Mean	Median	t-Test	Wilcoxon signed-rank test
Abnormal Return (ARs)					
-1	181	0.128%	0.166%	0.528	0.665
0	181	0.598%	-0.327%	1.569*	-0.098
+1	181	0.465%	0.354%	1.670**	1.674*
Cumulative Abnormal Return (CARs)					
-1, 0	181	0.725%	0.036%	1.706**	0.849
0, +1	181	1.063%	0.358%	2.381***	1.881*
-1, +1	181	1.191%	0.183%	2.606***	1.918*
Panel B: Non-Participated Firms					
Day	N	Mean	Median	t-Test	Wilcoxon signed-rank test
Abnormal Return (ARs)					
-1	274	-0.305%	-0.0503%	-1.823**	-1.046
0	274	-0.234%	-0.446%	-0.972	-2.480**
+1	274	0.890%	0.535%	5.215***	4.998***
Cumulative Abnormal Return (CARs)					
-1, 0	274	-0.540%	-0.314%	-1.746**	-1.849*
0, +1	274	0.655%	0.201%	2.573***	1.851*
-1, +1	274	0.350%	-0.053%	1.1489	0.915

Table 4.5 Participated and Non-Participated Firms in CDP for Crisis Period
*This table is based on our sample for the crisis period of 2007-2008, comprising 455 firm-year observations. * p<10% (one-tailed tests), ** p<5% (one-tailed tests), and *** p<1% (one-tailed tests).*

4.5 Conclusion

Climate change has become a major issue in corporate decision making and poses a challenge to corporate leadership. There is increasing pressure for businesses to operate in a climate-friendly way, but a potential conflict may arise when such a strategy contradicts the pursuit of shareholder value. Empirical studies have produced mixed results when examining the issue of CSR and firm's financial consequences. Our study set out to understand the market reaction to carbon disclosures for the UK context. To this end, a conceptual model was applied which explains the market reactions, negative or positive (i.e. Freedman, 1970; Porter, and Van der Linde, 1995). In line with this model, we hypothesise that there would be a significant market reaction, either positive or negative, following the announcement of voluntary carbon disclosure via the CDP survey. The study uses an event study approach and a data set of 1,564 firm-year observations of large firms listed on the FTSE350 index for the period 2009-2015. In addition, two subsamples were analysed, one based on industry status (carbon-intensive/non-carbon-intensive) for CDP participating firms, and another that included a sample for the GFC period 2007-2008.

For the main sample, our analysis showed a statistically significant negative market reaction to carbon disclosure announcements of FTSE350 firms. This suggests that investors perceive such disclosures to be associated with climate-related environmental investments, representing costs that are not perceived to be offset by tangible benefits and that weaken competitive advantage. This result supports the win-lose view that any costs incurred beyond regulatory compliance is against the interests of shareholders and would have a negative effect on firm value (Freedman, 1970). For the industry status subsample, our results also show that investors in firms operated in carbon-intensive industries react to carbon disclosure announcements in a significantly negative way. This result also supports the expectation that firms operating in carbon-intensive industries experience a more pronounced negative reaction on voluntary carbon disclosure. For the temporal subsample (2007-2008), carbon disclosure announcements are associated with a significantly positive market reaction. We conjecture that this may be explained as an investor perception of the carbon disclosure announcement in the crisis period as a signal of the financial robustness of participating firms, though this explanation does not necessarily align with Porter and Van der Linde (1995) and their win-win approach.

Hence, overall, we can conclude that, in the case of the London Stock Exchange's investors, voluntary carbon disclosures are deemed to have a negative value as they signal directly assignable associated costs that are not matched by tangible financial benefits. The exception to

this was the 2007-2008 crisis period. This finding leads to the implication that more emphasis needs to be placed by management on identifying and justifying firms' environmental strategies and the resultant initiatives. Carbon disclosures should be accompanied by these clarifications, and expressions of the resultant value should be as tangible as possible. Future research may consider the scores of voluntary carbon disclosure for the firms included in the CDP report as a possible factor in the market reaction toward climate change initiatives. This could be achieved by controlling the disclosure score as a piece of good news for firms with a high disclosure score and bad news for firms with a low disclosure score. Moreover, using carbon disclosures data from a different source to the CDP would add to the present study and the empirical robustness of its findings. Finally, market reaction to mandatory carbon disclosure announcements could be considered in future research.

Chapter 5.Conclusion

5.1 Recapitulation

The motivation for this research was drawn from the mounting interest in examining how corporate initiatives aimed at tackling climate change impact a firm's financial situation. The UK was selected for the research sample as it is a high-polluting country with established voluntary carbon disclosure practices. Voluntary participation in the UK-based CDP testifies to how these issues have emerged in the corporate agenda. The aim of this research is to provide a meaningful illumination of the financial consequences resulting from voluntary carbon disclosure for the firms listed in the FTSE350 index from 2007 to 2015. To meet this aim, we utilised unique environmental and financial data from well-established sources— Bloomberg, Datastream, and the CDP databases.

Non-financial consequences of carbon disclosure were beyond the scope of this research which restricted itself to financial aspects. Consequently, the research comprised of three separate studies, each presented in its own chapter. The objective of the first study presented in Chapter 2, was to investigate the impact of carbon disclosure on firm FP. The RBV of the firm was applied as a theoretical framework and is linked to voluntary carbon disclosures. A comprehensive FP index was developed, and firm characteristics were controlled. By performing multiple sensitivity tests, convincing evidence was found for a positive effect of voluntary carbon disclosures on firm FP. Among the measures of FP, market-based measurements were found to have a less significant relationship with carbon disclosure when compared to others. The study also included tests investigating the effect of the 2007-2008 GFC, revealing that carbon disclosure serves as a significant determinant of the FP of UK listed firms after the crisis period. Moreover, results indicated that firms that achieved high FP reported highly positive carbon disclosure compared to a modest disclosure for firms with low FP. Finally, firms that operate in carbon-intensive industries were found not to derive benefits from their carbon disclosures in the same way as their non-intensive counterparts. The findings reported in this first study offer new insights and policy implications for management, investors and regulators. The findings strongly suggest that effective strategic management should include consideration of a firm's carbon footprint and is consequent disclosure activities. Corporate transparency should be extended to cover carbon-related decision-making and the role of these decisoins in management's pursuit of a sustainable competitive advantage.

Different stakeholder groups can see in these findings the benefits of voluntary carbon disclosure. Investors inparticular can consider the findings when making investment decisions, presumably viewing voluntary discloser firms more favourably. The findings will also enable regulators to develop their evaluation of firms' willingness to disclose their carbon emissions voluntarily and use this improved understanding when reviewing the regulatory framework.

The objective of the second study, presented in Chapter 3, was to investigate the impact of carbon disclosure on FR by testing the potentially positive relationship between the FR and information asymmetry. Again, the RBV framework is used to develop an understanding of how the inclusion of climate change inititiatives in the overall business strategy impacts FR. The adoption of a positive carbon strategy, of which carbon disclosure is a part, was found to reduce the firm's systematic, idiosyncratic, and total risks. In line with the first study, this relationship is not significant until after the GFC period. Additionally, the relationship was found to be more noticeable for carbon-intensive industries. Stakeholders, who are greatly concerned with the firm's survivability and sustainability, will find these findings particularly insightful.

The third study, presented in Chapter 4, examined the market reaction to voluntary carbon disclosure announcements via the CDP. The objective was to develop an understanding of the cost-benefit consequences of both climate change mitigation activities and the reporting thereof. By applying the event study methodology, it was found that markets give a significantly negative response to carbon disclosure announcements. Furthermore, this negative reaction was significantly stronger for firms in carbon-intensive industries. Conversely, during the GFC period, the market reaction was significantly positive to such announcements. The clear inference from this finding is that management should place extra emphasis on explaining the advantages of climate change mitigation expenditures and justifying their overall environmental strategy.

Each of the research objectives were addressed in separate empirical chapters. However, these were each unified components of the overall research aim which was to examine the financial consequences of voluntary carbon disclosure on leading UK companies. In combination, FP, FR and market reaction form a triangulated picture of the financial consequences of voluntary carbon disclosure with greater validity than taking one aspect alone.

This thesis has added original contributions to knowledge of how voluntary carbon disclosure interacts with three financial consequences: FR, FR and market reaction. Some contributions are shared across all three emprical chatpers as well as others unique to a given chapter. The first shared contribution was providing evidence from the UK on the financial consequences of

voluntary carbon disclosures to help fill the gap that existed in the literature. The second shared contribution was the evidence provided on the effect of industry type (carbon-intensive vs non-carbon-intensive industries) on the financial consequences of volutary carbon disclosure. Thirdly, each chapter added to understanding of the effect of the GFC on these consequences. Regarding the chapter-specific contributions, the first study presented in Chapter 2 makes two further contributions to the literature. First, it develops RBV theory towards understanding how a proactive carbon strategy which includes voluntary carbon disclosure can effect FP. Second, it provided an original use of a financial index for quantification of the financial impacts of carbon disclosure which adds to the broad ranging environmental accounting literature by identifying the impact of carbon disclosure on separate indicators, e.g. accounting vs market-based measures of firm FP. For the second study, presented in Chapter 3, a conceptual model based on RBV theory was devised which considers the positive association between information asymmetry and FR and which builds understanding of how voluntary carbon disclosure could affect FR. Second, as far as is known to the researcher, this is the first study to investigate the impact of voluntary carbon disclosure on FR. A third study was presented in Chapter 4. Alongside the aforementioned shared contributions this study proposes a theoretical framework using the cost-benefit approach and aimed at facilitating understanding of market reaction to voluntary carbon disclosure announcements.

Today, climate change poses a major threat to global economic stability and can have important effects on a firm's financial situation. The conclusion of this research is that there is a significant relationship between voluntary carbon disclosure and each of FP, FR and market reaction. This forms the basis for the implication that improvements should be made to the credibility, reliability, and relevance of carbon-related information to improve the overall quality of disclosures. Furthermore, greater emphasis needs to be placed on explicitly explaining the benefits of climate change mitigation activities to counter the perception among investors that costs associated with them negatively affect firm performance.

5.2 Limitations and Future Research

This research limited its sample to large firms listed on the FTSE350 of the London Stock Exchange. Caution should be exercised in generalising the findings of the three studies to firms with varying sizes and those in other countries. Furthermore, gaps in the data were encountered for certain variables, namely the R&D expenditures advertising expenses which may have

affected the analysis of the relationships of interest. Moreover, corporate governance, ownership structure, and audit-related issues could also be important as explanatory variables and we have not considered all of them in the all examined relationships because of the limited research scope and the difficulty to control all related variables in one piece of research.

Future researchers are urged to examine the relationships again and to investigate the UK's overall carbon profile once it has completed its withdrawal from the European Union. This withdrawal may be highly significant as it may include withdrawal from the European Union Emissions Trading System. Additionally, this single-country research could be developed into a comparative study by comparing firms in two or more countries since there are major differences between countries, specifically in their regulation and business environment. Moreover, investigations on the largest firms in the UK can be replicated for other smaller firms. Small firms have different sets of characteristics particular in their size, therefore they will experience less pressure from stakeholders including regulators, to be more responsible towards the environment. Recognising that the CDP is not the only source of disclosed carbon data, a different or multiple sources can be used in future studies. Forthcoming research may consider the level of voluntary carbon disclosure for firms included in the CDP report as a possible factor in the market reaction toward the climate change initiatives. Finally, investor reaction to mandatory carbon disclosure announcements can be compared with reactions to voluntary disclosure announcements.

Appendices

Appendix 2.1: Financial Performance Index (FPI)

---

1. Accounting Measures

1.1 Return on Assets (ROA)

= Net Income / Average Total Assets

Is a firm's ROA > the Industry Average?

a value of 1 if yes; 0 otherwise.

ROA measures the efficiency of assets in generating income (e.g. Busch and Hoffman, 2011).

1.2 Return on Equity (ROE)

= Net Income / Common Shareholders Equity

Is a firm's ROE > the Industry Average?

a value of 1 if yes; 0 otherwise.

ROE measures the shareholder return (e.g. Busch and Hoffman, 2011).

1.3 Asset Turnover (AT)

= Net Sales / Average Total Assets

Is a firm's AT > the Industry Average?

a value of 1 if yes; 0 otherwise.

AT measures the company ability to use its assets to generate sales (e.g. Cochran and Wood, 1984).

1.4 Debt-to-Equity Ratio (D/E)

= Short and Long-Term Debt / Shareholders' Equity

Is a firm's D/E < the Industry Average?

a value of 1 if yes; 0 otherwise.

D/E measures the creditor influence as it captures the significance of creditors as stakeholders relative to equity investors (e.g. Roberts, 1992).

1.5 Interest Coverage Ratio (IC)

= {Net Income / [1 - (Effective Tax Rate / 100)] + (Total Interest Expense - Total Interest Income)} / (Total Interest Incurred - Total Interest Income)

Is a firm's IC> the Industry Average?

a value of 1 if yes; 0 otherwise.

IC determines whether the company can pay the interest on its loans in a timely manner (e.g. Harrison and McMillan, 2003).

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2. Market Measures

2.1 Stock Return Volatility (RV)

$$Standard\ Deviation\ of\ Return_{it} = \sqrt{\frac{1}{n}\sum_{t}^{n}(R_{it} - R_{mean})^2}$$

i= firm, t= year

Is a firm's RV < the Industry Average?

a value of 1 if yes; 0 otherwise.

RV measures the level of daily return volatility over the 12 months as a proxy for the unsystematic risk (e.g. Jo and Na, 2012).

2.2 Cost of Equity (COE)

= (Risk-free Rate + [Beta x Country Risk Premium])

Is a firm's COE < the Industry Average?

a value of 1 if yes; 0 otherwise.

COE measures the expected return, given its total risk (e.g. Lee *et al.,* 2010).

2.3 Price-Earnings Ratio (P/E)

= Market Value per Share / Earnings per Share (EPS)

Is a firm's P/E < the Industry Average?

a value of 1 if yes; 0 otherwise.

P/E measures the market expectations for a company's growth (e.g. Fogler and Nutt, 1975).

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3. Combined Measures

3.1 Altman Z-score (Z)

=1.2 * (Working Capital / Tangible Assets) + 1.4 * (Retained Earnings / Tangible Assets) + 3.3 * (EBIT / Tangible Assets) + 0.6 * (Market Value of Equity / Total Liabilities) + (Sales / Tangible Assets)}

Is a firm's Z-score > the Industry Average?

a value of 1 if yes; 0 otherwise.

Z measures the probability of a firm suffering financial distress or bankruptcy (e.g. Miller and Reuer, 1996).

3.2 Market-To-Book Ratio (P/B)

= Market Capitalisation / Book Value of Common Equity

Is a firm's P/B > the Industry Average?

a value of 1 if yes; 0 otherwise.

P/B captures the industry's growth opportunities (e.g. Barnea and Rubin, 2010).

Data Source: Bloomberg Database.

Appendix 2.2: Summary of the Carbon Disclosure and Scoring Weight

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1. Climate Change Management: Governance, Strategy, Targets and Initiatives and Communications – *Scoring weighted average = 41.5/188 × 100 = 22%*

1.1 Governance Questions

1.1.1 What are the highest level of direct responsibility for climate change within your organisation?

1.1.2 Please identify the position of the individual or name of the committee with this responsibility.

1.1.3 Do you provide incentives for the management of climate change issues, including the attainment of targets? Please provide further details on the incentives provided for the management of climate change issues.

1.2 Strategy Questions

1.2.1 Is climate change integrated into your business strategy?

1.2.2 Does your company use an internal price of carbon?

1.2.3 Do you engage in activities that could either directly or indirectly influence policy on climate change through any of the following? (tick all that apply)

- Direct engagement with policy makers ❍
- Trade associations ❍
- Funding research organisations ❍
- No ❍
- Other……. ❍

1.2.4 Please select the option that best describes your risk management procedures regarding climate change risks and opportunities at both company and asset level.

- Integrated into multi-disciplinary companywide risk management processes ❍
- A specific climate change risk management process ❍

1.3 Targets and Initiatives Questions

1.3.1 Did you have emissions reduction/initiatives target that was active (ongoing or reached completion) in the reporting year?

1.3.2 Does the use of your goods and/or services directly enable GHG emissions to be avoided by a third party?

1.4 Communications Questions

1.4.1 Have you published information about your organisation's response to climate change and GHG emissions performance for this reporting year in places other than in your CDP response? If so, please attach the publication(s).

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2. Climate Change Risks and Opportunities – *Scoring weighted average = 54/188 × 100 = 29%*

2.1 Regulatory, Physical and Other Climate Change Risks Questions

2.1.1 Have you identified any inherent climate change risks that have the potential to generate a substantive change in your business operations, revenue or expenditure?

2.2 Regulatory, Physical and Other Climate Change Opportunities Questions

2.2.1 Have you identified any inherent climate change opportunities that have the potential to generate a substantive change in your business operations, revenue or expenditure?

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3. Climate Change Emissions Methodology, Emissions Data, Energy, Emissions Performance and Emissions Trading – *Scoring weighted average = 91/188 × 100 = 48%*

3.1 Emissions Methodology Questions

3.1.1 Please provide your base year and base year emissions.

3.1.2 Please give the name of the standard, protocol or methodology you have used to collect activity data and calculate emissions, the source for the global warming potentials the company used and the emissions factors you have applied and their origin; alternatively, please attach an Excel spreadsheet with this data at the bottom of this page.

3.2 Emissions Data Questions

3.2.1 Please select the boundary you are using for your greenhouse gas inventory.

Financial control	❍
Operational control	❍
Equity share	❍
Other …….	❍

3.2.2 Please provide your gross global emissions figures in metric tonnes CO_2e.

3.2.3 Are there any sources (e.g. facilities, specific GHGs, activities, geographies etc.) emissions that are within your selected reporting boundary which are not included in your disclosure? If yes please provide further details about the sources of emissions.

3.2.4 Please estimate the level of uncertainty of the total gross global emissions figures that you have supplied and specify the sources of uncertainty in your data gathering, handling and calculations.

3.2.5 Please indicate the external verification or assurance status that applies to your reported emissions.

3.2.6 Please provide further details of the verification or assurance undertaken for your emissions, and attach the relevant statements.

3.3 Energy Questions

3.3.1 What percentage of your total operational spend in the reporting year was on energy?

3.3.2 Please state how much fuel, electricity, heat, steam, and cooling in MWh your organisation has purchased and consumed during the reporting year.

3.4 Emissions Performance Questions

3.4.1 How do your absolute gross global emissions for the reporting year compare to the previous year?

3.4.2 Please identify the reasons for any change in your gross global emissions and for each of them specify how your emissions compare to the previous year.

3.5 Emissions Trading Questions

3.5.1 Do you participate in any emission trading schemes? If yes, please provide further details.

3.5.2 What is your strategy for complying with the schemes in which you participate or anticipate participating?

3.5.3 Has your organisation originated any project-based carbon credits or purchased any within the reporting period? If yes, please provide further details.

Sign Off – *Scoring weighted average = 1.5/188 × 100 = 1%*

- Please provide the following information for the person that has signed off (approved) the CDP climate change response:

i) Name

ii) Job title

iii) Corresponding job category

Source: https://www.cdp.net/Documents/Guidance/2015/CDP-climate-change-scoring-methodology.pdf

Appendix 3.1: Summary of the Carbon Disclosure and Scoring Weight

---

1. Climate Change Management: Governance, Strategy, Targets and Initiatives and Communications – *Scoring weighted average = 41.5/188 × 100 = 22%*

1.1 Governance Questions

3.1.1 What are the highest level of direct responsibility for climate change within your organisation?

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- Direct engagement with policy makers ❍
- Trade associations ❍
- Funding research organisations ❍
- No ❍
- Other……. ❍

1.2.4 Please select the option that best describes your risk management procedures regarding climate change risks and opportunities at both company and asset level.

- Integrated into multi-disciplinary companywide risk management processes ❍
- A specific climate change risk management process ❍

1.3 Targets and Initiatives Questions

1.3.1 Did you have emissions reduction/initiatives target that was active (ongoing or reached completion) in the reporting year?

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2.2.1 Have you identified any inherent climate change opportunities that have the potential to generate a substantive change in your business operations, revenue or expenditure?

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3. Climate Change Emissions Methodology, Emissions Data, Energy, Emissions Performance and Emissions Trading – *Scoring weighted average = 91/188 × 100 = 48%*

3.1 Emissions Methodology Questions

3.1.1 Please provide your base year and base year emissions.

3.1.2 Please give the name of the standard, protocol or methodology you have used to collect activity data and calculate emissions, the source for the global warming potentials the company used and the emissions factors you have applied and their origin; alternatively, please attach an Excel spreadsheet with this data at the bottom of this page.

3.2 Emissions Data Questions

3.2.1 Please select the boundary you are using for your greenhouse gas inventory.

Financial control	❍
Operational control	❍
Equity share	❍
Other …….	❍

3.2.2 Please provide your gross global emissions figures in metric tonnes CO_2e.

3.2.3 Are there any sources (e.g. facilities, specific GHGs, activities, geographies etc.) emissions that are within your selected reporting boundary which are not included in your disclosure? If yes please provide further details about the sources of emissions.

3.2.4 Please estimate the level of uncertainty of the total gross global emissions figures that you have supplied and specify the sources of uncertainty in your data gathering, handling and calculations.

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3.2.6 Please provide further details of the verification or assurance undertaken for your emissions, and attach the relevant statements.

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Sign Off – *Scoring weighted average = 1.5/188 × 100 = 1%*

- Please provide the following information for the person that has signed off (approved) the CDP climate change response:

iv) Name

v) Job title

vi) Corresponding job category

Source: https://www.cdp.net/Documents/Guidance/2015/CDP-climate-change-scoring-methodology.pdf

Appendix 3.2: Board Composition Index

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1. **Chairman Independence** Are the chair positions separated from the CEO? 1 if yes; 0 otherwise.

2. **Board Size** Is a firm's Board Size > the Industry Average? 1 if yes; 0 otherwise.

3. **Board Independence** Is a firm's independent directors percentage > the Industry Average? 1 if yes; 0 otherwise.

4. **Female on Board** Is a firm's female board director percentage > the Industry Average? 1 if yes; 0 otherwise.

5. **Board Meeting Number** Are a firm's board meetings per year > the Industry Average? 1 if yes; 0 otherwise.

6. **Board Meeting Attendance** Is a firm's board attendance percentage > the Industry Average? 1 if yes; 0 otherwise.

Data Source: Bloomberg Database.

References

Al-Awadhi, A. M., and Dempsey, M. (2017) 'Social norms and market outcomes: The effects of religious beliefs on stock markets', *Journal of International Financial Markets, Institutions and Money,* 50, pp. 119-134.

Albuquerque, R. A., Durnev, A., and Koskinen, Y. (2013) 'Corporate social responsibility and firm risk: Theory and empirical evidence', *Management Science*.

Allen, R., Seaman, S., and DeLascio, J. (2009) 'Emerging issues: global warming claims and coverage issues', *Defense Council Journal*, 76(1), pp. 12–39.

Al-Tuwaijri, S. A., Christensen, T. E., and Hughes, K. E. (2004) 'The relations among environmental disclosure, environmental performance, and economic performance: a simultaneous equations approach', *Accounting, Organizations and Society*, 29(5), pp. 447-471.

Amit, R., and Wernerfelt, B. (1990) 'Why do firms reduce business risk?', *Academy of Management Journal,* 33(3), pp. 520-533.

Andrew, J., and Cortese, C. L. (2011) 'Carbon disclosures: Comparability, the carbon disclosure project and the greenhouse gas protocol', *Australasian Accounting, Business and Finance Journal,* 5(4), pp. 5-18.

Ascui, F. (2014) 'A review of carbon accounting in the social and environmental accounting literature: what can it contribute to the debate*?', Social and Environmental Accountability Journal*, 34(1), pp. 6-28.

Asquith, P., Pathak, P. A., and Ritter, J. R. (2005) 'Short interest, institutional ownership, and stock returns', *Journal of Financial Economics*, 78(2), pp. 243-276.

Auger, P., Devinney, T.M., Dowling, G.R., Eckert, C., and Lin, N. (2013) 'How much does a company's reputation matter in recruiting?', *MIT Sloan Management Review*, 54(3), pp. 79-88.

Ba, S., Lisic, L. L., Liu, Q., and Stallaert, J. (2013) 'Stock market reaction to green vehicle innovation', *Production and Operations Management*, 22(4), pp. 976-990.

Bagnoli, M., and Watts, S. G. (2003) 'Selling to socially responsible consumers: Competition and the private provision of public goods', *Journal of Economics and Management Strategy,* 12, pp. 419-445.

Balabanis, G., Phillips, H. C., & Lyall, J. (1998) ‘ Corporate social responsibility and economic performance in the top British companies: are they linked?’, *European Business Review, 98*(1), 25-44.

Balatbat, M. C., Taylor, S. L., and Walter, T. S. (2004) ‘Corporate governance, insider ownership and operating performance of Australian initial public offerings’, *Accounting and Finance,* 44(3), pp. 299-328.

Bansal, P., and Clelland, I. (2004) ‘Talking trash: Legitimacy, impression management, and unsystematic risk in the context of the natural environment’, *Academy of Management Journal,* 47(1), pp. 93-103.

Bansal, P., and Roth, K. (2000) ‘Why companies go green: A model of ecological responsiveness’, *Academy of Management Journal,* 43(4), pp. 717-736.

Barnea, A., and Rubin, A. (2010) ‘Corporate social responsibility as a conflict between shareholders’, *Journal of Business Ethics*, 97(1), pp. 71-86.

Barnett, M. L., and Salomon, R. M. (2012) ‘Does it pay to be really good? Addressing the shape of the relationship between social and financial performance’, *Strategic Management Journal*, 33(11), pp. 1304-1320.

Barney, J. (1991) ‘Firm resources and sustained competitive advantage’, *Journal of Management,* 17(1), pp. 99-120.

Barney, J.B. and Clark, D.N. (2007) *Resource-based theory: Creating and sustaining competitive advantage.* Oxford University Press on Demand.

Barnhart, S. W., Marr, M. W., and Rosenstein, S. (1994) ‘Firm performance and board composition: Some new evidence’, *Managerial and Decision Economics,* 15, (4), 329-340.

BBC News. (2017) *UK enjoyed 'greenest year for electricity ever' in 2017*. BBC News. [Online]. Available at: https://www.bbc.co.uk/news/uk-42495883 (Accessed: 4 April 2018).

Beatty, T., and Shimshack, J. P. (2010) ‘The impact of climate change information: new evidence from the stock market’, *The BE Journal of Economic Analysis and Policy*, 10(1).

Beliveau, B., Cottrill, M., & O'Neill, H. M. (1994) ‘Predicting corporate social responsiveness: A model drawn from three perspectives’, *Journal of Business Ethics, 13*(9), 731-738.

Beaver, W., Kettler, P., and Scholes, M. (1970) 'The association between market determined and accounting determined risk measures', *The Accounting Review,* 45(4), pp. 654-682.

Ben-Amar, W., and McIlkenny, P. (2014) 'Board effectiveness and the voluntary disclosure of climate change information', *Business Strategy and the Environment,* 24, pp. 704-719.

Benlemlih, M., Shaukat, A., Qiu, Y., and Trojanowski, G. (2018) 'Environmental and social disclosures and firm risk', *Journal of Business Ethics,* 152(3), pp. 613-626.

Benston, G. J. (1985) 'The self-serving management hypothesis: Some evidence', *Journal of Accounting and Economics,* 7(1-3), pp. 67-84.

Berthelot, S., Cormier, D., and Magnan, M. (2003) 'Environmental disclosure research: review and synthesis', *Journal of Accounting Literature,* 22, pp. 1-44.

Beyer, A., Cohen, D. A., Lys, T. Z., and Walther, B. R. (2010) 'The financial reporting environment: Review of the recent literature', *Journal of Accounting and Economics,* 50(2), pp. 296-343.

Black, and C. M. (2013) 'Accounting for carbon emission allowances in the European Union: in search of consistency', *Accounting in Europe*, 10(2), pp. 223–239.

Bouslah, K., Kryzanowski, L., and M'Zali, B. (2013) 'The impact of the dimensions of social performance on firm risk', *Journal of Banking and Finance,* 37, pp. 1258-1273.

Bowen, F. (2014) *After greenwashing: Symbolic corporate environmentalism and society.* Cambridge University Press.

Branco, M. C., and Rodrigues, L. L. (2008) 'Factors influencing social responsibility disclosure by Portuguese companies', *Journal of Business Ethics,* 83(4), pp. 685-701.

Brealey, R. A., Myers, S. C., Allen, F., and Mohanty, P. (2012) *Principles of corporate finance.* Tata McGraw-Hill Education.

Brickley, J. A., Coles, J. L., and Terry, R. L. (1994) 'Outside directors and the adoption of poison pills', *Journal of Financial Economics,* 35(3), pp. 371-390.

Brown, P., Beekes, W., and Verhoeven, P. (2011) 'Corporate governance, accounting and finance: A review', *Accounting and Finance,* 51(1), pp. 96-172.

Bui, B., Houqe, N., and Zaman, M. (2017) 'Carbon embedded governance: Effects on disclosure and performance', *Unpublished Working Paper,* S*SRN Website.*

Busch, T., and Hoffmann, V. H. (2011) 'How hot is your bottom line? Linking carbon and financial performance', *Business and Society,* 50(2), pp. 233-265.

Buysse, K., and Verbeke, A. (2003) 'Proactive environmental strategies: A stakeholder management perspective', *Strategic Management Journal*, 24(5), pp. 453-470.

Cairncross, F. (1995) *Green Inc.: guide to business and the environment*. Routledge.

Canadian Geophysical Union (CGU) (2009) *Climate Change Letter to the Government of Canada from 5 Canadian Scientific Organizations.* [Online]. Available at: http://www.cmos.ca/document/1043/ClimateChangeLetter_26Nov09.pdf (Accessed: 21 September 2017).

Cañón-de-Francia, J., and Garcés-Ayerbe, C. (2009) 'ISO 14001 environmental certification: a sign valued by the market?', *Environmental and Resource Economics*, 44(2), pp. 245-262.

Carbon Brief (2018) *UK could become 'net zero by 2050' using negative emissions.* [Online]. Available at: https://www.carbonbrief.org/uk-could-become-net-zero-by-2050-using-negative-emissions (Accessed: 1 November 2018).

Carbon Disclosure Project (CDP) (2018a) *About Us.* [Online]. Available at: https://www.cdp.net/en/info/about-us (Accessed: 28 October 2018).

Carbon Disclosure Project (CDP) (2018b) *New research shows clear gap between companies' awareness of climate risks and actions for tackling them.* [Online]. Available at: https://www.cdp.net/en/articles/media/new-research-shows-clear-gap-between-companies-awareness-of-climate-risks-and-actions-for-tackling-them (Accessed: 19 November 2018).

Carbon Disclosure Project (CDP) (2017) *New report shows just 100 companies are source of over 70% of emissions.* [Online]. Available at: https://www.cdp.net/en/articles/media/new-report-shows-just-100-companies-are-source-of-over-70-of-emissions (Accessed: 19 November 2018).

Central Intelligence Agency (CIA) (2018) *Country Comparison : Carbon Dioxide Emissions from Consumption of Energy.* [Online]. Available at: https://www.cia.gov/library/publications/the-world-factbook/rankorder/2254rank.html (Accessed: 28 October 2018).

Chalmers, K., and Godfrey, J.M. (2004) 'Reputation costs: the impetus for voluntary derivative financial instrument reporting', *Accounting, Organizations and Society,* 29(2), pp. 95-125.

Chang, K., Kim, I., and Li, Y. (2014) 'The heterogeneous impact of corporate social responsibility activities that target different stakeholders', *Journal of Business Ethics,* 125(2), pp. 211-234.

Chapple, L., Clarkson, P. M., and Gold, D. L. (2013) 'The cost of carbon: capital market effects of the proposed emission trading scheme (ETS)', *Abacus*, 49(1), pp. 1-33.

Chen, C. J., and Jaggi, B. (2001) 'Association between independent non-executive directors, family control and financial disclosures in Hong Kong', *Journal of Accounting and Public Policy,* 19(4), pp. 285-310.

Cheney, G., and McMillan, J. J. (1990) 'Organizational rhetoric and the practice of criticism', *Journal of Applied Communication Research,* 18(2), pp. 93-114.

Cheng, B., Ioannou, I., and Serafeim, G. (2014) 'Corporate social responsibility and access to finance', *Strategic Management Journal,* 35(1), pp. 1-23.

Cho, C., Guidry, R., Hageman, A., and Patten, D. (2012) 'Do actions speak louder than words? an empirical investigation of corporate environmental reputation', *Accounting, Organizations and Society*, 37(1), pp. 14-25.

Cho, S. Y., Lee, C., and Pfeiffer, R. J. (2013) 'Corporate social responsibility performance and information asymmetry', *Journal of Accounting and Public Policy,* 32(1), pp. 71-83.

Christmann, P. (2000) 'Effects of "best practices" of environmental management on cost advantage: the role of complementary assets', *Academy of Management Journal*, 43(4), pp. 663-680.

Chung, K. H., Elder, J., and Kim, J.-C. (2010) 'Corporate governance and liquidity', *Journal of Financial and Quantitative Analysis,* 45, pp. 265-291.

Clarkson, P. M., Li, Y., and Richardson, G. D. (2004) 'The market valuation of environmental capital expenditures by pulp and paper companies', *The Accounting Review*, 79(2), pp. 329-353.

Clarkson, P. M., Li, Y., Richardson, G. D., and Vasvari, F. P. (2008) 'Revisiting the relation between environmental performance and environmental disclosure: An empirical analysis', *Accounting, Organizations and Society,* 33(4), pp. 303-327.

Clarkson, P. M., Li, Y., Richardson, G. D., and Vasvari, F. P. (2011) 'Does it really pay to be green? Determinants and consequences of proactive environmental strategies', *Journal of Accounting and Public Policy,* 30(2), pp. 122-144.

Cochran, P. L., and Wood, R. A. (1984) 'Corporate social responsibility and financial performance', *Academy of Management Journal,* 27(1), pp. 42-56.

Cohen, M.A., Fenn, S. and Naimon, J.S. (1995) *Environmental and financial performance: are they related?* Citeseer.

Collis, D. J. (1994) 'Research note: how valuable are organizational capabilities?', *Strategic Management Journal,* 15(S1), pp. 143-152.

Connelly, B. L., Certo, S. T., Ireland, R. D., and Reutzel, C. R. (2011) 'Signaling theory: A review and assessment', *Journal of Management,* 37(1), pp. 39-67.

Consolandi, C., Jaiswal-Dale, A., Poggiani, E., and Vercelli, A. (2009) 'Global standards and ethical stock indexes: the case of the Dow Jones Sustainability Stoxx Index', *Journal of Business Ethics*, 87(S1), pp. 185-197.

Cormier, D., and Magnan, M. (1999) 'Corporate environmental disclosure strategies: determinants, costs and benefits', *Journal of Accounting, Auditing and Finance*, 14(4), pp. 429-451.

Cormier, D., and Magnan, M. (2003) 'Environmental reporting management: a continental European perspective', *Journal of Accounting and Public Policy,* 22(1), pp. 43-62.

Cornett, M. M., Marcus, A. J., Saunders, A., and Tehranian, H. (2007) 'The impact of institutional ownership on corporate operating performance', *Journal of Banking and Finance*, 31(6), pp. 1771-1794.

Cotter, J., and Najah, M. M. (2012) 'Institutional investor influence on global climate change disclosure practices', *Australian Journal of Management,* 37(2), pp. 169-187.

Cui, J., Jo, H., and Na, H. (2016) 'Does corporate social responsibility affect information asymmetry?', *Journal of Business Ethics,* 148, pp. 549-572.

Dalton, D. R., Daily, C. M., Ellstrand, A. E., and Johnson, J. L. (1998) 'Meta-analytic reviews of board composition, leadership structure, and financial performance', *Strategic Management Journal,* 19(3), pp. 269-290.

Dalton, D. R., Daily, C. M., Johnson, J. L., and Ellstrand, A. E. (1999) 'Number of directors and financial performance: A meta-analysis', *Academy of Management Journal,* 42, pp. 674-686.

de Villiers, C., and Van Staden, C. J. (2011) 'Where firms choose to disclose voluntary environmental information', *Journal of Accounting and Public Policy,* 30(6), pp. 504-525.

de Villiers, C., and Van Staden, C.J. (2006) 'Can less environmental disclosure have a legitimising effect? Evidence from Africa', *Accounting, Organizations and Society*, 31(8), pp. 763-781.

Deegan, C. (2014) 'An overview of legitimacy theory as applied within the social and environmental accounting literature', *Sustainability accounting and accountability*, pp. 248-272.

Deegan, C., and Gordon, B. (1996) 'A study of the environmental disclosure practices of Australian corporations', *Accounting and Business Research,* 26(3), pp. 187-199.

Deegan, C., and Rankin, M. (1996) 'Do Australian companies report environmental news objectively? An analysis of environmental disclosures by firms prosecuted successfully by the Environmental Protection Authority', *Accounting, Auditing and Accountability Journal,* 9(2), pp. 50-67.

Delmas, M. A., and Burbano, V. C. (2011) 'The drivers of greenwashing', *California Management Review,* 54(1), 64-87.

Deng, X., Kang, J. K., and Low, B. S. (2013) 'Corporate social responsibility and stakeholder value maximization: Evidence from mergers', *Journal of Financial Economics,* 110(1), pp. 87-109.

Department for Business, Energy and Industrial Strategy. (2017) *2017 UK Greenhouse Gas Emissions, Provisional Figures.* [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/695930/2017_Provisional_Emissions_statistics_2.pdf (Accessed: 10 February 2019)

Department for Environment, Food and Rural Affairs (DEFRA) (2012) *Leading businesses to disclose greenhouse gas emissions.* [Online]. Available at: http://www.defra.gov.uk/news/2012/06/20/greenhouse-gas-reporting/ (Accessed: 12 September 2016).

Department for Environment Food and Rural Affairs (DEFRA) '(2013) *Environmental Reporting Guidelines*. [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/206392/pb13944-env-reporting-guidance.pdf (Accessed: 28 October 2018).

Dhaliwal, D. S., Salamon, G. L., and Smith, E. D. (1982) 'The effect of owner versus management control on the choice of accounting methods', *Journal of Accounting and Economics,* 4(1), pp. 41-53.

Dhaliwal, D. S., Li, O. Z., Tsang, A., and Yang, Y. G. (2011) 'Voluntary nonfinancial disclosure and the cost of equity capital: The initiation of corporate social responsibility reporting', *The accounting review,* 86(1), pp. 59-100.

Diamond, D. W., and Verrecchia, R. E. (1991) 'Disclosure, liquidity, and the cost of capital', *The Journal of Finance,* 46, pp. 1325-1359.

Doidge, C., Karolyi, G. A., Lins, K. V., Miller, D. P., and Stulz, R. M. (2009) 'Private benefits of control, ownership, and the cross-listing decision', *The Journal of Finance,* 64(1), pp. 425-466.

Dowell, G., and Hart, S. (2011) 'A natural-resource-based view of the firm: fifteen years after', *Journal of Management*, 37(5), pp. 1464-1479.

Dowell, G., Hart, S., and Yeung, B. (2000) 'Do corporate global environmental standards create or destroy market value?', *Management Science*, 46(8), pp. 1059-1074.

Elsayed, K., and Paton, D. (2005) 'The impact of environmental performance on firm performance: static and dynamic panel data evidence', S*tructural Change and Economic Dynamics,* 16(3), pp. 395-412.

Elyasiani, E., and Jia, J. (2010) 'Distribution of institutional ownership and corporate firm performance', *Journal of Banking and Finance,* 34(3), pp. 606-620.

Energy and Climate Change Committee (2015) *Linking Emissions Trading Systems.* London: The Stationery Office. [Online]. Available at: https://www.parliament.uk/documents/commons-committees/energy-and-climate-change/Linking-emissions-trading-systems-Govt-response-HC-376.pdf (Accessed: 8 November 2018).

Erkens, D.H., Hung, M. and Matos, P. (2012) 'Corporate governance in the 2007–2008 financial crisis: Evidence from financial institutions worldwide', *Journal of corporate finance*, *18*(2), pp. 389-411.

European Commission (2016) *The EU Emissions Trading Scheme EUCTS*. [Online]. Available at: https://ec.europa.eu/clima/sites/clima/files/factsheet_ets_en.pdf (Accessed: 28 October 2018).

Faccio, M., and Lasfer, M. A. (2000) 'Do occupational pension funds monitor companies in which they hold large stakes?', *Journal of Corporate Finance,* 6(1), pp. 71-110.

Fernández-Kranz, D., and Santaló, J. (2010) 'When necessity becomes a virtue: The effect of product market competition on corporate social responsibility', *Journal of Economics and Management Strategy,* 19(2), pp. 453-487.

Ferrando, A., Marchica, M. T., and Mura, R. (2017) 'Financial Flexibility and Investment Ability Across the Euro Area and the UK', *European Financial Management,* 23(1), pp. 87-126.

Ferrell, J., and Fraedrich, J. (1991) *Business Ethics: Ethical Decision Making and Cases.* Boston: Houghton Mifflin Company.

Ferris, K., Hiramatsu, K., and Kimoto, K. (1989) 'Accounting information and investment risk perception in Japan', *Journal of International Financial Management and Accounting,* 1, pp. 232-243.

Fifka, M. S. (2013) 'Corporate responsibility reporting and its determinants in comparative perspective–a review of the empirical literature and a meta-analysis', *Business Strategy and the Environment,* 22(1), pp. 1-35.

Filbeck, G., and Gorman, R. F. (2004) 'The relationship between the environmental and financial performance of public utilities', *Environmental and Resource Economics,* 29(2), pp. 137-157.

Fisher, F. M. (1984) 'The misuse of accounting rates of return: Reply', The *American Economic Review,* 74(3), pp. 509-517.

Fisher, F. M., and McGowan, J. J. (1983) 'On the misuse of accounting rates of return to infer monopoly profits', *The American Economic Review,* 73(1), pp. 82-97.

Fisher-Vanden, K., and Thorburn, K. S. (2011) 'Voluntary corporate environmental initiatives and shareholder wealth', *Journal of Environmental Economics and Management*, 62(3), pp. 430-445.

Flammer, C. (2013) 'Corporate social responsibility and shareholder reaction: the environmental awareness of investors', *Academy of Management Journal*, 56(3), pp. 758-781.

Fogler, H. R., and Nutt, F. (1975) 'A note on social responsibility and stock valuation', *Academy of Management Journal*, 18(1), pp. 155-160.

Fombrun, C., and Shanley, M. (1990) 'What's in a name? Reputation building and corporate strategy', *Academy of Management Journal,* 33(2), pp. 233-258.

Freedman, M. (1970) 'The social responsibility of business into increase profit', *The New York Times Magazine*.

Freedman, M., and Jaggi, B. (2005) 'Global warming, commitment to the Kyoto protocol, and accounting disclosures by the largest global public firms from polluting industries', *The International Journal of Accounting,* 40(3), pp. 215-232.

Freeman, R.E. (1984) 'Strategic management: A stakeholder perspective', *Boston: Pitman*, p. 13.

Fujii, H., Iwata, K., Kaneko, S., and Managi, S. (2013) 'Corporate environmental and economic performance of Japanese manufacturing firms: empirical study for sustainable development', *Business Strategy and the Environment,* 22(3), pp. 187-201.

Galbreath, J. (2010) 'Corporate governance practices that address climate change: An exploratory study', *Business Strategy and the Environment,* 19(5), pp. 335-350.

Galbreath, J., and Galvin, P. (2008) 'Firm factors, industry structure and performance variation: New empirical evidence to a classic debate', *Journal of Business Research,* 61(2), pp. 109-117.

Gallego-Álvarez, I., García-Sánchez, I. M., and da Silva Vieira, C. (2014) 'Climate change and financial performance in times of crisis', *Business Strategy and the Environment*, 23(6), pp. 361-374.

Gallego-Álvarez, I., Segura, L., and Martínez-Ferrero, J. (2015) 'Carbon emission reduction: the impact on the financial and operational performance of international companies', *Journal of Cleaner Production,* 103, pp. 149-159.

Geczy C. C., Stambaugh R. F. and D. Levin, (2005) 'Investing in Socially Responsible Mutual Funds', *Unpublished Working Paper,* S*SRN Website.*

Gilley, K. M., Worrell, D. L., Davidson III, W. N., and El–Jelly, A. (2000) 'Corporate environmental initiatives and anticipated firm performance: the differential effects of process-driven versus product-driven greening initiatives', *Journal of Management*, 26(6), pp. 1199-1216.

Giroud, X., and Mueller, H. M. (2011) 'Corporate governance, product market competition, and equity prices', *The Journal of Finance*, 66(2), pp. 563-600.

Giroud, X., and Mueller, H. M. (2011) 'Corporate governance, product market competition, and equity prices', *The Journal of Finance,* 66, pp. 563-600.

Gonedes, N. J., and Dopuch, N. (1979) 'Economic analyses and accounting techniques: perspective and proposals', *Journal of Accounting Research,* 17(2), pp. 384-410.

Graafland, J., Hudson, P., and Werner, J. (2016) 'Does corporate social performance reduce greenhouse gas emissions at the macro level?', *Journal of Environmental Planning and Management,* 59, pp. 203-221.

Grant, R. M. (1991) 'The resource-based theory of competitive advantage: Implications for strategy formulation', *California Management Review,* 33(3), pp. 114-135.

Gray, R., Owen, D., and Adams, C. (1996) *Accounting and accountability: Changes and challenges in corporate social and environmental reporting*. London, England: Prentice Hall.

Griffin, J. J., and Mahon, J. F. (1997) 'The corporate social performance and corporate financial performance debate: Twenty-five years of incomparable research', *Business and Society,* 36(1), pp. 5-31.

Griffin, P. A., and Sun, Y. (2013) 'Going green: market reaction to CSRwire news releases', *Journal of Accounting and Public Policy*, 32(2), pp. 93-113.

Griffin, P. A., Lont, D. H., and Sun, E. Y. (2017) 'The relevance to investors of greenhouse gas emission disclosures', *Contemporary Accounting Research*, 34(2), pp. 1265-1297.

Griner, E. H., and Stark, A. W. (1991) 'On the properties of measurement error in cash-recovery-rate-based estimates of economic performance', *Journal of Accounting and Public Policy,* 10(3), pp. 207-223.

Grubb, M., Vrolijk, C., and Brack, D. (1999) *The Kyoto Protocol: a Guide and Assessment, London: RIIA/Earthscan*; Washington: Brookings

Guterres, A. (2017, March 23) *Remarks at the high-level meeting on climate change and the sustainable development agenda*. United Nations, New York, NY. [Online]. Available at: https://www.un.org/sg/en/content/sg/speeches/2017-03-23/secretary-generals-climate-change-remarks, (Accessed: 12 June 2017).

Gyourko, J., and Nelling, E. (1996) 'Systematic risk and diversification in the equity REIT market', *Real Estate Economics,* 24, pp. 493-515.

Hackston, D., and Milne, M. J. (1996) 'Some determinants of social and environmental disclosures in New Zealand companies', *Accounting, Auditing and Accountability Journal,* 9(1), pp. 77-108.

Hagerman, R. L., and Zmijewski, M. E. (1979) 'Some economic determinants of accounting policy choice', *Journal of Accounting and Economics,* 1(2), pp. 141-161.

Hahn, R., and Kühnen, M. (2013) 'Determinants of sustainability reporting: a review of results, trends, theory, and opportunities in an expanding field of research', *Journal of Cleaner Production,* 59, pp. 5-21.

Hahn, R., Reimsbach, D., and Schiemann, F. (2015) 'Organizations, climate change, and transparency: Reviewing the literature on carbon disclosure', *Organization and Environment,* 28(1), pp. 80-102.

Halme, M., and Niskanen, J. (2001) 'Does corporate environmental protection increase or decrease shareholder value? The case of environmental investments', *Business Strategy and the Environment*, 10(4), pp. 200-214.

Hamilton, J. T. (1995) 'Pollution as news: Media and stock market reactions to the toxics release inventory data', *Journal of Environmental Economics and Management,* 28(1), pp. 98-113.

Haney, A. B., Jones, I. W., and Pollitt, M. G. (2009) 'UK retailers and climate change: the role of partnership in climate strategies', *Unpublished Working Paper, University of Cambridge.*

Haque, F. (2017) 'The effects of board characteristics and sustainable compensation policy on carbon performance of UK firms', *The British Accounting Review,* 49(3), pp. 347-364.

Harcourt, G.C. (1965) 'The accountant in a golden age', *Oxford Economic Papers*, 17(1), pp. 66-80.

Harrison, A. E., and McMillan, M. S. (2003) 'Does direct foreign investment affect domestic credit constraints?', *Journal of International Economics*, 61(1), pp. 73-100.

Hart, S. L. (1995) 'A Natural-Resource-based View of the Firm', *Academy of Management Review,* 20(4), 986-1014.

Hart, S. L., and Ahuja, G. (1996) 'Does it pay to be green? An empirical examination of the relationship between emission reduction and firm performance', *Business Strategy and the Environment,* 5(1), pp. 30-37.

Hartmann, F., Perego, P., and Young, A. (2013) 'Carbon accounting: Challenges for research in management control and performance measurement', *Abacus,* 49(4), pp. 539-563.

Hartmann, F., Perego, P., and Young, A. (2013) 'Carbon accounting: Challenges for research in management control and performance measurement', *Abacus,* 49, pp. 539-563.

Haslam, C., Butlin, J., Andersson, T., Malamatenios, J., and Lehman, G. (2014) 'Accounting for carbon and reframing disclosure: A business model approach', *Accounting Forum,* 38 (3), pp. 200-211.

Hasseldine, J., Salama, A. I., and Toms, J. S. (2005) 'Quantity versus quality: the impact of environmental disclosures on the reputations of UK Plcs', *The British Accounting Review,* 37(2), pp. 231-248.

Hay, D. A., and Morris, D. J. (1991) *Industrial economics and organization: theory and evidence*. Oxford: Oxford University Press.

Heal, G. (2005) 'Corporate social responsibility: an economic and financial framework', *Geneva Papers on Risk and Insurance - Issues and Practice*, 30(3), pp. 387-409.

Hearit, K. M. (1995) ' "Mistakes were made": Organizations, apologia, and crises of social legitimacy', *Communication Studies*, 46(1-2), pp. 1-17.

Hermalin, B. E., and Weisbach, M. S. (1991) 'The effects of board composition and direct incentives on firm performance', *Financial Management,* 20(4), pp. 101-112.

Higgins, C., and Larrinaga, C. (2014) 'Sustainability reporting: Insights from institutional theory. In J. Bebbington, J. Unerman, and B. O'Dwyer (Eds.)', *Sustainability accounting and accountability* (273-285).

Hillman, A. J., and Dalziel, T. (2003) 'Boards of directors and firm performance: Integrating agency and resource dependence perspectives', *Academy of Management Review,* 28(3), pp. 383-396.

Hillman, A. J., and Keim, G. D. (2001) 'Shareholder value, stakeholder management, and social issues: what's the bottom line?', *Strategic Management Journal*, 22(2), pp. 125-139.

Hitt, M. A., Bierman, L., Shimizu, K., and Kochhar, R. (2001) 'Direct and moderating effects of human capital on strategy and performance in professional service firms: A resource-based perspective', *Academy of Management Journal,* 44(1), pp. 13-28.

HM Government (2017) [Online]. Available at: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/584281/uk-climate-change-risk-assess-2017.pdf (Accessed: 28 October 2018)

Hsu, A. W., and Wang, T. (2013) 'Does the market value corporate response to climate change?', *Omega*, 41(2), pp. 195-206.

Hui, T. K. (2005) 'Day-of-the-week effects in US and Asia–Pacific stock markets during the Asian financial crisis: a non-parametric approach', *Omega,* 33(3), pp. 277-282.

Hummel, K., and Schlick, C. (2016) 'The relationship between sustainability performance and sustainability disclosure–Reconciling voluntary disclosure theory and legitimacy theory', *Journal of Accounting and Public Policy,* 35(5), pp. 455-476.

Hussainey, K., and Salama, A. (2010) 'The importance of corporate environmental reputation to investors', *Journal of Applied Accounting Research*, 11(3), pp. 229-241.

Ingram, R. W., and Frazier, K. B. (1980) 'Environmental performance and corporate disclosure', *Journal of Accounting Research,* 18(2), pp. 614-622.

Jackling, B., and Johl, S. (2009) 'Board structure and firm performance: Evidence from India's top companies*', Corporate Governance: An International Review,* 17(4), pp. 492-509.

Jackson, G., and Apostolakou, A. (2010) 'Corporate social responsibility in Western Europe: an institutional mirror or substitute?', *Journal of Business Ethics,* 94(3), pp. 371-394.

Jacobs, B. W., Singhal, V. R., and Subramanian, R. (2010) 'An empirical investigation of environmental performance and the market value of the firm', *Journal of Operations Management*, 28(5), pp. 430–441.

Jaggi, B., and Freedman, M. (1992) 'An examination of the impact of pollution performance on economic and market performance: pulp and paper firms', *Journal of Business Finance and Accounting*, 19(5), pp. 697-713.

Jayachandran, S., Kalaignanam, K., and Eilert, M. (2013) 'Product and environmental social performance: Varying effect on firm performance', *Strategic Management Journal,* 34(10), pp. 1255-1264.

Jayaraman, T., and Kanitkar, T. (2016) 'The Paris Agreement: Deepening the Climate Crisis*', Economic and Political Weekly,* 51(3), pp. 10-13.

Jensen, M. C. (1986) 'Agency costs of free cash flow, corporate finance, and takeovers', *The American Economic Review,* 76, pp. 323-329.

Jensen, M. C., and Meckling, W. H. (1976) 'Theory of the firm: Managerial behavior, agency costs and ownership structure', *Journal of Financial Economics,* 3(4), pp. 305-360.

Jo, H., and Harjoto, M. A. (2011) 'Corporate governance and firm value: The impact of corporate social responsibility', *Journal of Business Ethics,* 103(3), pp. 351-383.

Jo, H., and Harjoto, M. A. (2012) 'The causal effect of corporate governance on corporate social responsibility', *Journal of Business Ethics,* 106(1), pp. 53-72.

Jo, H., and Na, H. (2012) 'Does CSR reduce firm risk? Evidence from controversial industry sectors', *Journal of Business Ethics,* 110(4), pp. 441-456.

Johnson, J. L., Daily, C. M., and Ellstrand, A. E. (1996) 'Boards of directors: A review and research agenda', *Journal of Management,* 22, pp. 409-438.

Kamasak, R. (2013) *Resource-based view (RBV) in all its aspects: Why some firms outperform others?* Germany, Europe: Scholar's Press.

Karpoff, J. M., Lott, Jr., J. R., and Wehrly, E. W. (2005) 'The reputational penalties for environmental violations: empirical evidence', *The Journal of Law and Economics*, 48(2), pp. 653-675.

Kendon, M., McCarthy, M., Jevrejeva, S., Matthews, A., and Legg, T. (2018) 'State of the UK climate 2017*', International Journal of Climatology*, 38, pp. 1-35.

Kennedy, P. (2003) *A guide to econometrics.* MIT press.

Khlif, H., Hussainey, K., and Achek, I. (2015) 'The effect of national culture on the association between profitability and corporate social and environmental disclosure: A meta-analysis'. *Meditari Accountancy Research*, 23(3), pp. 296-321.

Kim, E. H., and Lyon, T. (2011) 'When does institutional investor activism increase shareholder value?: the carbon disclosure project', *The BE Journal of Economic Analysis and Policy,* 11(1).

Klassen, R. D., and McLaughlin, C. P. (1996) 'The impact of environmental management on firm performance', *Management Science,* 42(8), pp. 1199-1214.

Klassen, R. D., and Whybark, D. C. (1999) 'The impact of environmental technologies on manufacturing performance', *Academy of Management Journal,* 42(6), pp. 599-615.

Knox-Hayes, J., and Levy, D.L. (2011) 'The politics of carbon disclosure as climate governance', *Strategic Organization,* 9(1), pp. 91-99.

Koh, P. S., Qian, C., and Wang, H. (2014) 'Firm litigation risk and the insurance value of corporate social performance', *Strategic Management Journal,* 35(10), pp. 1464-1482.

Kolk, A., Levy, D., and Pinkse, J. (2008) 'Corporate responses in an emerging climate regime: the institutionalization and commensuration of carbon disclosure', *European Accounting Review,* 17(4), pp. 719-745.

KPMG. (2015) *Survey of corporate responsibility reporting in the Oil and Gas sector.* [Online]. Available at: https://assets.kpmg.com/content/dam/kpmg/pdf/2016/06/corporate-responsibility-in-the-o-and-g-sector.PDF, (Accessed: 6 August 2017)

KPMG. (2017) *Environment, social and governance due diligence.* [Online]. Available at: https://home.kpmg.com/uk/en/home/services/advisory/risk-consulting/internal-audit/sustainability-services1/environment-social-and-governance-due-diligence.html, (Accessed: 18 January 2018)

Kuo, L., and Yi-Ju Chen, V. (2013) 'Is environmental disclosure an effective strategy on establishment of environmental legitimacy for organization?', *Management Decision*, 51(7), pp. 1462-1487.

Kwok, C. C. Y., and Reeb, D. M. (2000) 'Internationalization and firm risk: An upstream-downstream hypothesis', *Journal of International Business Studies,* 31, pp. 611-629.

Lam, H. K. S., Yeung, A. C. L., Cheng, T. C. E., and Humphreys, P. K. (2016) 'Corporate environmental initiatives in the Chinese context: performance implications and contextual factors', *International Journal of Production Economics*, 180, pp. 48-56.

Lambert, R., Leuz, C., and Verrecchia, R. E. (2007) 'Accounting information, disclosure, and the cost of capital', *Journal of Accounting Research,* 45, pp. 385-420.

Larcker, D. F., and Rusticus, T. O. (2010) 'On the use of instrumental variables in accounting research', *Journal of Accounting and Economics,* 49(3), pp. 186-205.

Laufer, W. S. (2003) 'Social accountability and corporate greenwashing', *Journal of Business Ethics,* 43(3), pp. 253-261.

Lee, D. D., and Faff, R. W. (2009) 'Corporate sustainability performance and idiosyncratic risk: A global perspective', *Financial Review,* 44, pp. 213-237.

Lee, D. D., Humphrey, J. E., Benson, K. L., and Ahn, J. Y. (2010) 'Socially responsible investment fund performance: the impact of screening intensity', *Accounting and Finance*, 50(2), pp. 351-370.

Lee, J.-S., and Jang, S. (2007) 'The systematic-risk determinants of the US airline industry', *Tourism Management,* 28, pp. 434-442.

Lee, S. Y., Park, Y. S., and Klassen, R. D. (2015) 'Market responses to firms' voluntary climate change information disclosure and carbon communication', *Corporate Social Responsibility and Environmental Management*, 22(1), pp. 1-12.

Lee, T. M., and Hutchison, P. D. (2005) 'The decision to disclose environmental information: A research review and agenda', *Advances in Accounting,* 21, pp. 83-111.

Lewandowski, S. (2017) 'Corporate Carbon and Financial Performance: The Role of Emission Reductions', *Business Strategy and the Environment,* 26(8), pp. 1196-1211.

Lewellen, J. (1999) 'The time-series relations among expected return, risk, and book-to-market', *Journal of Financial Economics,* 54(1), pp. 5-43.

Li, Y., Richardson, G. D., and Thornton, D. B. (1997) 'Corporate disclosure of environmental liability information: theory and evidence', *Contemporary Accounting Research*, 14(3), pp. 435–474.

Liesen, A., Figge, F., Hoepner, A. and Patten, D.M. (2017) 'Climate change and asset prices: are corporate carbon disclosure and performance priced appropriately?', *Journal of Business Finance and Accounting*, 44(1-2), pp. 35-62.

Lockett, A., O'Shea, R. P., and Wright, M. (2008) 'The development of the resource-based view: reflections from Birger Wernerfelt', *Organization Studies,* 29(8-9), pp. 1125-1141.

Luo, L., Tang, Q., and Peng, J. (2018) 'The direct and moderating effects of power distance on carbon transparency: An international investigation of cultural value and corporate social responsibility', *Business Strategy and the Environment,* 27(8), pp. 1546-1557.

Luo, L., and Tang, Q. (2014) 'Does voluntary carbon disclosure reflect underlying carbon performance?', *Journal of Contemporary Accounting and Economics,* 10(3), pp. 191-205.

Luo, L., Lan, Y. C., and Tang, Q. (2012) 'Corporate incentives to disclose carbon information: Evidence from the CDP Global 500 report', *Journal of International Financial Management and Accounting,* 23(2), pp. 93-120.

Luo, X., and Bhattacharya, C. B. (2009) 'The debate over doing good: Corporate social performance, strategic marketing levers, and firm-idiosyncratic risk', *Journal of Marketing,* 73, pp. 198-213.

Lyon, T. P., and Maxwell, J. W. (2011) 'Greenwash: Corporate environmental disclosure under threat of audit', *Journal of Economics and Management Strategy,* 20(1), pp. 3-41.

Lyon, T. P., and Montgomery, A. W. (2015) 'The means and end of greenwash', *Organization and Environment,* 28(2), pp. 223-249.

MacKinlay, A. (1997) 'Event studies in economics and finance', *Journal of Economic Literature*, 35(1), pp. 13–39.

Macve, R., and Chen, X. (2010) 'The "equator principles": a success for voluntary codes?', *Accounting, Auditing and Accountability Journal*, 23(7), pp. 890-919.

Mahoney, L. S., Thorne, L., Cecil, L., and LaGore, W. (2013) 'A research note on standalone corporate social responsibility reports: Signaling or greenwashing?', *Critical Perspectives on Accounting,* 24(4), pp. 350-359.

Margolis, J. D., and Walsh, J. P. (2001) 'People and profits? The search for a link between a company's social and financial performance. *New York: Psychology Press.*

Margolis, J. D., and Walsh, J. P. (2003) 'Misery loves companies: Rethinking social initiatives by business*', Administrative Science Quarterly,* 48(2), pp. 268-305.

Matisoff, D. C. (2013) 'Different rays of sunlight: Understanding information disclosure and carbon transparency*', Energy Policy,* 55, pp. 579-592.

Matsumura, E. M., Prakash, R., and Vera-Muñoz, S. C. (2014) 'Firm-value effects of carbon emissions and carbon disclosures', *The Accounting Review,* 89(2), pp. 695-724.

McDonald, J. H. (2009) *Handbook of biological statistics* (Vol. 2, pp. 173-181). Baltimore, MD: sparky house publishing.

McGuire, J. B., Sundgren, A., and Schneeweis, T. (1988) 'Corporate social responsibility and firm financial performance', *Academy of Management Journal,* 31(4), pp. 854-872.

McLaughlin, P. (2011) 'Climate change, adaptation, and vulnerability: Reconceptualizing societal–environment interaction within a socially constructed adaptive landscape*', Organization and Environment,* 24(3), pp. 269-291.

Menguc, B., and Ozanne, L. K. (2005) 'Challenges of the "green imperative": A natural resource-based approach to the environmental orientation–business performance relationship', *Journal of Business Research,* 58(4), pp. 430-438.

Miles, M. P., and Covin, J. G. (2000) 'Environmental marketing: A source of reputational, competitive, and financial advantage', *Journal of Business Ethics,* 23(3), pp. 299-311.

Miller, K., D., and Reuer, J. J. (1996) 'Measuring organizational downside risk', *Strategic Management Journal*, pp. 671-691.

Misani, N., and Pogutz, S. (2015) 'Unraveling the effects of environmental outcomes and processes on financial performance: A non-linear approach*', Ecological Economics, 1*09, pp. 150-160.

Mohr, L. A., Webb, D. J., and Harris, K. E. (2001) 'Do consumers expect companies to be socially responsible? The impact of corporate social responsibility on buying behavior', *Journal of Consumer Affairs*, 35(1), pp. 45-72.

Mollah, S., Hassan, M. K., Al Farooque, O., and Mobarek, A. (2017) 'The governance, risk-taking, and performance of Islamic banks', *Journal of Financial Services Research,* 51(2), pp. 195-219.

Molloy, L., Erekson, H., and Gorman, R. (2002), *Exploring the relationship between environmental and financial performance*. Miami, FL: Miami University.

Mulligan, T. (1986) 'A critique of Milton Friedman's essay 'the social responsibility of business is to increase its profits'', *Journal of Business Ethics,* 5(4), pp. 265-269.

NASA. (2019) *A blanket around the Earth.* [Online]. Available at: https://climate.nasa.gov/causes/ (Accessed: 10 February 2019)

Newbert, S. L. (2007) 'Empirical research on the resource-based view of the firm: an assessment and suggestions for future research', *Strategic Management Journal,* 28(2), pp. 121-146.

Nguyen, J. H. (2018) 'Carbon risk and firm performance: evidence from a quasi-natural experiment. *Australian Journal of Management*, 43(1), pp. 65-90.

Njoroge, J. (2009) 'Effects of the global financial crisis on corporate social responsibility in multinational companies in Kenya (Covalence Intern Analyst Papers) 'Geneva, Switzerland: Covalence, SA.

Oestreich, A.M. and Tsiakas, I., 2015. Carbon emissions and stock returns: Evidence from the EU Emissions Trading Scheme', *Journal of Banking and Finance*, 58, pp. 294-308.

Office for Low Emission Vehicles (2018) *Road to Zero Emissions* [online]. Available at: https://www.gov.uk/government/publications/reducing-emissions-from-road-transport-road-to-zero-strategy (Accessed: 31 October 2018).

Oikonomou, I., Brooks, C., and Pavelin, S. (2012) 'The impact of corporate social performance on financial risk and utility: A longitudinal analysis', *Financial Management,* 41, pp. 483-515.

Oikonomou, I., Brooks, C., and Pavelin, S. (2014) 'The effects of corporate social performance on the cost of corporate debt and credit ratings', *Financial Review,* 49(1), pp. 49-75.

Okereke, C., Wittneben, B., and Bowen, F. (2012) 'Climate change: Challenging business, transforming politics', *Business and Society*, 51(1), pp. 7-30.

Orlitzky, M., and Benjamin, J. D. (2001) 'Corporate social performance and firm risk: A meta-analytic review', *Business and Society,* 40(4), pp. 369-396.

Orlitzky, M., Schmidt, F. L., and Rynes, S. L. (2003) 'Corporate social and financial performance: A meta-analysis*', Organization Studies,* 24(3), pp. 403-441.

Palmer, K., Oates, W. E., and Portney, P. R. (1995) 'Tightening environmental standards: the benefit-cost or the no-cost paradigm?', *Journal of Economic Perspectives*, 9(4), pp. 119-132.

Patten, D. M. (1991) 'Exposure, legitimacy, and social disclosure', *Journal of Accounting and Public Policy,* 10(4), pp. 297-308.

Pava, M. L., and Krausz, J. (1996) 'The association between corporate social-responsibility and financial performance: The paradox of social cost', *Journal of Business Ethics,* pp. 15(3), pp. 321-357.

Payne, G. T., Benson, G. S., and Finegold, D. L. (2009) 'Corporate board attributes, team effectiveness and financial performance', *Journal of Management Studies,* 46(4), pp. 704-731.

Peloza, J. (2009) 'The challenge of measuring financial impacts from investments in corporate social performance', *Journal of Management,* 35(6), pp. 1518-1541.

Penrose, E. T. (1959) *The theory of the growth of the firm*. Cambridge, MA.

Peteraf, M. A., and Barney, J. B. (2003) 'Unraveling the resource-based tangle', *Managerial and Decision Economics,* 24(4), pp. 309-323.

Porter, M. E., and Kramer, M. R. (2006) 'Strategy and society: The link between competitive advantage and corporate social responsibility. *Harvard Business Review,* 84(12), pp. 78-92.

Porter, M. E., and Van der Linde, C.V.D. (1995) 'Toward a new conception of the environment-competitiveness relationship', *Journal of Economic Perspectives*, 9(4), pp. 97-118.

Prado-Lorenzo, J. M., and Garcia-Sanchez, I. M. (2010) 'The role of the board of directors in disseminating relevant information on greenhouse gases', *Journal of Business Ethics,* 97(3), pp. 391-424.

Prado-Lorenzo, J.-M., and Garcia-Sanchez, I.-M. (2010) 'The role of the board of directors in disseminating relevant information on greenhouse gases', *Journal of Business Ethics,* 97, pp. 391-424.

Prime Minister's Office (2017) *Prime Minister's Statement*. [Online]. Available at: https://www.gov.uk/government/speeches/g20-summit-july-2017-prime-ministers-press-statement (Accessed: 28 October 2018).

Qian, W., and Schaltegger, S. (2017) 'Revisiting carbon disclosure and performance: legitimacy and management views', *The British Accounting Review*, 49(4), pp. 365-379.

Qiu, Y., Shaukat, A., and Tharyan, R. (2016) 'Environmental and social disclosures: Link with corporate financial performance', *The British Accounting Review,* 48(1), pp. 102-116.

Raithel, S., Wilczynski, P., Schloderer, M. P., and Schwaiger, M. (2010) 'The value-relevance of corporate reputation during the financial crisis', *Journal of Product and Brand Management,* 19, pp. 389-400.

Ramanathan, R. (2018) 'Understanding complexity: The curvilinear relationship between environmental performance and firm performance', *Journal of Business Ethics,* 149(2), pp. 383-393.

Ramiah, V., Martin, B., and Moosa, I. (2013) 'How does the stock market react to the announcement of green policies?', *Journal of Banking and Finance*, 37(5), pp. 1747-1758.

Rao, P., and Holt, D. (2005) 'Do green supply chains lead to competitiveness and economic performance?', *International Journal of Operations and Production Management*, 25(9), pp. 898-916.

Reeb, D. M., Kwok, C. C. Y., and Baek, H. Y. (1998) 'Systematic risk of the multinational corporation', *Journal of International Business Studies,* 29, pp. 263-279.

Rees, L. L. (1995) 'The information contained in reconciliations to earnings based on US accounting principles by non-US companies', *Accounting and Business Research,* 25(100), pp. 301-310.

Reinhardt, F. (1999) 'Market failure and the environmental policies of firms: economic rationales for "beyond compliance" behavior', *Journal of Industrial Ecology*, 3(1), pp. 9-21.

Rhoades, D. L., Rechner, P. L., and Sundaramurthy, C. (2000) 'Board composition and financial performance: A meta-analysis of the influence of outside directors', *Journal of Managerial Issues,* 12(1), pp. 76-91.

Roberts, R. W. (1992) 'Determinants of corporate social responsibility disclosure: An application of stakeholder theory', *Accounting, Organizations and Society,* 17(6), pp. 595-612.

Russo, M. V., and Fouts, P. A. (1997) 'A resource-based perspective on corporate environmental performance and profitability', *Academy of Management Journal,* 40(3), pp. 534-559.

Salama, A., Anderson, K., and Toms, J. S. (2011) 'Does community and environmental responsibility affect firm risk? Evidence from UK panel data 1994–2006', *Business Ethics: A European Review,* 20(2), pp. 192-204.

Salamon, G. L. (1985) '*Acco*unting rates of return', *The American Economic Review,* 75(3), pp. 495-504.

Sarkis, J., Gonzalez-Torre, P., and Adenso-Diaz, B. (2010) 'Stakeholder pressure and the adoption of environmental practices: The mediating effect of training', *Journal of Operations Management,* 28(2), pp. 163-176.

Schaltegger, S., and Csutora, M. (2012) 'Carbon accounting for sustainability and management. Status quo and challenges', *Journal of Cleaner Production,* 36, pp. 1-16.

Schreck, P. (2011) 'Reviewing the business case for corporate social responsibility: New evidence and analysis', *Journal of Business Ethics,* 103(2), pp. 167-188.

Secretary of State. (2013) *Companies act 2006 (Strategic report and director's report) Regulations 2013*. UK: Secretary of State.

Semykina, A., and Wooldridge, J. M. (2010) 'Estimating panel data models in the presence of endogeneity and selection', *Journal of Econometrics*, 157(2), pp. 375-380.

Shane, P. B., and Spicer, B. H. (1983) 'Market response to environmental information produced outside the firm', *Accounting Review*, 58(3), pp. 521-538.

Sharfman, M. P., and Fernando, C. S. (2008) 'Environmental risk management and the cost of capital', *Strategic Management Journal,* 29(6), pp. 569-592.

Sharma, S., and Vredenburg, H. (1998) 'Proactive corporate environmental strategy and the development of competitively valuable organizational capabilities', *Strategic Management Journal*, 19(8), pp. 729-753.

Shleifer, A., and Vishny, R. W. (1997) 'A survey of corporate governance', *The Journal of Finance*, 52(2), 737-783.

Short, H., and Keasey, K. (1999) 'Managerial Ownership and the Performance of Firms: Evidence from the UK', *Journal of Corporate Finance,* 5(1), pp. 79-101.

Simerly, R. L., and Li, M. (2000) 'Environmental dynamism, capital structure and performance: a theoretical integration and an empirical test', *Strategic Management Journal*, pp. 31-49.

Spicer, B. H. (1978) 'Investors, corporate social performance and information disclosure: an empirical study, *The Accounting Review* 53(1), pp. 94–111.

Sroufe, R. (2003) 'Effects of environmental management systems on environmental management practices and operations. *Production and Operations Management*, 12(3), pp. 416-431.

Stanny, E., and Ely, K. (2008) 'Corporate environmental disclosures about the effects of climate change*', Corporate Social Responsibility and Environmental Management*, pp. 15(6), pp. 338-348.

Stechemesser, K., and Guenther, E. (2012) 'Carbon accounting: a systematic literature review', *Journal of Cleaner Production,* 36, pp. 17-38.

Stevens, W. P. (1984) 'Market reaction to corporate environmental performance*', Advances in Accounting*, 1, pp. 41-61.

Stoll, H. R. (2000) 'Presidential address: Friction', *The Journal of Finance,* 55, pp. 1479-1514.

Sullivan, R., and Gouldson, A. (2012) 'Does voluntary carbon reporting meet investors' needs?', *Journal of Cleaner Production,* 36, pp. 60-67.

Sun, N., Salama, A., Hussainey, K., and Habbash, M. (2010) 'Corporate environmental disclosure, corporate governance and earnings management', *Managerial Auditing Journal*, 25(7), pp. 679-700.

Surroca, J., Tribó, J. A., and Waddock, S. (2010) 'Corporate responsibility and financial performance: The role of intangible resources', *Strategic management journal,* 31(5), pp. 463-490.

Tang, Q., and Luo, L. (2011) 'Transparency of corporate carbon disclosure: International evidence', *Unpublished Working Paper,* S*SRN Website*.

Tauringana, V., and Chithambo, L. (2015) 'The effect of DEFRA guidance on greenhouse gas disclosure', *The British Accounting Review*, 47(4), pp. 425-444.

Teece, D. J., Pisano, G., and Shuen, A. (1997) 'Dynamic capabilities and strategic management', *Strategic Management Journal,* 18(7), pp. 509-533.

The Economist. (2017) *The Road to Action: Financial Regulation Addressing Climate Change*. [Online]. Available at: https://perspectives.eiu.com/sites/default/files/The%20road%20to%20action%20-%20WEB.pdf, (Accessed: 26 October 2017)

The UK Climate Change Committee (UKCCC) (2017) *Meeting Carbon Budgets: Closing the policy gap 2017 Report to Parliament.* [Online]. Available at: https://www.theccc.org.uk/wp-content/uploads/2017/06/2017-Report-to-Parliament-Meeting-Carbon-Budgets-Closing-the-policy-gap.pdf (Accessed: 1 November 2018).

The UK Climate Change Committee (UKCCC) (2018) *Carbon Budgets*. [Online]. Available at: https://www.theccc.org.uk/tackling-climate-change/reducing-carbon-emissions/carbon-budgets-and-targets/ (Accessed: 28 October 2018].

Tilling, M. V., and Tilt, C. A. (2010) 'The edge of legitimacy: Voluntary social and environmental reporting in Rothmans' 1956-1999 annual reports', *Accounting, Auditing and Accountability Journal*, 23(1), pp. 55-81.

Toms, J. S. (2002) 'Firm resources, quality signals and the determinants of corporate environmental reputation: some UK evidence', *The British Accounting Review,* 34(3), pp. 257-282.

Turban, D. B., and Greening, D. W. (1997) 'Corporate social performance and organizational attractiveness to prospective employees', *Academy of Management Journal*, 40(3), pp. 658-672.

Ullmann, A. A. (1985) 'Data in search of a theory: A critical examination of the relationships among social performance, social disclosure, and economic performance of US firms', *Academy of Management Review*, 10(3), pp. 540-557.

UNFCCC (1992) 'United Nations Framework Convention on Climate Change FCCC/84 Geneva: United Nations Environment Programme (UNEP)/World Meteorological Organization (WMO) '

Union of Concerned Scientists (UCS) (2018) *Each Country's Share of CO_2 Emissions.* [Online]. Available at: https://www.ucsusa.org/global-warming/science-and-

impacts/science/each-countrys-share-of-co2.html#.W7Dq3GhKiUm, (Accessed: 30 September 2018)

United Nations (2018) *Paris Agreement.* [Online]. Available at: https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATYandmtdsg_no=XXVII-7-dandchapter=27andclang=_en (Accessed: 1 November 2018).

United Nations (n.d) *United Nations Framework Convention on Climate Change.* [Online]. Available at: https://treaties.un.org/pages/ViewDetailsIII.aspx?src=TREATYandmtdsg_no=XXVII-7andchapter=27andTemp=mtdsg3andclang=_en (Accessed: 28 October 2018).

United Nations Framework Convention on Climate Change (UNFCCC) (2018) *The Paris Agreement.* [Online]. Available at: https://unfccc.int/process-and-meetings/the-paris-agreement/the-paris-agreement (Accessed: 1 November 2018) ‘

Waddock, S. A., and Graves, S. B. (1997) ‘The corporate social performance-financial performance link’, *Strategic Management Journal,* 18(4), pp. 303-319.

Ward, A. (2017) *Big investors to put more money into tackling climate change.* Financial Times. [Online]. Available at: https://www.ft.com, (Accessed: 16 November 2017)

Wassmer, U., Cueto, D. C., and Switzer, L. N. (2014) ‘The effect of corporate environmental initiatives on firm value: evidence from Fortune 500 firms’, *Management*, 17(1), pp. 1-19.

Watts, R. L., and Zimmerman, J. L. (1978) ‘Towards a positive theory of the determination of accounting standards’, *The Accounting Review,* 53(1), pp. 112-134.

Wegener, M. (2010) ‘The Carbon Disclosure Project, an evolution in international environmental corporate governance: motivations and determinants of market response to voluntary disclosures’. Master of Science in Management (Accounting) thesis. Brock University, St. Catherines, Ontario.

Weigand, K. (2010) ‘Climate change disclosure: Ensuring the viability of the insurance industry while protecting the investor’, *William and Mary Environmental Law and Policy Review* 34 (1): 281–314.

Wernerfelt, B. (1984) ‘A resource-based view of the firm’, *Strategic Management Journal,* 5(2), pp. 171-180.

Wernerfelt, B. (2016) *Adaptation, specialization, and the theory of the firm: Foundations of the resource-based view*. Cambridge, England: Cambridge University Press.

White, M. (1996) ‘Corporate environmental performance and shareholder value’, *University of Virginia Online Scholarship Initiative.*

Wilhelm, K. (2013) *Return on sustainability: How business can increase profitability and address climate change in an uncertain economy*. New Jersey, US: FT Press.

Winter, S. (1995) ‘Four Rs of profitability: rents, resources, routines, and replication. In Resource- Based and Evolutionary Theories of the Firm’, *Towards a synthesis* (147-178). Springer, Boston, MA.

Wintoki, M. B., Linck, J. S., & Netter, J. M. (2012) ‘Endogeneity and the dynamics of internal corporate governance’, *Journal of Financial Economics,* 105(3), 581-606.

Wiseman, J. (1982) ‘An evaluation of environmental disclosures made in corporate annual reports’, *Accounting, Organizations and Society,* 7(1), pp. 53-63.

Wood, D.J. (1991) 'Corporate social performance revisited', *Academy of management review*, 16(4), pp. 691-718.

World Economic Forum. (2016) *What are the top global risks for 2016?* Paper presented at the World Economic Forum Annual Meeting, Davos-Klosters, Switzerland. [Online]. Available at: https://www.weforum.org/agenda/2016/01/what-are-the-top-global-risks-for-2016/, (Accessed: 04 September 2017)

Wright, F. K. (1978) ‘Accounting rate of profit and internal rate of return*’, Oxford Economic Papers,* 30(3), pp. 464-468.

Yamashita, M., Sen, S., and Roberts, M. C. (1999) ‘The rewards for environmental conscientiousness in the US capital markets’, *Journal of Financial and Strategic Decisions*, 12(1), pp. 73-82.

Yermack, D. (1996) ‘Higher market valuation of companies with a small board of directors’, *Journal of Financial Economics,* 40(2), pp. 185-211.

Zaman, M., Hudaib, M., and Haniffa, R. (2011) ‘Corporate governance quality, audit fees and non-audit services fees’, *Journal of Business Finance and Accounting,* 38(1-2), pp. 165-197.

Zeghal, D., and Ahmed, S. A. (1990) ‘Comparison of social responsibility information disclosure media used by Canadian firms’, *Accounting, Auditing and Accountability Journal,* 3(1).

Ziegler, A., Busch, T., and Hoffmann, V. H. (2009) 'Corporate responses to climate change and financial performance: the impact of climate policy', *Unpublished Working Paper,* S*SRN Website.*

Ziegler, A., Busch, T., and Hoffmann, V. H. (2011) 'Disclosed corporate responses to climate change and stock performance: An international empirical analysis*', Energy Economics,* 33(6), pp. 1283-1294.